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# Science Process Skills of Madrasah Students and Implications for Science Learning in Islamic Education

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**ABSTRACT:** *This study aimed to describe the profile of basic science process skills (SPS) among Grade XI students at MAN 3 Palembang and to analyze its implications for science learning in madrasahs within the context of Islamic education. The study employed a quantitative descriptive approach using a survey method involving 314 Grade XI students selected through total sampling. Data were collected using the Basic Process Skills Test (BAPS), consisting of 36 multiple-choice items, and were analyzed using descriptive statistics in the form of percentages. The results showed that students' basic science process skills were generally at a moderate level, with an average achievement score of 65.89%. Among the six basic SPS aspects, prediction achieved the highest percentage (79.30%), followed by classification (73.51%), whereas measurement obtained the lowest percentage (50.11%). These findings indicate that students possess fundamental scientific thinking skills but still require reinforcement, particularly in measurement skills. In the context of Islamic education, the findings suggest the need for science learning in madrasahs to place greater emphasis on inquiry, laboratory activities, and scientific investigations integrated with Islamic values to develop students' scientific competencies while fostering reflective and responsible individuals. This study provides diagnostic information regarding the strengths and weaknesses of each SPS aspect that can serve as a basis for developing learning strategies, assessment practices, and science curricula in madrasahs to support the improvement of science learning quality within Islamic education.*

Penelitian ini bertujuan untuk mendeskripsikan profil keterampilan proses sains (KPS) dasar peserta didik kelas XI MAN 3 Palembang serta menganalisis implikasinya terhadap pembelajaran sains di madrasah dalam konteks pendidikan Islam. Penelitian menggunakan pendekatan deskriptif kuantitatif dengan metode survei yang melibatkan 314 peserta didik kelas XI yang dipilih menggunakan teknik total sampling. Data dikumpulkan menggunakan Basic Process Skills Test (BAPS) yang terdiri atas 36 butir soal pilihan ganda dan dianalisis menggunakan statistik deskriptif berupa persentase. Hasil penelitian menunjukkan bahwa keterampilan proses sains dasar peserta didik secara umum berada pada kategori cukup dengan rata-rata capaian sebesar 65,89%. Di antara enam aspek KPS dasar, aspek prediksi memperoleh persentase tertinggi (79,30%), diikuti aspek klasifikasi (73,51%), sedangkan aspek pengukuran memperoleh persentase terendah (50,11%). Temuan ini menunjukkan bahwa peserta didik telah memiliki kemampuan dasar dalam berpikir ilmiah, tetapi masih memerlukan

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penguatan pada keterampilan pengukuran. Dalam konteks pendidikan Islam, hasil penelitian mengindikasikan perlunya pembelajaran sains di madrasah yang lebih menekankan kegiatan inkuiri, praktikum, dan investigasi ilmiah yang terintegrasi dengan nilai-nilai Islam untuk mengembangkan kompetensi ilmiah sekaligus membentuk peserta didik yang reflektif dan bertanggung jawab. Penelitian ini memberikan informasi diagnostik mengenai kekuatan dan kelemahan setiap aspek KPS yang dapat dimanfaatkan sebagai dasar pengembangan strategi pembelajaran, asesmen, dan kurikulum sains di madrasah guna mendukung peningkatan kualitas pembelajaran sains dalam pendidikan Islam.

**Keywords:** *Science Process Skills, Madrasah, Islamic Education, Science Learning.*

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## I. INTRODUCTION

Science education is not only oriented toward mastery of concepts, facts, and principles, but also toward developing students' ability to think and work scientifically. In science learning, students need to understand science as a scientific process, namely how scientific knowledge is obtained through observation, measurement, data processing, communication, and systematic inference drawing (Aslan & Kılıç, 2022; Rezba et al., 2007). Therefore, meaningful science learning needs to provide space for students to engage in scientific activities that enable them to construct knowledge through direct experience, rather than merely receiving information verbally. One of the main components that supports meaningful science learning is science process skills (SPS). SPS are a set of skills used to obtain information, process data, interpret findings, and communicate results scientifically (Gizaw & Sota, 2023). These skills serve as a bridge between conceptual mastery and scientific practice because through SPS students learn to observe phenomena, classify information, carry out measurements, make predictions, and draw inference based on evidence. Thus, SPS are not merely a supplement to science learning, but an important foundation for forming scientific ways of thinking, accuracy, and problem-solving ability (Padilla et al., 1985; Rezba et al., 2007).

In general, science process skills are divided into basic science process skills and integrated science process skills. Basic science process skills include observation, communication, classification, measurement, prediction, and inference, whereas integrated science process skills include more complex abilities, such as formulating hypotheses, identifying variables, interpreting relationships among variables, and designing experiments (Gizaw & Sota, 2023; Rezba et al., 2007). Basic skills occupy a very important position because they are prerequisites for the development of advanced scientific skills. If basic skills have not developed well, students tend to experience difficulties when faced with more complex scientific activities that require data-based reasoning (Padilla et al., 1985; Rezba et al., 2007).

