Study of Science Process Skills Student Using Worksheet based on Science Process Skills

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Abstract: The science process is related to cognitive development because it needs to be applied in the skills learning process to support students' mastery of science concepts which can provide better learning outcomes. The focus of this research is to develop a worksheet based on science process skills on biology content for the first grade of high school. Research design is research and development which consists of defining, designing, and developing. The participants for this preliminary field testing were twelve second-grade high school students at I.T Dhia'ul Fikri Sukarara, East Lombok. Collecting data using worksheets refers to science process skills indicators consisting of observation, classification, prediction, communication, and inference. The results of preliminary field testing were analyzed descriptively quantitatively by giving a score of 3, 2, and 1 for each of science process skills indicators, then percentage based on the low, medium, and high categories. The results of the analysis showed that of the seven-biology content tested in the limited trial of developing worksheets, the results obtained were for the low category the highest percentage of content in the biogeochemical cycle for all science process skills indicators. The medium category has the highest percentage of inference indicators for environmental balance, environmental change, environmental pollution, and environmental management. High category on environmental balance content; the highest percentage with indicators of observation, classification, prediction, and communication., environmental changes on indicators of observation, classification, prediction, and communication, pollution indicators of observation, prediction, and communication. The conclusion based on the results of this preliminary field testing is that students are able to demonstrate science process skills using worksheets with various categories, and from the seven-biology content tested, the biogeochemical cycle is considered the most difficult by students.

Keywords: Worksheets; Science process skills; Biogeochemical cycle; Environment change; Environmental balance

Introduction

Natural science is one of the subjects that students need to learn to assist in the formation of a young generation that is intelligent, competitive, and skilled (Mat, 2019). Science as a process plays a role in acquiring and developing knowledge. Learners must have the ability to do things using scientifically controlled processes and principles, learning to know and learning to do must be achieved in teaching and learning activities (UNESCO, 2012). This is also in accordance with the implementation of the 2013 curriculum that applies in schools, the learning process emphasizes the application of a scientific approach (scientific approach) which includes observing, asking, trying, processing, presenting, concluding, and creating on several subjects. Because the 2013 curriculum wants students to be able to learn independently in order to be scientifically literate and gain a more meaningful learning experience

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so that they can develop three domains, namely attitudes, skills,

Science can practice these three domains because the purpose of studying science is to teach students to be scientific, master various skills, add, expand, and develop scientific concepts. In developing these three domains, of course, strategies are needed in the learning process by asking scientifically oriented questions. Lee & Shea (2016) stated that in addition to asking scientific questions, students can also respond to questions, formulate explanations, link explanations with scientific knowledge, and communicate them. Duran & Dokme (2016); Juhji & Nuangchalerm (2020) stated that because learning is essentially a process of developing new knowledge, skills, and behaviors in a person as a result of his interaction with various information and the environment, the teacher must be able to convey material well, assist students in exploring scientific phenomena, facilitate scientific discussion, construct cognitive structures, develop skills and assist in improving problem-solving skills.

Biology as one of the subjects at the secondary school level seeks to equip students with various abilities to understand concepts or facts in depth. Because the purpose of learning biology is to familiarize students with higher-order thinking, starting from finding solutions to the problems they face, critical thinking, and creative thinking, which in turn have innovative skills to support their lives. One way to achieve these learning objectives is to use teaching materials, namely student worksheets. However, the problem that is often found in some schools is the use of student worksheets in the learning process, especially for schools that are outside urban areas, teachers sometimes do not make. The results of the observation of the study of literature, namely analyzing the teaching materials (worksheets) used by the teacher, on the components discussion material, the questions asked in the worksheets still measure low-level knowledge, for example, state, and or explain, where the answers to be presented are already in the worksheet. Rarely in the worksheets do students measure scientific-based skills such as science process skills, critical thinking skills, and creative thinking. Therefore, teaching techniques are needed using teaching materials in the form of worksheets that can train DNA or measure students' scientific skills, one of which is science process skills. Yamtinah et al. (2016) argue that informal education, teachers play an important role in the development of science process skills as a provision to apply the scientific method. Because it can support students to become scientifically literate citizens, therefore educators should emphasize teaching strategies in the classroom (Hebert & Cotner, 2019).

