Science process skills students on cells and tissues concept during the covid-19 pandemic: how did it achieve?

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Abstract. The purpose of this study was to measure the achievement of students' science process skills (SPS) on cells and tissues concept during pandemic. The research was conducted in January 2021 at high school in Depok City. The sampling technique used purposive random sampling. SPS tested consist of 7 aspects (observing, applying concepts, interpreting, asking, communicating, classifying, and concluding). Data collection using an essay test with 16 questions and teacher-student interviews. The instrument was validated by five expert validators and calculated with the Aiken's V formula reaches 0.74 (valid) and the reliability test value with Cronbach-Alpha reaches 0.81 (reliable). The non-parametric normality test reach 0.361 (sample is normally distributed). The non-parametric Mann-Whitney test reach 0.011 (hypothesis accepted; there is a difference in achievement between grade XI and XII). The results of the survey showed that the students' SPS were in the moderate (grade XII) and less category (grade XI). The easiest aspect of SPS in both is the questioning aspect. The aspect that gets the least category is communicating (grade XII) and classification (grade XI). This can be influenced by the level of students' understanding of the concept and scientific process, experience in observing, and doing all scientific process.

1. Introduction

The 21st century is different from the previous century in terms of the demands of work, way of living in society, and self-actualization. Technology in the 21st century is developing very rapidly so that human resources can be replaced by machines or computers due to repetitive work [1]. Humans who have expertise in solving problems, critical thinking, communication skills, creativity and innovation, and collaborating will make someone excel and have competitiveness in the world [2].

The Indonesian government in facing the challenges of the 21st century has established the 2013 curriculum to improve the skills of human resources in real life. This curriculum consists of three educational attainment competencies, namely the dimensions of attitudes, knowledge, and skills [3]. These three dimensions are interrelated in developing the skills of the nation's children. In order to competence to be achieved, according to Permendikbud No. 104 year 2014 the learning experience is carried out scientifically through observing, asking, trying, associating and communicating or connecting what is being studied.

Scientific learning with a scientific approach directs activities in the scientific process by understanding nature with the aim of searching for information, asking questions and seeking explanations [4]. The science process can be built by teachers with science practicum activities [5]. Continuous activities will become a habit, giving rise to science process skills, namely skills used to
discover and develop existing concepts [6]. The results of the analysis of Permendikbud number 37 of 2018, the core competency Skills (KI-4) has directed to be skilled in the scientific process in providing reports on the results of their scientific work with a percentage of achievement of 72% at grade X, 78% at grade XI, and 90% at grade XII.

Learning problems faced in the 21st Century are accompanied by global health problems due to the COVID-19 pandemic. In 2020, Coronavirus Disease 2019 (COVID-19) entered Indonesia. COVID-19 is a disease that attacks human respiration with symptoms of pneumonia, fever, cough, and fatigue, and even death [7]. Cases of COVID-19 quickly spread to various regions, even to more than 190 countries including Indonesia [8]. This causes all activities, especially in the education sector, to be diverted from face-to-face learning at school to distance learning which is carried out at home [9, 10].

One of the scientific concepts that study living things starts from the concept of cells and tissues. Khodor et al emphasized that the cell concept and the tissue concept are constructed into fifth main chapters to start understanding biology accompanied by observations and practical work [11]. The solution to all life's problems can be solved at the cellular level [12]. Research Science process skills regarding cells and tissues in Indonesia have been carried out in various variations. Scientific process research by analyzing practical work reports on network concepts totaling 70% of all aspects of SPS [13]. The science process skills that emerged in distance learning during a pandemic only reached 50% based on questionnaires given to students and teacher interviews [14]. Cell in plant and animal tissues concept is included in the difficult category, reaching 52% and being the 3rd largest with the most difficult material based on the questionnaire given to students [15].

