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# Blended Project Based Learning: Strategy for Improving Critical Thinking of Pre-Service Teachers in Science Education

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## ABSTRACT

The purpose of this study was to analyze the effectiveness of blended project based learning to improve the critical thinking of pre-service teachers in science education. In this blended project based learning, students teacher must complete the multimedia project using various software and discuss the project and the concept through face-to-face and e-learning session. The content of multimedia project were developed based on science unit on the topics of Anatomy and Physiology of Human, Animal and Plant. The method of this research was mixed method with embedded design by involving 35 students teacher at Primary School Teacher Education in Indonesia University of Education, Purwakarta campus. The data were obtained using observation sheet and critical thinking test. The result showed that the students have a good activities in e-learning and face-to-face session and the critical thinking improved after the implementation of blended project based learning.

*Keywords: Blended Project based learning, science education, creative thinking*

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## Introduction

The purpose of science learning in schools is not simply that the students will become more aware of various phenomena in nature. More than that, the purpose of science learning emphasizes more on the involvement of students in a series of scientific activities that involve process skills and the ability to think well such as critical thinking skills. National Science Education Standard (2003) formulates various objectives of science learning which is substantially centered on the achievement of students' critical thinking. NSTA asserts that critical ability in analyzing arguments by reviewing scientific understanding when taking into account proofs and logical assessment to

make a decision as to which explanation or model is best also involves critical thinking activities. This shows that critical thinking skill is one of the main objectives that needs to be achieved in science learning.

Critical thinking skills are often defined as the ability to think clearly and rationally (Higgins, 2014). The National Strategies of the UK Government (2008) proposes that the ability to think critically is described as the ability to reason, reflect and perform skilled thinking activities that are used to decide what must be believed and done. Critical thinking relates to the activities of analyzing, making assessment, drawing conclusions and formulating solutions to problems (Paul & Elder, 2006; Lai, 2011). From the definition, it can be concluded

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that critical thinking skill is the ability to analyze and take into account facts or arguments to determine the right decision and action.

One of the efforts to improve teachers' ability to think critically can be done in the training program of student teachers in higher education. The implementation of the training program of student teachers needs to be carried out in an innovative manner and in accordance with the demands of the 21<sup>st</sup> century. Cox (2017) states that learning that is in accordance with the 21<sup>st</sup> century must fulfill five factors consisting of: 1) teaching strategies which is able to accommodate the varying needs of students; 2) implementation of technology, 3) encouragement for students to interact with each other; 4) being oriented to thinking activities; and 5) training of students to adapt to changes. Based on the statement above, it can be seen that critical thinking skills can be one of the important factors that needs to be accommodated in the learning of the 21<sup>st</sup> century which is supported by the existence of other abovementioned factors. Thus, in the study period of student teachers, the five factors above must be involved.

One of the strategies that is perceived to be in accordance with the demands of the 21<sup>st</sup> century and can be applied in higher education programs is blended project based learning (BPjBL). Blended project based learning is a combination of project based learning model with blended learning model. Project based learning is a learning model that consists of a series of scientific activities that consist of the formulation of problems/questions, investigation, work assignments and completion of project or product (Ferara, 2012; Thomas, 2000). In addition, White (2001) states that not only can the project based learning affect the

mastery of knowledge itself, but also it can be used as a way to develop self-directed learning that can improve the skills of students in solving problems that can be applied in different contexts of life.

In the context of the 21<sup>st</sup> century, PjBL can be integrated with blended learning strategies. Blended learning can be defined as a learning model that combines various types of learning approaches, learning environments and learning methods that can support the success of traditional learning (Marsh, 2012). Singh (2003) proposes that blended learning combines various learning media or learning tools such as real time virtual/collaboration software, face-to-face, web-based lecture, electronic performance support system (EPSS) which is integrated in the job task environment and knowledge management system designed to complement each other.

