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Saqbe : Sains dan Pembelajarannya

Analisis Keterampilan Proses Sains Siswa di SMP Muhammadiyah 1 Berbah

Analysis of Students' Science Process Skills at Muhammadiyah 1 Berbah Junior High School

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Abstrak
Penelitian deskriptif kuantitatif ini, yang merupakan studi awal, mengkaji keterampilan proses sains pada 193 siswa kelas VIII dan IX di SMP Muhammadiyah 1 Berbah, sebagai respons terhadap terbatasnya penilaian komprehensif terhadap keterampilan tersebut di Indonesia. Dengan menggunakan instrumen penelitian yang telah divalidasi sebelumnya dan menilai delapan indikator keterampilan melalui soal pilihan ganda, hasil penelitian menunjukkan tingkat penguasaan yang bervariasi: keterampilan observasi memperoleh skor terendah (18, sangat rendah), prediksi (33) dan klasifikasi (35) berada pada tingkat rendah, sedangkan eksperimen (48), interpretasi data (45), penerapan konsep (50), dan komunikasi (45) berada pada tingkat sedang, dengan perumusan hipotesis memperoleh skor tertinggi (69). Rata-rata skor keseluruhan adalah 43 (kategori sedang), dengan distribusi siswa yang cukup mengkhawatirkan di berbagai kategori kemampuan (8% sangat tinggi, 20% tinggi, 15% sedang, 41% rendah, 17% sangat rendah). Dengan 58% siswa berada di bawah tingkat sedang, hasil ini menunjukkan adanya kebutuhan mendesak akan intervensi pembelajaran yang menargetkan pengembangan keterampilan proses sains. Temuan ini juga menyediakan data dasar yang penting bagi pengembangan kurikulum dan reformasi pembelajaran, khususnya dengan menekankan pendekatan berbasis inkuiri untuk mengatasi kelemahan pada keterampilan observasi, prediksi, dan klasifikasi

Kata Kunci
Analisis, Keterampilan Proses Sains, Metode Deskriptif, Siswa SMP

Abstract
This quantitative descriptive research, a preliminary study, examined science process skills (SPS) among 193 eighth and ninth-grade students at Muhammadiyah 1 Berbah Junior High School, addressing the limited comprehensive assessments of these fundamental skills in Indonesia. Using a previously validated research instrument that assessed eight skill indicators through multiple-choice questions, findings revealed varied proficiency levels: observation scored lowest (18, very low), prediction (33), and classification (35) showed low levels while experimenting (48), data interpretation (45), concept application (50), and communication (45) demonstrated medium proficiency, with hypothesis formulation scoring highest (69); the overall average score was 43 (medium level), with concerning student distribution across proficiency categories (8% very high, 20% high, 15% medium, 41% low, 17% very low). With 58% of students performing below medium level, results indicate an urgent need for instructional interventions targeting SPS development. These provide critical baseline data for curriculum development and

instructional reforms, particularly emphasizing inquiry-based approaches to address deficiencies in observation, prediction, and classification skills.

Keywords
Analysis, Junior High School student, Descriptive Method, Science Process Skills

INTRODUCTION

Science learning is crucial not merely for knowledge acquisition but primarily for developing science process skills (SPS), which enable students to think critically, solve problems, and apply scientific knowledge in everyday contexts (Kurniawan et al., 2018). Despite its importance, current science education often emphasizes content memorization over practical application, creating a significant gap between classroom learning and real-world scientific literacy. This disconnect is particularly concerning, as research shows that students with well-developed SPS demonstrate greater scientific reasoning, experimental design abilities, and data interpretation skills (Lumbantoruan et al., 2019). Furthermore, the integration of SPS within collaborative learning environments enhances not only scientific understanding but also vital communication and teamwork competencies needed in modern scientific fields (Winarti et al., 2019; Kadan & Aral, 2022). The persistent challenges in implementing effective SPS instruction, including traditional assessment methods, teacher preparation gaps, and resource limitations, necessitate focused research on innovative approaches to SPS development (Ediyanto et al., 2018; Elliyani, 2024; Ural & Gençoğlan, 2019). As science education aims to prepare students for future careers increasingly dependent on scientific literacy and inquiry capabilities, investigating effective methods for cultivating robust SPS has become essential for educational advancement.

