Journal of Biology Education

The Effectiveness of Project Based Learning Ecosystems Dioramas with Jelajah Alam Sekitar Approach against Students' Critical Thinking Ability and Creativity

Ratih Kurniyanti[1✉], Nana Kariada Tri Martuti[1], Siti Alimah[2]

Biology Departement, FMIPA, Universitas Negeri Semarang, Indonesia

Info Article	Abstract
	The purpose of this study was to analyze the effectiveness of Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach against students' critical thinking ability and creativity and to analyze the relationship between critical thinking ability and students' creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach. This research method is pre-experimental design with pre-test and post-test one group design. The results showed that Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach was effective against students' critical thinking ability and creativity. The average of critical thinking ability in post-test is 84.96 and average of creativity in post-test is 84.50. The completeness of classical learning shows "High" criteria, the classical completeness rate in post-test of critical thinking and creativity is same (89.21%). The results of the N-gain mean on the test scores of critical thinking ability and creativity are in the "High" criteria. N-gain of critical thinking ability shows "High" category (66.66%) and N-gain creativity shows "High" category (79.42%). The results of the analysis of the two average difference test (one right side) on the critical thinking ability test has t table of 1.97 < t count of 20.89. The creativity test has t table of 1.97 < t count of 31.80, so it shows a significant difference between the achievements at the pre-test and post-test. Based on these results it can be concluded that the Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach are effective against students' critical thinking ability and creativity. The relationship between critical thinking ability and creativity shows the relation of 0.38, has a "Low" criteria, so it can be concluded that the relationship between critical thinking ability and student creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is low.

⬚ Address Correspondence:
Gedung D6 Lt.1 Jl Raya Sekaran Gunungpati Semarang
E-mail: ratihkur20@gmail.com

INTRODUCTION

Grade X of Senior High School in Chapter of Ecosystem discusses biotic and abiotic components of ecosystems, interaction between ecosystem components, ecosystem homeostasis, food chains and food webs in ecosystems, and biogeochemical cycles. Basic Competencies (Kompetensi Dasar) that must be achieved in the Chapter of Ecosystem are (KD 4.9) Analyzing ecosystem components and interaction between ecosystem components, and (KD 4.10) Presenting works that show the interaction between ecosystem components (Permendikbud Number 24 of 2016). Attempts to fulfill KD in learning Chapter of Ecosystem in MAN Kendal in the 2016/2017 school year were conducted through learning activities with presentation, discussions, literature studies, and written assignments. Data resulting from the Ecosystem Chapter obtained from class X-MIPA 4 MAN Kendal in the 2016/2017 academic year shows the number of classical completeness was 38.70% and class X-MIPA 5 in the same academic year has a classical completeness rate of 37.14%.

One of the activities to observe ecosystems can be done through the Jelajah Alam Sekitar (JAS). The JAS approach is a learning approach that utilizes the natural environment around students, as objects of learning biology whose phenomena are learned through scientific work (Alimah & Marianti, 2016). The JAS approach can be combined with Project Based Learning to improve students' critical thinking ability and creativity. One of the effective learning model that can improve critical thinking and creativity is Project Based Learning. Markham (2012) states that PjBL is a learning process that is student-centered inquiry-based using all resources in a learning involving projects. Larmer *et al.* (2012) added that PjBL provides opportunities for learning and integration between knowledge and ability.

Learning ecosystems in MAN Kendal is very suitable if done by Project Based Learning models making dioramas. Martha *et al.* (2009) explained that diorama is a photo-like work, a picture of plants and animals at a time in their natural environment. One of the supporting factors of PjBL learning diorama ecosystem in MAN Kendal is MAN Kendal is a school located in rural areas, the environment and natural resources around the school have the potential to be used as learning resources. The environment around MAN Kendal: rice fields, rivers, swamps, and beaches can be used as a source of learning in a project. In addition, abundant natural resources around the school can be used as learning materials, such as parts of plants and animals, materials, and rocks as materials for building products in Project Based Learning. The purpose of this study was to analyze the effectiveness of Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach against students' critical thinking ability and creativity and to analyze the relationship between critical thinking ability and students' creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach.

RESEARCH METHODS

This research was conducted at the Madrasah Aliyah Negeri (MAN) Kendal at Jalan Soekarno-Hatta Islamic Center Complex, Kendal. The research was carried out in 2017/2018 school year. The population in this study were students of Mathematics and Natural Sciences grade X MAN Kendal of 2017/2018 school year consisting of six classes: X-MIPA 1, X-MIPA 2, X-MIPA 3, X-MIPA 4, X-MIPA 5, and X-MIPA 6, with the total number of students, is 204 students. The sample in this study were 102 students taken from three classes, it is X-MIPA 2, X-MIPA 3, and X-MIPA 4 which were selected by cluster random sampling technique. This

research method is pre-experimental design with pre-test and post-test one group design. According to Sugiyono (2010), in this design, there was one experimental group which was given a pre-test to find out the initial state and was given a post-test to determine students' abilities after being treated.

Research design of pretest and posttest one group design (Sugiyono, 2010) Information:

$$O_1 \qquad X \qquad O_2$$

Keterangan:

O_1	:	Student's initial ability
X	:	Treatment by Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach
O_2	:	Students's ability after got the treatment

RESULTS AND DISCUSSION

Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is applied to 102 students from three classes: X-MIPA 2, X-MIPA 3, and X-MIPA 4 MAN Kendal in the 2017/2018 school year. Each learning is carried out within 3 weeks for each class, with 9 learning time allocation (6 meetings).

