Implementation Of Brain-Based Learning Capability To Improve Students Critical Thinking Skills

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Abstract

This research aims to examine the effectiveness of the Brain-Based Learning (BBL) models in improving students' critical thinking skills of elementary school. This research was a quasi-experimental, with a nonequivalent control group pretest-posttest design. The study subjects were all students in grade 5 at the city of Bandung, and is represented randomly by three school level, which are high, medium and low level, based on the value of accreditation (A, B and C). The form of research instrument were tests, observations, and interviews. Analysis of data and interviews about learning using qualitative descriptive analysis, while the analysis of the test data using the techniques of statistical analysis t test. The findings of this study as follows: (1) Learning BBL implemented through five stages: pre-exposure, preparation, implementation, and evaluation of cover. (2) Performance of teachers, infrastructure, facilities and environmental influences on learning success BBL, (3) There are differences increase students 'critical thinking skills in the experimental class and control, (4) There are differences increase students' critical thinking skills in every school rank (a, B and C), (4) There is no difference in the attitude of students at each school ranked the learning process by using the BBL, the overall attitude of the students showed a positive attitude towards learning by using the BBL. Recommendations resulting from this research is to improve the teaching skills of teachers in order to optimize brain with BBL students. Principal and Steak holder, providing the means, facilities and environment standards BSNP. For other researchers to conduct studies and research with a focus on a different approach.

KEYWORDS: Brain based learning, critical thinking, learning science.

Introduction

Poor quality of education is the current educational challenge faced by Indonesian. The result of surveys taken by several international institutions have shown that the development of education in Indonesia is far from satisfactory. This can be seen from UNESCO's report (Cassity, 2010), which exhibited that on the EFA Development Index (EDI), Indonesia position has fall from 58 to 62 from 130 countries. The low quality of education in Indonesia can be observed through the performance of the educational sector, which covers the access to education, teacher, students, school performance, and educational output. Moreover, several basic challenges faced by Indonesia can also be noticed from the literacy level of the people, for example the issues to access education that are still faced by families from a low economy status, gender disparity and people who lived in remote area. In addition, the level of illiterate in adulthood (above 15 years old) reached 15.5 million or in

percentage 9.07% from the total population in Indonesia (Chamdani et al., 2019).

The result of the survey on poor quality of education in Indonesia can be observed at the World Bank report on reading test of the 5th grade students, Indonesian students in this survey were ranked the lowest in Asia. Here are the results of the countries: Hongkong 75,5%, Singapore 74%, Thailand 65,1%, Philippine 52,6% and Indonesia 51,7%. The result of the research further state that Indonesian students only able to comprehend 36% of the reading material. To be more precise, the low level of students critical thinking can be seen from the research conducted by Suryanto and Somerset (Fachrurazi, 2011:76, Priatna et al., 2020), and Mayadiana, 2005). Other researches that specifically discuss elementary students' low level of critical thinking in which correlates with the facts on the field have shown that the evaluation given to the students were more on the cognitive aspects of memorising not on the aspect of analysis. Various problem-solving questions, open questions or essay, and challenging task are nearly cannot be found on this type of students' worksheet.

The importance of teaching and developing students' critical thinking should be viewed as an urgent matter that cannot be underrate. Various results of educational research presented that critical thinking can strengthen students' ability to comprehend different disciplines, which can be further utilized to fulfil the intellectual needs and development of students' potential, as it can help prepare students to build a career later in life. (Liliasari, 1996; Adams, 2003).

Increasing students' ability in critical thinking can be achieved in the learning process inside the classroom. The government has tried to adjust and improve the quality of education by improving the learning or curriculum. This can be seen from the changes or curriculum development of the curriculum 2004 to curriculum 2006 (through the shifting process from the curriculum based on material to curriculum based on competency). Thus, the policy should be supported by the continuous implementation of the development of innovation on the learning process to construct an effective learning. One of the learning processes that has an instructional effect on the process of students' thinking skill is the Science subject. However, on the other hand, science subject that is conducted at school has not generate an optimal result. Numerous studies have displayed the condition of education in Indonesia that are related to the result of the learning process, among others are the science subject.