Based on the definition of PjBL and blended learning, blended project based learning (BPjBL) can be defined as teaching strategies that integrate various media forms or ICT-based learning in the stages of project based learning which emphasize the production of a product as the end of the learning activities. The combination of the two is particularly in line with the concept of 21<sup>st</sup> century because it can help develop 4Cs (critical, creative, collaborative and communication) skills and it can develop the independence of learning and ICT literacy. In order to find proof, a research was conducted aiming to identify the effectiveness of BPjBL against students' critical thinking skill as one of the skills needed by the generation of the 21<sup>st</sup> century. To focus the research, several research questions were formulated as follows: For the the research to be focused, several research questions were formulated as follows:

- a. How are the students' learning activities in a series of lectures of Enrichment of Science Lesson based on blended project based learning.
- b. How are the students' critical thinking skills before and after the lecture of Enrichment of Science Lesson based on blended project based?

**Research Method**

The approach used in this research is qualitative and quantitative approach with mixed method and embedded design. Quantitative data gathered in this research are data regarding the students' ability to think critically while qualitative data obtained are data regarding students' learning activities. The subject of the research is 35 third-year university students. The research instrument used is observation sheet to obtain the description of the activities and a test to gather critical thinking skill data on basic clarification indicator with sub-indicator consisting of defining terminologies, focusing on questions, analyzing arguments, understanding and using graphs/mathematical concepts, completing and taking into account an assumption, and using ready knowledge (Ennis, 2013).

Student activity data on each learning session is calculated by analyzing the number and intensity of the students' participation in the learning process such as providing questions, providing answers/giving opinions, identifying problems, formulating solutions, collecting and compiling information, analyzing information, and identifying logical relationships between problems or information which has been obtained. The number of students' participation is expressed in form of percentage whereas

participation intensity is expressed in form of the scores consisting of : A (Excellent), B (Good), C (Fair), D (Poor). Student's critical thinking test data were analyzed by performing an N-gain test to identify the improvement of students' critical thinking ability as seen from the results of pre-test and post-test obtained through the N-gain formula = (post-test score - pre-test score) / (maximal score - pre-test score) N-gain scores obtained were then interpreted based on the following criteria:  $\geq 0.7$  (high),  $0.7 > N\text{-gain} \geq 0.3$  (moderate), and  $< 0.3$  (low) (Hake, 1999).

**Results and Discussion**

The class using blended strategy project based learning includes two learning sessions that consist of independent learning sessions and face-to-face learning sessions. The results of these observations on the students' activity in both sessions and students' critical thinking test data after the class can be seen in Tables 1 and 2 below.

Table 1. Students' activities in science subject based on blended based project based learning

Stages of Blended Project Based Learning:		Number (%) N=35	Participation Intensity			
			D	C	B	A
Week 1 (Face-to-face)	• Determining the problem and identifying the strategy of project completion	57	20	34	3	-
Week 2 (Face-to-face & online)	• Searching for and extracting information	63	31	23	9	-
Week 3 (Face-to-face)	• Synthesizing all the information in form of flowchart and storyboard	74	20	40	11	-
Week 4 (Face-to-face)	• Evaluating flowchart and storyboard	89	29	34.3	14.3	11.4
Week 5 (Face-to-face)	• Communicating the flowchart and storyboard → obtaining feedback	94.3	40	25.7	20	8.6
Week 6, 7 & 8 (Face-to-face & online)	• Revising flowchart and storyboard • Making of multimedia project • Project validation → feedback from lecturer → revision	89	17.2	37.2	20	14.3
Week 9, 10 & 11 (online)	• Publication of the project & discussion of lesson					
	Topic 1 : Respiration of plants	66	66	-	-	-
	Topic 2 : Photosynthesis	54	26	23	6	-
	Topic 3 : Skeletal System	60	14.3	20	11.4	14.3
	Topic 4 : Respiratory system of human and animal	77	23	17	17	20
	Topic 5 : Digestive System	83	17.2	34.3	31.4	-
	Topic 6 : Reproductive System	91.4	23	45.6	11.4	11.4

