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E-Beam Capture Aid Drawing Based Modelling on Cell Biology

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Abstract. The objectives of this research are to find out how far Drawing-based Modeling assisted with E-Beam Capture could support student’s scientific reasoning skill using Drawing-based Modeling approach assisted with E-Beam Capture. The research design that is used for this research is the Pre-test and Post-test Design. The data collection of scientific reasoning skills is collected by giving multiple choice questions before and after the lesson. The data analysis of scientific reasoning skills is using scientific reasoning assessment rubric. The results show an improvement of student’s scientific reasoning in every indicator; an improvement in generativity which shows 2 students achieving high scores, 3 students in elaboration reasoning, 4 students in justification, 3 students in explanation, 3 students in logic coherency, 2 students in synthesis. The research result in student’s explanation reasoning has the highest number of students with high scores, which shows 20 students with high scores in the pre-test and 23 students in post-test and synthesis reasoning shows the lowest number, which shows 1 student in the pretest and 3 students in posttest. The research result gives the conclusion that Drawing-based Modeling approach assisted with E-Beam Capture could not yet support student’s scientific reasoning skills comprehensively.

1. Introduction
The Drawing Based Modeling (DBM) approach is an effective way to teach scientific thinking skills. Drawing Based Modeling (DBM) is a learning approach where students themselves build the models of scientific phenomena [1]. The model is a representation of the reality used by scientists as a means to understand the observed phenomena. Approaches, strategies, and models of learning in the teaching and learning activities in the classroom cannot be separated from the teaching media. The selection and use of teaching media should be appropriate, especially in the approach of Drawing-Based Modeling (DBM) which uses computer media that is E-Beam Capture.

Using E-Beam Capture in the teaching-learning process is useful for students and teachers especially for facilitating in describing abstract phenomena. Computer models allow students to manipulate experimental variables with ease and produce learning products that are more predictable and easier to visualize [2]. In the E-Beam Capture, students draw objects, assign characteristics and behaviors to objects and observe how the interaction between objects takes place by running a simulation. This practice is called drawing based modeling.

The Drawing Based Modeling (DBM) approach using E-Beam Capture is an application of computer-based technology that has many advantages over manual approach or paper and pencil.
Some of the drawing functions in education system are as follows: (1) enhancing and activating learners’ motivation, (2) learning for the representation and for providing a deeper understanding of scientific concepts for students; (3) increasing scientific reasoning, for example in creating a series of drawings (4) as a Learning Strategy. Helping learners build their knowledge, and (5) as a means of communication with others [3].

In organizing the class in general or in presenting the lesson material in particular, the teacher must be able to determine the appropriate strategy, model or approach so that the learning objectives can be achieved. The choice of learning model should include the function of giving encouragement, the expression of the growing interest in learning, the delivery of learning materials, the creator of a conducive learning atmosphere, the energy to generate creativity, the impetus for self-assessment in the learning process and outcomes, and the incentive to complete the learning outcomes. The models that are developed to achieve three important learning objectives, namely academic learning outcomes, acceptance of diversity, and the development of social skills, are cooperative learning models [4]. Which means, that the process of involving students in learning activities or make students as an active learning subject and the interaction between teachers or lecturers with students to stimulate, support or improve the ability of scientific reasoning of learners.

Good classes such as observation, experimentation, and even scientific discussion should enable students to become active learning subjects, enabling such activities to trigger students’ thinking processes and also provide meaningful experiences. Student involvement in cognitive processes as well as class organizing is essential to train students so that they are capable of science literacy. Science literacy as a learning objective, encompasses students' understanding of the nature of science as well as the scientific reasoning of students [5].

In the teaching-learning process in the classroom, in addition to involving students in learning and using models, strategies, learning approaches, the educators should also be able to choose and use the appropriate teaching media. In schools or campuses that are lacking in terms of infrastructure, computer-aided image and modeling tools are the most appropriate medium to use in classroom learning.

In order to support the students' thinking ability especially scientific reasoning ability in Cell Biology course, the chosen approach is Drawing Based Modeling. Drawing Based Modeling in accordance with the demands of the curriculum and able to support the thinking process especially the students' scientific reasoning abilities is the answer to all the above problems.