Based on the aforementioned data, innovation is essential to establish students' competence in thinking optimally, specifically their critical thinking skill. Nevertheless, referring to the result of previous study at some elementary school in Bandung, the implementation of the learning process on science subject still display many weaknesses and challenges. Moreover, other than the issues on learning, the problem on the number of students can influence the success of learning science. The large number of students (average up to 50 per-class) will challenge teacher in paying attention to students' individual development. Meanwhile, in embedding critical thinking skill in learning science, stimulation, attention, guidance, and individual learning is needed. Other challenges that occurs relate to a good learning facility, both software and hardware. This facility is for example have an inadequate teaching sources, such as reference books, science teaching aids, science media to practice, and more. The small learning facility influence teacher's difficulties in optimizing students' ability in critical thinking in learning science.

In addition, the previous study demonstrates that teachers have the tendency to use a conventional teaching method in delivering the science learning material in the classroom. Teachers are reluctant to use diverse teaching methods, they prefer applying a lecture teaching method, assigning homework, and others. The active-creative learning model that can develop critical thinking skill has not been widely implemented. Teachers tend to use teacher-centred method on the learning process.

This is stated by the result of the study written by Zulfikar (2010) which found that the teaching and learning activities at school are proven to be ineffective. This is perceived by the students' national exam result at elementary, junior high school, and senior high school level, which further reveal that students only absorb 35% of the given learning material (Kodir and Rusdiana, 2018). Therefore, this research is conducted to formulate the implementation of the learning process that can increase students' critical thinking skill, especially for elementary students in learning science.

Methods

This research uses a quantitative approach and a quasi-experiment that analyse the impact of certain treatment towards a phenomenon of a certain groups and it were further compared to other groups which utilize different treatment (Supardi, 2008). Likewise, the research uses Non-equivalent (pre-test and post-test) Control Group Design. The study was intended to scrutinize the influence of Brain Based Learning (BBL) as an independent variable towards students critical thinking skill on Science subject as the dependent variable.

Research Design

This research uses a non-equivalent control group pre-test and post-test. Before receiving any treatments, both groups were given the first test (pre-test) to investigate the first condition (O1), subsequently the experiment groups were given the experimental treatment (X) and the control groups did not receive any treatment. Afterwards, both groups were given post-test to evaluate the result of the treatment (O2).

Research Procedure. The application of BBL in this research were given 4 times, the pre-test was given before the learning starts. Moreover, in the experiment class, after every meeting a post-test was completed to see the impact of BBL on students critical thinking skill. The final post-test was conducted after the fourth meeting. Furthermore, to see the enhancement of students critical thinking ability, the result of the post-test and pre-test

were compared. To analyse the effectivity of the utilised model. Conversely, the learning on the control group were completed conventionally. Pre-test were given before the learning begin, and post-test were given at the final meeting.

Population and Sample. This research employs elementary students at Bandung as the population of the study which each represented different school accreditation ranking (with accreditation A, B, C). The reason for selecting the schools based on the accreditation ranking is to see whether school rankings affect the effectiveness of the BBL on the science subject. The sample was taken randomly based on the class group. The school ranked A and B, the total population is more than 100. Therefore, the sample will be randomly chosen. Every 2 classes are considered as the experimental class and the comparison class at every school rank. However, for the school accredited C, the total population is less than 100. Hence, the sample taken from all students in grade 5, by dividing the students into two group, namely the experimental group and the control group.

The indicators of critical thinking implemented in this research are adapted from Norris & Ennis (1989). The indicators were revised to accommodate to the stages of critical thinking of the 5th grade students. The analysis of critical thinking is completed through an instrument that refer to the attainment of specified indicators. In measuring students' critical thinking, the model of WSU Rubric Adapted is employed to assess the General Education Outcome in Critical Thinking.

Moreover, in this measurement model, there are five component which consists of several indicator measured by the level of students' achievement, and every competence is given a scale. In providing the scale for each component of the rubric, the grading was divided into three groups, the highest grade with score ranging from 76-100, The medium grade with score ranging from 51-75, and the lowest grade with the score ranging below 50.