Education is a planned effort that is built to create a learning process so that students can develop their potential. According to Indonesian constitution about Indonesian Education System No. 20 year 2003, national education can achieve its goals through the existence of a national education system. The learning process becomes the way that will be taken in meeting various student achievements. The pandemic condition makes the learning process change suddenly. Many new challenges are faced in the learning process, that is online learning. Online learning is another option in learning that can be implemented and in accordance with very rapid technological developments [16, 17]. Scientific learning that raises science process skills is thought to be ineffective, because practical activities that support the scientific process are not maximal. Therefore, it is necessary to measure how much SPS is owned by students who have done practicum before the pandemic with students who have never done practicum. This research is expected to find out the student's SPS achievement during the pandemic.

2. Method
The research was carried out in January 2021, the second year of the COVID-19 pandemic at SMAN Depok area. This study was conducted to examine the differences in the science process skills of cell and tissue concepts in students who have studied offline and students who have studied online. Participants were selected by purposive random sampling from the population of grade XI and XII students who had received the concept of cells and tissues. The population in this study were grade XII students of SMAN 5 Depok City and SMA Negeri 10 Depok who were registered in the 2020/2021 academic year. The samples in this study were students of SMAN 5 Depok City and SMA Negeri 10 Depok grade XI MIPA (45 respondents) and XII MIPA (36 respondents) with a total number of 81 respondents. Interviews were conducted on 12 students and 4 teachers in both schools. The selection of aspects to be studied is based on the analysis of SPS aspects contained in the practical instructions in the student book (Table 1).
Table 1. SPS aspects that appear in the practical instructions in the student book.

| No. | SPS Aspect | Book 1 [18] | Book 2 [19] | Book 3 [20] | Book 4 [21] | Book 5 [22] | Book 6 [23] | Book 7 [24] |
|-----|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 1   | Observation| √           | √           | -           | √           | -           | √           | √           |
| 2   | Interpreting| -           | -           | -           | -           | √           | √           | √           |
| 3   | Classifying| √           | -           | √           | -           | -           | -           | -           |
| 4   | Communicating| -           | -           | √           | √           | √           | √           | -           |
| 5   | Applying   | √           | √           | -           | -           | √           | √           | -           |
| 6   | Asking     | -           | √           | -           | -           | -           | -           | -           |
| 7   | Concluding | -           | -           | -           | √           | -           | -           | -           |

Table 1 shows that each book presents a different aspect of SPS. Each book raises 2-5 aspects in its practical guide. Thus, when combined, the aspects that can be observed in the concept of cells and tissues are 7 aspects, namely observing, interpreting, asking, communicating, classifying, applying concepts, and concluding. Data collection was carried out with a test containing 16 description questions and interviews. The instrument used has been validated using 5 expert validators consisting of 1 university laboratory assistant, 2 high school teachers/equivalent, and 2 Biology Tadris lecturers. The assessments of the expert validators were analyzed using Aiken's V formula [25].

\[ V = \frac{\sum s}{n (c - 1)} \]

Description:
\( s = r - Lo \)
\( Lo = \) lowest validity rating score
\( c = \) highest validity rating score
\( r = \) the score given by the assessor.

the test instrument is also reliable, it has been calculated using Cronbach-Alpha with the formula [26]:

\[ r = \left( \frac{n}{n-1} \right) \left( 1 - \frac{\sum \sigma_i^2}{\sigma_r^2} \right) \]

Description:
\( r = \) reliability
\( \sum \sigma_i^2 = \) total variance score for each question
\( \sigma_r^2 = \) total variance.

After the respondents answered the questions in the instrument, then the answers were scored and analyzed using Microsoft Office Excel. To obtain the average of each question can be calculated using the following formula: [26]

\[ NP = \frac{R}{SM} \times 100\% \]

Description:
\( NP = \) Percentage value per question
\( R = \) The score obtained by the respondent
\( SM = \) Maximum score per question.

Calculations of normality, homogeneity, and Mann-Whitney tests are also carried out in determining conclusions. Non-parametric normality, homogeneity, and Mann-Whitney test was checked by SPSS application (Table 2 and 3). The non-parametric normality test reach 0.361 (sample
is normally distributed). The non-parametric Mann-Whitney test reach 0.011 (hypothesis accepted; there is a difference in achievement between grades XI and XII).

