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Submission date: 15-Jun-2023 01:01PM (UTC+0700)

Submission ID: 2116446849

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Word count: 2140

Character count: 11613

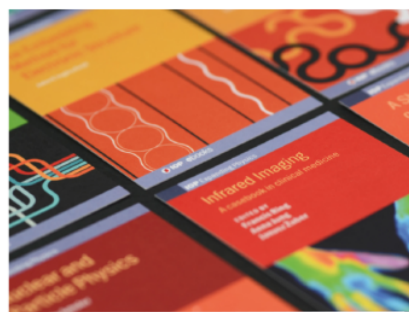
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To cite this article: M Taufiq *et al* 2020 *J. Phys.: Conf. Ser.* **1567** 042049

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Implementation of blended project-based learning model on astronomy learning to increase critical thinking skills

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Abstract. This study aims to analyse the critical thinking skills of prospective science teacher students during astronomy lectures by applying a Blended Project Based Learning model. This research is a type of descriptive research with a quantitative approach. The study population was all semester 4 science students of science at one of the state universities of educational staff in Central Java, Indonesia. Students' critical thinking skills experience a very good change after working on the project. The results of the average score of critical thinking skills that have significance values with medium and high N-Gain criteria. It was concluded that the implementation of Blended Project Based Learning model on astronomy learning able to increase critical thinking skills.

1. Introduction

21st Century skills are needed to be mastered in order to realize quality human resources that are globally competitive, better known as 6C (Collaboration, Creativity, Critical Thinking, Citizenship, Character, Communication). One of them is critical thinking skills to design and manage projects, solve problems, make effective decisions using various digital tools and resources. The ability to think critically is very important in almost all fields of study or practice where ideas need to be communicated, decisions need to be made and problems need to be discovered, analysed and solved [1,2,3].

Education is a field that is strongly influenced by science and technology. Human resources involved in it must have critical thinking skills to be able to keep up with technological advances [4]. Prospective science teachers are one of the human resources who have an important role in the education system. The professionalism of future science teacher candidates and science learning are closely related to 21st century skills, especially critical thinking skills that need to be included as one of the standard skills of prospective science teachers to respond to this century.

Astronomy courses must be taken by prospective science teachers as a reinforcement of content that has used a learning module, but the learning modules and systems that are implemented are not running effectively. Moodle-based Learning Management System (LMS) is only used as collector of tasks and materials. Implementation of learning that applies Blended Project Based Learning can overcome the problem of time constraints [5,6] and involve students in organized and meaningful activities [7,8,9], using project activities as a medium so students learn to explore, assess, interpret, synthesize, and information so that can improve students' critical thinking skills [10]. Blended Project Based Learning was uses online and offline learning tools. Online learning tools are realized in web



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learning that has been modified and contains content in the form of materials and assessments. The offline learning tool consists of a Learning Event Unit and a student activity sheet.

2. Methods

This research is a type of descriptive research with a quantitative approach. This study aims to analyze the critical thinking skills of prospective science teacher students during astronomy lectures by applying a blended project based learning model. The study population was all semester 4 science students of science at one of the state universities of educational staff in Central Java, Indonesia.

The sampling technique used was random sampling, with a sample of 42 students. The research instrument for measuring critical thinking is in the form of tests (pretest and posttest). The test contains 12 breakdown questions with a lattice developed according to the criteria of critical thinking abilities including: 1) interpretation; 2) analysis; 3) conclusion; 4) evaluation; 5) explanation; and 6) self-regulation [11]. Each of these skills is revealed again into several sub-indicators of skills that stimulate students' critical thinking abilities.

Test the validity of the questions carried out by construct test. The critical thinking rating scale is categorized into five criteria ranging from 0-100 with criteria ranging from very poor to very good. Table 1 shows the criteria for the range of critical thinking values.

Table 1. Criteria for the Range of Critical Thinking Scores

Code	Average Score (%)	Criteria
VG	86-100	very good
G	71-85	good
M	61-70	medium
P	51-60	poor
VP	0-50	very poor

Increased critical thinking skills are calculated by the N-Gain formula [12]:

$$N - Gain = \frac{(Posttest\ Score - Pretest\ Score)}{(Ideal\ Score - Pretest\ Score)}$$

The ideal score is the maximum (highest) score that can be obtained. The N-Gain rating categorization refers to Table 2.