In the Merdeka curriculum, SPS constitute a critical element of science education designed to develop essential 21st-century competencies required in today's modern era (Lubis, 2023; Dewi & Muhiri, 2020). While the curriculum recognizes the importance of these skills, significant challenges remain in their effective implementation across Indonesian schools. Current classroom practices often emphasize theoretical knowledge over practical application, creating a noticeable gap between curricular intentions and instructional reality. Unlike progressive international curricula such as Finland's phenomenon-based learning or Singapore's inquiry-based science curriculum, which have successfully integrated SPS into daily teaching practices, Indonesian schools frequently struggle with limited laboratory facilities, large class sizes, and traditional assessment methods that prioritize content memorization over process skills development (Sukma & Daud, 2022). Through properly implemented SPS, students should not merely learn theory but develop abilities to apply scientific thinking in authentic situations (Nahdi et al., 2020; Maisarah, 2023). Research demonstrates that students with well-developed science process skills demonstrate superior problem-solving abilities and critical thinking (Salim et al., 2019), preparing them for future challenges in scientific and technological fields (Sukarno & Hartoyo, 2023). These analytical thinking capabilities are fundamental for evidence-based decision-making in both academic and real-world contexts (Utami et al., 2017; Salmeron, 2023), ultimately enhancing academic achievement (Abungu et al., 2014; Deswita et al., 2023). Addressing the implementation gap between the Merdeka curriculum's aspirations and classroom realities regarding SPS development requires targeted research and evidence-based interventions to ensure Indonesian students truly develop the scientific competencies needed for global citizenship.

SPS represents an individual's capacity to effectively utilize thinking, logical reasoning, and practical actions to achieve desired outcomes during scientific learning activities (Chiappetta, E. L. & Koballa, 2010). These skills are essential for students to conduct scientific investigations effectively and generate new knowledge (Ongowo & Indoshi, 2013). SPS is categorized into two types: basic skills and integrated skills. Basic skills include abilities such as observing, measuring, and communicating results, while integrated skills involve more complex competencies, such as controlling variables and formulating hypotheses (Kurniawan, et al.,

2018; Ediyanto et al., 2018). Overall, SPS encompass a wide range of capabilities that enable meaningful participation in scientific exploration and research, forming the foundation for understanding and applying scientific principles and methodologies.

The importance of mastery of SPS in junior high school students cannot be ignored, because skills become the foundation for understanding conceptual and ability thinking. However, previous studies show that the level of mastery of SPS among junior high school students is still at a low level. Research on grade VII students of Muhammadiyah Middle School in Bima City showed that the average value of SPSwas 30.88%, which is included in the low category (Fathurrahman, 2023). Research conducted on grade VIII of SMPN 2 Sembawa showed that the average SPSwere 48.69%, which is included in the low category (Susanti et al., 2023). Research conducted at public schools in Tarakan City found that the average value of SPSwas 48.55%, which is included in the low category (Listiani & Kusuma, 2024). Research on grade IX junior high school students in Nunukan Regency showed that the average value of SPS was 38%, which is included in the low category (Buhera et al., 2024). These findings highlight that SPS levels among junior high school students in various provinces across Indonesia remain alarmingly low.

The low level of SPS(SPS) among students is influenced by several factors. These include the suboptimal utilization of ICT-based learning media and inadequate facilities and infrastructure (Ratnasari, 2023), as well as a lack of laboratory availability and a limited science background (Artun et al., 2020; Robiatul et al., 2020). Errors in the use of learning models also contribute to this issue (Santiawati et al., 2022). Furthermore, the dominant use of lecture-based methods without incorporating practical activities negatively impacts students' SPS (Novitasari et al., 2017). Overall, the low SPS levels can be attributed to the minimal use of ICT-based media, insufficient facilities and laboratories, inappropriate learning models, lack of active student involvement, and the overuse of lecture methods without practical applications.