Location and Time of the Research. This investigation was completed at three schools that were randomly pick based on their

accreditation ranking. The school ranked A is represented by an elementary school in Cicaheum, the school with B accreditation is represented by elementary school in Pasir Impun and the school in Kopo represented school that are ranked C. The time of the research is four months, starting from September 2012 until December 2012.

Research Instrument

The measurement in this to study is in a form of an instrument test and non-instrument test. Before collecting the data, the instrument used in the study was analysed.

Test

Test were put to use to collect data of students' critical thinking skill through the science subject. The test given were written test. The test was given at the beginning (pre-test) and at the end of the learning (post-test). Pre-test was hand out to the experiment and control group, to view the students' initial ability in critical thinking. To see the enhancement of the overall students critical thinking, consequently the post-test is conducted. Nonetheless, in the control class, post-test is given after the fourth meeting. After the data is collected then the validity and reliability of the data were tested.

Non-test Instrument

There are three types of non-instrument test used in this research. The instrument are questionnaire, observation, and interview.

    a. Questionnaire. The primary data was collected through the distribution of questionnaire. The researcher gave a list of questions (questionnaire) that need to be filled and returned. The type of questionnaire used is a closed questionnaire that were given to the students. The list of question covers students' attitude towards the implementation of BBL model. The respondents choose one of the possible answers that have been listed on the questionnaire. The score given to the non-test instrument are

determined by the ordinal scale. With the scale, score 5 is given to the answer that are most expected and score 1 are given to the least expected answer. The questionnaire was also given to the teacher to get a supporting data. This study also uses the school's learning activities that are commonly practiced, infrastructure, and teacher background as the supporting data. The teacher questionnaire is a mixed between an open ended and a closed ended questionnaire, this is intended so that teacher could have more freedom in answering the questions but they could also give a more definite answer. It is hoped that the questions could give a better picture of the learning process that they usually applied, starting from the preparation (constructing the syllabus, lesson plan), the classroom implementation (methods, teaching material, media), until the evaluation process on students' learning.

    b. Observation. The observation was completed to identify first-hand the ongoing activities and the subject that will be researched. The observation completed was a pre-experiment and on-experiment. The pre-experiment is the observation that are completed before the experiment of the BBL learning is implemented. The observation is completed on the class that will be use as sample of the research. The goal is to understand the daily learning process that later will be utilised as the supporting data. Moreover, the observation on the experiment day is performed to evaluate each of the learning process and see how the application of BBL affect the learning condition. Thus, observation on the experiment stage is essential because the researcher can see directly the implementation of

BBL in increasing students' critical thinking skill and see students' reaction on the learning process. In addition, the result of the observation become the primary data of the analysis. It will take place on every meeting in every school that participate in this research. To facilitate the observation, an observer's sheet contained of all the element that the teacher executed on the learning process were provided.

c. Interview. The interview was performed by using the interview guidelines. The guidelines were intended to ease the writer in remembering the main issues with the primary data (interview). The procedure taken in this interview are (1) determining the interviewee; (2) preparing the main issue for the material of the interview; (3) commencing the interview flow; (4) completing interview as the main activities; (5) recording the interview and documenting it as a field note; (6) conforming the interview result; and (7) following up the obtained interview result.

Data Analysis

The analysis utilized to gain the right conclusion is by analysing, 1) the pre-examination to gain the overall picture of learning science, the data were taken from observation, interview, document analysis, and analysing the questionnaire through qualitative methods. The analysis was linked to teachers' teaching performances on their preparation, implementation, evaluation and evaluation of infrastructure and environment of the schools. 2) The outcome of the experiment of the implementation of BBL were analyse as follows: the result of the observation from the four meetings while BBL is implemented were analysed with a qualitative approach. Those analysis were associated with the depiction of the implementation of the experiment, that

relate to teachers, students, material, methods, facilities and the environment as well as the various obstacles that occur during application on the field. 3). The descriptive statistics analysis technique is utilized by collecting and presenting the data on tables and also completing a statistical calculation (Sudjana, 2002). The descriptive statistic portrayed a condition to obtain a percentage of a number until it represents a meaning. After analysed and discussed, the next step is to generate conclusions.