Table 2. Critical thinking test data on students' basic clarification indicator

Sub-indicator	N	Pre-test	Post-test	Max score	Score N-Gain	Criteria
Defining terminologies	35	7,43	11,86	20	0,35	Moderate
Focusing questions		10	14,43	25	0,29	Low
Analyzing Arguments		3,86	9,43	10	0,91	High
Using mathematical concepts		4,14	12,57	20	0,53	Moderate
Completing and considering assumptions		2	9,14	20	0,39	Moderate
Using ready knowledge		3,86	13	20	0,56	Moderate

From Table 1, it can be seen that the students' activities in the science lesson enrichment class based on blended project based learning tends to increase both in face-to-face and e-learning sessions. The increase is seen not only in terms of the number of but also in terms of the participation intensity. Driving questions, identification and understanding of problems and defining of strategies for solving the problems through the assignment of the making of multimedia project are the key stages in gearing students into learning.

The result of the activity data shows that the adaptation of the project based learning steps in blended learning strategy is very effective in improving students' learning activity. As stated by Harper (2014), the existence of driving questions in project based learning will focus the students' activities because the students will try to understand the problems, explore information related to the problems that may affect the enhancement of their knowledge, enabling them to determine a problem-solving strategy based on the knowledge they already have which is an essential element that can affect the effectiveness of project based learning in the classroom.

Bell (2010) suggests that project-based learning combined with face-to-face learning and e-learning strategies and integrating various media and learning tools

(blended learning) can facilitate different student learning styles so that learning becomes more active. Meanwhile, Hsieh, Lou and Shih (2013) reveal that the application of blended learning in project based learning can affect students' learning activities when accompanied by clear work instructions from the teacher, the application of creative learning methods, the existence of group work, and sources of information that can be accessed online.

In addition to posing impact on students' learning activities, the application of blended project based learning also affects thinking skills. In Table 2, it can be seen that the students' critical thinking has increased with criteria ranging from low, moderate and high. Based on this, it can be concluded that the application of blended project based learning in the science subject can influence the improvement of critical thinking skills.

Several studies have shown that blended project based learning or project based learning that integrates self-learning and e-learning strategies can improve students' critical thinking skills as a manifestation of higher-order thinking skills (Husamah, 2015, Putri & pratomo, 2016; Sarifudin, Haryani & Wardani, 2015).

The improvement in critical thinking skills is influenced by the learning character of the blended project based learning itself. The National Strategies of the UK Government suggests several learning strategies that can help develop thinking skills, among others: 1) focusing on inquiry learning, 2) providing open ended questions, 3) directing towards the discussion process, 4) introducing a problem to students, 5) letting students take risks, identifying and seeing the interconnection in various aspects, 6) letting the students to lead (defining

strategies, making plans, synthesizing products, etc.), 7) assisting students in developing criteria to make a judgment, and 8) providing opportunities for students to explore ideas and make choices.

The eight strategies have been integrated in the stages of blended project based learning activities in the science subject so as to enable students to develop their critical thinking skills. In addition, chances of doing reflection and analysis such as those found in learning blended project based learning can also help develop students' critical thinking skills (Higgins, 2014). Similarly, Paul & Elder (2007) point out that students need to be invited to process information, formulate conclusions, consider several views, analyze concepts, theories and explanations, clarify issues and conclusions, solve problems, transfer ideas into different contexts, examine assumptions, assess facts, and explore implications and consequences. A series of scientific processes will affect an individual's thinking habit to be more critical towards a problem or event. In light of these opinions, it can be said that blended project based learning can be considered as an effective alternative to learning strategy in developing students' critical thinking skills.

### Conclusion

The integration of information and communication technology in the teaching and learning that are relevant to the needs of the 21<sup>st</sup> century is the issue in the context of present education. The complexity of the problems in the present situation of life amidst the rapid advancement in technology and knowledge forces education world to adjust the educational curricula so that they are capable of forming a

generation which is resistant and adaptive in the face of changes. 21<sup>st</sup> century poses challenges not only on the field of science but also on other fields.