The Drawing Based Modeling (subject drawing based modeling), this approach is more effective in achieving the conceptual and operational understanding that can stimulate scientific reasoning skills rather than other learning approaches [6]. Modeling can also provide an opportunity for students to think and discuss in a scientific way about students’ ideas [7]. The description of the above background is the basis of the researcher to know the extent to which Drawing-based Modeling approach assisted with E-Beam Capture can support students' scientific reasoning abilities, especially in Cell Biology course.

Theoretical material on Cell Biology about mechanisms of transport across the cell membranes consists of several subjects, namely active transport, passive transport, endocytosis and exocytosis [8]. Cell membrane it is thin, flexible, lipid barrier that separates the contents of the cell or organelles from its surroundings [9].

1.1 Problem Identification
The formulation of this research are: 1) Is Drawing-based Modeling approach with E-Beam Capture able to support students' scientific reasoning ability? 2) How is the students’ scientific reasoning ability using the Drawing-based Modeling approach assisted with E-Beam Capture?

1.2 Research Objectives
This research aims to determine the extent to which Drawing-based Modeling approach assisted with E-Beam Capture can support students' scientific reasoning ability and figure out the percentage of students’ scientific reasoning ability using the Drawing-based Modeling approach assisted with E-Beam Capture.
2. Method

2.1. Research Method

The method used in this research is the experiment method with the one group pre-test and post-test design [10]. Instruments used include: questionnaires, observations, interviews, and tests. The experimental class is given a learning treatment with Drawing Based Modeling approach assisted by computer application in the form of E-Beam Capture. The technique of data analysis and processing used during the research is descriptive analysis and percentage technique.

2.2 Research Design

This research uses the one group pretest and posttest design. One group pretest and posttest design can be fully seen in figure 1 below:

![Figure 1](image-url)

**Figure 1.** One group pre-test and post-test design

2.3 Research Subject and Location

The subjects of this research are 25 students of the Biology Education University of Muhammadiyah Bengkulu, consisting of 17 female students and 8 male students. This research involves validators consisting of: material experts, media experts, teaching tool specialists, 3 high education practitioners. Experiment I, is a test of the implementation of drawing based modeling approach and the use of E-Beam Capture application in supporting students' scientific reasoning capability, Trial II, is to test the functioning of lecturing programs, instruments, drawing based modeling approach by using E-Beam Capture application in supporting students’ scientific reasoning ability. The location of the research was conducted in Biology Education Study Program of Muhammadiyah University of Bengkulu located in the city of Bengkulu.

2.4 Research Procedure
Implementation of research was done by doing things that are necessary in the execution of research such as preparing the assessment rubric format of scientific reasoning ability [11], making a schedule of research activities, making syllabus and semester course plan for Cell Biology course, and arrange the instrument in the form of learning observation, pre-test and post-test. Data collection through interviews, observation and documentation and test result data. The selection of the classes is done in consideration of the number of students, characteristics, and capabilities of individual students who are considered equal.

The stage of approaches of learning in Drawing Based Modeling in Cell Biology consists of four steps, namely: The first step, Expressive, students express ideas about the Structure and Cell Organelle topic. Then describe their initial idea by using a computer application in the form of eBeam Capture. In the second step, Experimental, students collect empirical data to validate and improve their image models through books and lecturers’ explanations. In the third step, Evaluative, students evaluate the images they make by comparing their image models with their peers and then exchanging critical ideas with each other. In the fourth step, Exploratory, the lecturer gives a new phenomenon on each subject of Cell Biology in hope of facilitating the students to improve the image they have made. After observing the new phenomena given by the lecturers, the students then explore to create new images using eBeam Capture application.

2.5 Data Collection
Scientific reasoning skill data is collected by giving multiple choice questions before and after learning activities and viewing the learning recordings and discussions on drawing-based modeling implementation using the eBeam Capture computer application and assessed in the rubric of scientific reasoning [11].

2.6 Data Analysis
Scientific reasoning test is performed by giving test items. The test consists of 30 items written test of multiple choice with 5 choices. The results of the test are divided into six indicators of scientific reasoning skills, namely generativity, elaboration, justification, explanation, logic coherency, and synthesis.