Based on interviews with science teachers and direct observations at Muhammadiyah 1 Berbah Middle School, the school has an adequate laboratory, but its use in learning activities is still minimal. Practical activities, which should be an essential part of science learning, have also not been optimally implemented. On the other hand, every classroom in the school is equipped with ICT-based facilities, which can support the application of more interactive and innovative teaching methods. This condition allows for exploring how utilizing laboratories and ICT-based technology can improve students' science process skills. Thus, this school is suitable as a research site, and profiling SPS at this school is relevant as a preliminary study for thesis research. Therefore, according to the above information, this study's introduction aims to analyze the level of SPS of students at SMP Muhammadiyah 1 Berbah. Research results this expected can give a description of the SPS student profile and become a base for the development of more science learning programs at school.

METHODS

This study uses a quantitative descriptive approach to evaluate SPS of students at Muhammadiyah Junior High School in Yogyakarta, conducted between October 24–31, 2024. This approach was chosen because it can objectively measure and describe students' SPS levels. The study population consisted of 193 students from grades VIII and IX, selected through total sampling to enable comprehensive comparison across all classes. The distribution of research subjects is presented in Table 1.

Table 1. Research Subjects

No.	Class	Number of Students
1	IX-A, IX-B, IX-C, IX-D	93
2	VIII-A, VIII-B, VIII-C, VIII-D	100
	Total Research Subjects	193

This study employs an instrument adapted from prior research to assess students' SPS, using multiple-choice questions as the measurement. The instrument has been validated, so it has good reliability and validity, adapted from (Anggraini & Setyawarno, 2024; Jati & Setyawarno, 2024; Pramitasari & Hastuti, 2024). The indicators of SPS used can be seen in Table 2.

Table 2. SPS Indicators

No.	Indicator of SPS	Material	Question Indicator	Level Cognitive	Number Question
1	Observation	Temperature	Determining the upper fixed point, lower fixed point, and number of scales on different thermometers	C4	1
2	Proposing a hypothesis	Heat	Analyzing the heat transfer mechanism in a phenomenon based on experimental results	C3	2
3	Predicting	Substance	Predicting the solvent phase that can dissolve the components of the mixture	C2	8
4	Conducting an experiment	Temperature	Identify the correct procedure for using a thermometer to measure temperature.	C3	3
5	Interpreting data	Heat	Interpreting the relationship between the type of substance and the heat required to increase the temperature based on experimental data.	C4	4
6	Classification	Vibration	Identifying events that utilize vibrations in everyday life	C2	7
7	Implementing the concept	Temperature	Converting temperature from Celsius scale to Reamur scale	C3	5
8	Communicating	Temperature	Analyze the relationship between heating time and temperature changes based on observation data.	C4	6

Data were collected using a multiple-choice test distributed to each class via Google Form with a 20-minute completion time. Student scores were then converted to a 0 –100 scale. Determination of SPS levels modified from research Febryana et al., (2020), Bahri et al., (2022), and Santiawati et al., (2022) as shown in Table 3.

Table 3. Range of SPS Values

No.	Value Range (0 – 100)	Level
1	$81 \leq X$	Very high
2	$61 \leq X < 81$	High
3	$41 \leq X < 61$	Medium
4	$21 \leq X < 41$	Low
5	$X < 21$	Very low

RESULTS AND DISCUSSION

Result

The analysis of the data revealed findings regarding students' SPS levels at SMP Muhammadiyah 1 Berbah, as illustrated in Figure 1.