Student worksheets based on science process skills are a summary of the material, and write questions that can practice basic science process skills, with indicators of basic science process skills, with indicators of skills of observation, classifying, communicating, predicting, inference, and measurement. The student worksheets can be done individually or in groups and their implementation in the classroom and or outside the classroom (direct observation in the field). Gultepe (2016); Zulyadaini (2017) argues that Science process skills are tools that students use to investigate the world around them independently to study material and build science concepts. Science process skills are one of the constructivist lessons that can be used in biology learning, but of course, not all materials are suitable for use in their implementation. Science process skills can train students thinking skills when carrying out scientific activities, aiming to construct their knowledge. Achor et al. (2018) argue that some other methods do not allow students to acquire observation, classification, and communication skills. Therefore, the use of student worksheets in learning can be an alternative for teachers to direct learning or introduce a particular activity. The involvement of students with the real environment through learning is expected to make it easier to understand the subject matter as well as to be able to develop students' scientific literacy. From the activity of developing student worksheets based on science process skills, students are expected to develop skills in observing, classifying, predicting, measuring, communicating, and inferring. This study tries to develop student worksheets based on science process skills. As for the research question, are students able to demonstrate science process skills by using student worksheets based on science process skills on biology material?

Method

The focus of this research is to determine students' science process skills through the development of student worksheets on biology material. The research design used is development research which refers to Gall et al. (2003) consisting of defining, designing, developing, and disseminating. New development research is up to trial phase 1/limited trial. Participants for this student worksheet based on science process skills, totaling 12 students in class XI SMA IT Dhia'ul Fikri Sukarara, East Lombok. Data collection using student worksheets with material coverage, namely (1) interactions between components, (2) energy flow, (3) biogeochemical cycles, (4) environmental balance, (5) environmental changes, (6) environmental pollution, and (7) environmental management.

Data collection using student worksheets developed with include questions containing indicator science process skills namely observation, classification, prediction, measurement, communication, and

inference. The results of students' answers by answering the science process skill-based worksheets were corrected by giving scores of 3.2, and 1. Data analysis was carried out descriptively (Sugiyono, 2019), the scores obtained by students were then grouped into low, medium, and high categories based on the formula proposed by Ridwan (2010), the acquisition of these categories is a percentage (see table 1). As in Susanti et al. (2018) research looked at the profile of the science process skills of their students by categorizing the results of low, medium, and high abilities on the indicators of science process skills.

$$Interval = \frac{Range}{Category} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

Information:
Range= highest score – the lowest score
Category= number of categories
(Ridwan, 2010)

Table 1. Categorization of students' science process skills

Value interval	Category
100 – 68	Tall
67 – 35	Currently
34 – 0	Low

Result and Discussion

Observing, measuring, classifying, predicting, communicating, and inference are indicators of basic science process skills in general. However, from the results of developing this student worksheet, the indicators that emerge are observation, classification, prediction, communication, and inference. It is hoped that with the development of this student worksheet, students will be more active and bring up indicators of science process skills. As stated by Syukri et al. (2021) that with the development of learning tools based on science process skills, students can be more active, and interested in understanding concepts in learning activities.

The following are the results of the development of trial 1/limited trial of student worksheets based on science process skills for each biological material. Of the seven materials tested, the biogeochemical cycle material obtained the highest percentage results in the low category, namely 100% on the classification indicator. The results of the research by Mutmainnah et al. (2019) also found that classification skills were in the very low category. Next, the inference indicators are 90.00%, observation, prediction, and communication are 83.30% each. Followed by the material flow of energy, prediction indicators, communication, and inference each 75.00% (see Figure 1). Meanwhile, for the medium category, the highest percentage of inference indicators for environmental balance materials (92.00%),

environmental changes (92.00%), environmental pollution (83.30%), and environmental stewardship (75.00%) (See Figure 2). Next is the high category on environmental balance material on indicators of observation (91.60%), classification (91.60%), prediction (91.60%), and communication (91.60%). Next, the material for environmental change is on the indicators of observation (75.00%), classification (66.70%), prediction (66.70%), and communication (75.00%). Then the environmental pollution indicators are observations (75.00%), predictions (75.00%), and communication (75.00%) (See Figure 3). From the results of interviews that students have seen and or heard from the news on television, and social media about balance, change, pollution, and environmental management. For each category in the low, medium, and high categories.

There are several indicators of science process skills with a percentage of 0%. This is because students do not answer the questions in the student worksheets. Based on the results of interviews with teachers and students, several things caused this, including the biogeochemical cycle material which is difficult for students to understand while studying material, students have never seen the pictures displayed on student worksheets because of the lack of teaching materials at school, and if given a worksheet to discuss students usually just follow the instructions. As stated by Solihah et al. (2016) in making observations, students do it according to what is on the student worksheet and the results are recorded according to the observation table prepared in the student worksheet without looking at the sources.