**Table 2.** One-sample Kolmogorov-Smirnov test.

| ALL_01 | N |
|--------|---|
|        | 81|

| Normal Parameters<sup>a,b</sup> | Mean    | 24.3580 |
|--------------------------------|---------|---------|
| Std. Deviation                 | 8.51955 |

| Most Extreme Differences       | Absolute | .103 |
|--------------------------------|----------|------|
| Positive                       | .103     |
| Negative                       | -.058    |

Kolmogorov-Smirnov Z          | .923     |

Asymp. Sig. (2-tailed)        | .361     |

<sup>a</sup> Test distribution is Normal.

**Table 3.** Test statistics.

| ALL_01 |
|--------|

| Mann-Whitney U          | 541.500 |
| Wilcoxon W              | 1576.500|
| Z                      | -2.555  |

Asymp. Sig. (2-tailed)  | .011    |

<sup>a</sup> Grouping Variable: grade

3. Results and Discussion

The results obtained in this study are shown in Figure 1.

![Figure 1](image)

**Figure 1.** Science process skills achievement chart.

Based on Figure 1, the percentage that is classified as enough category for grade XII students are observing aspects (48.26%), interpretation (46.76%), asking questions (48.96%), and concluding...
(47.22%). The percentage that is classified as enough category for grade XI students are in the aspect of interpretation (35.76%) and asking questions (44.53%). Aspects that are included in the low category for grade XII students are aspects of applying concepts (30.90%), communicating (20.14%), and classifying (25.00%). Aspects included in the low category for grade XII students are aspects of applying concepts (29.86%), applying concepts (29.17%), communicating (26.56%), classifying (16.67%), and concluding (39.06 %). It can be seen that grades XI and XII are relatively low, as evidenced by SPS achievement below 50%. Although it is relatively low, the SPS grade XII achievement tends to be higher than the grade XI achievement. The percentage of achievement in each aspect of the student SPS can be seen in Table 4.

Table 4. Percentage of achievement in each student's KPS aspect.

| Score | O | XI  | XII | XI  | XII | XI  | XII | XI  | XII | XI  | XII | XI  | XII |
|-------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 4     | 1.1| 16.2| 1.4 | 3.7 | 12.0| 16.7| 22.2| 0.0 | 2.8 | 0.0 | 5.6 | 13.3| 25.0|
| 3     | 4.1| 8.3 | 6.7 | 5.6 | 5.9 | 23.1| 15.6| 4.2 | 4.4 | 8.3 | 0.0 | 8.3 | 22.2| 11.1|
| 2     | 18.9| 29.6| 15.6| 27.8| 34.8| 14.8| 21.1| 38.9| 35.6| 11.1| 15.6| 13.9| 15.6| 16.7|
| 1     | 73.0| 44.0| 68.9| 45.8| 50.4| 39.8| 34.4| 16.7| 28.9| 22.2| 40.0| 25.0| 15.6| 22.2|
| 0     | 3.0 | 1.9 | 7.8 | 19.4| 5.2 | 10.2| 12.2| 18.1| 31.1| 55.6| 44.4| 47.2| 33.3| 25.0|
| Total | 100| 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

It can be seen from the students' SPS percentage gain, the highest percentage gain is in categories 1 and 2. Score 1 is the student who answered but did not answer correctly. While score 2 is a student who answered correctly but was incomplete (only 50% of the answers were correct). This indicates that students have not often applied scientific activities so that it affects their SPS achievement. Learning with a scientific approach is also not optimal because it is seen that the percentage of each aspect of SPS is still low at both levels.

3.1. Observing Skills

Figure 2 shows the achievement of observing skills in grades XI and XII.