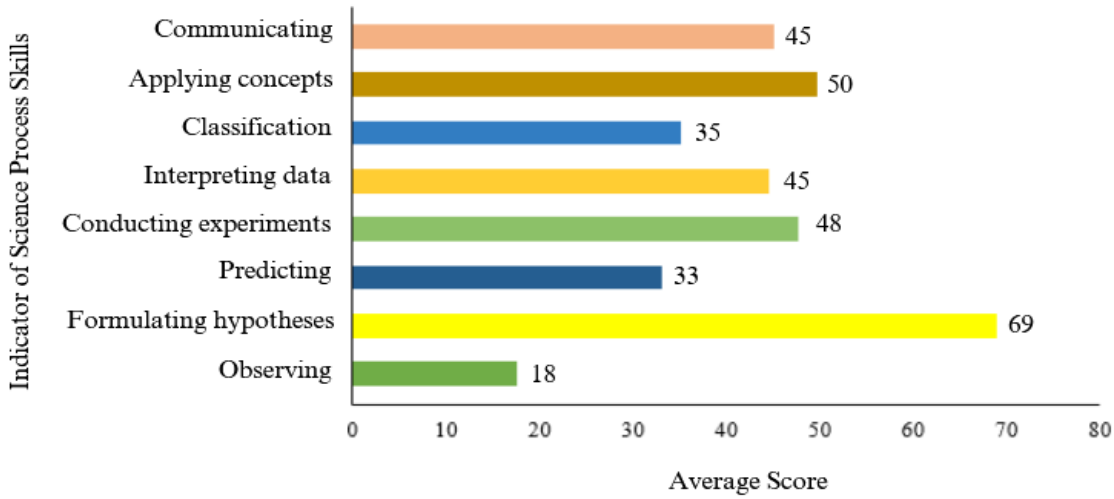

Figure 1. Score of SPS for Each Indicator

Figure 1 shows the average SPS scores for 8 different indicators. Formulating hypotheses obtained the highest score of around 70. Meanwhile, the observing indicator obtained the lowest score of around 18, and the other indicators were 30-50. To see the level of each indicator of students' SPS results, see Table 4.

Table 4. Level of Each SPS Indicator

No.	SPSIndicators	Score	Level
1	Observing	18	Very low
2	Formulating hypotheses	69	High
3	Predicting	33	Low
4	Conducting experiment	48	Medium
5	Interpreting data	45	Medium
6	Classification	35	Low
7	Applying concept	50	Medium
8	Communicating	45	Medium
Average SPS score		**43**	**Medium**

Table 4 shows the results of the assessment of 8 indicators of SPS, with an average score of 43, which is included in the medium level. From the data, it can be seen that the indicator of formulating hypotheses obtained the highest score of 69, which is high. In contrast, the observing indicator received the lowest score of 18, which is very low. The level of students' SPS at each grade level can be seen in Figure 2.

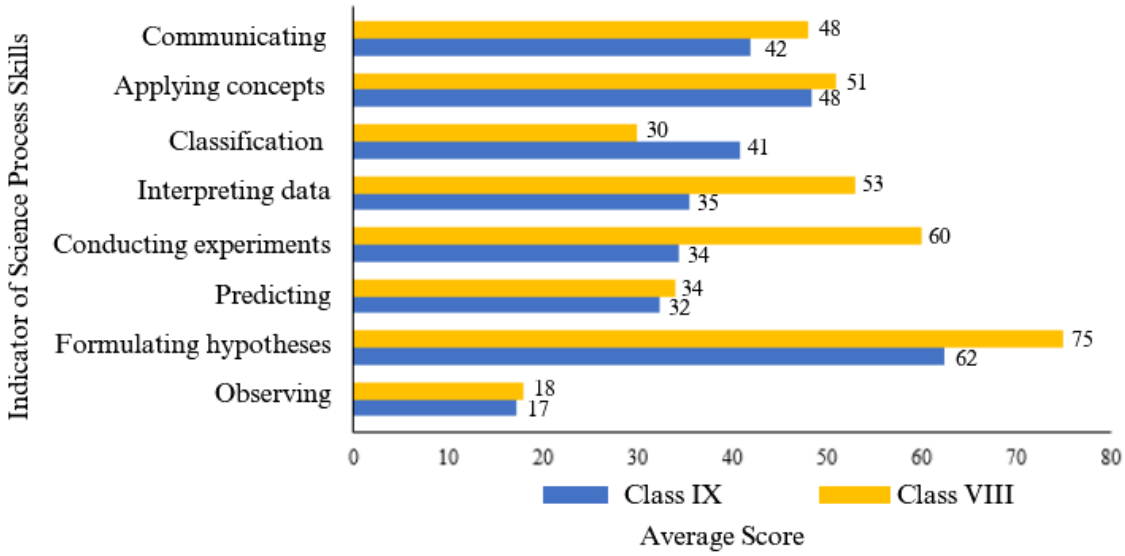

Figure 2. The score of SPS for each indicator

Figure 2 compares the average scores of SPS between classes VIII and IX. Class VIII excels in most indicators, especially formulating hypotheses (75) and conducting experiments (60). The lowest scores on the observing indicator were in grades IX (17) and VIII (18). Table 5 shows the level of each indicator in grades VIII and IX.