Madrasah aliyah has a distinctive educational context because science learning is conducted within an Islamic educational system that integrates intellectual development with ethical and spiritual values. In this context, the development of science process skills aligns with the objectives of Islamic education, where scientific understanding is developed alongside moral awareness and reflection on natural phenomena. The

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integration of Islamic values into science education encourages students to engage in scientific inquiry while connecting scientific knowledge with broader reflections on the natural world and human responsibility (Ilma & Purbowati, 2026). Studies in madrasah contexts have also shown that science learning integrated with Islamic values can strengthen scientific literacy and scientific competence by providing meaningful connections between empirical investigation and value-based understanding (Asiyah et al., 2024). Furthermore, inquiry-based science learning with Islamic values provides opportunities for students to develop reasoning abilities through scientific activities, including investigation, interpretation, and communication of findings (Anggraini & Fahyuni, 2025). Therefore, integrating science process skills into madrasah science learning contributes not only to the development of scientific competence but also to the formation of reflective and value-oriented learners.

The urgency of mastering science process skills has become stronger in the context of 21st-century education. These skills are closely related to critical thinking, problem solving, scientific communication, and scientific literacy. Students who are accustomed to observing carefully, processing data, and drawing evidence-based conclusions will be better prepared to face real problems that require scientific reasoning (Azzahra et al., 2024). In addition, SPS help students understand that scientific knowledge is built through processes that can be tested, observed, and accounted for, rather than merely memorized. Therefore, strengthening SPS in science learning is important for improving learning outcomes while also developing critical thinking, problem-solving ability, and scientific literacy relevant to 21st-century needs (Ernawati et al., 2021; Tawil, 2024).

From the perspective of Islamic Education, observing, reasoning, and reflecting on natural phenomena are integral components of the process of acquiring knowledge. Allah SWT emphasizes the importance of reflection on the signs of creation in the Qur'an:

> "Indeed, in the creation of the heavens and the earth and the alternation of the night and the day are signs for those of understanding" (Qur'an, 3:190).

This verse highlights that observation of the natural world serves as a means of developing intellectual capacity, acquiring knowledge, and strengthening faith through reflection upon Allah's signs manifested in the universe (Wijayanti, 2023).

In line with this principle, Islamic educational theory as reflected in contemporary interpretations of Al-Syaibany's educational philosophy, views education as a holistic process aimed at developing intellectual, spiritual, moral, and social dimensions of human beings. Within science learning, students are expected not only to master scientific concepts but also to develop critical thinking skills, conduct systematic inquiry, and understand scientific knowledge as a means of appreciating Allah's creation. This perspective remains highly relevant to science education in madrasahs, where academic excellence is expected to be integrated with Islamic values and character development (Amir & Rahman, 2022).

Furthermore, Al-Faruqi's concept of the Islamization of knowledge emphasizes that scientific inquiry and Islamic values should be integrated within the process of acquiring knowledge. In madrasah science learning, this perspective highlights that scientific understanding should be developed alongside ethical and spiritual awareness, enabling students to explore natural phenomena scientifically while recognizing their broader meaning and responsibility as learners (Amir & Rahman, 2022).

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Accordingly, the development of science process skills among madrasah students is important not only for supporting scientific literacy, critical thinking, and problem-solving abilities but also for supporting the broader goals of Islamic Education. These skills enable students to investigate natural phenomena systematically, evaluate evidence critically, and construct knowledge responsibly while maintaining awareness of the relationship between scientific inquiry and faith. Therefore, profiling students' science process skills provides valuable information for designing science instruction and curriculum development in madrasahs that align with the objectives of Islamic Education in the twenty-first century (Farida et al., 2023; Kurniawati & Siswanto, 2024). Nevertheless, empirical evidence indicates that students' science process skills do not develop uniformly across different skill indicators, highlighting the need for a more detailed analysis of each SPS aspect rather than relying solely on overall SPS scores (Risher & Lestari, 2024).

Nevertheless, various studies indicate that students' science process skills in Indonesia have not yet developed optimally and tend to vary across aspects. Previous research has reported that the overall profile of science process skills among senior high school students ranges from low to moderate levels, suggesting that students' mastery of these skills remains below expectations (Setyoningrum & Hidayah, 2026). Furthermore, students' achievement in science process skills has been found to vary across different indicators, with some aspects demonstrating higher levels of achievement than others (Ayuni et al., 2026). Previous studies have also shown that basic science process skills generally achieve better results than more cognitively demanding skills that require interpretation, reasoning, and scientific information processing (Hendriyani & Lestari, 2024). These findings suggest that students' mastery of science process skills is often uneven across aspects; therefore, analyses based solely on overall SPS scores may not adequately capture the strengths and weaknesses of specific skill indicators.

Research on science process skills in Indonesia has been widely conducted, and many studies have been directed toward the effects of certain learning models, media, approaches, or strategies on improving SPS. Such studies are important for determining the effectiveness of instructional treatments, but they do not fully provide a diagnostic picture of students' initial science process skills in each basic skill aspect. In fact, information about achievement in each aspect is needed so that teachers can determine which aspects have developed well and which still require reinforcement in science learning.

Despite these findings, studies that specifically profile each aspect of science process skills among madrasah students and discuss their implications for science learning within the framework of Islamic Education remain limited. Existing studies at the madrasah aliyah level generally report overall SPS achievement and provide limited information regarding the development of individual skill aspects. Therefore, analyzing SPS based on specific indicators is important because it enables teachers to identify students' strengths and weaknesses and design more targeted learning activities (Arsyad et al., 2024; Kurniawati, 2021). This study contributes by providing a comprehensive profile of students' science process skills, identifying variations across skill aspects, and offering empirical evidence to support the development of science learning in madrasahs that aligns with the objectives of Islamic Education. Based on the explanation above, this study aims to describe the science process skills profile of Grade XI students at MAN 3 Kota Palembang through an analysis of six basic skill aspects, namely observation, communication, classification, measurement, prediction, and inference.