![Figure 2. Observing skills percentage chart.](image)

Students can mention the characteristics of a given object image. The questions given in the observing aspect are observing pictures of objects, then students mention the characteristics and names of preparations that match these characteristics. Picture 1 is an image of a bacterial culture object, picture 2 is an image of a *Paramecium* sp. culture object, picture 3 is an image of a leaf object on a *Rhoeo discolor* plant, picture 4 is an image of a smooth muscle tissue object, picture 5 is an image of a tissue object on mammalian skin, and picture 7 is an image of a tissue object on the stem of a dicot plant.
Aspects of observing skills obtained an average percentage of 48.26% in grade XII and 29.86% in grade XI. Grade XII is in the sufficient category, while grade XI is in the less category. Obtaining a sufficient category is similar to the research of Rabacal [27], which obtained an observation result of 2.45 on a scale of 1-5. This indicates that students have been able to make observations to find characteristics and know the given object.

Grade XII students classified as enough category on 5 questions and good category on 1 question. The question that is most mastered by students is question number 2 with a percentage gain of 62.50%. Students have been able to mention the characteristics that appear in the picture, such as shape and size, as well as the name of the object image. Other object images, namely number 1 (43.75%), 3 (40.28%), 4 (59.72%), and 7 (45.14%) are included in the enough category. Students have been able to mention the characteristics that appear and mention the name of the image of the object. That is, they have been able to perform the process of observing skills.

Grade XI students are still in the low category in observing skills. The six questions in the observing aspect obtained a percentage of less than 35.00%. Of the six questions, the most that can be answered by grade XI students is question number 3. Other questions in grade XI also get a less category, namely on question number 1 (29.17%), 2 (28.13%), 4 (33.85%), and 7 (30.21%). Only a small number of students can mention the characteristics and names of objects according to the instructions for the questions. This is because students are not accustomed to observing activities in learning. According to Wahyuni et al [28], observation should be a pretty good achievement because this aspect only requires rational and logical thinking from students.

The most difficult question is question number 5 at both levels (grades XI and XII). This question gets a percentage of 38.19% for grade XII students and 22.92% for grade XI students. This indicates that students have not been able to fully observe the object image displayed. Many of the object names mentioned are incorrect. This incorrect answer is the result of students not being careful in observing the characteristics in the picture so that they mention the incorrect answer.

3.2. Concept Applying Skills

Figure 3 shows the achievement of skills in applying concepts in grades XI and XII.

![Figure 3. Applying concepts skills percentage chart.](image)

The aspect of applying the concept gets a percentage of 30.90% for grade XII students and 29.17% for grade XI students. Both of them get the less category. Questions on this aspect are that students can mention the part of the tissue in the organs of living things (plants or animals) that are designated in the problem and mention their functions according to the insight of students when they get learning. The questions given consist of 2 questions, that is, intestinal organs in animals (question number 6) and leaf organs in dicotyledonous plants (question number 8).

Students in grades XII and XI are both more able to answer question number 8. This is evidenced by the students in grade XII obtaining a percentage of 38.19% (enough category), while those in grade XI get 33.33% (less category). Both (grades XII and XI) differ only by 5% which indicates this aspect
is still considered difficult by students. Grade XII and XI students also scored low on question number 6, that is 23.61% in grade XII and 25.00% in grade XI (less category). Students have not been able to answer the questions according with the question instructions. Students still have difficulty in applying biological concepts, which can be seen from their answers that do not mention the name and function of the designated tissue. They do not know the location of the tissue even though they know the name and function, so that there is an inaccuracy between the tissue, name and tissue function. According to Khairunnisa et al [29], the thing that makes this achievement not too high is the lack of understanding so that it is still difficult to apply the concept. Not understanding the concept makes students unable to apply it in real life.

3.3. Interpreting Skills
Figure 4 shows the achievement of interpretation skills in grades XI and XII.

![Figure 4. Interpretation skill percentage chart.](image)

The next aspect of science process skills is interpreting skills. Interpreting in the aspect of science process skills is to find the correlations between tissues and organs of living things. This aspect is found in numbers 9, 10, and 11. Question number 9 shows pictures of smooth muscle objects and pictures of small intestine objects. Question number 10 shows pictures of skin and intestinal organs. Question number 11 shows pictures of stem and leaf organs in dicot plants. The interpretation aspect obtained an average of 46.76% in grade XII, while in grade XI it was 35.76%. Both of them get enough category.

