The Effectiveness of Scaffolding Based Virtual Class to Improve Student's Logical Thinking Ability

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Siti Romlah Noer Hodijah[1*], Ria Sudiana[2], Dewi Murni[3]

[1]Department of Science Education, Faculty of Teacher Training and Education,
Universitas Sultan Ageng Tirtayasa, Serang, Indonesia
Corresponding Author: *noerhodijah@untirta.ac.id

[2]Department of Mathematic Education, Faculty of Teacher Training and Education,
Universitas Sultan Ageng Tirtayasa, Serang, Indonesia

[3]Department of Biology Education, Faculty of Teacher Training and Education,
Universitas Sultan Ageng Tirtayasa, Serang, Indonesia

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Abstract

The low logical thinking ability of students causes them to experience difficulties in making the reasoning of genetic concepts. This study aims to examine the effectiveness of scaffolding based virtual class to improve student's logical thinking ability. Quasi experiment was used in this study. The population was the 4th semester students of Biology education of Faculty of Teacher Training and Education at one of University at Serang, Indonesia, Academic Year 2016/2017, taking the Genetics course. Samples were taken randomly. The student's logical thinking ability was measured by using the Test of Logical Thinking Ability (TOLT). The students pretest results of logical thinking ability in the experimental and control classes show the same average value of 2.64 included in the transition category, whereas post test results show different values. The experimental class indicates an average grade of 6.41 and a control class of 4.13, although the average difference between the two groups is significantly different, but both still show the same category of initial formal. Based on Mann-Whitney statistical test results, there is a difference of logical thinking ability between the two treatment classes. This can be interpreted that learning by using scaffolding based virtual class is effective in improving student's logical thinking ability.

Keyword**:** Virtual Class, Scaffolding, Logical Thinking

INTRODUCTION

Understanding of a lecture material is not enough just to memorize, but requires a specific skill in accordance with the characteristics it learns. The mistakes of the learning process generally make the students difficult to understanding the material and lower the learning achievement.

As a prospective teacher at Department of Biology Education, should be able to understand all the material in all subjects, including genetics. Genetics is one of the compulsory courses in Biology education program, which is in the fourth semester with the weight of 3 credits courses. Genetics has a fairly wide scope of material and demands logical thinking skills to understand it. So often considered difficult by students in understanding it. The difficulty of the concept of genetics is understood because of the presentation of fragmented genetic metrics presented at different levels of education over long distances (Boujema et al., 2010). The existence of time interval between learning meiosis material, reproduction and characteristic inheritance make it difficult for students to see the relationship between the three materials (Christine, 2005).

The low learning outcomes of students in genetic subjects is related to the low logical thinking ability of students because these subjects require basic level thinking skills such as logical thinking ability. The results of Hodijah et al., (2012) showed that the logical thinking ability of the students of Biology Education Department belongs to the transition category (the transition from concrete thinking to formal thinking). The low logical thinking ability caused the students not able to apply the basic concept of Mendel's Law in solving the problems of crossing opportunities in genetics. Bayram & Comek (2009) reported that logical thinking ability is positively correlated with learners' learning outcomes. This statement is supported by the fact that learners with high learning outcomes also have high logical thinking ability.

The skill of logical thinking has five different stages of development of reasoning, namely proportional reasoning, variable control, reasoning reasoning, correlational reasoning, and combinatorial reasoning. Proportional reasoning is necessary for the quantitative aspect, especially for interpreting data. Control of variables is used in planning, execution and interpretation. Probability reasoning is used in the interpretation of data from

findings, observations or experiments. Combinatorial reasoning is used in the formulation of alternative hypotheses to test the effects of selected variables. Logical thinking skills include the ability to use effective numbers, solve science problems, detect concept separation. These skills also include classification, generalization, presenting in mathematical formulas, computerization, hypotheses, tests and simulations (Tobin & Capie, 1981).

