



Analyzing students' science process skills through mobile learning using virtual laboratory

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ABSTRACT

Science process skills have to be taught during learning process in order students are able to develop their skills in examining and solving science problems by leading such investigation process in which are beneficial for their future life. This study aims at analyzing students' science process skills in the concepts of biodiversity through mobile learning using virtual laboratory. The research included in a descriptive quantitative study. The mobile learning was conducted on November 2021 toward 24 students from 7th grade in a junior high school. Students learned the concepts of biodiversity through virtual laboratory in which the virtual laboratory has been already stated as valid and appropriate to be implemented in the learning process. In addition, the students' science process skills were evaluated and measured using a test. Findings indicated that the students' science process skills is 60.42 ± 8.59 . Therefore, it can be concluded that students' science process skills reached moderate through mobile learning using virtual laboratory.

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INTRODUCTION

Science is one of branches of knowledge that discusses about living things, world entire, and phenomenon of life which have to be learned by students (Sari, Duygu, Şen, & Kirindi, 2020). Science is a knowledge consisting of principles, concepts, laws, theories, and examples that mostly can be obtained through scientific processes, such as observations and experiments (Hernawati, Amin, Irawati, Indriwati, & Omar, 2018; Imaduddin & Hidayah, 2019). By learning science, students are able to analyze and think scientific methods by applying science process skills. Science process skills are capabilities that refer to scientific processes, i.e., observing, communicating, predicting, classifying, measuring, and concluding (Díaz, Gómez, & De-la-calle, 2019). These skills might be always present in the science learning process, as well as into everyday life. Furthermore, these skills are often used in students' thinking processes (Adlim, Nuzulia, & Nurmaliah, 2020; Sari et al., 2020). Therefore, science process skills are very important to be taught during science learning process.

Based on the observation result from the preliminary study conducted in August, 2021 toward 36 students in the seventh grade of a junior high school at Sampang, it can be assumed that 78% students or around 28 students have difficulties in learning science, especially related to practical in science. Students found that science concepts are hardly to remember and comprehend. Therefore, it become difficult on developing their science process skills. According to the findings of study conducted by Ekici & Erdem (2020); Parmin, Sajidan, Ashadi, Sutikno, & Fibriana (2017); & (Bernacki, Greene, & Crompton, 2020), it also can be assumed that science process skills have to be integrated in the science learning since these skills play an important role in a daily life. Furthermore, the science process skills also can engage students to develop their cognitive knowledge by having investigation processes (Fahyuni, Wasis, Bandonu, & Arifin, 2020; Ratnasari, Sukarmin, Suparmi, & Harjunowibowo, 2018; Taufiq, Amalia, Parmin, & Leviana, 2016). Unfortunately, these skills are not often implemented in classes since educators need much more efforts to plan the science classes with several practical activities. It is also found that the practical activities in science classes is rarely implemented, therefore students cannot develop their science process skills (Ekawati, Iswari, & Lisdiana, 2018; Irwanto, Rohaeti, & Prodjosantoso, 2019). Moreover, the main objective of science learning process is to engage students developing their science process skills. Students need to apply science process skills in order that they are able to interact in society through a scientific way, by easily observing, analyzing, asking why something in the world could happen, and then predicting how it could occur, doing investigations to find the solutions, and concluding what the best solutions are (Sari et al., 2020; Savitri, Wusqo, Ardhi, & Putra, 2017; Setiawan & Sugiyanto, 2020). According to that view, science process skills are very important for science learners.

Science process skill is such transferable intellectual skill referring to a scientific inquiry (Setiawan & Sugiyanto, 2020). This skill engages students to focus on thinking and solving problems, learn science actively by themselves, and value science more meaningful. There are two groups of science process skills as basic and integrated skills (Iftene & Trandabăt, 2018; Yip, Wong, Yick, Chan, & Wong, 2019). Basic science process skills provide a basis for learning science in which the activities are simpler than integrated science process skills (Ekici & Erdem, 2020; Elfeky, Masadeh, & Elbyaly, 2020; Wahyuni, Indrawati, Sudarti, & Suana, 2017). Basic skills include observing, measuring, classifying, inferencing, communicating, and predicting. In contrast, integrated science process skills which are more detailed rather than basic science process skills include formulating hypotheses, identifying variables, defining variables operationally, describing relationship between variables, designing an investigation, organizing data in tables, graph, and figures, analyzing data, understanding cause and effect relationship, and formulating conclusion (Ekici & Erdem, 2020; Tanti, Kurniawan, Kuswanto, Utami, & Wardhana, 2020). Science process skills are very important to learn since by having these skills, students can build their knowledge, understand scientific phenomenon, and describe the science findings, and act as researchers.

Nowdays, learning situation is conducted in various ways. It is caused by the current global situation that is still under Covid-19 pandemic. However, learning processes are not only conducted in distance by online face-to-face meeting, but it is developed by implementing technology-based education that can support the learning process. The learning process is also conducted more flexible, in which it is called as mobile learning. Mobile learning is decided to be implemented because mobile learning offers students a new learning situation by integrating face-to-face meeting with the use of



mobile devices for studying (Elfeky et al., 2020; Irwanto et al., 2019). In addition, mobile learning allows students to learn at any time and place. Moreover, mobile learning is correlated to the principles of the socio-constructivist learning theory in which states that learners acquire active roles in a social collective learning environment by using their own mobile devices (Ekawati et al., 2018; Sholahuddin, Yuanita, Supardi, & Prahani, 2020). Furthermore, the implementation of mobile learning is also linked to the pedagogical approach in which mobile learning consisted of authenticity, collaboration, and personalization (Mulyeni, Jamaris, & Supriyati, 2019; Rani, Wiyatmo, & Kustanto, 2017). By conducting mobile learning in the aspect of authenticity, students can learn the science knowledge easily through mobile devices. In the aspect of collaboration, students can interact with lectures and their friends through the online learning community. In addition, in the aspect of personalization, students can adapt on new technology on the learning process (Ahied, Muharrami, Fikriyah, & Rosidi, 2020; Ratnasari et al., 2018).

