Journal of Physics: Conference Series

The effect of blended learning setting on students' critical thinking skills in physics

The effect of blended learning setting on students' critical thinking skills in physics

W Suana[1]*, W S A Ningsih[1], N Maharta[1] and N M A A Putri[2]
[1]Program Studi Pendidikan Fisika, Fakultas Keguruan dan Ilmu Pendidikan, Universitas Lampung, Jl. S. Brojonegoro No. 1, Bandar Lampung, 35145, Indonesia
[2]Independent Researcher

*wsuane@gmail.com

Abstract. This paper reports a study and results of the improvement of critical thinking skills in a blended learning environment in teaching high school physics. The research was a mixed-method quasi-experimental followed by a qualitative survey. Schoology is chosen as a blended platform for this study. The data of students' critical thinking skills were obtained by multiple choice tests and were analyzed by using n-gain. Moreover, the information on students' responses to the blended learning model was collected by open-ended questions at the end of learning process. Based on the results of the study, there were significant effects of blended learning on critical thinking skills. It is also reported that students have high interest, ease of learning, and have benefits in increasing their knowledge. It suggests that Schoology-based blended learning model is effective to improve students' critical thinking in Physics learning process.

1. Introduction

Triggering learners to develop their critical thinking ability is taking a significant issue now days. In regard to ever-changing and challenging current digital age, teachers and educational stake holders have to prepare and develop their learners to enable thinking critically and making a strong decision as necessary competence in social problem in rapidly changing world [1,2]. Critical thinking skill is also needed to foster students' thinking skill since it requires examining assumptions, discerning hidden values, evaluating evidence, and assessing conclusions. Furthermore, thinking critically also develop other skills, such as higher concentration levels, deeper analytical skills, and focusing problems [2].

Currently, literatures have defined critical thinking as the important skill in order to succeed since it engage learners learn in both professional and personal learning process [3]. In the same side, Saadé et al. [4] argue that critical thinking enables ones to differ between personals and logical reason as making it to be important and hard to achieve. Moreover, it also has special importance in making a decision and judgment which take them into their career. Lee has also supported by arguing that critical thinking is crucially needed in changing technology age since it is closely to the gap between skill and knowledge needed in workplace [5].

Considering to the dramatic IT used for teaching and learning, it suggest creating and exploits endless learning opportunities. Some researchers argue that giving opportunities by integrating technology in science learning can achieve more active engagement and higher quality than conventional one [6,7].

The ICT usage is also reported that it affects to foster critical thinking skill and changes its usage [4,8,9,10]. In line with a study by Bester and Brand [11], ICT-based teaching and learning is also claimed that it can foster cognitive, creativity and critical think skill. Furthermore, another study has also proved that information technology enable to foster students more active and critical in thinking [4].

Since the online learning has several problems dealing with it implementation, scholars and stake holder have tried to explore another cooperative learning approach named blended learning. Literatures report that researchers have explores various platform in the blended learning in teaching learning such as integrating WhatApp based blended class [9,12,13]. It is also mentioned that WhatApp is the most preferenced used as mobile integrated learning since it is free to download, easy to use, simple, asseseble, low cost, and also multifunction [12,13]. Some other studies also claimed that this platform give a lot of opportunities to create positive environment, motivate students be more active, easily to communicate and give positive feedback [13,14,15].

Nevertheless, some studies have also revealed that this platform cannot be easily applied in the class [16,17,18]. In other literature, Amry in his study of blended learning using Whatsapp suggests that the strategy give more negative impact than its positive impact on students' performance [17]. One of possible reason might be because of its limitations on textual resources of academic conceptualization and unsure within the academic grip of the discussion result using text messages in this application [18]. Then, both teachers and students more prefer to use it for interaction and others purposes than to education [16].

Thus, it remained great interest to explore other kinds of platform used in blended based learning especially for sustaining Physics teaching learning process. In addition, the limitations of the literature regarding the effect of blended learning in students critical thinking especially in Physics field in Lampung, Indonesia, are such a reason for conducting this research. Therefore, it is urge to do further investigation due to this matter. The purpose of this study were to examine the effectiveness of blended learning setting using Schoology in improving students' critical thinking and to explore students' response about the learning approach.