The wide range of genetic material and the lack of available lecture time is thought to be the cause of the low student learning outcomes. This is because lecturers tend to only pursue the target material achievement. Time constraints also cause the lecturer not to discuss examples of problems that can enrich students' understanding. Bahar & Polat (2007) states that the breadth of topics, time constraints, the use of language, mathematical terms and symbols and the lack of a conceptual linkage with life are the main reasons for the difficulty of learning material understood by learners. In addition, teacher-centered learning is also the reason for the difficulty of the lessons understood by learners. This is because learners can not participate actively in learning so that they become uninterested and tend to feel bored. Therefore, lecturers should use a learning approach that involves the role of students actively. Active engagement can improve his logical thinking ability, as well as his learning outcomes. The use of scaffolding is one learning approach that can be used to improve the ability to think logically as well as student learning outcomes in the genetic course. According to Puntambekar & Hübscher (2005), scaffolding-based learning is learning by providing help to learners at the beginning of the lesson, then reducing the help until the help is completely eliminated when the learners are able to work on the problem independently. Such assistance may be instructions, encouragement, warnings, parsing the problem into solving steps or providing an example.

Scaffolding based learning takes a long time to learn. As a solution, scaffolding learning can be applied through virtual class. Virtual class learning is more flexible and can take place outside the formal classroom. Thus, students do not always rely on lecturers in learning. Virtual class can be accessed by students through internet facility. According Darmawan (2012), virtual class can serve as complement, that is to complete the learning that have been received by learners in formal class.

Recently, virtual classroom learning has never been used in the

Department of Biology Education. Scaffolding approach has also not been applied in genetic subjects. Based on the problems that have been described previously, then conducted research on the application of virtual class based scaffolding. The purpose of this research is to see the effectiveness of virtual class based on scaffolding to improve students' logical thinking ability.

METHOD

This research used quasi experiment method. The research population is the 4th semester student majoring in Biology education of Faculty of Teacher Training and Education at one university in Serang, Indonesia of the academic year 2016/2017, which takes the course of Genetics. Samples are taken at random. The sample is divided into two classes: control class and experiment class.

Measurement of logical thinking ability, conducted by using the logical thinking ability test (Tobin & Capie, 1981), in the form of multiple choice beralasan as many as 10 questions. Data were taken as pretest and postes in both treatment classes. Assessment of students' logical thinking ability is done through scoring on TOLT answer of student Score 1 is only given when the answer is correct and the reason is also true. If the answer is wrong, the reason is wrong or both are wrong, then the student gets a score of zero (0). The final result of TOLT score is interpreted using table 1.

Table 1. Interpretation of TOLT Score

Score	Level logical thinking ability
0 – 1	Concrete
2 – 3	Transition
4 – 7	Formal beginning
8 - 10	Formal

(Valadines, 1996)

RESULTS AND DISCUSSION

The result of student's logical thinking initial ability in the experimental and control classes showed the same value of 2.64 included in the transition category, whereas posttest results showed different values of the experimental class indicated an average grade of 6.41 and a control class of 4.13, although the difference the average of the two groups is significantly different, but both still show the same category of early formal (Valadines, 1996). This statement is supported by statistical test results using Mann-Whitney, since pretest and postes data are not normally distributed. The test result of pretest data obtained significance equal to 0.636> 0.05 which means both classes have the same initial ability. While for the final ability obtained by significance value of 0.00 <0.05 which means there are differences in learning outcomes between the two treatment classes.

The highest TOLT score is 10 and the lowest score is 0. The distribution of the student's logical thinking ability in each category in the second group can be seen in Figure 1. In the figure it can be seen that the experiment class spread increased significantly after the treatment was compared to the control class. This is seen from the distribution of postes result logical thinking ability. The ability of the highest ability experimental group students is in the formal category, whereas in the highest capability control classes are still the same in the initial formal category. The lowest ability of the experimental class is in the transition category, while the control class is in the concrete category. This shows that the learning of virtual class based on scaffolding given can improve students' logical thinking ability compared to conventional learning.