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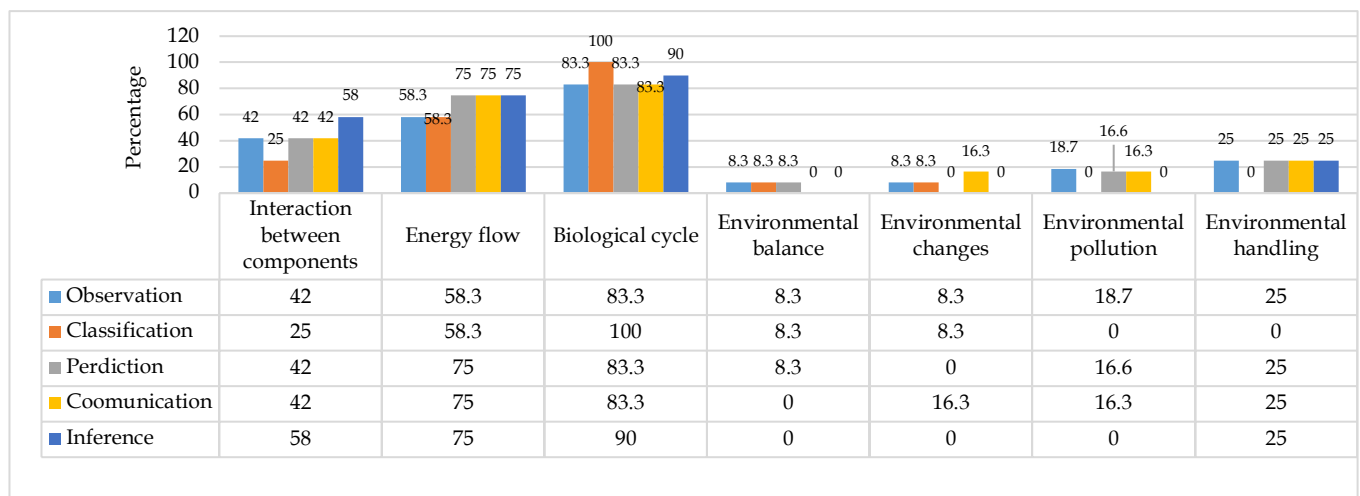

	Interaction between components	Energy flow	Biological cycle	Environmental balance	Environmental changes	Environmental pollution	Environmental handling
Observation	42	58.3	83.3	8.3	8.3	18.7	25
Classification	25	58.3	100	8.3	8.3	0	0
Perdiction	42	75	83.3	8.3	0	16.6	25
Coomunication	42	75	83.3	0	16.3	16.3	25
Inference	58	75	90	0	0	0	25

Figure 1. Percentage gain in the low category of students' science process skills

Observation indicators; Arrohman, et al., (2021) in their research results found that one aspect that has a percentage value of achievement below 70.00% is observing aspects. For students who have low science process skills, especially observation skills, teachers can train with various techniques such as taking students to the field and asking students to express what is being observed. Darmaji, et al (2018) state that one way to familiarize students with making observations is to connect direct experience with the theory being studied. This is in accordance with the opinion of Rahayu, (2017) which states that process skills need to be developed through direct experiences as a learning experience. Because through direct experience, someone can better appreciate the process or activity that is being carried out. With observing skills in the teaching and learning

process, students will be easy to be active, because in this aspect students will use all their five senses when observing objects (Rustaman, 2005; Gasila, et al; 2019).