2. Method

The study was conducted in order to explore the effectiveness of blended learning setting to support students critical thinking skills and also their perception through the process. This research was done in one of senior high school in Metro, Lampung, in odd semester of 2018/2019 academic year with 65 students in total, 32 students for experiment group and 33 students for control group. The present study carried mixed-method, a quasi-experimental followed by a qualitative survey in order to meet the objectives of the research. There were two stage in collecting the data namely quantitative stage and qualitative stage. In quantitative stage, the quasi experimental is adopted during the process. Before giving treatment, both experimental and control groups were given pre-test. In the experimental group, learning was done with Schoology-based blended learning system with a guided inquiry learning model. Blended learning used has a cycle of online face-to-face learning-online learning, referring to previous studies [19]. The number of face-to-face meetings in both classes is four meetings with duration of 90 minutes for each meeting. Meanwhile, control class only received conventional treatment. The end of the first stage, the post test was conducted in order to get information about students' critical thinking skill.

For collecting the quantitative data, multiple choice tests was used in term of critical thinking skill. The test included five indicators of critical thinking namely focusing questions, analyzing arguments, considering trusted sources, identifying assumptions and determining actions. Data taken from both pre-test and post-test is useful to identify the differences of students' critical thinking skills. The test used

in this study has been tested for its validity with Person Correlation >0.1954 tested at 70 students. Furthermore, regarding its reliability, the cronbach's alpha method was used and got the valued at 0.876.

Furthermore, in order to get better understanding about the issue, the second stage was done by conduction survey. In collecting qualitative data, the survey was done in order to getting better understanding of students' perception on blended learning process. A survey was conducted in the researcher's class consisting of 32 learners via a questionnaire. The instrument used for this study was a structured questionnaire to identify if the factors such as peer interaction, tutor support, online task, technology support, and knowledge acquired influence respondents satisfaction in the collaborative online learning assignment discussion; and to determine factors that are most indicative for learner satisfaction in a collaborative online discussion forum.

Since the study has two types of data namely quantitative and qualitative data, the researchers used two kinds of data analysis techniques. For analyzing data of quantitative, the statistical analysis of SPSS 21.00 which has 0.05 significant levels is used in this study. For having deepest understanding of the implementation, the descriptive qualitative was used to analyze the questionnaires. The results obtained from the questionnaires are in the form of percentage of students answers detailed on each question. Through this information, we can find out the effectiveness of learning using blended learning platform.

3. Result and Discussion

3.1 Result

In experimental stage, online-face to face-online learning was done with guided inquiry based learning adopted the blended learning proposed by Suana et al. [19]. In online platform, the students tried to have discussion related the topic before the class. From the online discussion, it is found that most of learners are having more confident in expressing their ideas.

Moreover, both experiment and control classes have received pre-test and post-test. The data obtained from those tests related to critical thinking skill are presented in Table 1.

Tabel 1. Pretest and Posttest Indicator Critical Thinking Skill

No	Indicator Critical Thinking Skill	Experiment Group (n=32)				Control Group (n=33)			
		Pretest	Posttest	N-Gain	Category	Pretest	Posttest	N-Gain	Category
1	Overall	33.28	62.34	0.43	Medium	35,91	44,09	0.10	Low
2	Focus on the Question	49.22	76.56	0.46	Medium	-0.11	62.12	-0.11	Low
3	Analyze Arguments	32.81	46.09	0.13	Low	-0.05	26.52	-0.05	Low
4	Determine the Source is Reliable or Not	32.03	89.84	0.84	High	-0.12	32.58	-0.12	Low
5	Identify Assumption	34.38	3.13	0.03	Low	0.42	93.94	0.42	Medium
6	Decide Actions	25.00	56.25	0.40	Medium	0.19	43.29	0.19	Low

Based on the N-Gain test if the sample is obtained in a normal and homogeneous distribution, the Independent Test T-test sample can be read in table 2 while if it does not meet these requirements using

the Mann Whitney U-Test which can be read in table 3. The result revealed that Blended learning schoology based on students' critical thinking skills was significant. It can be seen that the t_{count} is 7.266 while the table is 0.2027. The $t_{count} > t_{table}$ (7.266> 0.2027) and significance (0.000 <0.05) concludes that H0 is rejected so there is a significant difference in students' critical thinking skills in the class experiment with control class.

Tabel 2. Result of T-Test of Critical Thinking Skill

No	Indicator Critical Thinking Skill	Levine's test		T-test			
		F	sig	T	df	Asymp. Sig. (2-tailed)	Decision
1	Over All Indicator Critical Thinking Skill	1.604	0.21	7.266	63	0.000	Ho Rejected

The five indicators contained in the question of critical thinking ability obtained data that were not normally distributed and homogeneous so that the Mann Whitney U-Test Test was used which can be read in Table 3.