Question number 9 obtained a percentage of 48.61% in grade XII, while in grade XI it gets 41.15%. Both classified at enough category. This question gets the highest percentage of students in grade XI. Question number 10 obtained a percentage of 40.28% in grade XII and 31.77% in grade XI. Grade XII is in enough category and grade XI is in the less category. This question is the most difficult questions in interpreting aspect at both levels. Question number 11 obtained a percentage of 51.39% in grade XII and 34.38% in grade XI. Grade XII is in enough category and grade XI is in the less category. Question number 11, which is the picture of the object of dicot stems and leaves, is the question that has the highest achievement in grade XII in the aspect of interpreting.

In general, students have been able to mention the correlation between the two objects. However, there are some students who cannot connect one object with another object. This aspect is very dependent on how students can observe, identify, and then relate the results of observations that have been obtained. Not maximal observing skills in students, can cause they cannot find the correlation of two objects, because every aspect is interrelated to construct process skills.

3.4. Asking Skills
Figure 5 shows the achievement of questioning skills in grades XI and XII.
The next aspect of science process skills is the asking. This aspect expects students to be able to make a question related to the concept. The concept used in this research is cells and tissues. Thus, students are instructed to make questions related to the concept of cells and tissues. Students are required to make 4 questions from cell and tissue objects that have been observed in the previous question. This aspect consists of 2 questions on numbers 12 and 13. Grade XII students get a percentage of 48.96\% and grade XI students get a percentage of 44.53\%. Students have been able to make questions about the concept of cells and tissues. However, not all questions can be categorized as questions that explore curiosity. Questions made should arise due to curiosity in students, not just asking. Students have not fully raised their curiosity properly.

3.5. Communicating Skills

Figure 6 shows the achievement of communication skills in grades XI and XII.

The communicating aspect that wants to be seen is how do students explain the characteristics that have been mentioned previously in tabular form. The communicating aspect consists of one question (Q14) that includes eight objects. The communication aspect gets a percentage of 20.14\% in grade XII and 26.56\% in grade XI. Both are classified in the low category. This aspect is the lowest achievement tested in grade XII. This can be seen from the answers of students who have not been able to communicate what they have got. many students are not able to re-explain in tabular form. Communication here is not only conveying directly, but can be made in other forms such as graphs or tables to be easily understood by other people. Communication is very necessary in conveying scientific findings so that the interlocutor understands what is being conveyed [29].

3.6. Classifying Skills

Figure 7 shows the achievement of classifying skills in grades XI and XII.
Classification skills that are expected from students are able to categorize groups based on similarities and differences in characteristics. This question instructs students to group objects into 3 major categories of 8 objects given based on visible characteristics, namely microbes, animals, and plants. This grouping is based on the size, shape, and structure of cells contained in the object. This aspect received a low category at both grades, XII and XI. This can be seen in the percentage gain, that is 25.00% and 16.67% in grades XII and XI. Students have not been able to classify some objects from living things. A small number of students are able to group objects correctly. However, some others get a low category in doing the classification correctly. This low gain is similar to the study of Ilma et al [30], where the study obtained a low percentage of 33.07%. This small gain can occur because many students incorrectly observe the objects displayed, so that it has an impact on the characteristics mentioned and continues on students who cannot group correctly.

3.7. Concluding Skills

Figure 8 shows the achievement of concluding skills in grade XI and XII.

Concluding skills is that it can make a generalization from the results of scientific activities that have been carried out. The scientific activity referred to in this research is the observation of the 8 objects. This aspect gets a percentage of 47.22% in grade XII and 39.06% in grade XI. The category in grade XII is enough and in grade XI is less category. The results obtained are different from those in Novitasari and Aminatun's research [31], where the study obtained a high category with a percentage of 66.5%. Students must be skilled and more accustomed to making conclusions from something that happened, so that students can interpret and things they experience by knowing the essence of a problem.
3.8. Interview

Interviews were conducted after filling out the essay test. Interview questions are asking whether or not students have seen the 8 objects displayed. Students do not know all the objects displayed in the questions. Many of them said that the practicum carried out was not on all the object images shown in the question, only a few such as plant tissue.

