



# Analysis of Science Process Skills of Junior High School Students on The Concept of Elements, Compounds, and Mixtures Based on Education for Sustainable Development

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**Abstract:** This research aims to analyze students' science process skills in solving science questions at State Middle Schools in Blora. This research uses a qualitative descriptive method. The instrument used in this research was a SPS test question in the form of an essay. The research data was carried out quantitatively and qualitatively. The results of the study show that the SPS of students at State Middle Schools in Blora on the concepts of elements, compounds, and mixtures is in the low category with an average of 50%. Based on the nine indicators analyzed, observing indicators have an average percentage of 54%, grouping indicators have an average percentage of 45%, interpreting indicators have an average percentage of 53%, forecasting indicators have an average -an average percentage of 55%, the indicator of asking questions has an average percentage of 49%, the indicator of formulating a hypothesis has an average percentage of 52%, the indicator of applying concepts has an average percentage of 47%, the indicator of communicating has an average the average percentage is 53%, and the indicator of designing an experiment has an average percentage of 35%. The average score and achievement value of students is that there are 24 students in the sufficient category and 8 students in the low category.

**Keywords:** Elements; Compounds; Mixtures; Science processes skills.

## Introduction

Education for Sustainable Development is being implemented in various educational settings in Indonesia, including through the implementation of Merdeka Belajar Curriculum (Hunaepi & Suharta, 2024). In Blora, clinical supervision has been used to support the implementation of this curriculum, although there are still challenges as the implementation is still in its early stages (Anridzo et al., 2022). The main focus lies on developing 21st century skills, such as critical thinking, creativity, communication and collaboration (Ingrias et al., 2022). However, there are still obstacles in implementation, including teacher readiness and understanding the concept of Merdeka Belajar (Rochmat

et al., 2023). Nevertheless, various government agencies and companies have begun to implement the concept of Education Management for Sustainable Development (Fitriandari & Winata, 2021).

The implementation of the Merdeka Belajar Kampus Merdeka curriculum at the tertiary level has shown an increase in 21st century skills in students (Jufriadi et al., 2022). Science education in Indonesia faces complex challenges, including issues of teaching materials, curriculum and facilities (Khoiri et al., 2020). The country's performance in international science process assessments is consistently low, indicating a need for improvement (Narut & Nardi, 2019). The proposed National Education System Bill 2022 suggests changes to science teacher professional education,

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calling for collaboration between universities and professional associations (Yustiana et al., 2022). Research on science education in secondary schools in Indonesia highlights challenges and opportunities in science education (Narut & Nardi, 2019). Research trends in science education in Indonesia have been analyzed, revealing a range of foci including curriculum, teaching methods, and educational institutions (Mujahidin & Martanegara, 2020).

These studies collectively underscore the need for ongoing efforts to improve science education in Indonesia, by addressing pedagogical approaches and teacher preparation to improve student outcomes and students' science process skills (Mujahidin & Martanegara, 2020). Research has shown that SPS can be effectively improved through various teaching approaches. Nia et al. (2019) found that 8th grade students showed a good level of SPS in science learning. The application of guided inquiry-based learning materials proved effective in improving students' SPS (Syaf'ah & Setiani, 2024). These findings emphasize the importance of using active learning strategies to develop students' SPS in science education at the secondary school level. According to Astuti (2019), science process skills also have skills, namely observation skills, classification, interpretation, prediction, asking questions, making hypotheses, planning experiments, using tools / materials, applying concepts, and communicating (Tommy et al., 2024).

The inquiry learning model has been widely used in previous studies to improve students' science process skills, so researchers try to link the inquiry learning model with the Education for Sustainable Development (ESD) approach (Pramitasari et al., 2024). The inquiry learning model is taught by organizing students into a situation that will raise hypothesis questions, and also make students have knowledge and develop it into a complete concept (Warmadewi et al., 2024). Education for Sustainable Development is an educational approach that aims to prepare individuals to contribute to sustainable development (Rohmawati & Roshayanti, 2021).

ESD is increasingly integrated into science education to promote sustainable development goals (Purnamasari & Hanifah, 2021). Recent studies have explored innovative approaches to teaching elements, compounds and mixtures in science education. Aninindya et al. (2022) developed a scientific approach-based module for this topic, which was deemed highly suitable for classroom use with excellent teacher responses. Similarly Fitriyah et al. (2019) created problem-based learning worksheets for the same subject matter, receiving high ratings for content, language and graphics from experts. Both resources aim to improve

the learning process in science classrooms. In addition, Albeta et al. (2020) investigated the effectiveness of project-based learning in improving students' science process skills and concept mastery, specifically on mixture separation. Their study showed significant improvement in various aspects of science process skills, particularly in classification, and moderate improvement in concept mastery. These findings suggest that diverse teaching methods and materials can effectively support students' understanding of elements, compounds and mixtures.

**Method**

This research was conducted at SMP Negeri 3 in Blora. The research method used was descriptive qualitative method. The population in this study was SMP Negeri 3 in Blora with a sample of SMP Negeri 3 in Blora, the sample was taken by random sampling technique. The research instrument used in this study is the SPS test in the form of description questions consisting of 15 questions containing 9 indicators of science process skills, which include: observing, classifying, interpreting, predicting, asking questions, formulating hypotheses, applying concepts, communicating, designing experiments.