Tabel 3. Statistics test Mann Whitney U-Test

No	Indicator of Critical Thinking Skill	Mann Whitney U-Test	Z	Asymp. Sig. (2-tailed)	Decision
1	Focus on the Question	301.000	-3.119	0.002	Ho Rejected
2	Analyze Arguments	392.500	-1.825	0.068	Ho Accepted
3	Determine the Source is Reliable or Not	40.000	-6.585	0.000	Ho Rejected
4	Identify Assumption	320.500	-3.731	0.000	Ho Rejected
5	Decide Actions	224.000	-4.053	0.000	Ho Rejected

Based on Table 2 and Table 3 if the value of Asymp. Sig. (2-tailed) < 0.05) It can be concluded that H_0 is rejected. Based on the results of the test, it can be obtained that there is a significant difference in the critical thinking ability of the experimental class students and the control class. These data indicated that the indicators focused the questions, determined the sources to be trusted or not, identified assumptions and determined actions in which there were differences in students' critical thinking skills in the experimental class and the control class. Meanwhile, for the indicators in analyzing the arguments, there were no differences in the two classes. In short, the blended learning plat form is carried out an influence of students' critical thinking skills in the experimental class.

In second stage, a questionnaire regarding students 'responses to blended learning was given, which was related to students' attractiveness regarding learning the blended learning model, ease of participating in blended learning, the benefits of participating in blended learning, and constraints in following blended learning. Based on the results of the questionnaire that has been given to students, after doing blended learning has been drawn in Table 4.

Tabel 4. Analysis of The Use of Blended Learning

Category Using Blended Learning		Frequency	Percentage*
Actractiveness	yes	22	68%
	no	10	32%
Easiness	yes	26	82%
	no	6	12%
Strength	improve understanding	27	84%
	gain motivation	24	75%
	know how to use technology	27	84%
Obstacle	low internet connection	30	94%
	lack of internet facility	2	6%
Total Respondent		32	

*Percentage of total respondent

Based on the questionnaire it was obtained that attractiveness following blended learning students in one class more than 2/3 of the students. The ease of use of blended learning is found as the reason why students are interesting in blended learning. From the study, It is revealed that more than 80% students have felt blended learning easy to use and flexible due to time and place. The benefits of blended learning are almost 80% useful but have high obstacles for all students on internet connection problems. From the open ended questions, it is also found that blended learning suggests enriching students' learning experience.

3.2 Discussion

Mixed learning between face-to-face and online learning using guided inquiry methods further enhances students' critical thinking skills rather than conventional learning. This is in line with the results of research conducted by Zain that physics learning using guided inquiry models based on blended learning further enhances students 'critical thinking abilities [2]. This present finding is also similar with previous findings which claimed that ICT- based learning can foster critical thinking skill [11,8,9,4,10]. The other previous study has also proven that Schoology serves to conduct exercises and tests, provide learning content such as showing articles, videos or simulations and for collaborative activities such as discussion groups (Picaino, 2017). Online learning is carried out in this learning by giving a problem then students discuss the problem to give a hypothesis. Through this can improve the ability to think critically with indicators focusing questions and analyzing arguments. After that, doing face-to-face learning with an experimental method that starts with collecting data, analyzing data to draw conclusions so that it can develop critical thinking skills with indicators of critical thinking considering sources can be trusted or not, determine assumptions and determine actions. After that, at the last stage, online learning that is used to conduct discussions can make students' critical thinking abilities increase with indicators determining actions. Similar to the research conducted by Agnan (2018) through the method of argument analysis can improve critical thinking skills because through argument students will develop logic to provide these answers.

Based on the results of questionnaire give to students, it is revealed that many students were interested in learning using Blended learning through Schoology. The possible reasons are the learning system is easy to use and also increase the learners' motivation. This finding is similar with the previous study which claimed that blended learning has increased student motivation [20](Barbour & Reeves, 2009). Moreover, through this learning platform, learners can also have new learning experience. This result is simiar with study by Cooner which suggests that blended based learning claimed to improve students' learning experience [21]. By using this platform, from open ended questionnaire, students argue that they are interesting because learning process can be done anywhere and anytime. Pratt and Trewern

[22] and Parkes et al. [23] also found that blended learning provides flexibility learning and fosters learners' self-reliance. This similar finding is also found by another study which this learning setting provide students by flexibility of time [24,25].

4. Conclusion

Based on the results of this research, it can be concluded that there is a significant influence of learing using blended learning-base Schoolgy on students' critical thinking skill. Students are enjoyed during the learning process since it have flexiblelity of time and also easy to use. This platform is also reported having benefit in enriching students'learning experience and students motivation. However, the implementation also encounter some problems dealing with internet connection. Furthermore, it is suggested to conduct further research related to its impact in learning motivation and also learning outcome. The further study may also pay more intention on internet connection to supporting the implementation.

5. References

[1] Lau J Y 2011. *An introduction to critical thinking and creativity: think more, think better*. John Wiley & Sons.

