Effectiveness Research-based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananas comosus* L.) on Undergraduate Biology Education Students' Science Process Skills in Universitas Negeri Medan

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Abstract. The purpose of this study is to test the effectiveness of research-based textbook of *In vitro* rooting of Sipahutar Pineapple (*Ananas comosus* L.) in improving science process skills of undergraduate biology education students. This study is quasi-experimental research using pretest-posttest designs. The research subjects are determined through cluster random sampling method. Data collected through pretest and posttest and measured by using essay tests. The data statistically analyzed by using independent sample t-test using SPSS 22 for Windows. The result shows that there is a significant difference between experiment class and control class in science process skills (t_{count}=9.678; p=0.00). Further, N-Gain test performed to find out the increasing score from pretest to posttest. The result shows N-Gain score for group using Research-based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananas comosus* L.) is 0.64 (moderate category) while the other group N-Gain score is 0.35 (low category). It concluded that Research-based Textbook of *In vitro* Rooting of Sipahutar Pineapple was effective in improving students' science process skills.

1. Introduction

Improving the quality of education is a top priority of the current national education program. The process of improving the quality of education is a complex effort because it involves planning, funding, and managing the learning process. One of the most important factors that support objectives achievement in learning activities is the presence of teaching materials. Textbooks are part of teaching materials that designed to make students able to meet the expected competencies. Textbook can be used to improve students' creative thinking skills because it contain a systematic learning that will create learning conditions to make students involved in the learning process actively and creatively to achieve learning goals.

Plant tissue culture is one of the courses taught in the undergraduate Biology Education Study Program in Universitas Negeri Medan. Learning about tissue culture can be obtained from various sources, one of them is from textbooks. Tissue culture learning in Universitas Negeri Medan currently only focusing on mastering the concepts in tissue culture.
However, plant tissue culture textbook provided by the campus has not yet promote research activities for students. This will lead to condition where students depend heavily on lecture, which in the end resulting passive learning[1]. Further, students tend to just listen, resulting too much time was spent on monologues of teacher explanation, leaving too little time for students carrying out work and teacher to guide students in learning[2]. For these reasons, it is necessary to provide suitable textbook to develop students' skills such as science process skills.

Research-based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) was developed previously by Hasanah et al. (2018). This book provides all research procedures such as finding information, arrange the hypotheses, collecting data, analyzing data, and making a conclusions based on data.

However, the book could not yet be used since by refers to R and D research, the development had not yet reach dissemination stage. The dissemination process is a final stage of R and D research which carried out to promote product development in order to be accepted by users, either individuals, groups, or systems. Therefore, finding out the effectiveness of this book is very much needed, to find out the advantages of the book, which in this case in obtaining students' science process skills.

2. Theoretical review
Research is an important tool to improve the quality of learning. The research component consists of: background, procedures, implementation, research results and discussion and publication of research results. All those components provide important meaning that can be seen by how students able to formulate and solve problems and their ability to communicate the benefits of research results. Research-based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) is expected able to support the achievement of expected skills in learning [3].

This book was develop based on research procedures, such as seeking information, arrange hypotheses, collecting data, analyzing data, and making a conclusions based on data. By using this book, teachers or students are expected able to apply those procedures into learning and act like scientist to gain the knowledge. Students must be accustomed to working scientifically, therefore students must have the ability to become a scientist through research, so they can form science process skills are themselves.

Science process skills have a very important role in the knowledge formation. Familiarize students with the process of scientific work, in addition able to practice the details of scientific skills and systematic work, can also shape students' scientific thinking patterns. Empowering students in developing science process skills will shape student character with scientific attitudes, ability to think and act critically in both during learning and in the context of daily life [4].

Science process skills are skills that can equip students to be able to perform a variety of physical activities during the discovery process (Hands on Activities) and thinking process skills (Minds on Activities) and instill scientific attitudes (Heart on Activities) [5]. Science process skills are assimilation of various intellectual skills applied to the learning process. Science process skills arranged in hierarchy, from simple levels to more complex levels [6].

Science process skills are categorized into two; basic skills and integrated skills [7]. Science process skills without accompanied by assessment will cause all learning process done in vain. Therefore, suitable instrument to assess science process skills are needed [8].

Science process skills are students' thinking skills using scientific methods so students are able to find concepts or knowledge. The scientific method, scientific mindset and critical thinking are the terms of this skill. Therefore, for at least the past two decades science process skills has become more commonly heard [9].

Learning conditioning through the science process can train scientific skills and systematic work, and form students' scientific thinking patterns. Therefore, the development of science process skills can gave implications to the development of higher order thinking skills [10]. Science process skills will mastered by students if students are able to think at a high level [11].
As explained above, it was concluded that science process skills are intellectual skills that applied in the learning process in order to carry out various learning activities using scientific methods to make students able to find concepts or knowledge.