Table 2. N-Gain Criteria

N-gain Score	Criteria
$0.7 < g \leq 1.0$	high
$0.3 \leq g < 0.7$	medium
$g < 0.3$	low

3. Results and Discussion

Blended Project Based Learning is a model of teaching which combines face – to – face and online learning [12, 13]. The implementation of Blended Project-based learning model in this research using syntax consists of five stages, namely: (1) planning an investigation process according to driving question (face to face), (2) searching for the theoretical background of the driving question (online), (3) presenting that theoretical background to class and discussion about issue (face to face), (4) deciding the study group of the way of collecting data and data analysis (online), and (5) evaluating data, arriving a conclusion, presenting the project in class as preferred and discussion (both face to face and online) [14].

Critical thinking is a type of thinking that involves the use of analytical and evaluative cognitive processes, especially analysis relating to arguments based on logical consistency that aims to recognize biases and errors in reasoning [15]. Based on the results of the analysis and calculations that have been done, an average score of students' critical thinking scores obtained in the form of ratio data

from the object being measured, includes 6 critical thinking skills (interpretation, analysis, conclusions, evaluation, explanation and self-regulation) presented in Table 3.

Table 3. Profile Information Critical Thinking Skills (CTS) of Prospective Science Teacher Students

Indicator	Average Score (%)	CTS Criteria	N-Gain	N-Gain Criteria
Interpretation	84.37	good	0.41	medium
Analysis	89.17	very good	0.72	high
Conclusion	90.63	very good	0.91	high
Evaluation	84.54	good	0.44	medium
Explanation	86.93	very good	0.76	high
Self-Regulation	88.76	very good	0.71	high

The average score shows a range of values that do not differ much between indicators of critical thinking skills. The critical thinking ability of prospective science teacher students in terms of interpretation and evaluation has a good category. Interpretation is the ability to categorize problems, define characteristics and clarify meaning well [16]. This means that if the interpretation skills are good, then the prospective science teacher student is able to understand how to interpret the data properly including classifying, encoding meaning and understanding meaning clearly. The critical thinking ability of prospective science teacher students in terms of evaluating is also classified as good criteria. Evaluation is a very important skill possessed by students as prospective teachers, because this skill can help students solve various problems and make appropriate decisions. Evaluation is a skill that is able to actively involve students in solving problems, uncertainties and the questions they face [17].

On the indicators of analysis skills, conclude, explanation and self-regulation of the criteria is very good. In the implementation of astronomy learning with the Blended Project Based Learning model, it gets hands-on learning experience and helps make it easier for students to conclude the answers to the problems they encounter. Science Education students are facilitated to be able to explain the results, procedures and arguments presented in the problem. Through online learning activities students are facilitated to implement self-regulation that leads to self-monitoring and improvement. Students will consciously monitor their own abilities or knowledge, analyze and evaluate and apply their skills as an effort to improve themselves.

Students' critical thinking skills experience a very good change after working on the project. The results of the average score of critical thinking skills that have significance values with critical thinking indicators whose posttest scores are higher than pretest with medium and high N-Gain criteria. In the project making activities students are more active so as to gain new knowledge that they apply in real life and be more meaningful. Making projects for students can facilitate the deepening of concepts in astronomical material so that they are more active in drawing from various online literature. This study shows results that are relevant to some of the previous studies [18,19,20,21] that Blended Project Based Learning facilitates students to better understand the material taught by giving students the task required in thinking to solve various problems in the classroom by way of groups, so students have knowledge the wider. Students find concepts and construct their knowledge through projects that have been given. In its application students are invited to optimize group activities with the ease of online literacy to complete projects through experiments related to the surrounding environment. Students have the freedom to search for information sources online or ask face to face (blended) at the lecturer. Students discuss and work together in completing projects. This can be seen that Blended Project Based Learning is an active learning model both in individuals and in groups so that it can develop the ability to think productively in solving real problems in the environment.

4. Conclusion

Students' critical thinking skills experience a very good change after working on the project. The results of the average score of critical thinking skills that have significance values with critical thinking indicators whose posttest scores are higher than pretest with medium and high N-Gain

criteria. It was concluded that the implementation of Blended Project Based Learning model on astronomy learning able to increase critical thinking skills.

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