Yenilmez et al. (2005) show that only a small percentage of research subjects have logical thinking ability at the formal stage and the majority are at a concrete stage. The variation in students' logical thinking ability is caused by the different environments that influence the development of each student. This is in accordance with the statement of Wiji et al. (2014) that students' logical thinking ability is not the same and certainly depends on the environment that make it. Cook & Cook (2005) states that the initial formal category begins at age 12. At this age, a person has begun to think abstractly and able to think deductively, that is able to use the general principle to define something more specifically. A person who is at the formal operational stage is able to present various solutions of a problem.

In Figure it can be seen that the control group still has 10.3% of the students included in the concrete category. This indicates that the student has not reached the logical thinking ability appropriate to his age because this category should be at the age of 7 - 11 years. That is, the student is experiencing a delay in the development of his logical thinking ability. The student is only able to think concretely. If they have no direct experience of an object, they are unable to use their operational mentality. This is supported by the statement of Bastable & Dart (2014) that a person who belongs to a concrete operational category is only able to classify an object and express concretely. Wood et al., (2001) states that there are people who are incapable of operational thinking despite their adult age. This situation can hamper the students' success in the learning process, especially in the abstract subject and requires the ability to solve the problem.

The student's logical thinking ability are measured by five aspects, namely proportional reasoning, variable control, probability reasoning, correlational reasoning and combinatorial reasoning. The result of data analysis of logical thinking ability of each aspect can be seen in figure 1 and Figure 2.

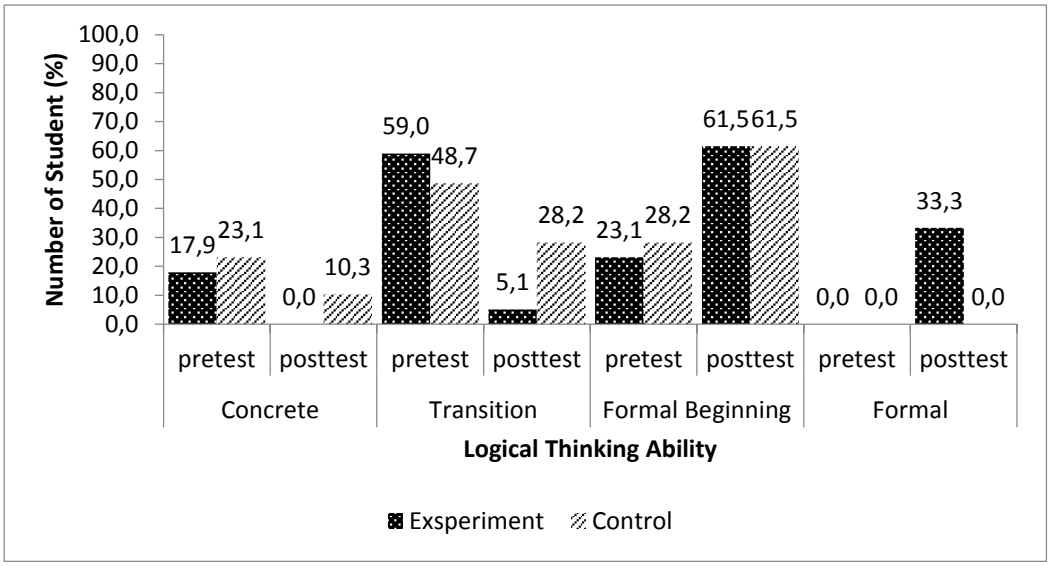

Figure 1. Distribution of Student's Logical Thinking Ability in Each Category.