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The results of this study are expected to provide an empirical picture of the actual condition of students' science process skills and serve as a basis for developing science learning in madrasahs that integrates scientific competence with the objectives of Islamic education.

## II. METHOD

This study employed a quantitative descriptive approach using a survey method. This approach was selected because the study aimed to describe the profile of students' science process skills based on achievement in each skill aspect without implementing any instructional intervention. A quantitative descriptive approach is appropriate for describing educational phenomena systematically and objectively through numerical data, while a survey method enables researchers to collect information from a defined population to portray existing conditions (Patty et al., 2024; Sari et al., 2023). The study was conducted at MAN 3 Kota Palembang, a public madrasah aliyah that implements science learning within the context of Islamic secondary education. The research subjects were all Grade XI students in the 2025/2026 academic year, totaling 314 students. Total sampling was applied because all members of the population were included as research subjects to obtain a comprehensive description of students' science process skills.

The research instrument was a multiple-choice science process skills test consisting of 36 items adapted from the Basic Process Skills Test (BAPS*)* developed by Padilla et al. (1985). The instrument was selected because BAPS was specifically designed to measure students' basic science process skills and has been widely used in science education research. The instrument measured six basic science process skill aspects, namely observation, communication, classification, measurement, prediction, and inference, with each aspect represented by six items corresponding to the science process skill indicators. The adaptation process was carried out by adjusting the content of the items to the research context and aligning the measured aspects with the theoretical framework of science process skills and the objectives of this study. The use of the BAPS instrument was supported by previous studies that applied similar instruments to identify students' science process skills profiles (Hartono et al., 2022). The distribution of test items based on each science process skill aspect is presented in Table 1.

**Table 1. Blueprint of Basic Science Process Skills (SPS) Test**

| No | Aspect | Item |
|---|---|---|
| 1 | Observation | 2, 13, 15, 16, 30, 33 |
| 2 | Communication | 8, 19, 20, 21, 22, 27 |
| 3 | Classification | 4, 7, 11, 18, 31, 35 |
| 4 | Measurement | 1, 5, 14, 23, 29, 36 |
| 5 | Prediction | 3, 10, 12, 17, 25, 32 |
| 6 | Inference | 6, 9, 24, 26, 28, 34 |

Each science process skill aspect in the instrument was measured based on operational descriptors adapted from Rezba et al. (2007). These descriptors define the abilities assessed in each aspect, including observing phenomena using senses, communicating information through various representations, classifying objects based on similarities or differences, measuring quantities using appropriate units, predicting events based on

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available data, and drawing conclusions based on observations. The descriptors of each science process skill aspect are presented in Table 2.

**Table 2. Descriptors of Science Process Skills Aspects**

| No | Aspect | Descriptor |
|---|---|---|
| 1 | Observation | Using the senses to obtain information about an object. |
| 2 | Communication | Communicating information through writing, images, graphs, or other media. |
| 3 | Classification | Grouping objects based on similarities or differences. |
| 4 | Measurement | Determining the value of a quantity by comparing it with standard or non-standard units. |
| 5 | Prediction | Using data to estimate what might happen. |
| 6 | Inference | Drawing meaning or explanations based on observation results. |

Source: Rezba et al., (2007)

Data collection was conducted during the odd semester of the 2025/2026 academic year by administering the SPS test to all Grade XI students of MAN 3 Kota Palembang. Students were instructed to answer all 36 test items according to the provided instructions. Each correct answer received a score of 1, while an incorrect answer received a score of 0. The obtained scores were then grouped according to the measured science process skill aspects to determine students' achievement levels.

The collected data were analyzed using descriptive statistics. The analysis was performed by calculating the percentage achievement of each science process skill aspect based on students' correct answers. The percentage score was calculated using the following formula (Susanti et al., 2023):

$$Percentage = \frac{R}{SM} \times 100\%$$

Description:
R = obtained score
SM = maximum score

The percentage results were used to describe the achievement level of each science process skill aspect and identify aspects with higher and lower achievement. Since this study aimed to describe students' science process skills profiles rather than examine causal relationships, differences between groups, or relationships among variables, inferential statistical analyses were not applied. The obtained percentages were interpreted using the criteria presented in Table 3

**Table 3. Interpretation Criteria for Science Process Skills**

| Percentage (%) | Interpretation |
|---|---|
| 85-100 | Very Good |
| 70-84 | Good |
| 55-69 | Moderate |
| 40-54 | Poor |
| 0-39 | Very Poor |

Source: Ariyansyah & Nurfathurrahmah (2022)

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## III. RESULT AND DISCUSSION

### Profile of Madrasah Students' Science Process Skills

The analysis results of students' science process skills are presented in two forms, namely category distribution based on total scores and percentage achievement in each aspect of science process skills. To provide a general overview of students' level of science process skills, each student's total score was grouped into science process skills categories based on the predetermined interpretation criteria. The frequency distribution and percentage of each category are presented in Table 4.

