The Development of Collaborative Learning Based on Brain-Based Learning (BBL)Model for The Junior High School Science Learning in The Agroecosystem Area

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Abstract

The agroecosystem plays an important role in the national economy. However, the role of the agroecosystem in education in the form of teaching and learning has not been used optimally. It is less in providing opportunities for students to develop their mindset based on their abilities so that the students do not understand the potential requiring the surrounding area. Modification of collaborative learning with the Brain-Based Learning (BBL LC) model makes the learning appropriate for the 2013 curriculum. The purpose of the study is to obtain a valid, effective, and practical model which is suitable for junior high school science learning in the agroecosystem area. The research and development study used three out of four stages in the 4-D model. This research was conducted at Junior High School 7 Jember. The data collection techniques were filling out the validation sheet, interview, observation, test, and documentation. The data analysis techniques include data analysis from the validation results, model analysis, and model effectiveness analysis. The result showed that the percentage of product validation was 85.81% or in a very valid category. While the average of N-gain learning outcomes that represent the model effectiveness was 0.53 and the students' problem-solving skill questionnaires got 75.87% or in a good category. The model practicality was from the teacher, and student response questionnaires obtained 92.94% and 94%, which falls to a very practical category.

***Keywords*:** Collaborative Learning, BBL approach, agroecosystem area

1. INTRODUCTION

Indonesia has unique characteristics, such as being the largest archipelago in the world[1]. According to the Central Statistics Agency (BPS) in 2017, 39.5 million hectares of cultivated areas are in the agricultural sector and the other 8.02 million hectares are referred to paddy fields in Indonesia. The existence of this data allows Indonesia as an agricultural country whose development is supported by the agricultural sector [2]. The role of the agricultural sector or agroecosystem in the education sector has not been utilized optimally [3]. The less use of the environment contradicts the demands of the 2013 curriculum orientation, which emphasizes application-based learning in daily life [4].

The observation result, done at junior high schools in the agroecosystem area, which was on the science teachers from Junior High School 7 Jember, Junior High School 8 Jember, Junior High School 9 Jember, revealed that the students were less interested in the learning because they still used conventional learning. The lecturing method has weaknesses if it is often used for too long that it will be boring and cause the students to be passive [5]. The students tend to accept the teacher's decisions in the teaching and learning given by the teacher [6].

The decline in the students' enthusiasm happens because conventional learning can be overcome by employing more enjoyable learning. Brain-Based Learning (BBL) is one of learning that is synchronized with the brain. Such kind of learning facilitates students with

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fun learning, without threats, and be able to increase relaxation [7]. BBL can be interpreted as an approach adapted to the functions of the brain naturally, which is devoted to learning [8]. Brain-based learning involves the application of principles that are carefully designed by considering the effects on before, during, and after the learning started [9].

The use of the BBL approach will be easier to implement by involving the students in groups, searching for knowledge independently, ways of thinking through the learning process, and encouraging the students to make their own decisions [10]. These criteria can be implemented well if the application uses collaborative learning. Collaborative learning focuses on the use of small groups that help educators to improve learning. This learning can make the students actively involved in the learning process, can understand the concepts better for the long term, and help the students in problem-solving [11]. Learning Cell type is a form of collaborative learning by using small groups. The students ask questions about reading assignments or other learning activities, then ask and answer questions with each other [12]. One student acts as a tutor, facilitator, or teacher for other students, while the second student acts as a listener and will also contribute if the explanation is incomplete [13].

Collaborative learning has to do with the students' skills in problem-solving. Problem-solving skill needs to be owned by every student because it is a person's basic ability to solve problems that involve critical, logical, and systematic thinking [14]. The correlation between the Collaborative Learning model that refers to the use of small groups, with joyful learning or BBL, can support students' problem-solving skills and learning outcomes. Therefore, the purpose of this study is to obtain a valid, effective, and practical model that is suitable for junior high school science learning in the agroecosystem area.

2. RESEARCH METHOD

Research Type

The research was done by using a 4D development model consisting of 4 stages, namely, Define, Design, Develop, and Disseminate stages. Yet, this study only Used three development models (Define, Design, and Develop) because of the limited time and costs of the study.

Place and Time of The Research

The research on the development of a collaborative learning cell based on Brain-based Learning (BBL) was conducted from August to September in the 2018/2019 academic year. The research development was conducted in the odd semester in the Biology Education Study Program, FKIP, University of Jember. The model development trials were applied at Junior High School 7 Jember, Patrang District, Jember Regency. The subjects in this study were the VII grade students of Junior High School 7 Jember.

Research Design

The research design employed in this model development was based on the 4-D development model (four D models) proposed by Thiagarajan and Semmel in 1974.