Table 1. Analysis of pre-test results and post-test critical thinking ability and creativity

Variant Source	Critical Thinking Ability		Creativity	
	Pre-test	Post-test	Pre-test	Post-test
Amount of students	102	102	102	102
The highest score	86	100	82	100
Lowest score	12	38	10	46
Average score	43,39	84,96	32,92	84,50
The number of students	4	91	1	91
Classical completeness	3,92%	89,21%	0,98%	89,21%

Table 1 shows that the average score of 102 students in the test of critical thinking ability and creativity has increased after experiencing Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach. The average score of students in the post-test was higher than the average score at the pre-test. Classical learning completeness at the pre-test of critical thinking ability and creativity is very low.

PjBL is a learning model that involves constructivism theory in its implementation. Students build their understanding and knowledge independently through experience and reflect on these experiences. Learning is an activity that is individual in nature by trying to understand all the information obtained and "building" itself the meaning of the information that obtained. Knowledge in the students' memory does not have to be in accordance with the real world, it means that students have their own way of looking at a problem that he/she learned and how the student is incorporating knowledge into his cognitive structure. Bhattacharjee (2015) argues that in constructing their knowledge, students will continue to try to get their "personal mental models" from the real world and build their perceptions of things. Students will collect knowledge from every new experience and continue to renew their own mental models. The process of problem-solving is at the core of the development of thought in constructivism theory.

Constructivism takes place in individuals based on the process of observations and scientific studies conducted by individuals on how to learn. Individuals who find new information will process and unify these new ideas with ideas that already existed before, but new irrelevant information will be "discarded".

Table 2. Analysis of N-gain test of critical thinking ability and creativity

Criteria	Critical Thinking Ability		Creativity	
	Amount	%	Amount	%
High	68	66,66	81	79,41
Medium	33	32,25	20	19,60
Low	1	00,98	1	00,98
N-gain Mean	0,73	High	0,76	High

Table 2 shows the N-gain of critical thinking ability and creativity mostly in the "High" category and a small portion is in the "Medium" category, and in very small numbers are in the "Low" category. The increasing of the critical thinking ability and creativity achievement is also calculated into the N-gain mean. The results of the calculation of N-gain mean on the test scores of critical thinking ability and creativity are in the "High" criteria.

Analysis of two average difference test (one right side) shows the difference between the achievement of critical thinking ability and creativity before and after experiencing Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach. The results of the two average difference test (one right side) on the test of critical thinking ability produces t count of 20.89 and the creativity test has t count of 31.80. T table that obtained in the test of critical thinking ability and creativity is 1.97. The calculation results t count $\geq$ t table, then t is in the rejection area H_0. So that there are differences in achievement at the pretest and posttest, which is the average achievement of the post-test is better than the achievement of the pre-test on the test of critical thinking ability and creativity.
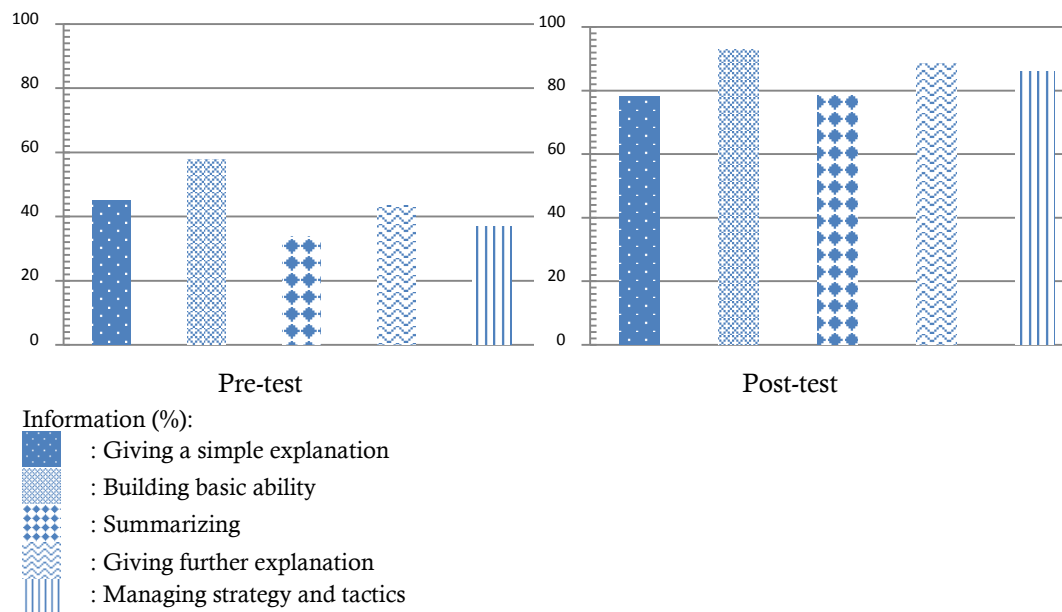

Information (%):
: Giving a simple explanation
: Building basic ability
: Summarizing
: Giving further explanation
: Managing strategy and tactics

Figure 1. Achievement of critical thinking ability aspects in pre-test and post-test

Figure 1 shows that the magnitude of the achievement of each aspect of critical thinking ability from 102 students in pre-test varied. The aspect of "Building basic ability" has the highest level of critical thinking ability achievement among other aspects and the "Summarizing" aspect has the lowest level of critical thinking abilities achievement among the other aspects. The magnitude of the achievement of each aspect in critical thinking ability in post-test varied. Achievement of each aspect $\geq 76\%$ so it has "Very Good" criteria of critical thinking ability. The aspect of "Building basic ability" has the highest level of critical thinking ability achievement among other aspects and the aspect of "Giving a simple explanation" has the lowest level of critical thinking abilities achievement among other aspects.