**Figure 1.** The research design (Yani & Rosana, 2024)

**Table 1.** SPS indicator

Parameters	Indicator of Science Process Skill
I	Observe
II	Categorizing
III	Predicting
IV	Asking Questions
V	Formulating Hypothesis
VI	Applying Concept
VII	Communicating
VIII	Designing Experiment

The calculation of the average value is then categorized with the following criteria:

**Table 2.** Categories of SPS Assessment

Value Criteria	SPS Criteria
≥ 85	Very good
70 - 85	good
55 - 70	Fair
40 - 55	Not good
≥ 40	Very poor

Calculation of the value of science process skills can be calculated by the Formula 1.

$$\bar{X}_{SPS} = \frac{\text{Total number point of indicator}}{\text{Number of student}} \quad (1)$$

### Result and Discussion

Student learning outcomes in this study start from observing indicators consisting of two description questions, classifying indicators consisting of one description question, interpreting indicators consisting of one description question, predicting indicators consisting of one description question, asking questions indicators consisting of one description question, formulating hypotheses indicators consisting of one description question, applying concepts indicators consisting of four description questions, communicating indicators consisting of one description question, designing experiments indicators consisting of three description questions.

**Table 3.** Grade IX Science Process Skills

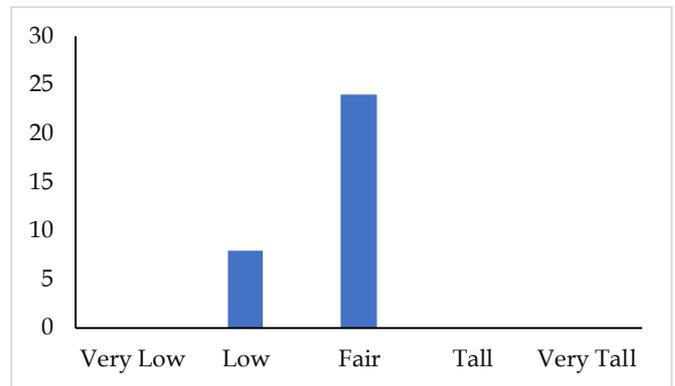
Indicator of Science Process Skill	Average Score	Category
Observe	54	Low
Grouping	45	Low
Interpret	53	Low
Predict	55	Low
Asking Questions	49	Low
Formulate a Hypothesis	52	Low
Applying Concept	47	Low
Communicate	53	Low
Designing Experiment	35	Very Low
Average	50	Low

The results of the application of science process skills obtained after analyzing various relevant journals to draw conclusions from the results of the application of science process skills. The results of the application of science process skills on indicators of observing, classifying, interpreting, predicting, asking questions, formulating hypotheses, applying concepts, communicating, designing experiments.

The results that can be known that the results of the application of science process skills obtained different values for each indicator. The results of the application of all indicators of science process skills can be obtained by presenting the score category of the whole shown in the diagram calculated with an excel microscope as shown in Figure 2.

The Figure 2 shows that the overall average score criteria are divided into five categories. The data obtained from the results of the study, that no students scored very low, eight students scored low, twenty-four students scored moderately, no students scored high,

and no students scored very high. The success of the learning process in addition to being influenced by the learning model is also influenced by students. Factors that influence are basic abilities and student attitudes.



**Figure 2.** Average achievement score criteria

The low level of science process skills at SMPN in Blora reflects that most students have not been able to formulate a hypothesis to solve a problem. The students are very good at memorizing, but still lack skill in using the knowledge they have. The learning that takes place shows that students are less skilled and active in participating in the learning process, students tend to be more silent and just pay attention to the material presented. Recent studies have explored innovative approaches to improve science process skills and concept mastery in education. Project-based learning is proven to improve students' science process skills and concept understanding in mixture separation (Rahmadani et al., 2021). Problem-based learning worksheets have been developed and considered very suitable for teaching elements, compounds, and mixtures (Anisa, 2024). Tudents exhibited increased confidence and independence in their approach to experiments and data analysis on students science process skills (Alfian et al., 2024). This is done in order to evaluate the curriculum for further development, find existing deficiencies and problems, and produce the expected solutions/developments. This is done because it is not possible to provide all the competencies in the curriculum as teaching materials (Sari et al., 2024).

### Conclusion

Based on the research results and data analysis in general, it can be concluded that the science process skills of state junior high school students in Blora City can be concluded as follows: Science process skills of junior high school students in Blora based on each indicator, the indicator that has the highest value is the observation indicator with an average value with a low category, and for the lowest science skills indicator is

designing experiments with an average value with a very low category. Based on the average score and the accuracy value of the data obtained from the results of the study, that no students get a very low score, eight students get a low score, twenty-four students get a sufficient score, no students get a high score, and no students get a very high score. Many factors influence low student learning outcomes, one of which is low self-confidence. So to improve learning outcomes at SMPN 3 Blora, it is necessary to apply process skills to learning.

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In writing this article, the authors do not have any conflict of interest.

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