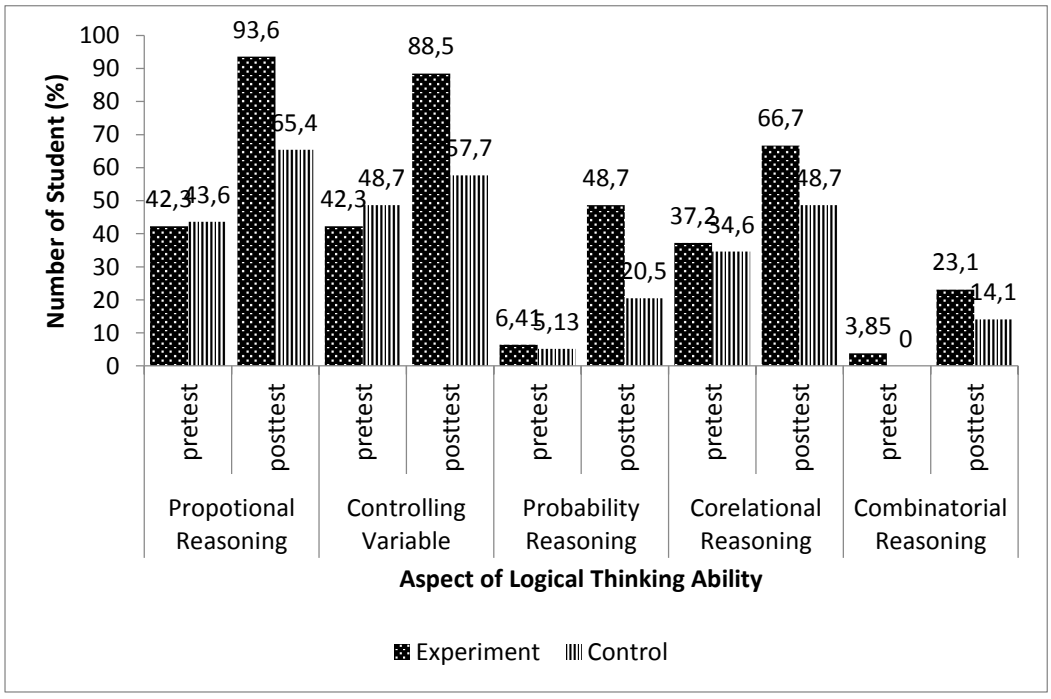

Figure 2. The Student's Logical Thinking Ability of Each Aspect

In Figure 2 it can be seen that the combinatorial reasoning aspect shows the lowest increase in value for both groups. This means that students are still not able to make a combination of data presented in the problem. The low ability of students in combinatorial reasoning aspect is feared will affect the students' understanding on the concept of the opportunities contained in the genetic course. In addition to low combinatorial reasoning reasoning reasoning is still relatively low as well. Though aspects of reasoning reason also play an important role in determining the possibility that will occur in a cross. This is in line with Murni et.al. (2016) which states that combinatorial reasoning plays a role when a person uses information to decide whether it is likely to be true or possibly untrue.

Genetic recovery, which is done in a virtual class with scaffolding combined with face-to-face lectures in the classroom, improves logical thinking ability. The assistance provided in the form of tiered problem exercises from the easiest to the most difficult level on each material, as well as video steps chromosome mapping provides flexibility to students to construct their logical thinking ability independently. Katminingsih (2009) states that scaffolding is the process of providing large amounts of assistance to learners in the early stages of learning. Subsequently the aid is reduced to allow the learner to assume responsibility once he is able to do it on his own.

In this study virtual class developed by using moodle designed to convert conventional classroom into digital classroom which can be accessed anywhere online. This digital classroom has the same functionality as the actual space. However, based on the interview results of various obstacles encountered by students when accessing the virtual class. Low signal quality in the area around the student residence, resulting in students cannot access the virtual class optimally. In addition there are still some students who have not been motivated to take advantage of the virtual class so that the assistance provided is not used optimally. Student participation in online learning determines the success of learning in lectures (Hughes and Hagie, 2005).

Scaffolding-based virtual class that is designed and applied as a learning environment tailored to the level of potential and characteristics of students is effective enough to improve the logical thinking ability of biology teacher candidate.

CONCLUSION

Genetic lectures using scaffolding based virtual class is effective improving student's logical thinking skills. The result of statistical test using Mann-Whitney on postes obtained significance value of 0.00 <0.05 which means there is a difference of logical thinking ability between two treatment classes. Although both groups are still in the same category of logical thinking ability, the formal beginning.

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