A series of scientific activities in an innovative learning strategy that leads students to be sensitive to issues and problems and strive to solve the problems through the process of collecting, analyzing and clarifying information obtained from various sources, reflecting and revising through individual or collaborative activities to formulate a solution can develop a number of skills such as critical thinking, being creative, communication and collaborative thinking. From this research, it can be concluded that the implementation of blended project based learning in the science subject could affect the student teachers' critical thinking activities as well as their critical thinking skills. Thus, blended learning strategies can be resorted as an alternative to learning that can be applied in higher education to realize the 21<sup>st</sup> century generation.

### Reference

- Bell, S. 2010. Project-Based Learning for the 21<sup>st</sup> Century: Skills for the Future. The Clearing House, Vol 83, page 39-43
- Ennis, H. R. 2013. The Nature of Critical Thinking: Outlines of General Critical Thinking Dispositions and Abilities. [Online].<http://www.criticalthinking.net/longdefinition.html>
- Ferrara, J. 2012. *Using Project-Based Learning to Increase Student Engagement and Understanding*. [online]:[https://education.ti.com/sites/US/downloads/pdf/t3/Ferrara\\_Church\\_Boneau\\_Using\\_PBL\\_Increase\\_Student\\_Engagement.pdf](https://education.ti.com/sites/US/downloads/pdf/t3/Ferrara_Church_Boneau_Using_PBL_Increase_Student_Engagement.pdf)

- Hake, R. 1999. Analyzing Change/Gain Scores. [Online]:  
<http://www.physics.indiana.edu/~sdi/AnalyzingChange-gain.pdf>
- Harper, A. 2014. Teacher Guide: Using Project Based Learning to Develop Students' Key Competences. European Schoolnet: Brussels.
- Higgins, S. 2014. Critical thinking for 21st-century education: A cyber-tooth curriculum?. United Kingdom: Durham University
- Husamah 2015. Blended Project Based Learning: Thinking Skills Of New Students Of Biology Education Department (Environmental Sustainability Perspective). Indonesian Journal Of Science Education. Vol 4, No.2
- Hsieh, Y.H., Lou, J.S., Shih, C.R. 2013. Applying Blended Learning with Creative Project-Based Learning: A Case Study of Wrapping Design Course for Vocational High School Students. The Online Journal of Science and Technology. Vol 3, No,2, p 18-27
- Lai, R.E. 2011. Critical Thinking: A Literature Review. [Online].  
<http://images.pearsonassessments.com/images/tmrs/CriticalThinkingReviewFINAL.pdf>
- Marsh, D.2012. *Blended Learning: Creating Learning Opportunities for Language Learners*. Cambridge University Press
- Paul, R. & Elder, L. 2006. Critical Thinking: Concepts and Tools. [online]:  
[http://www.criticalthinking.org/files/Concepts\\_Tools.pdf](http://www.criticalthinking.org/files/Concepts_Tools.pdf)
- Putri, U, S., Pratomo, Y. 2016. Identifikasi level HOTS Mahasiswa Calon Guru Melalui Perkuliahan IPA Berbasis Blended Project Based Learning. UPI Research Report
- Sarifudin, A., Haryani, S., Wardani, S. 2015. Characterized Project Based Learning To Improve Critical Thinking Skill. [Online]:  
[Http://Icmseunnes.Com/2015/Wp-Content/Uploads/2016/03/46\\_CE.Pdf](Http://Icmseunnes.Com/2015/Wp-Content/Uploads/2016/03/46_CE.Pdf)
- Singh, H. & Reed, C. 2001. A White Paper: Achieving Success with Blended Learning. Available online at:  
<http://www.leerbeleving.nl/wbts/wbt2014/blend-ce.pdf>
- The National Strategies. 2008. Developing Critical and Creative Thinking in Science. [online]:  
<http://webarchive.nationalarchives.gov.uk/20130401151715/https://www.education.gov.uk/publications/eOrderingDownload/Developing%20critical%20and%20creative%20thinking%20in%20science.pdf>
- Thomas, W.J. 2000. A Review of Research On *Project based learning*. Available Online at:  
[http://www.bie.org/research/study/review\\_of\\_project\\_based\\_learning\\_2000](http://www.bie.org/research/study/review_of_project_based_learning_2000)
- White. 2001. Problem Based Learning. *Journal of Winter* Vol. 11, No.16