Outstandingly, mobile learning is suitable provided by implementing virtual laboratory in the current learning process. Since it has been proved that students gain much more motivation by conducting mobile learning, and it also impacts on their comprehension (Taufiq et al., 2016). However, mobile learning is not enough if there is no learning media applied during the learning process. During this study, mobile learning and virtual laboratory is provided for students in order they are able to learn and have a science practice. As it is already reported that recently about 80% of teenagers have own mobile phones, though most of them use mobile phones for social networking, taking pictures, and playing games, in which only a few who uses them for studying (Ekici & Erdem, 2020; Ngabekti, Prasetyo, Hardianti, & Teampanpong, 2019). Therefore, it is very possible to apply virtual laboratory in mobile phones, since this learning media is able to offer students to have a new experience in learning science.

Virtual laboratory is defined as an online laboratory that can be used by students to learn and practice science easily since this virtual laboratory can be accessed through mobile phone. It also offers a flexibility of use and learn, since students do not need to come to the conventional laboratory to conduct experiment or observation (Estriegana, Medina-Merodio, & Barchino, 2019; Mayer, 2020). Students can learn and conduct investigations directly by operating the virtual laboratory. Several studies also found that virtual laboratories provide more advantages rather than traditional laboratories (Estriegana et al., 2019; Seifan, Robertson, & Berenjian, 2020). Virtual laboratory offers science classes with technology and active learning as key elements to improve students' learning achievements. It also can make students easy to interpret the science phenomenon, perform investigation process, and collect more information during shorter time in which different if students learn in traditional laboratories (Adlim et al., 2020; Subali, Rusdiana, Firman, Kaniawati, & Ellianawati, 2017). Unfortunately, science educators are not often engaging students to learn science by using virtual laboratories because they prefer to choose traditional laboratory (Estriegana et al., 2019; Subali et al., 2017; Tanti et al., 2020). The traditional laboratories are more often chosen in science classes since teachers do not have to prepare more (Mayer, 2020).

Furthermore, the virtual laboratory used in this study offered several benefits which are different with other virtual laboratories. Mostly virtual laboratories only can be accessed in PC, meanwhile the virtual laboratory in this study can be applied in mobile phones, and so it is more suitable for students. Students can operate and access the virtual laboratory everytime and everywhere. In addition, students can understand the science concepts deeper by recalling the concepts through accessing the virtual laboratory. This virtual science laboratory also consisted of several contents that can engage students to enhance their science process skills. It also provides science content that is integrated with biodiversity in Madura. As we know, science process skills are easily observed and measured when students carry out practical (Adlim et al., 2020; Rizal, Rusdiana, Setiawan, & Siahaan, 2020). During this study, students can learn science concept while improve their science process skills by using the virtual science laboratory.

Therefore, this study focused on the implementation of mobile learning using virtual laboratory which offers a solution toward the problem related to the innovation of learning process. In addition, this study is also beneficial since it provides an interactive learning process that can help students not only to carry out science practice but also to enhance students' science process skills. According to the



previous views, this study aims at analyzing students' science process skills in the concepts of biodiversity through mobile learning using virtual laboratory.

METHODS

Research Design

This study included in a descriptive quantitative research that was conducted on November, 2021. This research included in a descriptive quantitative study since it discussed about current conditions that happens related to the education during pandemic, and also used certain instrument to measure the skill. In addition, this study also used big samples, focused on some information about processes, and applied statistical analysis of several numerical findings in which are the features of descriptive quantitative study (Taherdoost, 2018).

In addition, this study also used ex post facto research design, since there was no controlled and manipulated variables. This design was chosen to know the description of fact related to certain objects. In this study, the objects were about students' science process skills that were analyzed based on the results and facts of mobile learning using virtual laboratory, so that it can be manipulated. Furthermore, this learning process was implemented referring to ASSURE instructional design (Heinich, Molenda, Russell, & Smaldino, 2012). ASSURE instructional design consists of systematical stages. It is also correlated to the objective of this study since ASSURE design purposes at creating an effective learning process.

Population and Samples

The population in this research was about all students of the seventh grade in a junior high school in Sampang. The demography of population in this study is represented in Table 1 below.

Table 1
Demography of research population

Number	Class	Gender		Frequency
		Male	Female	
1	7A	7	14	21
2	7B	4	16	20
3	7C	5	17	22
4	7D	5	19	24
Total		21	66	87

Furthermore, the samples taken from its population were 24 students in one class. The research subject was decided and chosen using a non-probability sampling technique, in the type of purposive sampling. The students were chosen according to the aim of this study and were also selected according to the certain criteria and considerations, such as development of knowledge, learning styles, and learning background. The demography of samples in this study are represented in the Table 2 below.

Table 2
Demography of research samples (n=24)

Number	Category	Frequency (f)	Percentage (%)
Gender			
1	Male	5	20.83
	Female	19	79.16
	Total	24	100.00
Age			
2	Teenager (13 years old)	24	100.00
	Total	24	100.00
Class			
3	7 th grade (7D)	24	100.00
	Total	24	100.00

Students in class 7D consisted of 5 boys and 19 girls in the age of 13 years old. They have already studied science concepts during one semester in which the concepts were integrated in this study.



According to the observation result during the learning process, students also preferred to learn by having audio-visual learning styles, therefore it is proper to conduct a learning process which apply a technology-based learning media.

Instrument

The test instrument questioned about the concept of biodiversity with ten questions of multiple choice in which every question represented five indicators of science process skill, i.e, predicting, designing investigation, observing, analyzing data, and making conclusion. The outline of science process skill test instrument is represented in the [Table 3](#).