Results and Discussion

The result of this research is consisting of the outcome of students' critical thinking from the experiment and control class, and students' attitude on the implementation of BBL.

Comparison of critical thinking ability on the experiment class and the control class

The investigation outcome reveals that the average result of the students' pre-test on the experiment class are 48,88. Meanwhile, the control average of the control class is 46,32. Whereas, the enhancement of critical thinking skill for the experiment class is 27,38 and the control class is 5,97. The calculation of the difference between the experiment class and control class on critical thinking can be analyse through t-test in order to determine the significant difference of the two average data. The calculation result of the post-test difference evaluation from the experiment class and control class display that the t-value is 10,0518. If the amount of t-value is compared with the t-table of 1.9744, accordingly, the t-value > t table means that there is a significant difference between the post-test of experiment class and the post-test of the control class. Hence, the hypotheses which state that "there is a difference between the experiment class's post-test and control class's post-test" is acknowledge. The comparative value of critical thinking skill in the experiment and control class can be seen from Table 1 and the descriptive statistic (the minimum, maximum,

average and standard deviation score) of the pre-test, post-test and gain of the experiment in each school ranking can be observed on table 2.

Table 1 Descriptive statistic score of pre-test, post-test and gain from the experiment and control class

	Experiment			Control		
	Pretest	Post test	Gain	Pretest	Post test	Gain
min	25	45	0	20	17	-24
max	75	100	60	85	76	45
average	48.88	76.26	27.38	46.32	52.29	5.97
std	14.66	15.28	12.63	17.25	15.72	17.05

Table 2 Descriptive statistic score of pre-test, post-test and gain from the experiment class on each school ranking

	Rank A			**Rank B**			**Rank C**		
	Pretest	Post test	Gain	Pretest	Post test	Gain	Pretest	Post test	Gain
Min	25	45	20	20	36	4	20	26	6
max	75	100	25	62	100	38	70	85	15
Average	49.50	76.50	27.00	44.85	71.65	26.79	43.25	52.80	9.55
Std	15.28	16.14	12.91	8.59	16.12	14.36	15.07	15.59	7.35

The outcome of statistic descriptive calculation demonstrates that the experiment class in rank A school have the highest average score for both pre-test and post-test, followed by B. On the other hand, the school ranked C obtain a low pre-test and post-test average score. In regard to the improvement (gain score), Rank A school achieve the highest gain (27.00), rank B school receive 26.79 gain and the rank C school only acquire 9.55 gain.

Enhancement of students critical thinking ability in control class on every school ranking

The improvement of critical thinking skill in control can also be viewed from the advancement (gain) and the comparison of the pre-test and post-test average from the control class. The following table present the statistic descriptive (minimal, maximum, average, and standard deviation) of the pre-test, post-test, and gain of the control class on every school ranking.

Table 3 The descriptive statistic value of pre-test, post-test and gain of the control class in every school rank

	Rank A			Rank B			Rank C		
	Pre-test	Post-test	Gain	Pre-test	Post-test	Gain	Pre-test	Post-test	Gain
min	20	17	-24	40	30	-30	20	30	-5
max	85	76	45	65	82	22	60	68	20
average	45.83	52.13	6.30	53.18	54.27	1.09	39.25	46.85	7.60
Std	17.96	16.45	17.95	9.34	15.19	13.16	13.21	10.88	5.93

The calculation result of the descriptive statistic displays control class on rank B have the highest average score for both of their pre-test and post-

test. Conversely, the rank C school receive the highest average gain (7.60). While rank A

school have average gain 6.30, and the B school only obtain average gain of 1.09.

Comparison of the enhancement of the experiment and control class's critical thinking in every school rank

The distinction of the enhancement of students' critical thinking in both class in every school rank are quite significant. The rise of the pre-test to post test on the experiment class in rank A school is 27. On the control class, the number on pre-test to post-test increase to 6,3. The rank

B school in experiment class extend to 26.8 and in controlled class by 1.09. Meanwhile on rank C school the development between the experiment and control class are not substantial, on the experiment class, the acceleration are only 9.55 and on the control class the improvement are only 6,3. Overall, the development of student's critical thinking in experiment and control class based on the school rank can be seen on the following chart.