The defining stage is the stage for defining the learning conditions. This stage includes five main steps, namely front end analysis, student analysis, task analysis, concept analysis, and formulation of learning objectives. The design phase is the stage for designing learning devices. This stage consists of three stages, namely the preparation of benchmark reference tests, media selection, and format selection. The developing phase is the stage to produce a draft of revised learning products based on the input from development experts or two validators; 2 lecturers from the University of Jember and 1 Science teacher from Junior High School 7 Jember, as well as the data obtained from the trial results.

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Data Collection Method

The data collection techniques are systematic procedures for obtaining data. The data collection techniques in this study consisted of filling in the validation sheet by experts as validators, interviews with science teachers, observation at schools in the agroecosystem area, tests (pre-test and post-test), and documentation which were collected in the form of writing and photos.

Data Analysis Method

The data analysis was carried out to interpret data based on the results of the research to be able to give a clearer picture of the results of the research. This technique is described as:

a. Validation model analysis

Two validators validated the model; 2 lecturers from the University of Jember and one science teacher from Junior High School 7 Jember. The validity is based on the average value of the indicators submitted to each validator. The generated data is in the form of quantitative and qualitative data. Analysis and percentage techniques were obtained based on the results of the student's model validation:

$$\text{Validation} = \frac{\sum The\ Obtained\ Score}{\sum The\ Maximum\ Score} \text{ x } 100$$

Table 1. Validation criteria

Validity Level (%)	Validation Criteria	Decision
84<x<100	Very Valid	Very ready to be used in the teaching and learning process
68<x<84	Valid	Able to be used, but with adding components that are still lacking. Additions are not too big or basic
52<x<68	Valid Enough	Able to be used by repairing the components which are not suitable.
36<x<52	Less Valid	The revision is done by reviewing carefully and looking for weaknesses for improvement
20<x<36	Invalid	Revise almost all components

b. Practicality model analysis

The practicality of the model was obtained based on the student questionnaire. Questionnaire responses were given as soon as the teaching and learning activities were completed. The response analysis was carried out with student questionnaire sheets. Furthermore, the responses were analyzed by using percentages, i.e.:

Percentage of response =

$$\frac{\sum The\ Obtained\ Score}{\sum The\ Maximum\ Score} \text{ x } 100\%$$

c. Effectiveness model analysis

The effectiveness model analysis used the assessment of cognitive learning outcomes in the form of pre-test and post-test results and then being analyzed with N-gain (Normalized gain), and the problem-solving skill was obtained from analyzing students' answer to cognitive problem-solving test along with the developed indicators.

3. RESULT AND DISCUSSION

Results of the Development Process of the BBL LC Learning Model

The process of developing a collaborative learning model for BBL LC has been done at Junior High School 7 Jember and being described as follows.

1. Development result of Define stage

Front-end Analysis activities were carried out by the researchers to determine the problems faced and needed to be implemented in the development. At this stage, it refers to the students' problems obtained from the need-assessment questionnaire in the seventh grade IPA Subject Teacher Discussion (MGMP)

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throughout Jember Regency. The results of data analysis indicate that 84.37% of the teachers still do not know the Brain-Based Learning (BBL) approach. The questionnaire data also identified that 87% of the 31 questionnaire fillers stated that the problem in the learning process is that the students who are not focused. Learner analysis activities were done by the researchers to examine the students' characteristics. The interview results with the SMP Negeri 7 Jember science teacher revealed that the students' problem-solving skills were still low, the students did not understand what was meant by the problem, and the students lack knowledge regarding the problem. Task analysis activities were used to identify the main tasks needed by students. Tasks are adjusted between research and learning material, namely in the form of Student Worksheets (LKS), presenting the results of the discussion and making conclusions. Concept analysis activities were carried out by researchers to identify the key concepts. Basic competencies that are following the developed model are (KD 3.2 and 4.2) on the material that discusses agroecosystems. Learning objectives are formulated following the basic competencies, and are used to convert the results of task analysis and concept analysis.

2. Development result of the Design stage

This Design stage is the stage for designing learning devices. Test preparation activities are based on KD 3.2 and 4.2 by using the learning outcomes test (10 multiple choice questions and five essay questions) and problem-solving skill tests. The selection of media following the material is native plant media, livestock photos, learning videos, music instruments, powerpoint, Student Worksheets (LKS), lab equipment, and materials. The selection of syllabus and RPP formats is following the revised version of K13 2017. The format of the question grid, worksheet, and pretest and posttest question sheets is following the results of the discussion.