Table 3
Outline of Science Process Skill Test Instrument

Number	Indicator of Science Process Skills	Questions
1	Observing	According to the figure below, which one is the correct one related to the structure of the leaves?
2	Predicting	Based on the figure and the description below, can you predict what type of the plant is included in?
3	Designing investigation	Several tools are provided, i.e., pencil and ruler., the materials are also given, consisted of plants in which are provided in virtual lab. Which flow chart is the correct one to present about investigation to know the structure of plants?
4	Analyzing data	According to data in table below. Which description of data analysis is the most correct one?
5	Making conclusion	According to data in table above. Which conclusion is the correct one?
6	Observing	According to the figure below, which one is the correct one related to the structure of the stem?
7	Predicting	Based on the figure and the description below, can you predict what type of the plant is included in?
8	Designing investigation	Several tools are provided, i.e. pencil and ruler., the materials are also given, consisted of leaves of plants in which are provided in virtual lab. Which flow chart is the correct one to present about investigation to know the structure of leaves?
9	Analyzing data	According to data in table below. Which description of data analysis is the most correct one?
10	Making conclusion	According to data in table above. Which conclusion is the correct one?

In addition, the test instrument of science process skills which was shared to students to evaluate their science process skills is shown in the [Table 4](#) below.

Table 4
Science Process Skill Test Instrument

Indicator of Science Process Skills	Questions
Observing	1. According to the figure below, which one is correct related to the morphology of leaves in that plant? <ol style="list-style-type: none"> That plant has complete leaves That plant has incomplete leaves That plant has compound leaves That plant has double leaves



Indicator of Science Process Skills

Questions

Predicting

2. According to the figure and description below, can you predict in which group is the plant?

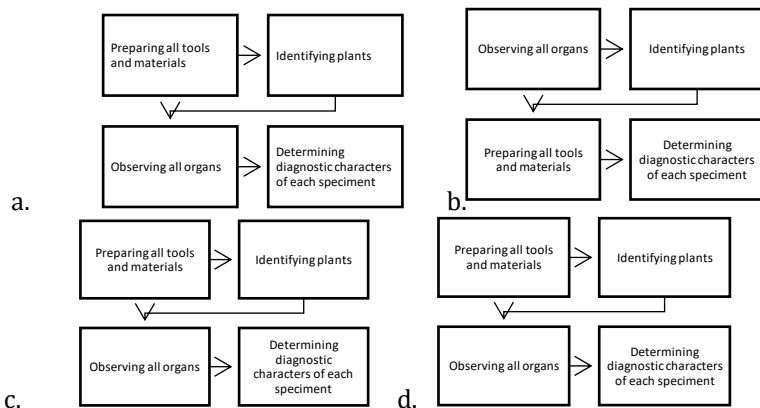
Single stem and tubular
Stem growth direction: erectus
Nodus and internodus are present
Root system including taproot
There is a root neck, root tip, and root fibers



- a. Palm trees belong to the class Dicotyledoneae
- b. The palm plant belongs to the Monocotyledoneae class
- c. Coconut plants belong to the class Dicotyledoneae
- d. Coconut plants belong to the class Monocotyledoneae

Design investigation

3. Some tools are provided, including pencils and rulers, as well as materials, namely plants. Which of the following is a flow chart that represents the activity of observing plant morphology?



Analyzing data

4. Based on the data in the table below, which is the most appropriate description of data analysis?

The leaf edge is integer
The tips of the leaves are split
The base of the leaf is flat
Green leaf color



- a. Leaf structure in coconut plants has a morphology in the form of uneven or integer leaf edges, split leaf tips, flat leaf base, and green leaf color.
- b. The leaf structure in coconut plants has a morphology in the form of a flat or integer leaf edge, the leaf tip is not split, the leaf base is flat, and the leaf color is green.
- c. Leaf structure in coconut plants has a morphology in the form of flat or integer leaf edges, split leaf tips, uneven leaf base, and green leaf color.
- d. Leaf structure in coconut plants has a morphology in the form of flat or integer leaf edges, split leaf tips, flat leaf base, and green leaf color.

Making a conclusion

5. Look at the following table.

Root	stem	Leaf
Root system: fibrous	Single rod, terrace shape	Single leaf when young, compound when old
Root color: dark brown	Growing direction: erectus	Integer leaf edge
Neck, ends and fibers Visible.	The books and stems are visible	Split leaf tips



Indicator of Science Process Skills

Questions

Based on the data in the table above, which is the most appropriate conclusion?

- Based on the morphology of the plant, the plant belongs to the class Dicotyledoneae
- Based on the morphology of the plant, the plant belongs to the class Monocotyledoneae
- Based on the morphology of these plants, these plants belong to the class Angiospermae
- Based on the morphology of the plant, the plant belongs to the class Spermatophyta

Observing

6. Based on the picture below, which one is correct regarding the morphological structure of the stem in this plant?



- The plant has a single stem, terrace-shaped, and the direction of growth of the stem is caulescent.
- These plants have a single stem, terrace-shaped, and the direction of growth of erectus stems.
- These plants have compound stems, terrace-shaped, and the direction of growth of erectus stems.
- These plants have a single stem, terrace-shaped, and the direction of growth of columnar stems.