**Table 4. Distribution of Students' Science Process Skills Categories**

| Category | Frequency | Percentage (%) |
|---|---|---|
| Very Good | 27 | 9 |
| Good | 132 | 42 |
| Moderate | 91 | 29 |
| Poor | 26 | 8 |
| Very Poor | 38 | 12 |
| **Total** | **314** | **100** |

Based on Table 4, the good category was the group with the largest frequency, namely 132 students (42%), followed by the moderate category with 91 students (29%). A total of 27 students (9%) were in the very good category, while 26 students (8%) and 38 students (12%) were in the poor and very poor categories, respectively. These results indicate that most students had science process skills in the good category, although around one-fifth of the students were still in the poor and very poor categories. This condition suggests that students' science process skills varied in terms of mastery level; therefore, analysis of each aspect was needed to identify the aspects that served as strengths and those that still required reinforcement.

Next, an analysis was conducted on achievement in each aspect of science process skills, namely observation, communication, classification, measurement, prediction, and inference. The percentage achievement of each aspect is presented in Table 5.

**Table 5. Percentage Achievement of Science Process Skills**

| SPS Indicator | Percentage (%) | Category |
|---|---|---|
| Observation | 61.46 | Moderate |
| Communication | 65.02 | Moderate |
| Classification | 73.51 | Good |
| Measurement | 50.11 | Poor |
| Prediction | 79.30 | Good |
| Inference | 65.92 | Moderate |
| **Average** | **65.89** | **Moderate** |

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To clarify the comparison of achievement in each aspect, the data in Table 5 were visualized in the form of a bar chart, as presented in Figure 1.

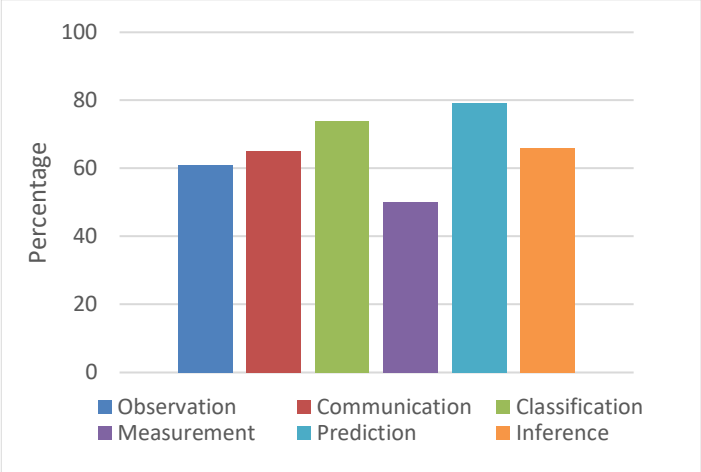


***Figure 1.*** *Comparison of Percentage Achievement in Science Process Skills*

Based on Table 5 and Figure 1, the prediction aspect showed the highest achievement at 79.30%, followed by classification at 73.51%. Both aspects were in the good category. Conversely, the measurement aspect obtained the lowest percentage, namely 50.11%, and was in the poor category. Meanwhile, observation at 61.46%, communication at 65.02%, and inference at 65.92% were in the moderate category. Overall, the average achievement of students' science process skills was 65.89% and fell into the moderate category. Although the largest group was in the good category, the overall average remained in the moderate category. This indicates that the distribution of students' scores was not even. The presence of a number of students in the poor and very poor categories lowered the overall average score. The category distribution shows that most students were in the good category (42%), while 9% of students reached the very good category. On the other hand, 20% of students were still in the poor and very poor categories. This finding suggests that although the majority of students demonstrated adequate mastery of science process skills, some students still required reinforcement, particularly in developing basic scientific skills.

The results showed that the science process skills of Grade XI students at MAN 3 Kota Palembang were generally in the moderate category, with an average percentage of 65.89%. Nevertheless, the category distribution showed that the largest group of students was in the good category. This difference indicates that students' science process skills achievement was not evenly distributed. The presence of students who were still in the poor and very poor categories caused the overall average to remain in the moderate category. This finding shows that students had basic skills in carrying out scientific processes, but their mastery had not developed evenly across all aspects of science process skills. Therefore, analysis of each aspect is important to identify students' strengths and weaknesses in greater detail (Hartono et al., 2022; Jannah et al., 2024; Kurniahtunnisa et al., 2024).

These findings indicate that the science process skills profile of madrasah students is relatively adequate, although mastery remains uneven among students. Science process skills are essential components of scientific literacy because they enable learners to observe phenomena, collect evidence, analyze information, and solve problems scientifically. Therefore, identifying students' science process skills profiles is

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important as a basis for designing learning activities that are more responsive to students' needs and characteristics.

**Analysis of Each Aspect of Science Process Skills in Science Learning in Madrasah**

***Observation Aspect***

The observation aspect reached 61.46% and was categorized as moderate. This achievement indicates that students had an initial ability to obtain information through observation, but they were not yet fully proficient in identifying important details of an object, event, or phenomenon. This condition indicates that students still need to be trained to observe important characteristics more carefully, distinguish relevant information, and record observation results systematically.