The learning situation before and after the COVID-19 pandemic became the next question. Both grades XII and Grade XI agree that the preferred learning is face-to-face learning rather than distance learning such as during a pandemic situation. Many concepts were not conveyed and various laboratory activities could not be carried out optimally because of the limited tools and materials available at home. There are many other obstacles, such as unstable connection for e-learning, only a few practicums being carried out, and also difficulties in group discussions.

This year's changing learning system due to the entry of the COVID-19 pandemic is also another factor that causes science process skills to become lower. Students who are currently in class XII, do not fully receive optimal learning when they are in grade XI (previous academic year) and students in grade XI also receive full online learning. The normal learning system has not high achievement, it will be even worse in the online learning system during the COVID-19 pandemic.

Learning and practicum guides are needed by students to be a guide in carrying out a series of learning activities. According to teacher interviews, learning and practicum guides were given to students. However, there are some learning activities that are not given guidance, but are only guided directly on the work steps at meeting’s room.

Teachers are also faced with obstacles that arise due to changes in learning from face-to-face to online. Previously, teachers were more flexible in conveying concepts, directing practicums and directly monitoring activities carried out by students while studying. Meanwhile, when learning online, the teacher only uses virtual videos. Not all of the students were able to activate the camera during a meeting due to constraints. Regulations in online learning have been made, one of which is by requiring the camera to be turned on while studying. However, not all students comply with these rules. Providing information also becomes difficult so that teachers contact students only through text messages.

Practicum is very important and related to skills, where skills are mandatory in the 2013 curriculum. But the implementation is adjusted again with the ability and availability. If you can't, you can transfer them to other skills, such as making posters. However, when learning online, for cell and tissue concepts that do not do practical work, don't just give powerpoints, summaries, and simple pictures. SPS can be further honed with various scientific activities and apply a scientific approach in order to be able to map problems and be able to solve them well.

Practicum is very important and related to skills, where skills are mandatory in the 2013 curriculum. However, its implementation is adjusted again with abilities and availability. This can be transferred to other activities, such as making posters. However, when studying online, for cell and network concepts that don't do practical work, don't just provide powerpoints, summaries, and simple pictures. SPS can be further honed with various scientific activities and apply a scientific approach in order to be able to map problems and be able to solve them well. Other methods can involve learning through animation with explanations of scientific concepts, quizzes, activities, virtual experiments that can increase the capacity of science process skills through a screen [32].

From the interviews and the results obtained, it can be said that the practicum carried out has not been able to reveal the existence of students' scientific process skills. In fact, these process skills are very important for the learner's experience. These skills can be further improved by using learning that applies process skills in every lesson, especially science. So that the learning carried out can be more meaningful and can even be applied in everyday life. Students' science process skills are also closely related to learning methods and teacher direction as facilitators. Learning Biology that using a scientific approach will have an effect on students' science process skills [33]. If the scientific approach is implemented, then scientific skills will also be achieved. However, if the scientific approach is not implemented properly, the achievement of students' science skills will be low.
4. Conclusion
The results of the science process skills of high school students are categorized as enough (42.62%) in grade XII and less (34.41%) in grade XI. The aspect of science process skills that is highest achievement in grade XII and XI is the questioning aspect (48.96% and 44.53%). The aspect that received the low category in grade XII students was the communication aspect (20.14%), while in grade XI was the classification (16.67%). Thus, the results of this study can be used as an evaluation that students are not familiar with and understand deeply the process skills in learning biology using practical methods and scientific learning. If the teacher has facilitated students to carry out scientific activities in learning, then the student science process skills will be high, so that students have various 21st century skills. Pandemic conditions are indeed not normal conditions, but as much as possible learning does not reduce activities that can develop students' skills. This research can be used as data that students' achievement at this time is still low and must be handled further.

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