Predicting

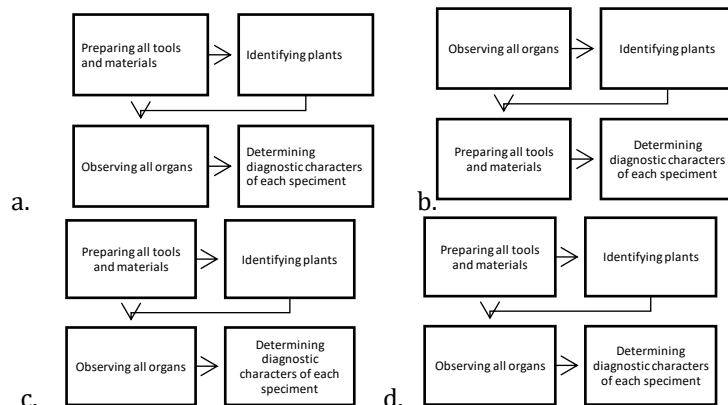
7. Based on the pictures and explanations below, can you predict which plant class the picture belongs to?
 Single stem and terrace shaped
 The direction of growth of the stem is erectus
 The surface of the stem is visible both the books and the segments
 The root system includes fibrous roots
 There is a root neck, root tip, and root fibers

- Palm trees belong to the class Dicotyledoneae
- The palm plant belongs to the Monocotyledoneae class
- Coconut plants belong to the class Dicotyledoneae
- Coconut plants belong to the class Monocotyledoneae



Design investigation

8. Some tools are provided, including pencils and rulers, as well as materials, namely leaves. Which of the following is a flow chart that represents the activity of observing plant morphology?




Analyzing data

9. Based on the data in the table below, which is the most appropriate description of data analysis?

Fibrous root system	
Root neck visible	
Root tips and fibers are visible	



Indicator of Science Process Skills	Questions														
	Dark brown root color														
Making a conclusion	<p>10. Based on the data in the table above, which is the most appropriate conclusion?</p> <table border="1" data-bbox="622 694 1428 884"> <thead> <tr> <th data-bbox="622 694 901 728">Root</th> <th data-bbox="901 694 1220 728">stem</th> <th data-bbox="1220 694 1428 728">Leaf</th> </tr> </thead> <tbody> <tr> <td data-bbox="622 728 901 761">Root system: fibrous</td> <td data-bbox="901 728 1220 761">Single rod, terrace shape</td> <td data-bbox="1220 728 1428 761">single leaf</td> </tr> <tr> <td data-bbox="622 761 901 817">Root color: dark brown</td> <td data-bbox="901 761 1220 817">Growing direction: erectus</td> <td data-bbox="1220 761 1428 817">The edge of the leaf</td> </tr> <tr> <td data-bbox="622 817 901 884">Neck, ends and fibers are visible.</td> <td data-bbox="901 817 1220 884">The books and stems are visible</td> <td data-bbox="1220 817 1428 884">Incomplete leaves</td> </tr> </tbody> </table> <p>a. The root structure in these plants is a fibrous root system, with a neck, tip, and root fibers, and the color of the roots is dark brown</p> <p>b. The root structure in these plants is a fibrous root system, with tips and root fibers, and the color of the roots is dark brown</p> <p>c. The root structure in these plants is a fibrous root system, with a neck and root fibers, and the color of the roots is dark brown</p> <p>d. The root structure in these plants is a fibrous root system, with a neck and root fibers, and the color of the roots is dark brown</p> <p>a. Based on the morphology of the plant, the plant belongs to the class Dicotyledoneae</p> <p>b. Based on the morphology of the plant, the plant belongs to the class Monocotyledoneae</p> <p>c. Based on the morphology of these plants, these plants belong to the class Angiospermae</p> <p>d. Based on the morphology of the plant, the plant belongs to the class Spermatophyta</p>			Root	stem	Leaf	Root system: fibrous	Single rod, terrace shape	single leaf	Root color: dark brown	Growing direction: erectus	The edge of the leaf	Neck, ends and fibers are visible.	The books and stems are visible	Incomplete leaves
Root	stem	Leaf													
Root system: fibrous	Single rod, terrace shape	single leaf													
Root color: dark brown	Growing direction: erectus	The edge of the leaf													
Neck, ends and fibers are visible.	The books and stems are visible	Incomplete leaves													

Procedure

This study has been conducted in the science class of junior high school by referring to ASSURE instructional design, in which consisted of six stages. The first stage was conducted by analyzing students in the aspects of age, learning styles, and cognitive development. The students are in the age of around 13 years old who have already reached high levels of abstract thinking and problem solving based on the cognitive development. They also have already studied science so that they have already reached prior knowledge related to the concept of biodiversity. In addition, mostly students also have audio-visual learning styles, so it is assumed that the learning process with technology-based multimedia can be conducted respectively.

The second stage was conducted by stating learning aims. The learning aims that was measured in this study were about students are able to understand concept of biodiversity and analyze students' science process skills through the learning process using virtual laboratory. The science process skills that were measured in this study was about i.e, predicting, designing investigation, observing, analyzing data, and making conclusion.

In addition, the third stage was about selecting instructional methods, media, and materials. The method applied in this study was mobile learning using a virtual laboratory in which this selection is caused by the current learning situation, and the materials were about the concepts in biodiversity. Furthermore, the fourth stage was utilizing method, media, and materials. The virtual laboratory was developed in the form of .apk program that can be installed in smartphone. The virtual laboratory has been evaluated and validated by experts in the aspect of content and construction, before used in the learning process. Outstandingly, the virtual laboratory was concluded as valid and feasible media with 3.5 on total score. Therefore, the virtual laboratory was appropriate to apply in the mobile learning process to engage students' science process skill. Furthermore, the view of virtual laboratory in this research is presented in the [Figure 1](#) as follows.