Figure 1 shows that the graph of critical thinking ability achievement in each aspect at the pretest and posttest shows the forwarding trend, meaning that there is no change in the graph pattern in each aspect assessed in the student after experiencing the PjBL, it is because students have the same critical thinking ability and creativity, so the population used is a normal and homogeneous population. Instruments used to measure critical thinking skills and creativity of each student have the same grid and the same questions, and each student experiences the same treatment, so the results of critical thinking ability and student creativity can not show significant changes in graphic patterns, but can show an increase in achievement of critical thinking ability and creativity in each aspect. The evaluation needs to determine what elements in the learning situation are considered important. Even the most important aspect in all kinds of learning is the goal of the student itself. Learning is started because of the need for encouragement or because there is a problem that is felt forced or the existence of a situation of experience to be mastered (Asrul *et al.,* 2015).
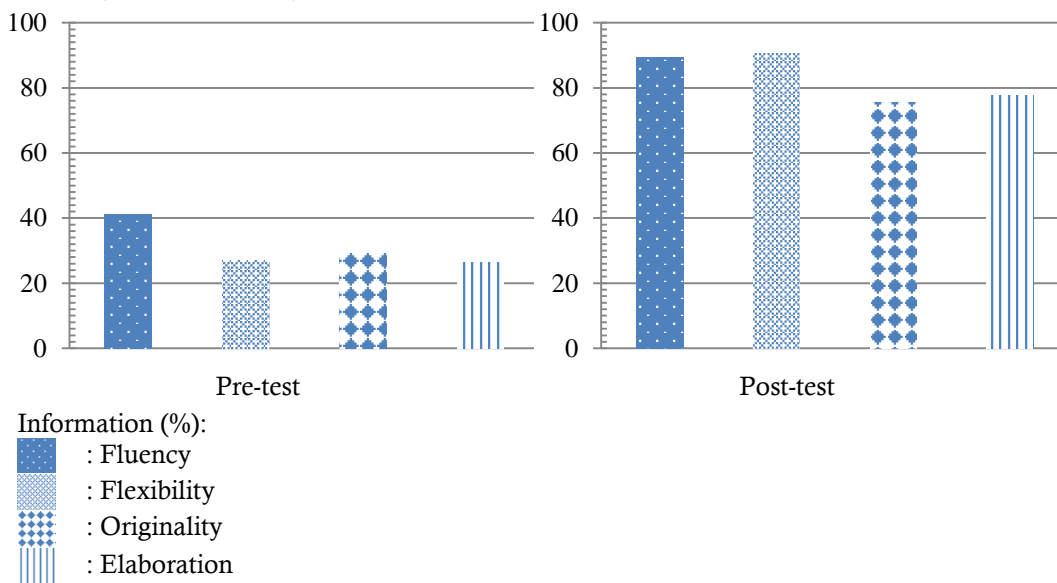

Information (%):
- : Fluency
- : Flexibility
- : Originality
- : Elaboration

Figure 2. Achievement of the creativity aspect in pre-test and post-test

Figure 2 shows that the magnitude of the achievement of the creativity aspects from 102 students in pre-test varied, but the magnitude of the achievement of each aspect was 26%-50% so it has "Enough" criteria of creativity. The aspect of "Fluency" has the highest level of creativity achievement among other aspects and the aspect of "Flexibility" has the lowest level of creativity achievement among other aspects. The magnitude of the achievement each aspect of creativity in posttest varied, but the achievement of each aspect $\geq 76\%$ so it has the "Very

Good" criteria of creativity. Aspect "Flexibility" has the highest level of creativity achievement among the other aspects. While the aspect of "Originality" has the lowest level of creativity achievement among the other aspects.

Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is arranged by involving elements of bioedutainment. Bioedutaiment is packaged in a pleasant learning atmosphere so it invites students to learn enthusiastically (Alimah & Marianti, 2016). Students are invited to work together in groups to solve problems in project activities and produce project outcomes in the form of ecosystem dioramas. Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach guides students to be active in carrying out learning both cognitively and physically, so students can develop critical thinking and creativity effectively. Activities in projects are designed by "learning by doing" so the students can directly understand the concepts of ecosystems through the creation of dioramas. PjBL is a type of learning "hand on project" with a long-term learning period, involves many disciplines, and student-centered. PjBL as part of modern learning guides students to be able to do various activities with the aim of developing creativity, giving encouragement to learn more, training the ability to think critically, and the ability to set strategies independently. Miftari (2014) said that the most important thing in PjBL is the collaborative group learning atmosphere, students are asked to learn and work together in groups, sharing ideas, organizing their groups, and arranging project implementation schedules to get maximum products. Students are given the burden of being responsible for the success of the project in the group, answering each question and providing feedback, and being an independent learner.

