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Analysis of Planning Carrying Out Investigation Skills Using the Next Generation Science Standards Learning Framework on Plant Structure and Function Material

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Abstract: Meaningful understanding becomes the goal of the learning process. Science as a scientific discipline not only includes theory but also practicum implementation as proof of the theory that has been taught. The implementation of practicum is a demand in the science learning process. Introducing and training students with practicum activities is still rarely done in schools in Gowa district. It is necessary to impose international educational standards that lead to more specific learning outcomes. The purpose of this study is to analyze planning and carrying out investigation skills using the NGSS-oriented inquiry learning model. This research is a qualitative descriptive research. The sample in this study was class VIII E students of SMP Negeri 4 Sungguminasa, Gowa, totaling 31 people. Sample determination is carried out by purposive sampling. The instrument used is in the form of a multiple-choice question test to determine the planning and carrying out investigation skills of students. Based on the results of the analysis, it can be seen that the planning and carrying out investigation skills of students are in the medium category with indicators determining the title to get the highest percentage, with 66.66% and the indicator of choosing tools and materials got the lowest percentage, which is 31.91% is in the low category on the material structure and function of plants.

Keywords: Function Material; Investigation Skills; Learning Framework; Next Generation; Planning Carrying; Plant Structure; Science

Introduction

National education as one of the national development sectors in an effort to educate the nation's life, has a vision of realizing an education system as a strong and authoritative social institution to empower all Indonesian citizens to develop into quality human beings, so that they are capable and proactive in responding to the challenges of an ever-changing era. Natural Sciences (IPA) is one of the disciplines taught in schools. Science subjects equip students with knowledge, ideas and concepts about the natural environment, which are obtained from experience through a series of scientific processes, including investigation and preparation (Panggabean et al., 2021). However, what happens in junior high schools, teachers rarely practice practical skills. Practicum-based science learning functions to clarify concepts or theories through the direct use of tools and materials. The application of practicum-based science learning is an efficient way to achieve learning objectives. Learning that is in accordance with the nature of natural science is science learning based on practicum, in this case practicum-based learning provides opportunities for students to discover and prove theories (Khaerunnisah et al., 2022).

Based on the results of an interview with a science teacher at SMPN 4 Sungguminasa Gowa, the integration of science learning with practicum is rarely practiced. The introduction of laboratory equipment is only limited to material without direct appointment. The large number of science subjects that require practicum is a challenge for educators in designing complete learning

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so that the science concepts given can be delivered in full. However, in reality, innovations in devices used in science learning are still rare. The device is made according to national standards without adding anything new.

One of the future challenges is a shift in the world economy. To face the challenges of the global economy, not only improving education according to national standards but also how the education system is implemented internationally, the fact is that the education system is not yet in accordance with international standards which does lead to achieving specific learning outcomes. (OECD, 2010). So, the integration of Science and Engineering Practices (SEPs) based on the Next Generation Science Standards (NGSS) in science learning needs to be done. NGSS is the core of the field of science. This standard consists of three dimensions, namely: practices (SEPs), disciplinary core ideas (DCI), and cross-cutting concepts incorporated in the K-12 science education framework (Harris et al., 2017). The K-12 Science Education Framework builds on the ideas of discovery-based science learning and developmental progress, focusing on a number of core ideas in important science and engineering across all disciplines. The National Research Council [NRC] (2007) concluded that, with proper instruction, students can successfully engage in making hypotheses, gathering evidence, and understanding the phenomena they are investigating to answer complex problems.

NGSS Science and Engineering Practices are clearly identified not as learning objectives separate from what learners need to know but as ways of reasoning them (Shernoff et al., 2017). The NGSS describes what students should know and be able to do when they graduate from high school. The NGSS is based on the development of learning core ideas in learning and practices that enable learners to use knowledge in meaningful ways (Haag, 2015). A unique aspect of the NGSS is that standards are designed to develop knowledge throughout the life of learners in K-12 education by preparing them for university and careers (Calmer, 2019). NGSS is based on the premise that an authentic science approach is a critical learning objective that must be acquired by students. In particular, NGSS incorporates authentic scientific investigations, students pose their own scientific questions, derive their own hypotheses, develop methods to test hypotheses, and make logical conclusions as evidence-based arguments to defend their conclusions (Asowayan et al., 2017).

DCI (Disciplinary core ideas) is very important to every field of science because it provides explanatory power to a number of phenomena. Thus, DCI guides scientists and students in observing, thinking, explaining phenomena, solving problems, and asking and finding answers to new questions. The more connections developed, the greater the ability of students to solve problems, make decisions, explain phenomena, and understand new information (Krajcik et al., 2017). Crosscutting Concept facilitates how to explain, interpret, evaluate phenomena scientifically, justify and refute using several different concepts in learning (Hasan et al., 2022).

Practice emphasizes that engaging in scientific inquiry requires concurrent coordination of knowledge and skills. However, in fact at SMPN 4 Sungguminasa there is still not enough training in linking knowledge and skills together. Planning Carrying Out Investigations (PCOI) is part of the Dimensions of Science and Engineering Practices (SEPs) which can be trained for students in schools to understand science more deeply. Planning carrying out investigations (PCOI) is the practice of planning scientific investigations individually and collaboratively. Scientific investigations can be conducted to describe a phenomenon, test a theory or model of how the natural world works (NGSS Lead States, 2013). The capability of Planning Carrying Out Investigations is one dimension of SEPs oriented to NGSS which is a skill issue in the 21st century. However, the fact is that students have not been trained to develop Planning Carrying Out Investigations skills in science learning. Based on this background, the purpose of this study was to analyze the Planning Carrying Out Investigation (PCOI) skills of class VIII E students of SMPN 4 Sungguminasa Gowa, using the Next Generation Science Standard (NGSS) oriented inquiry learning model on the material structure and function of plants.