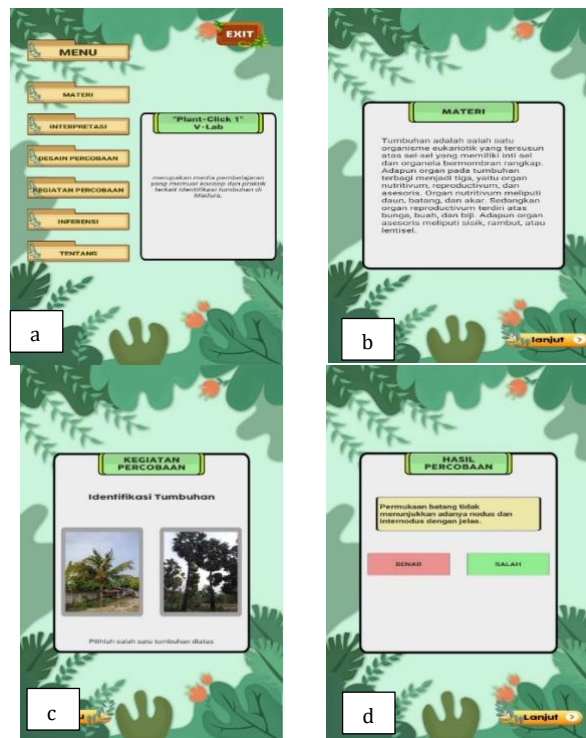


Figure 1. View of several contents on virtual laboratory; a) menu view, b) explanation of concept menu view, c) observation menu view, d) interpretation menu view.

The fifth stage in this study was conducted by requiring learner participation in which the learners were engaged actively during the mobile learning process. The learning process was implemented in the mobile situation. The virtual laboratory was shared to students during the learning process in order they are able to be easily understand and practice the concepts of biodiversity. By using this virtual laboratory in the learning process, students also can enhance their science process skills since this learning media consisted of concept related to biodiversity, knowledge about science process skills, and also practice about biodiversity.

To sum up, the last stage was conducted by evaluating and revising according to the findings of the learning process, i.e. students' science process skills. Data of students' science process skills were measured using a test instrument. In the last meeting of the learning process, students were asked to answer all the questions in the test instrument for 60 minutes individually without any discussions with friends. All in all, the procedure in this study is shown in [Figure 2](#).

Data Analysis Techniques

Virtual laboratory was evaluated and validated by using formula below:

$$\bar{x} = \frac{\sum xi}{n}$$

- Note: \bar{x} : mean of validation score
 $\sum xi$: total score
 N : maximal score

Furthermore, the validation score is concluded by referring to the criteria in [Table 5](#) below.

Table 5.
Criteria of Validation

Score	Criteria	Note
$3,6 \leq P \leq 4,00$	Very valid	Can be used without any revisions
$2,6 \leq P \leq 3,50$	Valid	Can be used with minor revisions
$1,6 \leq P \leq 2,50$	Less valid	Can be used with major revisions
$1,0 \leq P \leq 1,50$	Not valid	Cannot be used

In addition, data of students' science process skills were analyzed descriptively to measure its average and standard deviation. In addition, students' answers from science process skills test were

organized in a certain table and categorized based on the criteria (Savitri et al., 2017) on the Table 6 below.