Figure 3 shows the relationship between critical thinking ability and creativity calculated by the correlation coefficient formula developed by Karl Pearson. The analysis shows that the r value obtained from 102 students is 0.38, this means that the relationship between critical thinking ability and creativity has the "Low" criteria.
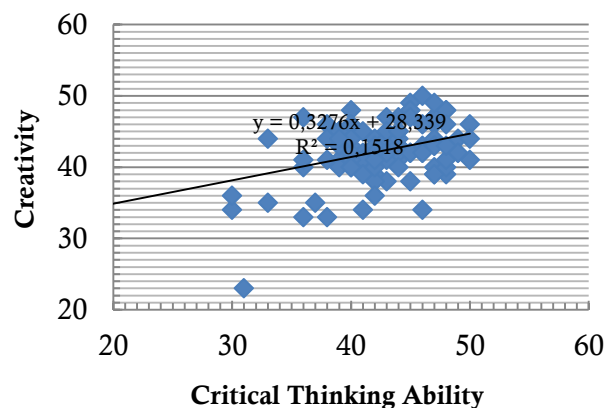

Figure 3. The relationship between critical thinking ability and creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach

The first aspect of critical thinking ability is "Giving simple explanations". This aspect in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is mainly trained in phase I (start with the essential questions to get the ideas). In this phase, students are given assignments to answer questions about ecosystems and ecosystem problems. The answers of these questions can be obtained by students through observation of ecosystems in groups. The

types of ecosystems observed by each group are different: rice fields ecosystems, coastal ecosystems, pond ecosystems, swamp ecosystems, garden ecosystems, and river ecosystems. The observation activity was carried out through JAS. The things observed in JAS activities are the constituent components of the ecosystem, the interactions that occur between components in the ecosystem (making food chains and ecosystem food webs), ecosystem homeostasis, damage/ecosystem problems, and solutions to overcome the damage to the ecosystem. In this step, several problems are presented regarding the impact and causes of ecosystem damage. This step can trigger students' curiosity in solving problems and provide solutions to these problems (Rakhmayanti *et al.,* 2018). Students are trained to be able to provide an explanation of the ecosystem based on the topic by answering the questions that have been provided in the LKS-LDS.

The questions in the LKS-LDS included requiring students to: (1) explain the definition of the ecosystem through discussion and study of literature, (2) mention the types of ecosystems through discussion and study of literature, (3) analyze the types of ecosystems through Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach, (4) analyzing ecosystem components through Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach, (5) explaining the definition of ecosystem dioramas, (6) explaining the types of ecosystems that will be made into dioramas. Students are given the freedom to construct their knowledge. The teacher gives essential questions to students and provides reinforcement and feedback on the results of discussions and observations, then gives emphasis to important things during project implementation (Pradita *et al.,* 2015). Markham (2012) argues that project activities are carried out authentically based on emerging issues, problems in the surrounding environment, and solutions overcome problems. An authentic project is a project that has associations with real and accessible problems. Authentic in PjBL are described as "reasons for learning", why is an important concept or ideas to be studied further.

The second aspect of critical thinking ability is "Building basic ability". This aspect in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach are mainly trained in phase I (start with the essential questions to get the ideas) and phase VI (evaluation the experiences). This aspect is the aspect that has the most dominant achievement in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach because students practice critical thinking ability through "recalling" knowledge during project implementation and involving problem-solving processes. Students build basic ability through activities to consider whether the sources used as reference material for ecosystem concepts in project activities can be trusted or not. This is done through further literature study activities by utilizing relevant and reliable literature sources.

Observation are carried out to connect the knowledge by students through literature study activities with the facts in the real world. Investigation and exploration activities carried out by students during the learning process can stimulate students to think more critically. Critical thinking as an activity of investigating and exploring a situation, phenomena, and problems to determine hypotheses and conclusions (Setyorini *et al.,* 2017). In developing the "Building basic ability" aspect, curiousity is an indispensable thing. Curiosity provides a reason for someone to answer questions that he "worries" about relevant issues. Students need broader and more complex learning resources to solve curiosity in the project and need freedom of space in exploring and controlling what he learns, this gives freedom for them to increase "intellectual curiousity" (Moon, 2008).

The third aspect of critical thinking ability is "Summarizing". This aspect in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is mainly trained in phase I (start with the essential questions to get the ideas) and phase V (assess the outcomes). Concluding activities are carried out by deducing and inducing a case, students focus on the questions that arise regarding the observed ecosystem to be able to draw the essence of the ecosystem problem. The "Summarizing" aspect was trained through LKS-LDS, where students were asked to be able to express ideas and answer various questions about the ecosystem. The "Summarizing" aspect can also be trained through presentation activities. Each group made a presentation to explain the results of the Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach that had been carried out. Other groups were given the opportunity to comment on the results of ecosystem dioramas and provide questions about the ecosystem under discussion. The sequence of presentation activities is a scientific approach, students are trained to be able to create solutions, present the results of their activities, and evaluate information that they find themselves (Saripudin *et al.,* 2015).