3. Development result of Develop stage

This stage is the stage to produce a revised draft based on the input from experts as well as the data obtained from the trial tests. This stage includes a) validation of the collaborative learning cell model by development experts, the validated products including model manuals and learning devices, b) revisions to the validation of model manuals and learning devices by experts, c) limited trials or small class trials with 9 students in the specified school (9 students consisting of; 3 low category students, 3 moderate category students, and 3 high category students), d) revised revisions (if any) after small class trials, e) large class trial (implementation) uses all students in the class three times a meeting or face to face.

Validation Result of BBC LC Learning Model

The validation stage was divided into two sequences, namely the validation of the research instrument and the validation of the research product. The validation of the research instruments was carried out by two development experts, namely two lecturers from the University of Jember, while the validation of the research products was added by including one science teacher from Junior High School 7 Jember. The validated research instruments include; a guidebook for the model, syllabus, Learning Implementation Plan (RPP), and pre-test and post-test questions. The average results of product validation are 85.81% belonging to the very valid category.

Effectiveness Result of BBC LC Learning Model

The development effectiveness of the collaborative learning model for BBL LC can be measured using the pre-test and post-test as well as the data on the students' problem-

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solving skills before and after the application of the learning model. The cognitive learning outcomes data of students in large class trials have an average N-gain of 0.53 belonging to the moderate category and questionnaires of students' problem-solving skills of 75.87% belonging to the good category.

Table 2. Students' cognitive outcome test data

		Average	***N-gain Average***	**Category**
Large class trial	*Pre-test*	36,80	0,53	Moderate
	Post-test	70,47		

Practicality Result of BBC LC Learning Model

The practicality of the model can be identified by analyzing the teacher's and the students' responses after the research test process. The results of the teacher's response analysis revealed that the total average assessment given by the teacher was 92.94%, with a very good average category. The results of the students' response analysis showed that the total average assessment given by the teacher was 94% with a very good average category.

Discussion

The development process used a 4-D development model (four D models). The first activity of the define phase is the front-end analysis aimed at establishing the basic problem, which becomes the reason for the development of the learning model [15]. At this stage, it refers to students' problems obtained from the need-assessment questionnaire in the seventh grade IPA Subject Teacher Discussion (MGMP) in Jember regency, as well as observation and interview with the science teachers at Junior High School 7 Jember. The result is that the utilization of this potential is still difficult because the teacher is accustomed to using conventional learning models, besides there are problems about 74% of students' problem-solving skill are classified as low. The effort to improve problem-solving skills is that teachers are more trying to train and familiarize students with the form of problem-solving presented in learning [16].

Student analysis activities were carried out by the researchers to examine the students' characteristics. The students as the object of research in Junior High School 7 Jember have an average age of 12 years and above or moderate in the formal operational period. This period students can use concrete operations to form more complex operations. Progress in students during this period is that students do not need to think with the help of objects or concrete events, students can think abstractly. Students have been able to understand the form of argument and are not confused with the other side of the argument [17].

Task analysis activities aim to identify the main skills that will be reviewed by the researcher and analyze them into additional sets of skills that may be needed [15]. Student Worksheets (LKS) are learning media that are used as guidelines to carry out activities, both individually and in groups [18]. LKS is adapted to the BBL LC model, so students are not relying on ideas from others, but they will learn to involve their minds and interact within and between groups to solve problems [19].

Concept analysis activities are carried out by researchers to identify the main concepts to be taught, systematically compile, and relevant concepts. Material classification of living things is the material that presents five living kingdoms and their specific characteristics, as well as examples of each kingdom [20]. Material classification of living things requires students to think critically in identifying organisms and then classify them, as well as make comparisons of specific characteristics for each kingdom [21].

The activity of formulating learning objectives is useful for summarizing the results of concept analysis and task analysis [15]. The

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stages of determining learning objectives are based on the scope of material and basic competencies. Learning objectives must also contain the elements of ABCD (*audience, behavior, condition, dan degree*) [22].

The first design phase is the preparation of benchmark reference tests conducted by formulating core competencies (KI), basic competencies (KD), and learning objectives in the subject of Natural Sciences (IPA), the subject of living things, and classification [15]. The preparation of tests is based on the formulation of specific learning objectives. This step develops parallel assessment items (benchmark reference tests) to measure the behavior described in the learning objectives [23].

Media selection activities are stages to choose formats that are suitable for core competencies, basic competencies, learning objectives, materials, and methods used to meet the needs of developing learning models [24]. Learning material for classification of living things should present a real object so that students can identify the characteristics of living things [21]

Format selection activities are carried out to choose the format that fits the core competencies, basic competencies, learning objectives, materials, and methods used that have been described in the indicators to design the development model [24]. The syntax of the collaborative Learning Cell model was modified by incorporating 12 principles of the BBL learning approach.