3. Result and Discussion
Scientific reasoning tests are performed using the written pre-test and post-test, this test consists of 30 items written test of multiple choice with 5 choices. The results of the test are divided into six indicators of scientific reasoning skills, namely generativity, elaboration, justification, explanation, logic coherency, and synthesis. Based on those reasoning indicators, the research results can be seen in Figure 2 below:

![Figure 2. Scientific reasoning test results data](image)
The graph 2 shows the number of students in each scientific reasoning which achieve high scores in pre-test and post-test of the indicator of the implementation of drawing based modeling approach assisted with eBeam Capture in Cell Biology. In general, it appears that the students’ scientific reasoning skills in every indicator show improvements from pre-test to post-test, this is shown in generativity reasoning which has 2 students achieving high scores. Then in elaboration reasoning consists of 3 students, justification consists of 4 students, explanation consists of 3 students, coherency consists of 3 students, synthesis consists of 2 students. This research result also shows that in explanation reasoning consists of the most number of students with high scores, which is 20 students in the pre-test and 23 students in post-test, this is because of the students’ ability in making and explaining pictures with the explanation of parts of the picture completely. While synthesis reasoning consists of the least number of students achieving high scores, which is only 1 student in the pre-test and 3 students in post-test, this is because the students could not synthesize image explanation that they made, therefore, the answers did not form a systematic theory structure.

The students’ scientific reasoning skill is still categorized low in Biology Cell using drawing based modeling approach assisted with eBeam Capture, because the use of eBeam Capture application in assisting drawing based modeling is the first time ever used in Biology Cell. The use of a computer application for the first time should be tested frequently and designed insomuch to the students with hope for easier use in a learning activity [11].

Students’ scientific reasoning skill is still low because in the process of teaching and learning especially in group discussion, there are still many students that could not cooperate with others. Scientific reasoning skill is gained by the process of thinking logically individually and collaborative cognition through a problem-based teaching and learning model [12]. Besides, based on the journal article analysis result that has been conducted, reasoning skill can be improved through the application of some inquiry teaching and learning model [13], Problem Based Learning [14], ICT-based [15], playing and group discussion [16]. In other context, besides the application of teaching and learning model to the improvement in reasoning skill, it can be in form of reasoning correlation to conceptualization [17], presentation [18], logical thinking [19].

Based on the progress of students’ scientific reasoning skill both on pre-test and post-test can be seen in table 1 below:

| Test  | Student | N  | Total Test Score | SD  | G-Gain |
|-------|---------|----|------------------|-----|--------|
| Pretest | All     | 25 | 1,45             |     | g=0,05 |
| Postes | All     | 25 | 1,50             |     |        |

The table 1 above shows that the score of post-test (SD = 1.50) is statistically higher than the score of pre-test (SD = 1.45), with N-Gain of 0.05. This number shows that drawing based modeling approach assisted with E-Beam Capture still gives contribution although it is not so huge or not too significant.

From the score, it can be seen that the lecturer using the Drawing-Based Modeling approach could not yet support students’ scientific reasoning skill in Cell Biology. This is in accordance with the explanation that the role of teachers in learning using a drawing approach with the help of computer media should be tested initially and re-designed in order to improve a scientific thinking skill of students [20].

4. Conclusion

Based on the research that has been conducted above, it can be concluded that Drawing-based Modeling approach assisted with E-Beam Capture cannot yet support students’ scientific reasoning skill comprehensively, this can be seen from the very small and the number of students achieving high
scores in every reasoning indicator is still very small. E-Beam Capture serves as a medium in the Drawing-based Modeling Approach which can not yet support scientific reasoning skill comprehensively, as seen in the post-test score and pre-test score with a very small. The Drawing-based Modeling Approach with E-Beam Capture Assistance in Cell Biology course should be simulated or tested first. Trials are conducted as an effort to anticipate the lack of implementation of the learning steps due to the limited time. Through the trial, it can be known how much the time should be allocated at each stage of learning and the weaknesses contained in the scenario that has been prepared. Thereby can be done improvement effort before applying to the actual research.

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