The fourth aspect of critical thinking ability is "Giving further explanation". This aspect of Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is mainly trained in phase I (start with the essential questions to get the ideas) and phase V (assess the outcomes). A further explanation, in this case, is the ability of students to define the terms in ecosystem concepts and consider the definition of the term into three dimensions. Students explain concepts about ecosystems based on understanding that are built independently and more deeply by strong reasons, and expressed in different sentences. Aspect "Providing further explanation" in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is trained through LKS-LDS. LKS-LDS develop students' abilities in providing further explanations containing questions to (1) explain the problems that occur in the ecosystem, (2) explain a balanced ecosystem through the creation of ecosystem dioramas, (3) explain the meaning of ecosystems in a balanced state (homeostasis), and (4) explain the effects that occur if the ecosystem experiences a damage.

The questions contained in the LKS-LDS guide students to be able to provide explanations about the ecosystem more detail, especially explanations of the ecosystem conditions, ecosystem homeostasis, and appropriate solutions to overcome problems in the ecosystem. Students are trained to be able to understand difficult terms in the Ecosystem topic so they can translate and explain concepts about ecosystems based on their understanding. Providing further explanation has a close connection with the ability of students to solve problems experienced while working on the project. Students can solve problems in the project if they are able to translate and understand concepts about ecosystems in depth and in more detail. Wahyuni & Efuansyah (2018) states that students can solve problems faced in the project if they are able to translate and understand concepts about ecosystems in depth and in more detail. Each group resolves the questions in the LKS-LDS aims to train and develop students' ability to solve problems, especially in thinking, speaking, and interacting in their groups, and writing down the ideas obtained.

The application of PjBL invites students to create a product by giving students the freedom to explore some creative ways and give their creative ideas. Creativity is seen from the ability of students to give initiative and see the possibilities that can be done in solving problems and finding new concepts (Ardianti *et al.,* 2017). Chiang & Lee (2016) examined the effect of PjBL on one of the indicators in critical thinking, PjBL is able to improve students' problem-

solving abilities. Through PjBL, students are encouraged to obtain and analyze problems based on their views independently and find solutions to these problems.

The fifth aspect of critical thinking ability is "Managing strategies and tactics". Governing strategies and tactics can be achieved, specially trained through several phases, including phase II (design a plan for the project), phase III (create a schedule), phase IV (monitor the students and the progress of the project), and phase V (assess the outcomes). Strategies and tactics are needed in the project so the project can be carried out effectively and efficiently, and products can be successfully completed. Project activities are carried out collaboratively, so the burden of completing projects is borne in groups. Students can share roles in project implementation for each individual in the group, so work will take place efficiently. The materials used to make ecosystem dioramas are generally easy to obtain and inexpensive. Students can use used goods and natural resources available around the school. The implementation process and products produced in project-based learning will be successful if students are given the opportunity to work in a supportive learning environment, organize ways for the project to succeed, involve students in various digital activities to obtain information and learning resources, adequate planning mature, and cohesiveness in the team (Lou *et al.*, 2017).

Creative thinking is a part of thinking ability. To realize the ability to think creatively, an individual needs the opportunity to realize his imagination, including the availability of adequate time, a supportive learning environment, and facilities (Ersoy & Baser, 2014). The aspects contained in creativity according to Munandar (1999) in Moma (2015) are: (1) fluency, (2) flexibility (3), (3) originality, and (4) elaboration. The first aspect of creativity is "Fluency". This aspect in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach are trained in phase I (Start with the essential questions to get the ideas), phase III (monitor the students and the progress of the project), and phase V (assess the outcomes). The activities in the Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach train students to be able to produce many ideas and provide many answers to questions about ecosystems that are observed accurately and clearly.

Students are trained to be able to express their thoughts about various solutions to ecosystem problems by giving their ideas in group discussion activities. The aspect of fluency is also trained as long as students work on the project. Students are trained to think deeply by answering the questions contained in the LKS-LDS. These questions require students to be able to explain precisely about what components are contained in the ecosystem that observed, explaining the types of ecosystems around the school environment of MAN Kendal, explaining the interactions that occur between ecosystem components in ecosystem dioramas, explaining the negative impacts of disturbed ecosystems, explaining whether the ecosystem observed through PjBL is in a balanced state (homeostasis), and answers questions in the presentation of the results of ecosystem diorama projects. Presentation in project requires students to be able to answer questions verbally, accurately and clearly.

The fist aspect of creativity is "Flexibility". This aspect has the highest achievement of creativity among the other aspects. "Flexibility" is trained in the most basic phases and the most portion in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach. This aspect in PjBL diorama of ecosystems is trained in phase II (Design a plan for the project), phase IV (Monitor the students and the progress of the project), and phase VI (Evaluation the experience). Monitoring the students and the progress of the project is a project implementation phase that requires teachers to supervise and advise students when the project takes place.

Students carry out the project plan actively to produce products in the form of ecosystem dioramas. Students are guided to pour their ideas optimally into diorama works. The division of roles for each group member and group collaboration must be considered during project implementation. PjBL is learning carried out in teamwork, students learn how to work in a group atmosphere, integrate the ideas of each group member into a mutual agreement, and combine the knowledge that each member has into more knowledge complex in discussion activities. Students are trained to be able to find solutions to problems in ecosystems and problems during project implementation. Students present concepts in ecosystems and concepts about ecosystem homeostasis in different ways through making dioramas. Learning atmosphere and working together in a group can train social ability and communication to students (Munakata & Vaidya, 2015).