The moderate achievement of this aspect suggests that observation skills have begun to develop but have not yet reached the expected level. Observation achievement that had not reached the good category may occur when science learning emphasizes verbal conceptual understanding more than giving students opportunities to conduct direct observations of objects, images, graphs, or real phenomena. Students' observation ability is strongly influenced by learning habits and direct experience in observing changes or scientific phenomena (Wirayuda, 2023). Science process skills also need to be practiced directly so that students become accustomed to using scientific skills when understanding phenomena (Farida et al., 2023). Therefore, science learning needs to involve more guided observation activities, identification of characteristics, and systematic data recording.

***Communication Aspect***

The communication aspect obtained a percentage of 65.02% and was in the moderate category. This result shows that students had basic ability to communicate scientific information, but this ability still needs to be improved. In science process skills, communication does not only mean conveying information orally or in writing, but also includes the ability to read, interpret, and present data in various forms of representation, such as tables, graphs, images, symbols, or other visual forms.

Communication achievement that remained in the moderate category indicates that students were not yet fully accustomed to converting observation results or data into appropriate scientific representations. This condition may occur because learning activities often provide limited opportunities for students to present and interpret scientific data independently. Students still need reinforcement in reading visual data, selecting suitable forms of presentation, using symbols accurately, and constructing coherent scientific explanations. The skills of creating and reading tables or graphs are important parts of scientific communication that still require attention in science learning (Akbar et al., 2023). Assessment of science process skills also needs to be designed to reveal students' ability to use representations and scientific contexts, not merely to recall concepts (Sarıoğlu, 2023). Therefore, science learning needs to provide opportunities for students to present observation results, create tables, read graphs, write brief reports, and present findings systematically.

***Classification Aspect***

The classification aspect obtained a percentage of 73.51% and was in the good category. This achievement shows that students were relatively able to classify objects, data, or phenomena based on similarities and differences in certain characteristics.

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Classification skills play an important role in science learning because they help students organize complex information into a more structured, organized, and meaningful form.

Good achievement in the classification aspect indicates that students were sufficiently able to recognize the characteristics of an object or phenomenon, compare its characteristics, and determine the basis of classification appropriately. However, some students may still experience difficulties when required to classify data using multiple criteria or when dealing with more complex scientific contexts. In science learning, this skill often appears when students are asked to group objects, substances, tools, data, or phenomena based on certain characteristics. The relatively high achievement in this aspect may be influenced by the frequent use of classification activities during science learning, which require students to identify characteristics, compare features, and organize information into meaningful categories. Aspects of science process skills related to organizing information tend to develop more easily when students are frequently involved in activities of identifying characteristics, comparing features, and classifying data (Hartono et al., 2022; Jannah et al., 2024).

***Measurement Aspect***

The measurement aspect obtained the lowest achievement, namely 50.11%, and was in the poor category. Although the achievement was low, students demonstrated a basic understanding of measurement concepts and still encountered difficulties in applying these concepts accurately in scientific situations. The low percentage of measurement indicates that this aspect was the main weakness in students' SPS profile. The considerable gap between measurement and prediction suggests that students found it relatively easier to use information patterns to estimate answers than to perform quantitative processes requiring accuracy in reading data, using measuring instruments, determining units, and interpreting measurement results.

The low achievement in the measurement aspect may also be influenced by the characteristics of learning that have not fully provided students with opportunities to conduct practical activities directly and repeatedly. Measurement skills do not only require conceptual understanding, but also experience in using measuring instruments, reading scales accurately, and recording observation results precisely. Science process skills develop more optimally when learning involves experimental and scientific inquiry activities that provide hands-on and minds-on experiences for students (Idris et al., 2022). This finding is also supported by studies showing that practical activities play an important role in developing science process skills through direct scientific experience (Kriswantoro et al., 2025).

Low achievement in the measurement aspect is in line with Hartono et al. (2022), who showed that several indicators of students' science process skills were still in the low to moderate categories. Measurement is one of the skills that requires particular attention because it is related to students' ability to read data, determine units, and use quantitative information accurately (Sarıoğlu, 2023). In addition, this skill requires continuous practice and cannot develop optimally if learning focuses only on conceptual mastery without providing adequate practical experience (Astalini et al., 2024). Hartanti and Wiyanto (2024) also reported that students' ability to estimate or determine measurements remains one of the main weaknesses when dealing with representations of measuring instruments and units. Therefore, low achievement in the measurement aspect indicates the need to strengthen practical learning through activities involving the

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use of measuring instruments, scale reading, data recording, unit determination, and direct interpretation of measurement results.

### *Prediction Aspect*

The prediction aspect obtained the highest achievement, namely 79.30%, and was in the good category. This achievement shows that students were relatively able to recognize patterns, connect available information, and use that information to estimate possible outcomes or events. Prediction in science is not merely a guess, but the ability to estimate what might happen based on data, trends, relationships among variables, or previous experience.

The high achievement in the prediction aspect can be understood because this skill is often involved in daily learning activities, both when students are asked to predict the outcome of an event based on patterns and when they interpret simple cause-and-effect relationships from the available information. Good achievement in this aspect shows that students had a fairly good foundation of scientific reasoning in projecting an event based on the information provided. However, some students may still experience difficulties when making predictions in more complex situations that require the integration of multiple variables, interpretation of quantitative data, or deeper scientific reasoning. Prediction is a skill closely related to the ability to recognize patterns and use previous experience or data to estimate possible outcomes (Rezba et al., 2007). Achievement in certain SPS aspects, including prediction, can be higher than in other aspects because students are more accustomed to using information patterns in completing science tasks (Hartono et al., 2022; Jannah et al., 2024). Thus, the prediction aspect can be one of students' strengths that needs to be continuously developed through data-based learning, pattern analysis, and scientific problem solving.

