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Promoting Students' Science Process Skills Through Predict Discuss Explain Observe Discuss Explain Implementation

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Abstract

The ideal science classroom prepares students to enhance not only mastery knowledge but also skills. Certain skills can be developed during the process of learning science. One of the skills that expected to be possessed is Science Process Skills (SPS). SPS can be gain by applying Predict-Discuss-Explain-Observe-Discuss-Explain (PDEODE). Therefore, the intent of this study was analyzing students' science process skills after the implementation of PDEODE. Measurements of SPS were obtained by collecting data from three domains of learning. SPS of students ranges from good to excellent level. About 18,29% students got excellent marks of SPS while most of them (81,71%) successfully reached good level. To put in a nutshell, PDEODE learning assisted students to attain all indicators of SPS.

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INTRODUCTION

Learning science is not only about mentioning concepts, facts, and principles of nature and scientific formula (conceptual and factual) but also mastering them along with skills integrated during the process of learning (procedural). Procedural knowledge cannot be separated from the process of science learning especially when students do experiment to construct new knowledge. To be able to synthesize new concept and solve problems, students need to propose experiment procedure while the skills underlying it is Science Process Skills (SPS). Through the process, students are expected to acquire SPS which is divided to basic and integrated SPS (Artun et.al., 2020; Ekici & Erdem, 2020). Nworgu & Otum (2013) mentioned basic process skills consists of observing, grouping, measuring, inferring, predicting, and communicating while integrated SPS is combination from two or more basic skills so students must proficient the basic one before they reach integrated SPS. Turiman (2012) argue that It has an interserction with 21st century skills since it helps students to gain SPS through science learning with using the latest educational application features such as virtual experiment, blog, online discussion, and online quizzes.

The importance of SPS has been discussed for over 23 years yet the actual condition especially in Indonesia reported that many students are still lacking in mastering SPS. Preliminary research from Safitri et al., (2022), Uliya & Muchlis (2022); and Fajrina et al., (2020) reported that in general, students SPS did not be measured yet or lab activity were organized seldom so that they did not possess complete skills of SPS. The similar fact was found at SMP Negeri 2 Guntur. Students could not even carry out basic SPS. There was only 15 % of them achieved communicating, concluding, predicting, measuring and classifying. Meanwhile, observing skill was shown by approximately 25% of students. Thus, most of students lack of basic SPS and considered lack of all integrated SPS.

One of promising model that support students gain SPS is PDEODE (Halimah et al., 2019). It guides students to carry out learning activities by recognizing or observing their learning environment directly. In contrast to the previous learning model, which used more adheres to the learning material delivered conceptually without involving the delivery of contextual material such as providing examples and or applications that can be applied to everyday life that occurs in the environment around students. Costu et.al., (2016) equally stated that PDEODE facilitates contextual changes to students' prior knowledge. Contextual changes that occur is a change in the concept or initial prediction held by students with new knowledge that is proven true through experiment or demonstration.

The PDEODE model consists of six stages, namely the predict stage, discuss I stage, explain I stage, observe stage, discuss II stage, and explain II stage (Samsuddin et al., 2015). First stage is *Prediction*. This stage requires students to create prediction of certain issue or phenomena individually. Next is *Discussion* stage that direct students to share their prediction to their friends within group. At the third step, *Explain*, they should explain the possible concept underlying the issue according to their group discussion. Furthermore, students are required to work in group doing scientific experiment to test their previous prediction and explanation. At this step, students should make a careful *Observation* while doing the experiment. After collecting the experiment data, they do a group *Discussion* to analyze and discuss the experiment result. Later, they need to communicate their *Explanation* according to their discussion (Demircioglu, 2017). PDEODE model offers steps such as discussing and communicating which are carried out during two stages which are the advantages of the PDEODE model stage to assist students in reaffirming things that were not believed before, and equipped with prediction stages and observation stages which means students can make initial predictions after doing experiment to answer their initial predictions.

This research focuse on how the implementation of PDEODE affect students' SPS from cognitive, affective, and psychomotoric skills.

METHOD

This research was conducted at SMP Negeri 2 Guntur which is located at Jalan Tlogorejo, Guntur District, Demak Regency, Central Java in odd and even semesters of the 2021/2022 academic year. The subjects of this study were students of grade 8 as many as 48 students.

Research instrument to measure SPS were SPS test and SPS observation sheet. Analysis of students' SPS were conducted by using formula (1).

(score obtained)/(maximum score) x 4..... (1)

Scores taken then classified into 4 criteria of SPS according to Table 1. SPS measurement

include affective, cognitive, and psychomotor assessments. Final score and criteria determination gotten by calculating average score of those three measurements.