The aspect of "Flexibility" is trained through LKS-LDS. Questions arranged in LKS-LDS can lead students to think flexibly. In LKS-LDS, students are trained through activities (1) explaining solutions to improve problems in the ecosystem, (2) mentioning the tools and materials used in ecosystem diorama projects, (3) mentioning tools and materials that are difficult to obtain in making ecosystem dioramas, (4) explain the solution to the problem of tools and materials that are difficult to obtain in ecosystem dioramas, (5) find the problem that are still present in ecosystem dioramas and how to overcome these problems, (6) explain the obstacles that occur in ecosystem diorama projects and how to overcome, and (7) make final improvements to ecosystem dioramas.

Phase evaluation the experiences is a phase where the teacher and students evaluate the implementation of the project and the ecosystem diorama product. Teachers and students reflect on the project activities and outcomes. This phase trains students the ability to find shortcomings before, during, and after the implementation of the project quickly and accurately. Evaluation can improve the quality of learning through sharing the information with other students through discussion activities, so the problems in the implementation process and project outcomes can be detected for further improvement. This makes students aware the goals in learning and responsible for their work. In addition, evaluation can increase students' confidence and encouragement in learning (Jones, 2005).

The third aspect of Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is "Originality". Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach train students to provide ideas that have never existed before. Aspects of originality in PjBL dioramas ecosystems are trained, especially in phase II (Design a plan for the project) and phase IV (Monitor the students and the progress of the project). Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach provide opportunities for students to be able to make decisions with certain considerations in accordance with their wishes. Teacher accommodates students to look for ideas and develop ecosystem dioramas through literature study and observations. Ecosystem diorama preparation activities provide freedom for students to express new ideas that they find easily.

Students are trained to build beautiful ecosystem dioramas by utilizing natural materials that can be found in the environment around the school, such as sand, gravel, and wood, as well as used goods. Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach trains students to develop original ideas by: (1) drawing ecosystem diorama designs, (2) selecting specimens (biotic components) which will be described in ecosystem dioramas, (3) choosing abiotic components in ecosystem dioramas, (4) selecting organic materials from the

surrounding environment to build ecosystem dioramas, (5) choosing rocks and minerals in the surrounding environment to build ecosystems, (6) choosing synthetic materials (artificial) to build ecosystem dioramas, (7) making food webs based on ecosystem dioramas prepared, and (8) creating a scheme for one of the biogeochemical cycles in ecosystem dioramas. Capraro & Slough (2009) argue that PjBL provides a learning atmosphere for students to develop creativity and a more competitive learning environment. PjBL learning supports students in the inquiry learning process as a form of response to complex problems raised. PjBL provides opportunities for students to vote and the freedom to choose things that will be planned in the project. Projects are planned carefully, regularly, and provide opportunities for evaluation.

The fourth aspect of creativity is "Elaboration". Group discussions serve as an opportunity to enrich answers the questions that arise during project implementation. The elaboration aspect in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is trained especially in phase I (Start with the essential questions to get the ideas) and phase V (Assess the outcome). Assess the outcome phase is an assessment of students' work. Students present the results of their work (ecosystem dioramas) in groups. Presentation activities in this learning trains the students to exchange ideas between students in class. Students present the results of their group while presenting the project. Each group is given 10 minutes for presentation and discussion. While other students listened to presentations from other groups and were given the opportunity to give questions or comments, so class discussions took place. LKS-LDS trains students' elaboration ability through activities explaining findings that obtained in PjBL dioramas ecosystems, and explaining interactions between ecosystem components in ecosystem dioramas through presentations.

Assessment is not only carried out at the end of learning. This phase carries the principle of authentic assessment, meaning that the assessment is carried out before, during, and after the learning process. Integrated assessment and carried out in an integrated and comprehensive manner in the learning process is able to help students to construct concepts. Authentic assessment emphasizes the learning process, so the data collected must be obtained in real-time that is done by students when conducting activities in the learning process (Alimah and Marianti, 2016).

The results analysis of the relationship between critical thinking ability and creativity shows the value of the relationship obtained from 102 students is 0.38, meaning that the relationship between critical thinking ability and creativity has "Low" criteria. The ability to think critically according to Anazifa & Dzukri (2017) is the ability to translate a data, make conclusions, explain an information, and evaluate. Creativity is the ability of a person to express ideas that are unique and valuable, and the ability to convince the value of the uniqueness of the idea to others. Creative thinking according to Birgili (2015) is a whole set of cognitive activities carried out by individuals in accordance with certain objects, problems, and real conditions in life. Someone in creative thinking tries to use the imagination, intelligence, insight, and ideas that they have freely according to their wishes.

The ability to think critically and creativity should be two interrelated variables. The ability to think critically is one of the basic abilities of a person in thinking and involving cognitive elements. Creativity is one's ability to create ideas and implement these ideas. Creativity is an ability that is considered a talent for creating something unique. An individual can develop creativity if the individual has capable cognitive abilities, including the ability to think critically. Critical thinking ability can be achieved if students continue to practice through

the problem-solving process. The ability to think, both critical and creative thinking is needed to be owned by each student in solving the problems in life. Teachers must have the ability to invite the students to thinking and solving a problem properly (Husnah, 2017). Based on data analysis, the relationship between critical thinking ability and students' creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach showed "Low" results. The results from interview with the MAN Kendal Biology's teacher showed that Biology learning in the previous chapters was done through learning activities with lecture and presentation methods.