### *Inference Aspect*

The inference aspect obtained a percentage of 65.92% and was in the moderate category. This result indicates that students had a basic ability to draw meanings or explanations based on data; however, this ability had not yet developed optimally. Inference is a skill that requires students not only to read data, but also to interpret the meaning of data, recognize relationships among pieces of information, and formulate logical explanations based on evidence.

Inference achievement that remained in the moderate category indicates that some students were not yet fully able to connect data with appropriate scientific explanations. Students may be able to find the available information, but they are not always able to distinguish among data, assumptions, and inferences. This condition may occur because learning activities often emphasize obtaining answers rather than encouraging students to justify inferences using scientific evidence and logical reasoning. This condition shows that inference skills are closely related to evidence-based reasoning. If this skill has not developed optimally, students tend to experience difficulty when asked to explain why an event occurs or how data support a inference. Science process skills need to be assessed in a targeted manner because each skill has different characteristics and thinking demands (Sarıoğlu, 2023). Inference skills also need to be strengthened through learning that provides opportunities for students to interpret data and connect them with evidence (Susanti et al., 2024). Thus, science learning needs to provide more targeted practice in reading evidence, interpreting relationships among data, connecting observation results with concepts, and constructing inferences argumentatively. An

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overview of the strengths and areas for improvement across each science process skill aspect is presented in Figure 2.


***Figure 2.*** *Analysis of Each Aspect of Science Process Skills*

Overall, students' science process skills profile showed variations in achievement across aspects. Prediction and classification obtained the highest percentages, whereas measurement obtained the lowest percentage. This pattern indicates that students were relatively more capable of processing information to recognize patterns and make predictions than of performing skills that require procedural accuracy, the use of measuring instruments, and systematic data recording. This condition suggests that the learning experiences obtained by students may have developed conceptual thinking more than investigative skills through practical activities. Therefore, learning needs to involve more experimental activities so that all aspects of science process skills can develop more evenly.

The variation in achievement across science process skills aspects indicates that students possessed different levels of mastery in scientific competencies. Skills related to pattern recognition and information organization tended to develop better than skills requiring procedural accuracy and quantitative reasoning. This finding suggests that science learning in madrasahs needs to provide a more balanced emphasis on conceptual understanding and investigative experiences through inquiry-based and practical activities (Anggraini & Fahyuni, 2025). Furthermore, science learning in madrasahs should integrate Islamic values with scientific inquiry to support the development of science process skills and critical thinking abilities (Firmansyah et al., 2025).

**Implications of Science Process Skills for Science Learning in Islamic Education**

Overall, the science process skills profile of students in this study showed an uneven achievement pattern. Prediction and classification were in the good category, while observation, communication, and inference were in the moderate category, and measurement was in the poor category. This pattern indicates that students were

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relatively more capable of recognizing patterns and organizing information but still required reinforcement in skills involving careful observation, quantitative data use, scientific communication, and evidence-based reasoning. These findings imply that science learning should provide greater opportunities for students to engage directly in scientific activities and should integrate science process skills into both learning and assessment practices so that students become accustomed to applying scientific skills when understanding concepts and solving scientific problems (Idris et al., 2022).

The findings also suggest that teachers need to design more student-centered learning environments through laboratory activities, experiments, scientific discussions, investigations of contextual phenomena, and problem-solving tasks related to everyday life. Learning experiences that actively involve students in scientific inquiry can support the development of science process skills, scientific reasoning, and meaningful knowledge construction (Ramlawati et al., 2025). Furthermore, authentic scientific activities that require students to investigate problems, analyze evidence, and communicate findings have been shown to enhance science process skills and critical thinking abilities (Rapi et al., 2025).

These pedagogical implications are particularly relevant in madrasah contexts, where science learning is expected to integrate scientific knowledge with Islamic values. Science learning in madrasahs has distinctive characteristics because it is expected to integrate scientific knowledge with Islamic values. Unlike science learning that focuses solely on conceptual understanding, science education in madrasahs also emphasizes the development of religious awareness, moral values, and reflection on the signs of Allah in nature. In the context of Islamic education, the findings of this study have broader implications because science learning in madrasahs is not only intended to develop academic competence but also to foster students' religious character. Science instruction should integrate scientific activities with Islamic values so that students understand that studying natural phenomena is one way of recognizing the greatness of Allah through His creation (Wakit et al., 2025).

This implication is consistent with Al-Faruqi's concept of the integration of knowledge, which argues that the dichotomy between religious and modern sciences should be eliminated through the paradigm of tawhid (Permadi et al., 2025). From this perspective, scientific inquiry serves not only as a means of acquiring empirical knowledge but also as a way to cultivate spiritual awareness and human responsibility as Allah's vicegerents *(khalifah)* on earth. This view is also in line with Al-Syaibani's educational philosophy, which emphasizes the holistic development of learners' potential, including intellectual, spiritual, moral, and physical dimensions, to develop well-rounded individuals capable of fulfilling their responsibilities in society (Salam, 2025).