Table 6.
Criteria of Science Process Skills

Score	Criteria
86-100	Excellent
76-85	Good
60-75	Enough
55-59	Bad
<54	Very bad

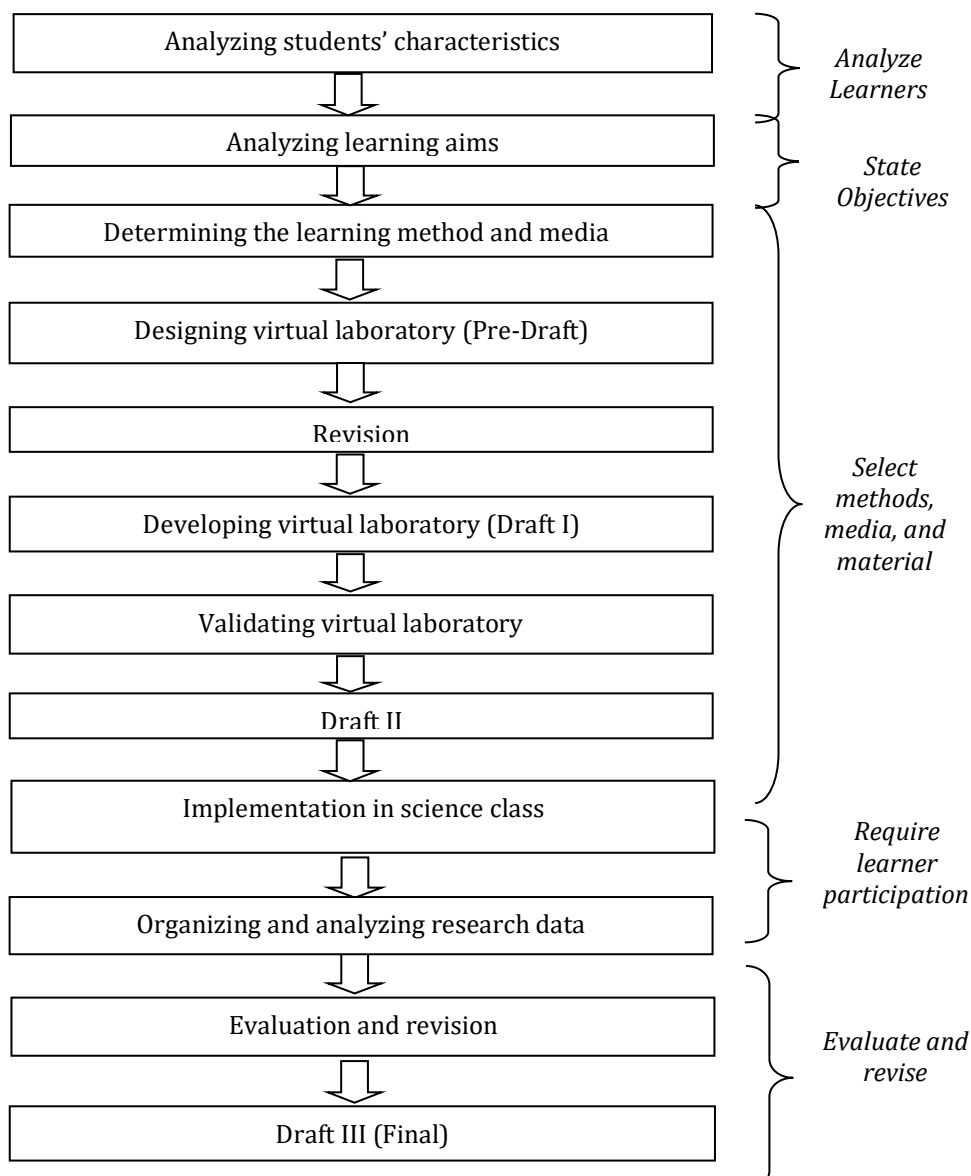


Figure 2. Research procedure

RESULTS AND DISCUSSION

By using mobile learning in a virtual laboratory in this research, students were guided to understand biodiversity concepts. Besides, students were also asked to have a virtual practice related to biodiversity through the virtual laboratory. Students could also enhance their science process skills by operating the virtual laboratory, consisting of several aspects of science process skills, i.e., predicting,

designing an investigation, observing, analyzing data, and making a conclusion. The students' science process skills can be measured and analyzed, conferring to the results of the test of science process skills that students have answered. Data on students' science process skills are represented in [Figure 3](#).

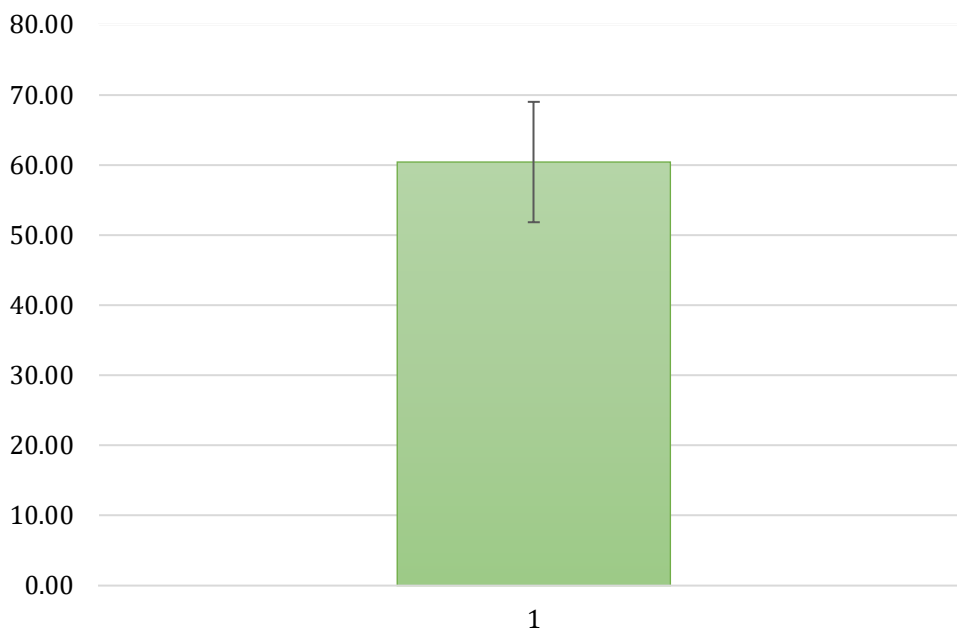


Figure 3. Score of students' science process skills

Findings in [Figure 3](#) above indicated that the average score of students' science process skill is 60.42 ± 8.59 . According to the data, it can be assumed that students reached moderate score of science process skills. Students in this research have ever conducted several experiment activities in schools, however the science process skills were not often to be taught and increased during the activities. This situation influences the students' science process skills; therefore, they reached moderate score of science process skills. Therefore, it can be supposed that the mobile learning using virtual laboratory in this research is able to engage students' science process skills. However, the score is still moderate, so it can be assumed that the science process skills must be taught continually toward student during the learning process.