The problem-solving process is not routinely applied in learning so it plays an important role in the development of students' critical thinking ability and creativity. Problem-solving abilities can be developed if the learning environment is organized in such a way that the learner is actively able to develop the strategies and methods in solving problems. Learning environment must provide the conditions that require problem-solving, it will train students to develop meaningful experiences, so the students' ability to think will also develop (Yusnaeni *et al.,* 2016). Husamah (2015) argues that the three categories of thinking ability are the ability to think critically, creatively, and the ability to think independently. Thinking ability helps humans make decisions. The ability to think critically requires the ability to interpret, evaluate the results of observation, and communication. Creativity enhances new ideas from imagination, concepts, plans, and other things that can make someone more valuable. The ability to think critically can be increased by familiarizing students with activities that involve the problem-solving process.

The relationship between critical thinking ability and creativity by Ulger (2016) on a sample of 174 people show that there is a correlation between critical thinking ability and creativity. Significant value of the correlation between critical thinking ability and creativity shows a score of r = 24 and p <0.01 with a correlation coefficient of 0.06, this indicates that critical thinking ability influences students' creativity in "Low" level.

Critical thinking is as an attitude in challenging a theory or idea, developing its own argument, deconstructing an idea or synthesizing various ideas related to complex ideas. Critical thinking is the ability to think that involves depth, flexibility of time, objective and not objective judgment. Critical thinking is something related to human logic, critical thinking is a wise or meaningful consideration of reason. Critical thinking is the activity of examining evidence that might be supportive or contradictory, exploring active contradictions and searches to find conflicting points of view. Critical thinking is a process of deep thinking that helps us to understand what might be right or wrong, examine the knowledge and understanding that already exists in the cognitive system and match it with the current situation.

Critical thinking according to Fisher (2009) in Razak (2017) is a mode of thinking about things, substances, or problems, in which the thinker increases the quality of his thinking by handling skillfully the structures inherent in thinking and applying intellectual standards. Critical thinkers build their own arguments, work with their own presentations regarding evidence and reasoning, and conclude the results of their thoughts. Critical thinking involves the habit of observing, listening, and seeing the issues that exist. These issues are processed, in other words, evaluating, and reflecting on these ideas, these habits will bring critical thinkers with the ability to process experiences and express themselves in other ways (Moon, 2008).

Creativity is considered a divine gift. However, creativity is not the only ability of special individuals, but this ability can be obtained for anyone who has the capacity to learn. Creativity is the ability to describe and synthesize ideas. Creativity is related to the ability to

analogize ideas to produce and communicate new ideas because creative individuals are able to provide a starting point to understand the potential of new concepts, this can lead to gradual changes which in turn become innovative or breakthrough ideas. Creativity is a willingness to accept new experiences, open new imagination and concepts that allow individuals to explore previously unknown ideas. Creativity and curiosity are something that is related, curiosity can encourage creativity, and vice versa, both lead to further problem solving (Sola *et al.,* 2017).

CONCLUSION

The conclusions in this study are: (1) Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is effective against the achievement of students' critical thinking abilities, (2) Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach is effective against the achievement of students' creativity, and (3) The relationship between critical thinking ability and creativity in Project Based Learning ecosystems dioramas with Jelajah Alam Sekitar approach are in the "Low".

REFERENCES

Alimah, S. & A. Marianti. 2016. *Jelajah Alam Sekitar: Pendekatan, Strategi, Model, dan Metode Pembelajaran Biologi Berkarakter untuk Konservasi.* Semarang: FMIPA Universitas Negeri Semarang.

Ardianti, S.D., I.A. Pratiwi, & M. Kanzannudin. 2017. Implementasi *Project Based Learning* (*PjBL*) Berpendekatan Science Edutainment terhadap Kreativitas Peserta Didik. *Jurnal Refleksi Edukatika,* 7(2): 145-150.

Bhattacharjee, Jayeeta. 2017. Constructivist Approach to Learning-An Effective Approach of Teaching Learning. *International Research Journal of Interdiciplinary & Multidiciplinary Studies (IRJIMS)*, 1(6): 65-74.

Capraro, R.M. & S.W. Slough. 2009. *Project Based Learning, An Integrated Science, Technology, Engineering, and Mathematics (STEM) Approach.* Rotterdam: Sense Publishers.

Chiang, C.L. & H. Lee. 2016. The Effect of Project Based Learning on Learning Motivation and Problem-solving Ability of Vocational High School Students. *International Journal of Information and Educational Technology*, 6(9): 709-712.

Haryani, Desti. 2016. Profil Proses Berpikir Kritis Siswa SMA dengan Gaya Kognitif Field Independen dan Berjenis Kelamin Perempuan dalam Memecahkan Masalah Matematika. *Seminar Nasional Matematika dan Pendidikan Matematika.* Yogyakarta: Universitas Negeri Yogyakarta.

Husamah. 2015. Thinking Skills for Environmental Sustainability Perspective of New Students of Biology Education Departement through Blended Project Based Learning Model. *Jurnal Pendidikan IPA Indonesia*, 4(2):110-119.