The development phase is the activity of validating and developing the product so that it is ready to be implemented [25]. This stage applies small class trials intending to find out the responses from the observers to improve the developed learning model [26]. Therefore, by conducting this small class trial, it is expected that the developed model can find out its weaknesses or shortcomings to fix in the next stage.

After all stages of development are passed, a learning syntax is formed, which begins with pre-learning activities. This activity begins with ensuring that the students' stomachs are filled with food; researchers give highly nutritious appetizers, such as biscuits, bread, cake, or milk. Students must be accustomed to having breakfast because breakfast is a healthy behavior that is useful for meeting the nutritional and energy needs of school-age children during growth and development [27].

The brain will work well if there are available physiological processes from stimuli in brain cells. This is related to the needs and activities of the body, which is defined as the need for food and activities in the form of movements. Thus, in addition to breakfast, a simple motion exercise is put together and combined to help optimize the function of the brain called *Brain Gym* [28].

The initial activities of learning are separated into three, namely, submitting apperception questions, motivating students, and delivering learning objectives and agendas. Apperception can be realized in the form of questions, showing videos, and showing pictures to students [29]. It is continued by growing students' motivation so that students can develop their ability and willingness to learn [30].

The core activity of learning must make students comfortable because the brain can absorb information directly when the attention is focused. The brain is divided into three parts but still in one unit, which means that one brain functions properly when the other parts also function properly. If the brain circuit can work properly, students will be easier to understand the material provided. Brainwork will be good if learning is created safely, comfortably, and pleasantly [31]. At the moment of giving the material, the teacher must be able to consolidate what is received by students using different intonations, different speeds, and different volume in explaining the material.

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Thus, students will easily absorb knowledge, and the BBL LC model can run in the research easily.

The BBL LC model will improve students' ability to make questions according to the deep level of the material obtained. Students will connect to form knowledge networks, which allow them to build knowledge, understand the context of knowledge through the social networks they obtain [32]. The next activity of students in one class is divided into nine diverse groups with the design of sharing levels. Solving groups like this have a common goal, and each individual is responsible for one another so that they depend on each other to complete a common task or goal [33].

The activity was continued with the teacher starting the implementation of the model and students trying to remember the material and analyzing the questions given by their friends. The question and answer process were also accompanied by the use of alpha musical instruments or calm music that can make the brain thinking smoothly. Music is believed to be able to restore brain waves to the alpha zone. Music affects the brain. The rhythm of music can increase serotonin production in the brain so that it will restore the mood of students [34]. The core learning activities end with jumping task questions. This activity requires students to maximize their brain's ability to understand questions and remember the material taught. The maximum learning outcomes are not released in functioning the brain with unique characteristics between the left brain and right brain. The right brain has the characteristics of long term memory, while the left part is classified as short memory [35].

The next was closing activity. It must be lively, and students can remember the previous learning moment. Games are full of cheerful nuances that have goals for joy and pleasure. [36] Students invited to play games can activate all connections in the brain, playing will involve students' sensory-motoric, social, emotional, and cognitive skills simultaneously [37].

This study also looked at the students' cognitive learning outcomes and problem-solving skills. Tests of students' cognitive outcomes were taken from the pre-tests and post-tests[38]. The increase in learning outcomes obtained by students also proves that the syntax of the model can make students enjoy the learning process that is not tense. Students have enthusiasm in following each step of the learning model, they can concentrate more, and the material can be absorbed properly.

Problem-solving can be trained by knowing its characteristics first. The sequence of problem-solving characteristics is the existence of a beginning or the statement to start, the existence of a statement of goals to be achieved, and a series of actions needed to solve the problem [39]. Problem-solving skills themselves are interpreted as a learning strategy in the context of real-life oriented to problem-solving and the development of critical, synthetic, and practical thinking by utilizing multiple intelligences to familiarize and maximize the work of the brain to learn [40].

The BBL LC collaborative learning model must also be practical before it is implemented in the research test. The practicality of the learning model was measured using a questionnaire[41]. The questionnaire consists of three indicators, including interest in learning, the use of learning, and interest in learning for the next chapter stating that students are very happy to take part in learning activities using the BBL LC collaborative learning model. In addition to the questionnaire, there are also observations so that it becomes a benchmark for further learning. Data from questionnaires and observations show that the steps or syntax performed can influence students in learning.

Thus, the stages of the BBL LC learning model are valid, effective, and practical to be

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used and able to improve cognitive learning outcomes and students' problem-solving skills.

4. CONCLUSION

The validity of the BBL LC learning model was seen from the analysis of product development validation sheets with very valid categories. The effectiveness of the model was seen from its ability to improve cognitive learning outcomes and problem-solving skills of students who are included in the good category. The BBL LC learning model is also practical, which seen from the teacher response questionnaire and student responses after participating in the study, which belongs to the excellent category.

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