Table 1. Criteria of Science Process Skills

Score	Criteria
3,33 < score ≤ 4,00	Very Good
2,33 < score ≤ 3,33	Good
1,33 < score ≤ 2,33	Slightly good
Score ≤ 1,33	Not good

RESULT AND DISCUSSION

SPS Profile from Affective Assessment

The profile of students' SPS on affective assessment is measured through a peer assessment test. In this affective assessment, students have the achievement of science process skills in the aspects of observing, predicting, classifying, measuring, communicating, and concluding which are described in 12 statements. The result of each SPS's indicators can be seen in Figure 1.

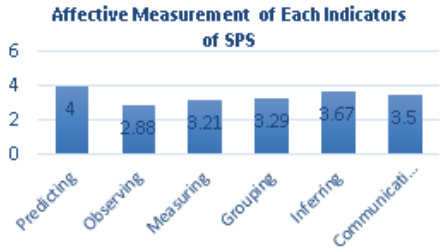

Figure 1. Result of affective measurement of SPS

First aspect of SPS is observing skill. Most of students stated that they observe lab apparatus before starting experiment and make sure the tools are clean. Nevertheless, students did not maintain the tidiness and cleanliness of those tools before, during, and after lab activities. Liestiyanti (2022) argue that the achievement of science process skills in observing aspects is said to be successful if students can observe everything that happens during pre-practicum, practicum, and post-practice.

Next SPS skill is predicting. Predicting skills gets the highest score among others because students can precisely make prediction of lab equipment that are not suitable for use and used tools that can still be operated. This is in accordance with Rahayu & Efendi (2021) explained that predicting is defined as all student behaviour both from thoughts and actions which are the result of observing and gaining information from any resources.

In Grouping skill, students found carelessly threw away reused tools such as stirrer, straw, and mineral bottle. While the expectation of grouping or classifying is all activities are in the form of comparing differences and similarities, so that later you can record and contrast each classification of observations separately (Ariska & Wulandari, 2021).

During lab activity, the vast majority of students lack to communicate practical steps or procedures. Students were unconfident to report their data analysis. By contrast, students should possess writing and verbal communication by representing the results of writing into the form of action and or providing an overview of empirical data from research results, so that it can explain the results of the experiment (Muna, 2017).

Inferring is defined as formulating hypothetical results from the experiment, meaning that students can take the essence of the activities carried out, so that the core can be applied when making data inference of the experiment and post-experiment (Hamadi *et al.,* 2018). Students were able to define aims of experiment and related it with the underlying concept. However, students could not conclude the tools and practicum waste materials that must be disposed or kept.

Of all SPS, students' measuring skill generally get the lowest achievement because students experience errors when measuring materials. They got material too much than the actual needed. Students utilized it without carefully read the instruction. Whereas students should consider and carefully measure all materials according to the needs in every lab activity (Hamadi et al., 2018).

SPS Profile from Cognitive Assessment

The profile of students' SPS based on cognitive assessment comprise all basic process skills is measured through multiple choice test sheets. Figure 2 indicates the measurement of each indicator of SPS from cognitive aspect.

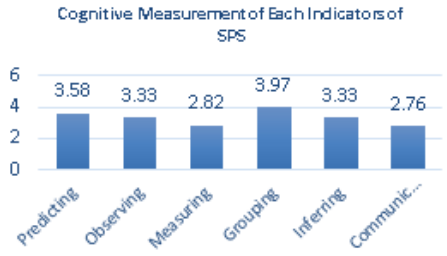

Figure 2. Result of cognitive measurement of SPS

Observing skill was tested by giving stu-

dents the opportunity to identify the Figure, tables, and statements available in the questions. Students generally show proficiency in this ability because they are used to making multiple representations of data in experimental activities. This is in line with Fitriyani et al., (2017) finding that observing is defined as a process of data collection about phenomena or events by using the senses and or represented in the form of pictures, tables, and facts that can be more clearly illustrated.

Widyaningsih & Yusuf (2016) stated that grouping is a systematic method used to classify things based on similarities. This grouping skill requires students to classify the types of additives and addictive substances based on their classification, for example students classify additives into dyes, sweeteners, and preservatives and classify addictive substances into narcotics and psychotropics. The problem contains several statement numbers that encourage students to classify the right types of additives and addictive substances. Other questions are presented in the form of tables containing random statements, and students are asked to group the correct statements.

Next, predictability was expressed as systematic and probable conjectures or estimates of several events based on the results of observations and information search (Yolanda, 2019; Rahmatillah et.al., 2017). The ability to predict is trained with questions that present a table of the types of additives along with their examples and benefits, then students were asked to predict statements that match the contents of the table. Another form of question is a case study, for example questions presents the statement of someone who suffers diabetic so they need to consume artificial sweeteners. Then students are asked to predict chemical compound contained in artificial sweeteners.