Table 5. SPS Levels for Each Class

No.	Indicators of Science Process Skills	Class IX		Class VIII	
		Average score	Level	Average score	Level
1	Observing	17	Very low	18	Very low
2	Formulating hypotheses	62	High	75	High
3	Predicting	32	Low	34	Low
4	Conducting an experiment	34	Low	60	Medium
5	Interpreting data	35	Low	53	Medium
6	Classification	41	Medium	30	Low
7	Applying concepts	48	Medium	51	Medium
8	Communicating	42	Medium	48	Medium
The average score for each class		**39**	**Low**	**46**	**Medium**

Table 5 shows that the average score of SPS of grade IX students is 39, with a low level. The average score of SPS of grade VIII students is 46, with a medium level. The percentage of students at each level can be seen in Figure 3.

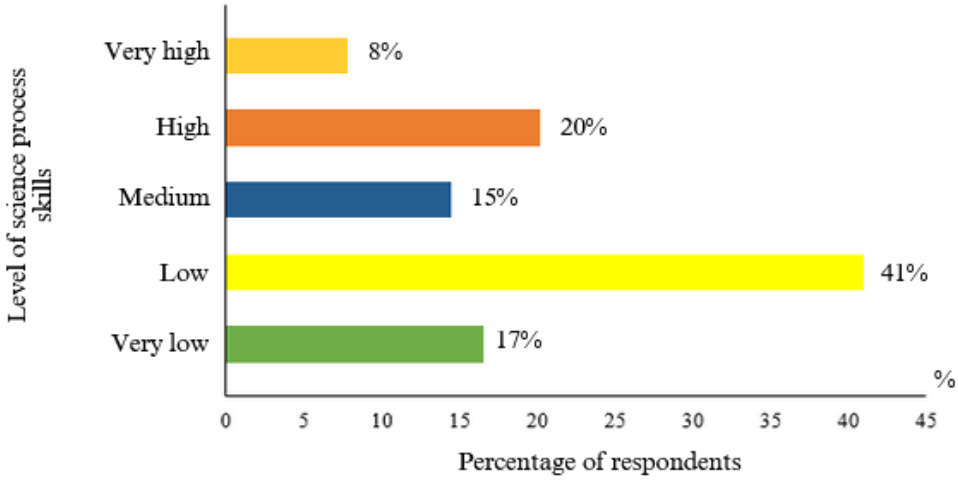

Figure 3. Percentage of Respondents for each Level

Figure 3 shows that the level of respondents' science skills is dominated by the low category, with the highest percentage of 41% or 79 students, followed by the high level of 20% or 39 students, very low 17% or 32 students, medium 15% or 28 students, and the lowest percentage at the very high level is only 8% or 15 students.

Discussions

Students' SPS have an average score of 43, which is at the medium level. The indicator with the highest score proposes a hypothesis (69, high category), indicating good ability in this aspect. In contrast, the observation indicator has the lowest score (18, very low level), indicating significant weaknesses that require special attention. Several other indicators, such as predicting and classifying, are in the low category, while indicators, such as conducting experiments, interpreting data, applying concepts, and communicating, are in the moderate category. This shows that although there are strengths in some areas, comprehensive development efforts are still needed, especially in basic skills such as observation and prediction, to improve SPS comprehensively.

The level of respondents' SPS is dominated by the low level, with the highest percentage, which is 41% or 79 students. This shows that most respondents have low science skills and require special attention. The high category is in second place with 20% or 39 students, followed by the very low category at 17% (32 students) and Medium by 15% (28 students). Meanwhile, the very high category has the lowest percentage, only 8% or 15 students. These data indicate that the majority of students are still at low and very low levels, so efforts are needed to improve science process skills.