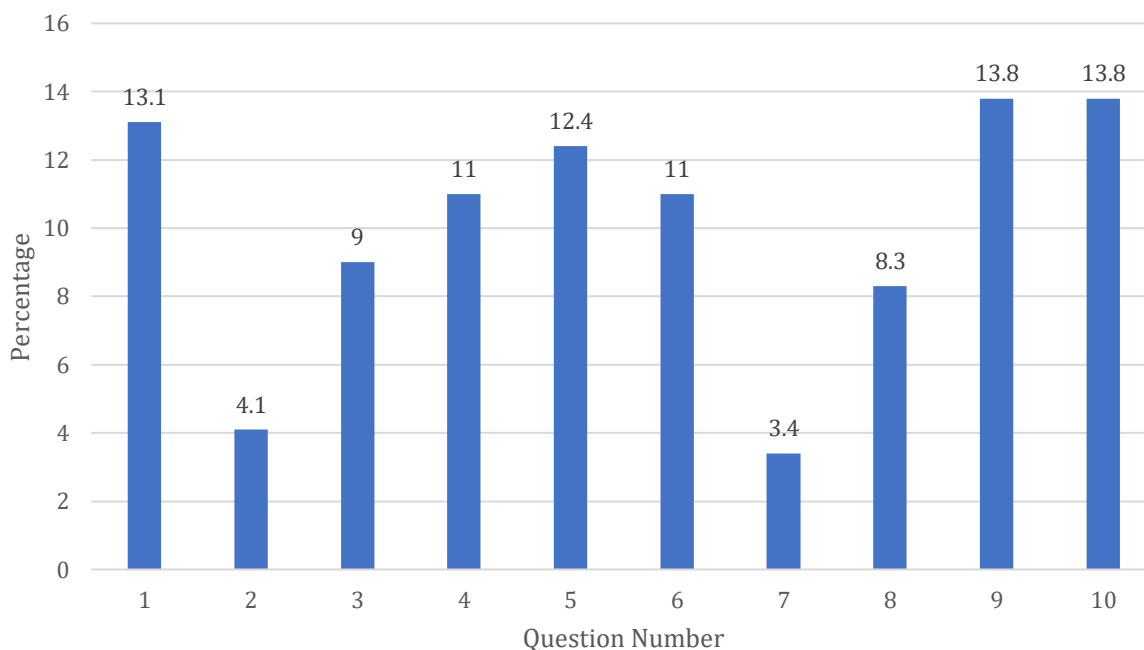


Figure 4. Percentage of Students' Answers

According to the findings related to the students' answers of the science process skills test instrument showed in Figure 4, percentage of correct students' answers in question item 1 is 13.1%; item 2 is 4.1%; item 3 is 9%; item 4 is 11%; item 5 is 12.4%; item 6 is 11%; item 7 is 3.4%; item 8 is 8.3%; item 9 is 13.8%; and item 10 is 13.8%. It is found that mostly students answered correctly in the question number 9 which asked about the indicator of analyzing data, and number 10 which asked about the indicator of making conclusion. Meanwhile, mostly students answered incorrectly in the question number 2 and 7, related to the indicator of predicting. It is assumed that mostly students could not understand and apply the skill of prediction. It is caused that students do not often learn science by having prediction. In addition, the students' answer toward the science process skills is showed in the Figure 5.

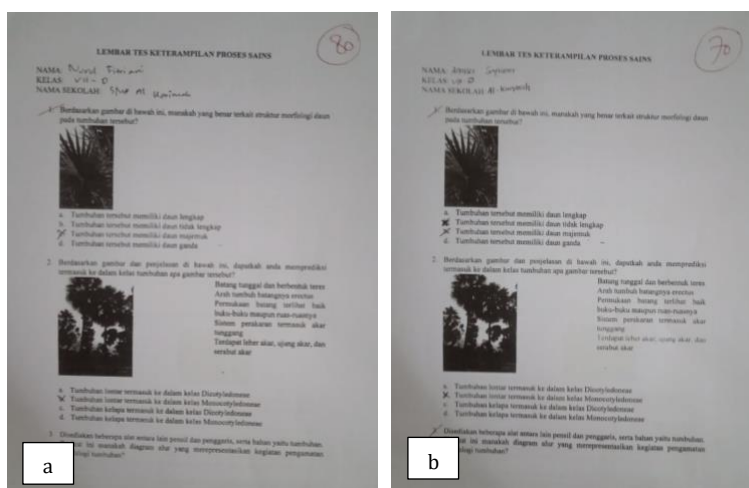


Figure 5. Students' Answers; a) Student A5 and b) Student A13

By learning science, students are able to analyze and think scientific methods by applying science process skills. Science process skills are capabilities that refer to scientific processes, i.e., observing, communicating, predicting, classifying, measuring, and concluding. During this study, students are taught biodiversity concepts through virtual laboratory in which the science process skills are provided in the virtual laboratory. Therefore, students are engaged to develop their science process skills during the science learning process. Science process skill is such transferable intellectual skill referring to a scientific inquiry (Setiawan & Sugiyanto, 2020). This skill engages students to focus on thinking and solving problems, learn science actively by themselves, and value science more meaningful. Students need to apply science process skills in order that they are able to interact in society through a scientific way, by easily observing, analyzing, asking why something in the world could happen, and then predicting how it could occur, doing investigations to find the solutions, and concluding what the best solutions are (Sari et al., 2020; Savitri, Wusqo, Ardhi, & Putra, 2017; Setiawan & Sugiyanto, 2020). In addition, the percentage of science process skills in every indicator is shown in Figure 6.

Findings in this study indicated that indicator of science process skills that reached the highest percentage is making conclusion in which it is proved that students answered correctly in this indicator. Meanwhile, the lowest percentage is reached by the indicator of predicting since mostly students' answers were incorrect in this indicator. To sum up, the learning process that has been conducted could be received well by students. As it is already stated, mobile learning is a learning environment that can ensure students to understand and build the knowledge using mobile devices. By conducting mobile learning, students can learn whenever and wherever they want, as long as the mobile device is connected to the Internet. Students are also able to repeat the activities and recall the comprehension more than once since the virtual laboratory can be installed in smartphone and operated every time and everywhere. It has been proved that the virtual laboratory was able to engage students to comprehend the concepts easier.