Husnah, Miftahul. 2017. Hubungan Tingkat Berpikir Kritis terhadap Hasil Belajar Fisika Siswa dengan Menerapkan Model Pembelajaran *Project Based Learning*. *Journal of Physics and Science Learning* (*PASCAL*), 01(2): 10-17.

Jones, C.A. 2005. *Assesment for Learning*. London: Learning and Skills Development Agency.

Larmer, J., J.R. Mergendoller, & S. Boss. 2012. 7 Essentials for Project-Based Learning. *Article of Buck Institute for Education, Educational Leadership*: 68(1).

Lou, S.J., Y.C. Chou, R.C. Shih, & C.C. Chung. 2017. A Study of Creativity in CaC2 Steamship-derived STEM Project-based Learning. *EURASIA Journal of Mathematic Science and Technology Education*, 13(6): 2387-2404.

Markham, T. 2012. *Project Based Learning, Design, and Coaching Guide: Expert Tools for Innovation and Inquiry for k-12 Educators.* California: HeartIQ Press.

Martha, M., D. Oliveira, & A. Marianne. 2009. Discussing Biodiversity in Dioramas: A Powerful Tool to Museum Education. *Article of ICOM Natural History Committee Newsletter*. Copenhagen: University of Copenhagen.

Miftari, I. 2014. Project Based Learning: Developing 21st Century Collaborative and Technology Skills. *European Journal of Research Education*, 52-57.

Moma, L. 2015. Pengembangan Instrumen Kemampuan Berpikir Kreatif Matematis untuk Siswa SMP. *Delta-Pi: Jurnal Matematika dan Pendidikan Matematika*, 4(1): 27-41.

Moon, J. 2008. *Critical Thinking, an Exploration of Theory and Practice*. London: Routledge Taylor & French Group.

Munakata, M. & A. Vaidya. 2015. Using Project- and Theme-Based Learning to Encourage Creativity in Science. *Journal of College Science Teaching*, 45(2): 48-53.

Munandar, U. 1999. *Mengembangkan Bakat dan Kreativitas Anak Sekolah, Penuntun bagi Guru dan Orang Tua*. Jakarta: Grasindo.

Pradita, Y., B. Mulyani, & T. Redjeki. 2015. Penerapan Model Pembelajaran *Project Based Learning* untuk Meningkatkan Prestasi Belajar dan Kreativitas Siswa pada Materi Pokok Sistem Koloid Kelas XI IPA Semester Genap Madrasah Aliyah Negeri Klaten Tahun Pelajaran 2013/2014. *Jurnal Pendidikan Kimia* (*JPK*), 4(1): 89-96.

Rakhmayanti, R., A.F. Hindriana, & Handayani. 2018. Penerapan Metode *Gallery Walk* terhadap Kreativitas Siswa pada Materi Pencemaran Lingkungan di Kelas X SMA Negeri 1 Gegesik. *Qangga* 10(2): 20-25.

Razak, Firdha. 2017. Hubungan Kemampuan Awal terhadap Kemampuan Berpikir Kritis Matematika pada Siswa Kelas VII SMP Boarding Immim Putri Minasatene. *Jurnal Mosharafa*, 6(1): 117-128.

Saripudin, A., S. Harayani, & S. Wardani. 2015. Characterized Project Based Learning to Improve Critical Thinking Skill. *International Conference on Mathematics, Science, and Education*. Semarang: Universitas Negeri Semarang.

Setyorini, D., Adisyahputra, & D. Vivanti. Pengaruh Model Pembelajaran *Project Based Learning* dan Gaya Belajar "VAK" terhadap Kemampuan Berpikir Kritis Siswa SMA pada Materi Ekosistem. *Prosiding Seminar Nasional Biologi*. Jakarta: Universitas Negeri Jakarta.

Sola, E., R. Hoekstra, S. Fiore, & P. McCauley. 2017. An Investigation of the State of Creativity and Critical Thinking in Engineering Undergraduates. *Journal of Creative Education,* 8: 1495-1522.

Sugiyono. 2010. *Metode Penelitian Pendidikan.* Bandung: Alfabeta.

Wahyuni, R. & Efuansyah. 2018. Model Pembelajaran *Missouri Mathematics Project (MMP)* Menggunakan Strategi *Think Talk Write* (*TTW*) terhadap Kemampuan Berpikir Kritis dan Kemampuan Pemecahan Masalah. *JNPM* (*Jurnal Nasional Pendidikan Matematika*), 2(1): 24-36.

Yusika, Meda. 2018. Pengembangan Lembar Kerja Siswa (LKS) Berbasis Inkuiri untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Universitas Negeri Kediri,* 2(3): 1-5.

Yusnaeni, H. Susilo, A.D. Corebima, & S. Zubaidah. 2016. Hubungan Kemampuan Berpikir Kreatif dan Hasil Belajar Kognitif pada Pembelajaran *Search Solve Create and Solve* di SMA. *Prosiding Seminar Nasional Biolog.* Malang: Universitas Negeri Malang.

Zulfana, M.D., B.A. Prayitno, & Harlita. 2015. Pengaruh Model Pembelajaran Biologi Berbasis Konstruktivits-Kolaboratif terhadap Keterampilan Proses Sains Siswa SMA Negeri 2 Karanganyar Tahun Pelajaran 2012/2013. *Jurnal Pendidikan Biologi,* 7(3): 108-118.