The low SPS is caused by several factors, namely the lack of practical activities in schools, and many teachers focus more on delivering theoretical material than involving students in practical activities (Sukarno & Hartoyo, 2023; Hardiyanto et al., 2017; Rini et al., 2022). The application of inadequate learning models also contributes to low skills (AS Rahayu, 2024). Many teachers still use traditional teaching approaches, which tend to prioritize knowledge transfer rather than developing students' practical skills (Novitasari et al., 2017; Mansur, 2021). The use of ICT-based learning media in schools is still very limited, which has an impact on students' mastery of science process concepts and skills (Ratnasari, 2023), technological facilities that are not optimally utilized contribute to low SPS(Maisarah & Prasetya, 2023). Learning that focuses on delivering information rather than involving students in an active learning process (Bachtiar, 2017), and the rarity of practical activities (Isnaeni & Kumaidi, 2015). Based on these various factors, an effort is needed to improve

and innovate the science learning process that can integrate practical activities, the use of technology, and active learning approaches to improve students' SPS.

Some solutions that can be applied to overcome these problems include experiment-based learning (Masus & Fadhilaturrahmi, 2020; Putri et al., 2022). The use of virtual laboratories can also improve SPS (Suswati & Subhan, 2021; Hermana et al., 2022; Nahdi et al., 2020). Improving SPS can also be done by using guided inquiry learning models (Hediana & Nurita, 2022; Nuayi, 2020; Wegasanti & Maulida, 2017), using discovery learning models (Minasari et al., 2020; Meishanti et al., 2020; Ciptaning et al., 2019), using PBL models (Hardiyanti et al., 2017; Lawi & Putra, 2020), using PjBL models (Wismaningati et al., 2019; Nawahdani et al., 2021; R. Rahayu & Ismawati, 2022). These various learning solutions have been proven effective in improving students' science process skills, so educators need to consider implementing these learning models according to the conditions and learning needs in their classes.

Improving SPS can be done through the use of integrated PhET inquiry-based worksheets (Buhera, et al., 2024), ethnoscience-based worksheets (Andriani & Widodo, 2018; Indrawati et al., 2017), inquiry-based worksheets (Junianti & Fauziah, 2018), guided inquiry-based worksheets (Apriliani et al., 2022), PjBL-based worksheets (Maryani et al., 2017; Fajriyanti et al., 2018), use of PhET-assisted discovery-based worksheets (Novebrini et al., 2021). Improving SPS can be done through PhET-assisted practical activities (Kusnandar & Suswati, 2023), the use of PhET based on guided inquiry (Subeki et al., 2022s; Djola et al., 2021). Thus, various worksheet-based and PhET-based learning models have proven effective in improving students' SPS.

However, this study has several limitations. As a profiling study, the findings only describe the current level of SPS among grade VIII and IX students at one school and cannot be generalized to other schools or regions. The instrument consisted of only 8 multiple-choice items covering 8 SPS indicators, which may not fully capture all dimensions of SPS. Future research is recommended to use a larger and more diverse sample, increase the number of SPS indicators, and employ performance-based or observational assessments to obtain a more comprehensive profile of students' SPS.

CONCLUSIONS

This study concludes that the overall SPS of students at SMP Muhammadiyah 1 Berbah, Yogyakarta, is at a medium level with an average score of 43. These findings suggest that students' SPS still require significant improvement, particularly in basic skills such as observing and predicting, so that more innovative and practical learning approaches are strongly recommended to enhance students' SPS comprehensively.

The findings of this study have several practical implications. First, the results provide an initial profile of students' SPS, which can serve as a reference for teachers and schools in designing more targeted learning strategies. Given that most students are still at low and very low levels, teachers are encouraged to shift from theory-based teaching toward more practical and inquiry-based learning approaches. Second, the low scores on observation and prediction indicators suggest that schools need to increase the frequency of hands-on activities and laboratory-based learning. Third, the use of innovative learning models such as discovery, inquiry, PjBL, PBL, and PhET-based learning is strongly recommended to improve students' SPS. Finally, this study can serve as a baseline for future research aimed at developing and evaluating interventions to enhance SPS among junior high school students.

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