Figure 1 The increase of critical thinking ability on experiment class and control class based on the school rank
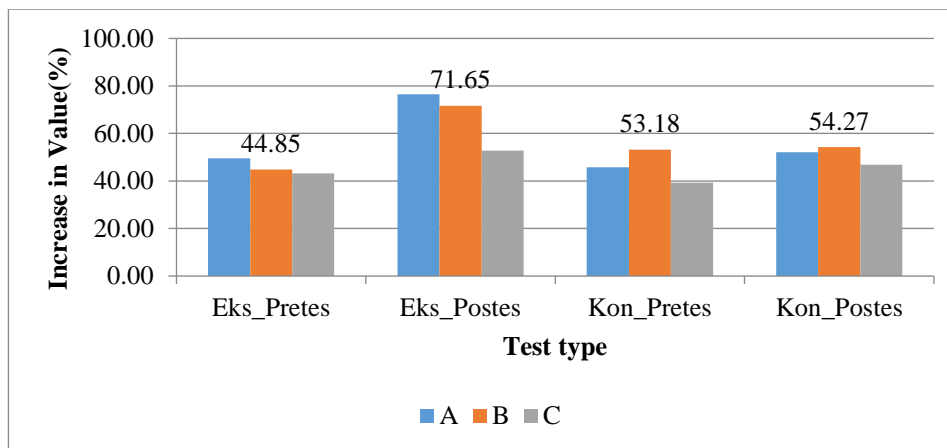
Based on picture 1, it can be observed that the comparison between the experiment class and the control on rank A and B are highly significant. Nonetheless, on the school that are accredited C, the enhancement of the ability on the experiment class and control class are comparatively the same.

Test of critical thinking skill advancement on every school rank

The outcome of the descriptive analysis and the hypotheses test exhibit generally that the implementation of the models (brain-based learning/BBL) on the science subject have a great influence on the rise of elementary students' critical thinking skill for the rank A and B school. However, the rank C school have an insignificant impact. This can be seen through the development of the average (gain) score of the students' that are considerably great

on the experiment class rank A and B, which are 27,00 on the rank A and 26,79 on rank B, yet the rank C school only obtain average gain of 9,55.

The assessment of the comparison test of the two averages display the presence of the significance difference between the average score of the pre-test and post-test on the experiment class rank A and B. Moreover, the rank C school does not have a significant difference. Henceforth, the proposed hypothesis in this research can be accepted for the rank A and B schools. Nonetheless, the hypothesis of the rank C school is rejected. This indicates the great influence that the BBL has over the development of elementary students' critical thinking in learning science on the rank A and B, but not on the rank C as it does not have a significant impact.

Nonetheless, the control class which does not receive any treatment of the BBL learning model does not present any substantial improvement on the critical thinking skill. This can be identified by the calculation of the test of difference of the two averages in the controlled class. In this case, all schools in the study do not display any significant presence of value on the pre-test and post-test.

Students attitude in the implementation of BBL

Students' attitude in this study are linked to their attitude and feeling when they were stimulated by certain conditions, for instance learning while listening to instrumental music, playing game before starting the learning material, do a brain gym activities, providing students' preferred drink, scented classroom, hanging a display picture on the wall, doing science practicum directly, doing an active question and answer session with teacher or other students, learning outside the classroom, receiving compliment from teacher after asking a questions or answering it, the use of power point slide, doing group assignment, using pictures or props, acting, filling the evaluation assessment, creating mind map, and reflecting. To concise student's attitude in the implementation of BBL, the outcome of every schools' rank is provided in the following table.