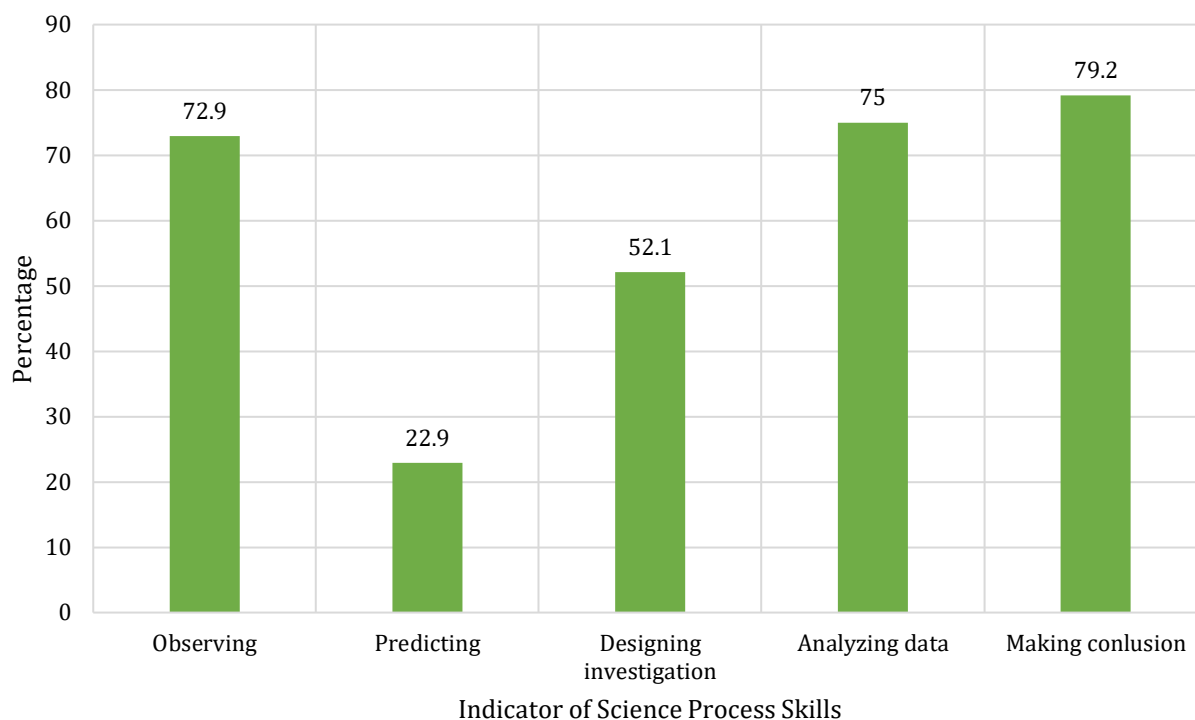


Figure 6. Percentage of Science Process Skill Indicator

Nevertheless, the science process skills reached by students were still on moderate criteria. It is suggested that students must be taught and engaged to develop their science process skills. Science process skills are capabilities that have to be developed in students since these skills refer to the processes of scientific thinking, problem-solving, and decision-making (Ekici & Erdem, 2020; Irwanto et al., 2019; Tanti et al., 2020). However, if these skills are not taught continually during learning process, these skills cannot be developed very well. It is found that students are easily to forget the explanation from teachers if the explanation are not repeated and recalled more than once. Therefore, students need to be taught continually in order that students can understand the concepts and enhance the science process skills much better than before.

As it is already stated that science process skills are the complex abilities that are used to conduct scientific investigation through the series of learning activities (Bano, Zowghi, Kearney, Schuck, & Aubusson, 2018; Ekawati et al., 2018). Students can apply scientific methods to understand, analyze, and discover science phenomena easily if the science process skills are developed well (Mulyeni et al., 2019; Rani et al., 2017). Furthermore, students have to be engaged actively during the learning process and guided to learn the science concepts. Additionally, they are also asked to improve the science process skills in order students are able to construct their knowledge and enhance their abilities in examining, identifying, and classifying concepts and principles related to science phenomenon, and assuming conclusions by conducting experiment process in which are beneficial for their future life (Anitha Kumari, Hemalatha, Subhani Ali, & Naresh, 2020; Jenö, Dettweiler, & Grytnes, 2020; Ratnasari et al., 2018).

Mobile learning was implemented in this study since mobile learning is the learning process by using mobile devices in which students are able to learn at any time and place. Mobile learning offers students a new learning environment where students can access and have a science experiment activity without being limited by place and time (Bernacki et al., 2020; Ekici & Erdem, 2020). In addition, the implementation of mobile learning leads the opportunities for student to learn by using mobile technology, and also can reduce the use of paperless learning media. Students also was able to learn science easily, participate actively, solve problems, and cooperate in a simulated learning environment. Outstandingly, it is showed that virtual laboratory ensures students to learn science in a meaningful context where learners can relate with the content more effectively in a safe environment in which this learning situation is very suitable for the current learning challenges. Moreover, the virtual laboratory

also provides three-dimension learning environments that can gain students' learning motivation. These features can change the learning focus from a passive learning environment to one of active situation. Therefore, learners were able to understand, analyze, explore, interact, and solve problems more effectively, showing that the moderate enhancement of science process skills (Crompton & Burke, 2020; Ngabekti et al., 2019).

Based on this study, it is found that by employing the virtual laboratory, students gained a deeper understanding about biodiversity, since they were able to conduct science experiments in which it is correlated as the findings of some studies. Learners acquired an experiment easily without limitations of space, time, and cost, since the software is available every time without being limited to a specific time or place. Students also showed many interests during the learning process since this learning process delivered a comfortable and enjoyable learning in which learners also can strengthen the concepts by repeatedly listing to the contents. Nevertheless, there were several weaknesses found in this study. Several students did not have mobile phone which is compatible with the application of virtual laboratory, therefore they could not learn science easily by accessing the virtual laboratory. However, this problem was solved by providing mobile phone that is compatible with the virtual laboratory.

All in all, the implementation of mobile learning using a virtual laboratory in this study is proved that can help students to carry out science experiments. As it is already explained that this learning process could be correlated to the principles of the socio-constructivist learning theory where learners could acquire active roles in a social collective learning environment by using their own mobile devices. It is also assumed that the learning process could be a solution for science learning activities. However, the learning process should be conducted continually in order that students can develop the science process skills much better than before.

CONCLUSION

This study aims at analyzing students' science process skills in the concepts of biodiversity through mobile learning using virtual laboratory. Findings in this study indicated that the average score of students' science process skill is 60.42 ± 8.59 . According to the data, it can be assumed that students reached moderate score of science process skills. Therefore, it can be supposed that the mobile learning using virtual laboratory in this research is able to engage students' science process skills. However, the score is still moderate, so it can be assumed that the science process skills must be taught continually toward student during the learning process.

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