Classification indicators; classification, namely skills based on observing skills. Fadhilla, et al (2021) stated Classification is the skill of choosing, comparing, looking for differences, finding the basis of grouping. This skill is also important for students to have because if it is not mastered, students will experience problems in identifying an object during the observation process. Classification skills assist participants in processing the data used to derive a concept. Fatmawati (2021) suggests that teachers need to explain the meaning of classification so that there is no misunderstanding of meaning because usually classification and grouping are interpreted the same way in the process.
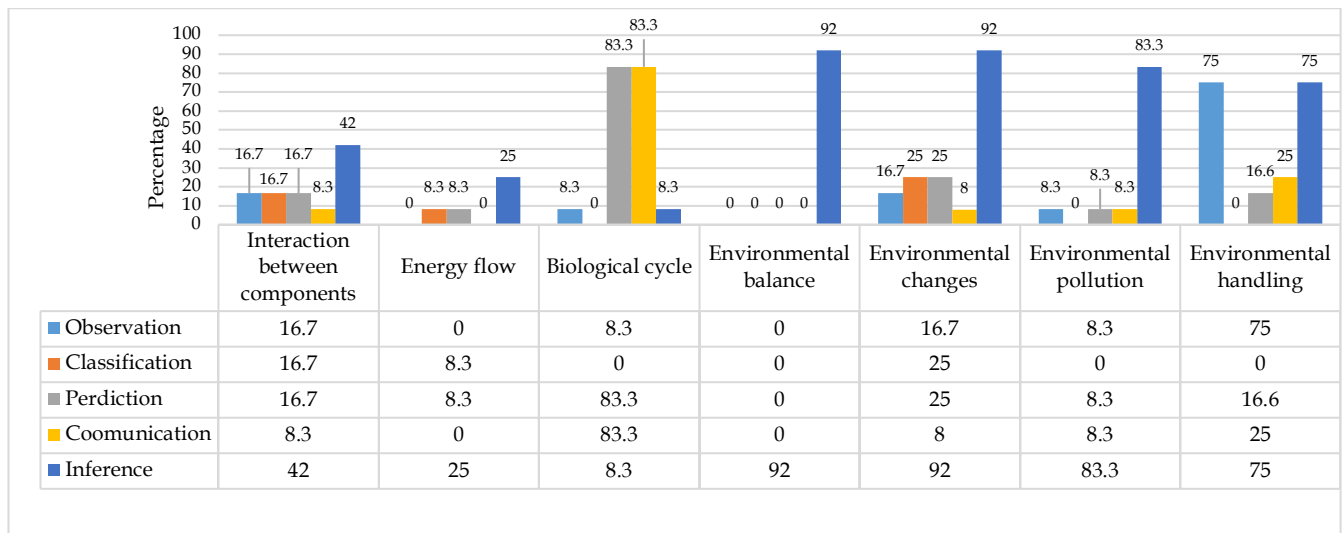
Figure 2. Percentage gain in the medium category of students' science process skills

	Interaction between components	Energy flow	Biological cycle	Environmental balance	Environmental changes	Environmental pollution	Environmental handling
Observation	16.7	0	8.3	0	16.7	8.3	75
Classification	16.7	8.3	0	0	25	0	0
Perdiction	16.7	8.3	83.3	0	25	8.3	16.6
Coomunication	8.3	0	83.3	0	8	8.3	25
Inference	42	25	8.3	92	92	83.3	75

Prediction indicator; Predicting is assigning ideas to possible future events and their results based on previous experience. To make good predictions, observations must be made with care and the relationships between observed events must be interpreted correctly (Aslan, Erta s-Kılıc & Kılıc, 2016). If students have low predictive skills, this shows that students have not been able to apply the concept well so they are less able to predict what will happen because of the difficulty of understanding the concept. In addition, students are less able to read the data provided so it becomes one of the causes of difficulty in predicting the data. Predictive ability is highly dependent on the recognition of phenomena which are part of observation skills.

Communication indicators; Important communication skills are also mastered by students because they affect how findings are conveyed during the observation process, communication can be done orally and in writing, mastery of communication can also be trained through the display of images, graphics, or charts. One of the most important characteristics of communication is reaching an agreement of mutual understanding, and sharing observations with others using scientific language (Duruk, et al; 2017). Mutmainnah, et al (2019) in their research found communication science process skills, namely 90.74% obtained in the very good category, which means that students can read and interpret information well vice.
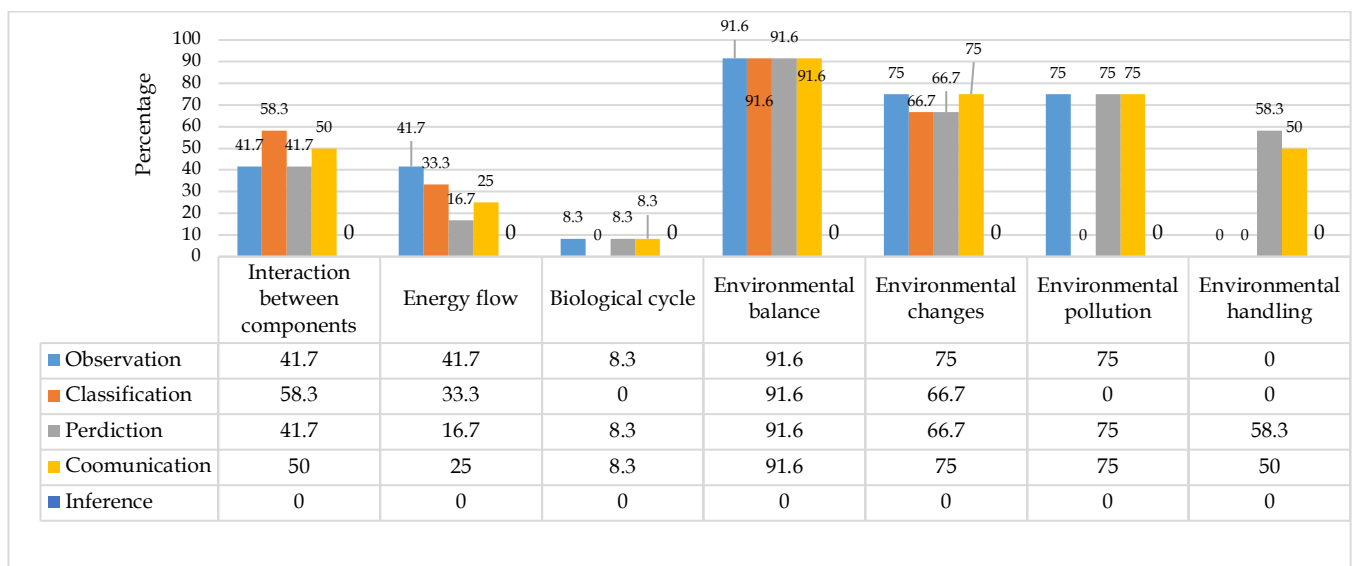