[2] Zain A R 2018 Effectiveness of guided inquiry based on blended learning in physics instruction to improve critical thinking skills of the senior high school student. *Journal of Physics: Conference Series* (Vol. 1097, No. 1, p. 012015). IOP Publishing.

[3] Johnson S C, Dweck C S, Chen F S, Stern H L, Ok S J and Barth M 2010 At the intersection of social and cognitive development: internal working models of attachment in infancy. *Cognitive Science*, *34*(5), 807-825.

[4] Saadé R G, Morin D and Thomas J D 2012 Critical thinking in E-learning environments. *Computers in Human Behavior*, *28*(5), 1608-1617.

[5] Lee K 2007 Online collaborative case study learning. *Journal of College Reading and Learning*, *37*(2), 82-100.

[6] Jimoyiannis A 2010 Designing and implementing an integrated technological pedagogical science knowledge framework for science teacher profesional development. *Computer & Education*, 55, 1259-1269.

[7] Srisawasdi N 2012 The role of TPACK in physics classroom: case studies of preservice physics teachers. *Procedia-Social and Behavioral Sciences*, *46*, 3235-3243.

[8] Kustijono R and Zuhri F 2018 The use of Facebook and WhatsApp application in learning process of physics to train students' critical thinking skills. In *IOP Conference Series: Materials Science and Engineering* (Vol. 296, No. 1, p. 012025). IOP Publishing.

[9] Longo C M 2016 Changing the instructional model: utilizing blended learning as a tool of inquiry instruction in middle school science. Middle School Journal, 47 (3), 33-40.

[10] Thomas J D and Morin D 2010 Technological supports for onsite and distance education and students' perceptions of acquisition of thinking and team-building skills. *International Journal of Distance Education Technologies (IJDET)*, *8*(2), 1-13.

[11] Bester G, and Brand L 2013 The effect of technology on learner attention and achievement in the classroom. *South African Journal of Education*, *33*(2).

[12] Tang Y and Hew K F 2017 Is mobile instant messaging (MIM) useful in education? examining its technological, pedagogical, and social affordances. *Educational Research Review*, *21*, 85-104.

[13] Bouhnik D and Deshen M 2014 WhatsApp goes to school: mobile instant messaging between teachers and students. *Journal of Information Technology Education: Research*, *13*, 217–231.

[14] Plana M G C, Escofet M I G, Figueras I T, Gimeno A, Appel C and Hopkins J 2013 Improving learners' reading skills through instant short messages: A sample study using WhatsApp. 4th World- CALL Conference, Glasgow.

[15] Chipunza P R C 2013 Using mobile devices to leverage student access to collaboratively-generated resources: a case of WhatsApp instant messaging at a South African University. *International Conference on Advanced Information and Communication Technology for Education* (ICAICTE) 2013.

[16] Alabdulkareem S A 2015 Exploring the use and the impacts of social media on teaching and learning science in Saudi. *Procedia-Social and Behavioral Sciences*, *182*, 213-224.

[17] Amry A B 2014 The impact of WhatsApp mobile social learning on the achievement and attitudes of female students compared with face to face learning in the classroom. *European Scientific Journal, ESJ*, *10*(22), 116-136.

[18] Rambe P and Bere A 2013 Using mobile instant messaging to leverage learner participation and transform pedagogy at a South African University of Technology. *British Journal of Educational Technology*, *44*(4), 544–561.

[19] Suana W 2019 Supporting blended learning using mobile instant messaging application: its effectiveness and limitations. *International Journal of Instruction, 12*(1), 1011-1024.

[20] Barbour M K and Reeves T C 2009 The reality of virtual school: a review of the literature. Computers and Education, 52 (2), 402-416.

[21] Cooner T S 2010 Creating opportunities for students in large cohorts to reflect in and on practice: Lessons learnt from a formative evaluation of students' experiences of a technology-enhanced blended learning design. *British Journal of Educational Technology*, *41*(2), 271-286.

[22] Pratt K and Tweren A 2011 Student's experiences of flexsible learning options: what can they tell us about what they need for success? *Computers in New Zealand Shool: Learning Teaching Technology*, 23 (2) x.

[23] Parkes S, Zaka P and Davis N 2011 The first blended or hybrid online course in a New Zealand secondary school: A case study. *Computers in New Zealand Schools: Learning, Teaching, Technology, 23*(1), 1-30.

[24] Baepler P, Walker J D, and Driessen M 2014 It's not about seat time: blending, flipping, and efficiency in active learning classrooms. *Computers & Education*, *78*, 227-236.

[25] Rosenbaum P E L 2012 *E-learning: a study of students' attitudes and learning outcome when using blended learning with integration of multimedia instructions*. The University of Bergen.