Method

This research is a qualitative descriptive research. Qualitative descriptive research is used to describe existing phenomena that are both natural and human-made, with more importance on characteristics, quality, interrelationships between activities and does not provide treatment and manipulation of the variables studied (Aprilia et al., 2017). The sample in this study were 31 students in class VIII E of SMPN 4 Sungguminasa, Gowa. The technique of determining the sample using purposive sampling because the class chosen is adjusted to the time of the researcher. Purposive sampling is a sample determination technique with certain considerations (Sugiyono, 2016). Data collection was carried out using a test technique, using sheets in the form of multiple choices given as pretest and posttest to measure planning carrying out investigatio skills. Data analysis techniques used descriptive analysis. Descriptive statistics function to

describe the object studied through sample data. The research implementation chart can be seen in Figure 1.

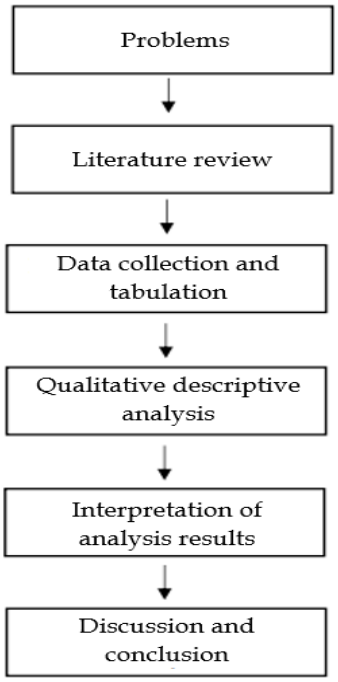

Figure 1. Chart of research implementation

Result and Discussion

Innovative learning is highly emphasized in 21st century learning. Science is a field of science that requires knowledge and skills in understanding content. The analysis process starts from giving the pretest to students as an initial test to find out their skills. Then the learning process was carried out for 1 face-to-face meeting in the laboratory of SMP Negeri 4 Sugumnasa. In the learning process, students are trained so that they can design and carry out practicum according to the steps in the NGSS-oriented worksheets. The learning model used is the inquiry learning model. Inquiry emphasizes the process of thinking critically and analytically to seek and find answers to a problem in question (Umami et al., 2013).

Table 1. Results of Statistical Analysis of Class VIII E PCOI Pretest and Posttest Scores

Statistics	Class VIII E	
	Pretest	Posttest
Number of Samples	31	31
Highest score	31	42
Lowest score	3	27
Average score	16.1	33.7
Standard deviation	7.6	4.3

Before students are taught using the NGSS-oriented inquiry learning model, a pretest is carried out first to find out the students' initial abilities then provides learning and at the end provides a posttest planning carrying out investigation. Based on Table 1, it can be seen that the highest score for pretest 31 and posttest 42 with an average score for the pretest and posttest respectively is 16.1 and 33.7. From the results of the analysis it can be seen that there is an increase between the pretest and posttest seen from the average score of students.

The planning carrying out investigation skills have several indicators, namely: 1) determining the title, 2) choosing tools and materials, 3) compiling work steps, 4) conducting experiments and 5) drawing conclusions. The following presents the average difference of each indicator.

Table 2. Results of the average analysis of each Class VIII E PCOI indicator

Indicator	Percentage (%)	Category
Defines a title	66.66	Currently
Select material tools	31.91	Low
Develop work steps	45.61	Currently
Do practicum	47.45	Currently
Draw a conclusion	61.66	Sedang

From the results of the analysis above, it can be seen that the indicator for determining the title has the highest percentage with a percentage of 66.66% and is in the medium category, while the indicator for selecting tools and materials has the lowest percentage with a percentage of 31.91% and is in the low category. The PCOI indicator that has the highest percentage is determining the title of 66.66%. The high percentage of determining the title is because students can determine the exact title of the experiment they will do after observing the video displayed in front of the class. Meanwhile, the PCOI indicator that received the lowest presentation was 31.91%, namely the indicator for choosing tools and materials, this was because students still did not know the names of the tools, they needed to do practicum. Students only know the shape of the tool but do not know the name of the tool so that it makes students difficult to determine tools and practicum materials. According to (Ayu et al., 2019). The lack of practicum implementation and the lack of involvement of students in the preparation process before the practicum is carried out, makes practicum activities less than optimal. Implementation of science practicum is an important activity in learning, because carrying out practicum can support students' understanding of material (Duwi Wahyuningtias et al., 2021). Learning using NGSS-oriented devices is also more effective than conventional learning. NGSS-oriented learning tools can be used if learning materials require practical activities.

Conclusion

Based on the results of the analysis that has been carried out at SMP Negeri 4 Sungguminasa, it can be concluded that the planning carrying out investigation skills of class VIII E students using the NGSS-oriented inquiry learning model are in the medium category on plant structure and function material. The Planning carrying out investigation indicator determines the trial title to get the highest presentation.

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Conflicts of Interest
The authors declare no conflict of interest.

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