Others skill in SPS is measuring. Guritno et al., (2015) explained that measuring is comparing data so that the data is obtained will be clear and simple. Measurement is essential to fostering quantitative observation, compare everything around, and communicate appropriately and effectively to others (Diella & Ardiansyah, 2019). For instance, students are asked to compare the results of observations with relevant theories and concepts. Moreover, when presented with the story of a family living in a rural area who consume salt eggs, students must calculate the ratio of salt added to eggs and its immersion time.

Formulating conclusion is a skill to decide the situation and describe the important points of an object or event based on facts, concepts, and principles available (Hendrawati, 2015; Hamadi et al., 2018). For example, according to short story, students were asked to conclude the proper way of preserving fish or determine what additives in some traditional food.

In cognitive assessment, communication skill reached the lowest score among others. In general, students faced difficulties to represent experiment steps in the form of long text into answers in the form of short text. On the other hand, students are expected to transferring information in the form of tables, pictures, and Figures into story form or vice versa and represent practicum activities or presentation of story questions in the form of short statements or answers according to their opinion (Prasojo, 2016).

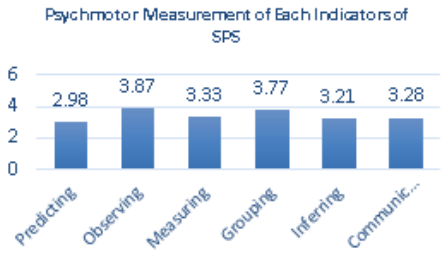

Figure 3. SPS measurement result from psychomotor domain

SPS Profile from Psychomotor Assessment

Students SPS on psychomotor assessment were measured using observation sheet and its rubric. Every student's basic SPS was observed during their laboratory activities. Figure 3 shows the result of SPS measurement from psychomotor aspect.

Lepiyanto (2017) mentions that the aspect of observing of science process skills is defined as use of one's senses through sight, hearing, tasting, touching, and smelling. It was clear that during lab activit, students were able to distinguish the colour changes that occur on sausages, tofu, and dumplings by using indicators of turmeric and dragon fruit skin to identify formaldehyde presence. Students utilized their senses could mention additives from commercial snacks, and observe the pictures of addictive substances, psychotropic, and narcotics as well.

Next, grouping is classifying objects according to similarities, differences and certain characteristics resulting from observations (Rahayu & Anggraeni, 2017; Janah et al., 2018). Students did not face difficulties in this section to classify tools and material that required to conduct experiment of additives test and addictives test. Therefore, most of them reached mastery of grouping skill.

Students' measuring skills will appear on

the accuracy of observations and the measurement of materials used to carry out experiment (Fadillah, 2017). In general, students were quite good in measuring the amount of materials and determined tools that are sufficient to do practical work. However, some students have not been able to estimate the amount of tools and/or materials used so that less waste produced.

The last SPS is making a logic and brief conclusion. Even though students could summarizing the results of the experiment and the results of the discussion well, they still found it difficult in interpret the results of the experiment, converted oral discussion into brief sentences, and wrote an outline or conclusion of the results of the experiment appropriately. Meanwhile Gasila et al., (2019) explained that concluding is defined as summarizing all the main contents of the chapter into a brief conclusion based on the results of the discussion.

Table 2. Students' average score of each SPS

SPS	Average score	Category
Observing	3,34	Very Good
Predicting	3,32	Good
Grouping	3,17	Good
Measuring	3,01	Good
Inferring	2,70	Good
Communicating	2,72	Good

Overall SPS profile

Data of overall SPS profile of students were then collected from cognitive, affective and psychomotor aspect. The final SPS score were obtained from the average of scores from those aspects. The mastery of each skill of SPS can be seen on Table 1. Students were fascinating at observing tool, materials, and experimental result using their senses. While they reached satisfactory result in five other skills.

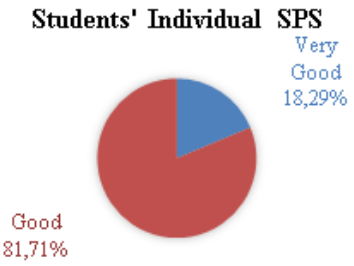

Figure 4. Recap of students' individual SPS

Mapping of individual's SPS can be refer to Figure 4. The majority of students reached good category and only fifth of them acquired perfect scores.

CONCLUSION

Measurement of students basic SPS has been done. For every SPS, students' observing skills were excellent while other skills could be improved to reach the perfect category. The minority of them were successfully got superb level while others grasped good mastery of basic SPS.

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