3. Method

This research was conducted in Universitas Negeri Medan (one of national university) which located in Jl. Willem Iskandar Pasar V Medan Estate, postal code 20221, North Sumatera, Indonesia. The research was held from February to June 2019. The population was all 8th semester undergraduate biology education students in academic year 2018/2019 (8 classes). Two classes (A and B) taken as sample for the Experimental Group by cluster random sampling method. Class A taught using Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.), while Class B taught using Plant Tissue Culture textbook. This research was a quasi-experimental research by using Pretest-Posttest Control Group Design.

Besides providing material during lecture, researchers were also guide students to carry out the research in YAHDI’s plant tissue culture laboratory. Students performed procedures that usually done when carrying out the experiment, such as: tools and materials sterilization, culture media making and sterilization, and of *In vitro* propagation of pineapple plants.

The data obtained from pretest and posttest were analyzed using descriptive and inferential statistics then the conclusions drawn according to the proposed hypothesis. Research design displayed in table 1. below:

| Group | Pretest | Postest |
|-------|---------|---------|
| Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) (A) | X₁E | X₂E |
| Plant Tissue Culture Textbook (B) | X₁K | X₂E |

Note:
- X₁E: The initial test in form of science process skills questions before the learning process
- X₂E: The final test in form of science process skills questions after learning process
- X₁K: The initial test in form of science process skills questions before the learning process
- X₂K: The final test in form of science process skills questions after learning process

As prerequisite test, normality and homogeneity test were performed. Normality test was performed by using Kolmogorov-Smirnov test at significance level 0.05. Homogeneity test was performed to find out wether data distributed normally or not. To test it homogeneity, we used Levene’s test at significance level 0.05 by using Software Statistical Package for Social Science 22.00. Hypotesis by t-test with level trust 0.05 %computed by SPSS Program version 22.00. Further, N-Gain test performed to find out the effectiveness of Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.). N-Gain testuse to identify the improvement of pretest and posttest score in both classes. The formula used was:

\[ \text{N-Gain} = \frac{s_{post} - s_{pre}}{s_{max} - s_{pre}} \]

N-Gain score obtained then adjusted to the N-Gain score criteria in table 2. below:

| Score range | Category |
|-------------|----------|
| G > 0.7     | High     |
| 0.3 < g ≤ 0.7 | Moderate |
| g ≤ 0.3     | Low      |

(Modified from Hake, 1999)
4. Result and Discussion

Result of implementation of Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) and Plant Tissue Culture textbook in plant tissue culture course presented in Table 3. below:

| No | Group | Pretest | Postest |
|----|-------|---------|---------|
|    |       | Mean score | Standard Deviation | Mean score | Standard Deviation |
| 1  | Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) (A) | 60.40 | 6.641 | 86.30 | 4.153 |
| 2  | Plant Tissue Culture Textbook (B) | 60.34 | 6.956 | 74.89 | 3.894 |

According to Table 3, students' mean score from pretest in class A was 60.40 with standard deviation score 4.153, while in class B, mean score obtained from pretest was 60.34 with standard deviation score 6.956. Mean score obtained from posttest in class A was 86.30 with standard deviation 4.153, while in class B, means score obtained was 74.89 with standard deviation 3.894.

Data of students' science process skills in class A was distributed normally (0.070>0.05). Data of students' science process skills in class B was also distributed normally (0.161>0.05). Then homogeneity test performed in both classes. Result of homogeneity test in class A showed that data was homogenous (0.0654>0.05). Data of students' science process skills in class B was also homogenous (0.473>0.05). It means that both classes have same characteristics in term of science process skills.

After normality and homogeneity test performed, data then analyzed by using t-test. Result from t-test showed that the probability value obtained was lower than 0.01 ($t_{count}$=9.678; $p=0.00$), which means that students' science process skills in class A was higher compared to class B. Students' science process skills in class taught by using Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) was significantly higher (86.30 ± 4.153) compared to students' science process skills in class taught by using Plant Tissue Culture Textbook (74.89 ± 3.894).

Therefore, it was concluded that Research-Based Textbook of *In vitro* Rooting of Sipahutar Pineapple (*Ananascomosus* L.) able to increase science process skills of undergraduate biology education students' in Universitas Negeri Medan.
Figure 1. Science process skills of undergraduate biology education students' in Universitas Negeri Medan using Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) ($t_{count}=9.678; \ p=0.00$). Different letter means it was significantly different.

Result of hypothesis testing showed that Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) was effective in improving students’ science process skills because there was significant difference in science process skills between class that used this book and the class that didn’t use it. The present of research procedures such as finding information, compiling hypotheses, collecting data, analyzing data, and making conclusions, trained students to work scientifically, which then will improve their science process skills.