Figure 3. The percentage gain with the high category of students' science process skills

	Interaction between components	Energy flow	Biological cycle	Environmental balance	Environmental changes	Environmental pollution	Environmental handling
Observation	41.7	41.7	8.3	91.6	75	75	0
Classification	58.3	33.3	0	91.6	66.7	0	0
Perdiction	41.7	16.7	8.3	91.6	66.7	75	58.3
Coomunication	50	25	8.3	91.6	75	75	50
Inference	0	0	0	0	0	0	0

Inference indicator; The findings of Gasila, et al (2019) that the science process skills of students who

have the lowest score of all indicators conclude with an average value of 76.67 in the sufficient category.

Inference skills need to be continuously trained so that students are accustomed to making conclusions from the objects observed, the results of research from Utami et al. (2019) that inference skills increased in the 2nd observation, because the 1st observation obtained a percentage of 69.00%, not according to the researchers' expectations, but in the 2nd, observation increased to 77.00%. Arrohman et al. (2021) found that in the results of their research there is one aspect that has an achievement percentage value below 70.00%, namely the concluding aspect.

Science is the process by which humans acquire testable knowledge and utilize that knowledge to solve human problems. If students want to understand how science works, they can use both basic and integrated science process skills, supported by scientific knowledge and attitudes. This scientific attitude is needed to carry out basic and integrated science process skills activities such as asking questions, observing, designing experiments, using tools and materials, and communicating the results of experiments (Dewi et al., 2017). This is in accordance with the suggestion from Onojo & Daikwo, (2021) that the next research researchers will continue to explore learning methods in order to be able to improve science process skills.

The assessment of science process skills still refers to each indicator of science process skills using essay questions in the discussion sheet. Yumusak, (2016) also developed science process skills with indicators of observation, comparison, classification, conclusion, forecasting, communication, and quantification. In contrast to the results of the research Mahdian et al. (2019), the indicators observed include; observing, asking questions, making hypotheses, designing and conducting experiments, interpreting data (associating), concluding, communicating, and applying concepts. Science process skills are one of the learning strategies that can be used by teachers because students will be trained to explore their knowledge during observations both inside and outside the classroom. Rowland et al. (1987) proposed indicators of basic science process skills, namely observation, classification, communication, prediction, inference, and measurement. To help apply these science process skills, the researchers tried to develop teaching materials in the form of student worksheets based on science process skills. Astutik et al. (2020) stated that the purpose of making student worksheets based on higher-order thinking skills is to explore students' higher-order thinking skills through questions that are prepared by paying attention to indicators of higher-order thinking skills including critical thinking, and creative thinking. Pradana et al. (2020) have also looked at critical thinking skills using science process skills-oriented worksheets in junior high school students.

Conclusion

Whether or not learning is effective depends on the learning strategies used by teachers in the classroom, teachers should innovate by using various learning strategies that can generate interest and motivation in student learning. Train students to think at a higher level, of course, by using interesting teaching methods. The ability to use science process skills for everyday problems is important for individuals living in rapidly developing societies. Student worksheets are the teacher's efforts to guide students in a structured manner, whose activities provide incentives for students to learn. Based on the data obtained, the conclusion in this study is that students can demonstrate science process skills on biological material by using student worksheets based on science process skills in high school with the acquisition of different categories of variations in each indicator and on different materials. Obtaining a high category of 91.9% on environmental balance material on indicators of observation, prediction, classification, and communication, while for inference it was obtained in the medium category for all materials tested in a limited trial.

Acknowledgments

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