Building upon Al-Faruqi's concept of the integration of knowledge, strengthening science process skills should not merely be viewed as an effort to improve students' scientific competence but also as a means of implementing the tawhid-based integration of knowledge in madrasah science education. Within this paradigm, scientific knowledge is understood as a way of exploring the order of Allah's creation while simultaneously cultivating ethical awareness and social responsibility. Therefore, science learning in madrasahs should integrate scientific reasoning with ethical and spiritual reflection so that students not only understand natural phenomena through empirical investigation but also recognize their responsibility to apply scientific knowledge for the benefit of society and environmental sustainability. Such an approach

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supports an integrated learning model that connects revelation, reason, and empirical reality as complementary sources of knowledge in the learning process (Harahap et al., 2025).

The implementation of this paradigm can be realized through inquiry-based science learning that systematically develops science process skills. During activities involving observation, measurement, classification, prediction, inference, and communication, teachers can encourage students to relate scientific findings to Islamic values, such as honesty in collecting data, responsibility during scientific investigations, and environmental stewardship as a trust from Allah. Consequently, science process skills function not only as scientific competencies but also as a means of internalizing Islamic values throughout the learning process. This integralistic approach enables a meaningful dialogue between revelation, reason, and empirical reality, thereby creating science learning experiences that are more holistic and meaningful (Afrizal et al., 2025).

The findings of this study further suggest that strengthening science process skills contributes to achieving the broader goals of Islamic education. Skills such as careful observation, objective measurement, evidence-based analysis, and accurate scientific communication are closely aligned with Islamic values, including *ṣidq* (truthfulness), *amanah* (trustworthiness), objectivity, and critical thinking. Considering that measurement was identified as the weakest science process skill in this study, teachers should provide more opportunities for students to conduct quantitative investigations that emphasize accuracy, honesty in recording data, and responsibility in interpreting experimental results. Integrating Islamic values into these scientific activities enables the development of scientific competence to occur simultaneously with character formation, allowing students to acquire not only scientific concepts and science process skills but also religious attitudes, honesty, responsibility, discipline, and environmental awareness (Fitriana et al., 2025; Handoko et al., 2024). Furthermore, based on the findings of this study, such integration has the potential to strengthen students' scientific competence and scientific literacy, enabling them to apply scientific knowledge responsibly in everyday life.

These implications further reinforce Al-Syaibani's view that the objective of Islamic education is to develop individuals holistically through a balanced integration of intellectual, spiritual, moral, social, and physical dimensions (Salam, 2025). In the context of science learning, strengthening science process skills provides students with opportunities to construct knowledge through scientific inquiry while simultaneously developing discipline, collaboration, responsibility, and environmental awareness. Consequently, science learning not only equips students with scientific competence but also fosters Islamic character, which constitutes one of the distinctive characteristics of madrasah education. Ultimately, strengthening science process skills supports the realization of Islamic educational goals by balancing intellectual development with moral character and social responsibility (Salam, 2025).

Science learning in madrasahs can also be strengthened through the integration of *kauniyah* verses that encourage students to observe, investigate, and reflect upon natural phenomena as manifestations of Allah's creation (Wakit et al., 2025). Integrating these verses into inquiry-based science learning enables students to perceive scientific investigation as both an academic activity and an act of reflecting on Allah's signs in nature. Consequently, science process skills become not only scientific competencies for understanding natural phenomena but also educational instruments for fostering

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religious awareness, ethical responsibility, and character development in accordance with the objectives of Islamic education. The conceptual relationship among the pedagogical, philosophical, and Islamic value implications of science process skills in madrasah science learning is presented in Figure 3.

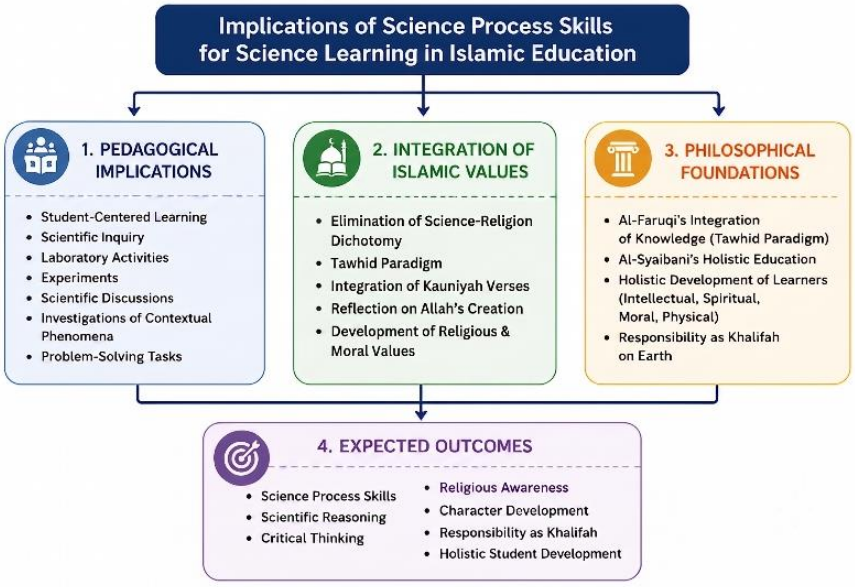


***Figure 3.*** *Implications of Science Process Skills for Science Learning in Islamic Education*

**Relevance of Findings to the Development of Science Learning in Madrasahs**

The findings of this study provide valuable information for science teachers in madrasahs regarding students' science process skills profile. The identification of strengths and weaknesses across different science process skill aspects provides diagnostic information that can help teachers plan learning activities that better address students' learning needs. The lower achievement in measurement skills and the moderate achievement in observation, communication, and inference found in this study indicate specific aspects that require greater instructional attention. Previous studies have emphasized that assessing science process skills is important because it provides information that can be used to improve science teaching and learning practices (Tawil, 2024).