Science process skills that used in this research were skill to observe, classify, interpret, predict, ask questions, plan the experiment, apply the concepts, and communicate. Science process skills have a very important role in the process of science formation. That is, the ability of science process skills can influence the development of student knowledge. Familiarizing learning through scientific work processes, in addition to being able to practice detailed scientific skills and systematic work, can also form students' scientific thinking patterns [13].

A series of science process skills that can enhance students' curiosity prove the theory previously obtained directly so that learning will be more meaningful and help students understand the material by constructing their knowledge through a series of experiments [14]. Thus, the knowledge gained lasts long because it will be stored in long-term memory. Based on observations while in class and in the laboratory, students in class A were seen working scientifically or in accordance with the research steps that contain in the book, both during learning in class and when doing experiment in the laboratory.

Science process skills needed when a student conducts experiments in a laboratory, which was a part of learning tissue culture. Students will work like a scientist who works using high scientific process accuracy and skills. Therefore, the present of Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) greatly helps students to work in accordance with scientific procedures that have the potential to increase students' scientific process skills. So the book can be used as a guide for students to conduct research in tissue culture because tissue culture courses lead students to conduct research to shape the science process skills.

Observation is the first indicator of science process skills. For observing activities, students in class A obtained mean score 90.00, while students in class B obtained mean score 80.68. Students make observation to find facts related to learning material. Observing activities can provide more
meaningful learning, because students observe existing phenomena. Observation activities are useful for fulfilling students' curiosity, so learning process has a high meaningfulness [15].

Second indicator was skill to classify. Mean score of students’ skill to classify in class A was 94.00, while in class B was 85.23. Third indicator was skill to interpret. Mean score of students’ skill to interpret in class A was 85.50, while in class B was 73.30. The purpose of this activity was to be able to interpret result of object observation or measurement according to observation result from one another [16]. Fourth indicator was skill to predict. For this skill, students in class A obtained mean score 80.00, while means scores of students in class B was 68.18. Students were able to predict what will happen if treatments given to the plants in plant tissue culture.

After all three indicators above were done, students' curiosity was increase which lead to the emergence of fifth skill, which was asking question. This activity seen when students asked questions while doing tissue culture experiment in the laboratory. Students ask each other questions about what they find during practical activities in the laboratory or when students experience difficulties related to understanding learning material. For this skill, students in class A obtained mean score 94.00, while means scores of students in class B was 80.68.

Sixth indicator was skill to plan the experiment. Mean score of students’ skill to plan the experiment in class A was 80.00, while in class B was 73.87. Planning the experiment is skill that need to be trained to students in order students able to work scientifically. Science process skills are needed when a student is conducting an experiment in practical activities [17].

Seventh indicator was skill to apply the concepts. Mean score of students’ skill to apply the concepts in class A was 89.00, while in class B was 75.00. Students who have science process skills will be able to answer the questions correctly because they are able to use concepts that have been studied previously. This occurred because students have reserved science process skills and find out their own concepts in the learning process.

The last indicator for science process skills was skill to communicate. Communication activity was done by presenting observations result in various forms, such as: picture, chart, and writing and graph. Based on research result, mean score obtained for this indicator in class A was 85.00 and class B was 68.77.

Based on overall data obtained, the highest mean scores was achieved by students in class A (classifying and asking question skills), which were taught by using Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.). Science process skills train students to think using scientific method procedure that makes students active to think and develop the knowledge they have.

Further, to find out improvement of pretest scores to posttest scores, N-Gain analysis was performed, the result was displayed in Table 4. below

| No | Textbook | N-Gain mean score | Categories |
|----|----------|-------------------|------------|
| 1  | Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) | 0.64 | Moderate |
| 2  | Plant Tissue Culture Textbook | 0.35 | Low |

According to N-Gain test result in Table 4, N-Gain scores obtained for class A was in “moderate” category, with mean score obtained was 0.64. N-Gain scores obtained for class B was in “low” category, with mean score obtained was 0.35.

N-Gain score obtained prove that Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) in learning process was effective to use in improving undergraduate biology student science process skills. The improvement of students' science process skills occurred because during learning students required to learn according to research procedures which include
finding information, compiling hypotheses, collecting data, analyzing data, and making conclusions based on data obtained. Therefore, students were motivated to be always act like scientists in gaining knowledge.

5. Conclusion

Based on research result and analysis, it concluded that Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) effective to use in improving undergraduate biology education students’ science process skills. Probability value of students' science process skills was lower than 0.01($t_{count}=9.678; p=0.00$), which means students' science process skills in class taught by using Research-Based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) was higher than students in class taught by using Plant Tissue Culture Textbook. N-Gain score for group using Research-based Textbook of In vitro Rooting of Sipahutar Pineapple (Ananascomosus L.) was 0.64 or in “moderate” category, while the other N-Gain score was 0.35 or in “low” category.

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