Table 4 students' attitude in the implementation of BBL in every school rank

School Rank	Very Happy	Happy	Moderate	Less happy	Not happy
School A	54.02%	30.96%	11.68%	2.12%	1.21%
School B	70.75%	20.82%	6.26%	0.00%	2.18%
School C	77.31%	13.45%	7.00%	0.84%	1.40%
Total Value	67.36%	21.74%	8.32%	0.99%	1.60%

The rank A school can feel that the BBL model looks moderate because some of the methods used in this model are relatively common practice. The differences are when the learning is wrapped up to be fascinating by creating a fragrant classroom combined with instrumental music when they first arrive. The brain game in the start of the learning process is also one of the parts that they enjoy. This is found in their questionnaire answer which 86% of the students claimed that they feel "very happy" and "happy". Moreover, through movement, the blood flow, energy and oxygen to the brain are running very well. Thus, student's brain is prepared to be active. Other things that stand out from the students' answer is receiving complement from the teacher as 74% of the students' answer are "very happy". Over complement, students' positive emotion will play a role. This is in line with Sagala (2014) study which reveal that the effectivity of learning is determined by the students' emotion. Beside the attitude that have been mention in the previous statement, several students answer that they feel least happy on the reflection point. This is understandable because previously they are not accustomed to express what and how they feel and explaining the challenges that they found in the learning process. The points that are dislike in the implementation model of BBL can act as a suggestion and revision for the learning and material in the future.

The attitude of students on the rank B school are also very high (70.75%), they responded "very happy". This can also be seen on the field observation, where students are very enthusiast to join all the learning process. Even though this does not mean that the rank B school never applied a variation of teaching methods, but perhaps the design of the BBL learning model which are arrange continuously are presumed to make the students feel a challenge as in every meeting the students are required to be active. These are the one that make students' brain work optimally and in time the stimulation to the brain will increase students' ability in

critical thinking. Moreover, students' answer that standout (the average 81% of the students answer "very happy") are the use of practice, where the students create an optic model and group discussion. Moreover, 89% of the students said that they feel very happy to receive complement from the teacher. In addition, some students feel less happy to learn outside the classroom. This can be caused by the time of the learning as they need to learn in daylight. This can also be a suggestion for the teacher, so that the implementation of the learning can be adjusted to the situation on the field.

Students attitude in rank C school are the highest in comparison to the other two school, which is 77.31% of the students' answer are "very happy". If it is connected to the observation result on the field, several factors influence students' enthusiasm. Firstly, the methods of variation that are applied in the BBL model are rarely applied, for example in the science practicum students seems very enthusiast and they admitted that while studying science they have never performed a science practicum. This is caused by the lack of facility in the rank C school to support students' activities to make students active. On the other hand, the education background of the teacher is not yet qualified (are not university graduate) and it can also be one of the possible factors for the lack of variety in teaching methods.

Students' attitude that are distinct in this school rank can be identify by the result of the questionnaire which on the point of brain gym (85% of the students answer "very happy"), receiving complement from teacher (80% of the students answer "very happy"), and also the point of practicum and making model (around 80% students answer "very happy"). Meanwhile, the least like point for the students in this school is presentation. This can be understood if we see students' intake on the learning process. Additionally, presenting orally need a great courage and skill in delivering ideas or message to other people. This require a habituation and it can be a suggestion for teacher to give students chances

so that through presentation it is hoped that students will gain confidence.

Some aspects on the implementation of BBL that has been revealed through students' questionnaire are the similarities of good attitude in all school rank. For example, almost every student in each school prefers the learning to start with brain gym/being mobile. Additionally, nearly in every school rank student like compliment and like the practicum. Other than the aforementioned theories, the writer will review the educational aspect according Islamic view. In Islam, known a method named suluk, this learning method also completed a practicum, for instance, the story of prophet Musa and prophet Khidir. There is also the targhib wa tarhib method, which is balanced, when students do a good deed, they receive an appreciation and compliment from their teacher. And to practice responsibility, if students' make mistakes, they need to face some consequences. However, some of the things the students least favour are technical factor and habituation.

Conclusion

The BBL learning can increase elementary students' critical thinking skill significantly in learning science. There is difference in the impact of learning BBL on the critical thinking. Brain based learning (BBL) influenced students' critical thinking skill in rank A and B. However, the rank C school does not affect the critical thinking skill significantly, even though on the attitude aspect students display a good attitude. Otherwise, the application of BBL can work effectively in enhancing students' critical thinking skill in learning science. In other word, the implantation of BBL can effectively develop students critical thinking skill if the all the supporting requirement are fulfilled. Students' attitude has proven that the students like learning BBL because they believe that it is different with other type of learning model that has been applied.

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