The findings also have implications for the development of science learning strategies in madrasahs. Teachers need to select learning approaches that effectively facilitate the development of students' science process skills. One learning model that can be considered is guided inquiry, which has been shown to have a positive effect on students' science process skills. Previous research indicates that guided inquiry learning can serve as an effective alternative for improving the quality of science learning and supporting the development of students' scientific skills. Therefore, teachers are encouraged to optimize the implementation of guided inquiry learning to promote students' science process skills more effectively (Ristiani et al., 2025).

Furthermore, the findings contribute to the improvement of assessment practices in madrasahs. Science assessment should not only measure students' conceptual understanding but also evaluate their ability to perform scientific processes. Therefore, teachers should incorporate performance-based assessment, laboratory activities, project assignments, and observation-based evaluation to obtain a more comprehensive

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picture of students' science process skills. Assessment practices that evaluate both scientific knowledge and process skills can better support the development of students' scientific competencies (Achor et al., 2024).

At the curriculum level, the findings support the need to strengthen the integration of science process skills into learning outcomes, classroom instruction, and assessment practices in madrasahs. Greater emphasis on observation, measurement, scientific communication, and evidence-based reasoning can help students develop a stronger foundation for scientific learning. Science process skills are recognized as a fundamental component of science education and should be systematically embedded within science curricula to promote scientific literacy, inquiry-oriented learning, and students' ability to apply scientific knowledge in real-world contexts (Hussain et al., 2026).

In addition to their implications for teaching, assessment, and curriculum development, these findings should also be interpreted within the context of the distinctive characteristics of science learning in madrasahs as Islamic educational institutions. This perspective is important because science learning in madrasahs is not solely intended to develop students' scientific knowledge and process skills but also to integrate scientific learning with Islamic values in achieving the broader goals of Islamic education. Madrasahs are Islamic educational institutions that integrate religious education and general knowledge within a unified formal education system. As part of the national education system, madrasahs maintain their Islamic identity by internalizing Islamic values throughout the teaching and learning process while fostering students' character development in response to scientific advancement and the evolving needs of society (Saputra & Faridi, 2026). Therefore, the distinctive characteristic of science learning in madrasahs lies not only in developing students' scientific competencies but also in integrating Islamic values so that students are able to understand natural phenomena scientifically while strengthening their faith, moral character, and responsibility in applying scientific knowledge.

The findings of this study revealed that measurement skills demonstrated the lowest level of achievement, whereas observation, communication, and inference skills remained at a moderate level. These results indicate that students require more structured learning experiences through observation, laboratory activities, scientific investigations, and collaborative discussions. Within the context of science learning in madrasahs, these scientific activities should be integrated with Islamic values so that students not only construct knowledge based on empirical evidence but also develop honesty, accuracy, responsibility, and an awareness of Allah's greatness through the study of natural phenomena. The integration of science learning with Islamic values represents one of the distinctive characteristics of science education in madrasahs, aiming to promote students' cognitive, affective, and spiritual development in a balanced manner (Handoko et al., 2024).

These findings suggest that improving students' science process skills is not only necessary to enhance scientific competence but also to support the holistic educational mission of madrasahs as Islamic educational institutions. Therefore, strengthening science process skills in madrasahs not only contributes to improving the quality of science learning but also supports the achievement of the educational goals of Islamic education by fostering students' balanced intellectual, spiritual, moral, and social development. Integrating science process skills into teaching and assessment enables

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students to acquire scientific knowledge through systematic inquiry while simultaneously internalizing the values of honesty, responsibility, environmental stewardship, and ethical conduct in the application of scientific knowledge. In this way, science learning in madrasahs is expected to produce graduates who possess scientific literacy and critical thinking skills while also demonstrating faith, piety, noble character, and the ability to apply scientific knowledge responsibly in accordance with Islamic values.

## IV. CONCLUSION

This study revealed that the science process skills of Grade XI students at MAN 3 Palembang were generally categorized as moderate, with prediction and classification as the highest-achieving aspects and measurement as the lowest-achieving aspect. These findings indicate that students had developed basic scientific abilities but still required reinforcement in skills related to observation, quantitative data use, scientific communication, and evidence-based reasoning. Therefore, science learning in madrasahs needs to provide balanced opportunities for conceptual understanding and scientific experiences through practical and inquiry-based activities. In the context of Islamic education, this study contributes to strengthening the role of science learning in madrasahs by highlighting the importance of developing scientific competencies alongside students' intellectual and moral development. However, this study was limited to one madrasah and focused on descriptive analysis of students' science process skills, which limits the generalization of the findings. Future researchers are encouraged to involve broader samples, different educational contexts, and experimental designs to examine the effectiveness of specific learning strategies in improving students' science process skills.

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