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# Science Process Skills Profile of Madrasah Students in Supporting the Quality of Islamic Education

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**ABSTRACT:** *Science process skills (SPS) are essential competencies in science learning that support students' scientific thinking and inquiry abilities. However, empirical evidence regarding the SPS profiles of madrasah students as a basis for improving science learning within the context of Islamic education remains limited. This study aimed to analyze the science process skills profiles of tenth-grade students at State Islamic Senior High School 3 Palembang based on six basic science process skill indicators and to examine differences according to gender. A quantitative descriptive approach was employed involving 230 tenth-grade students selected through total sampling. Data were collected using the Basic Science Process Skills (BAPS) test and analyzed using descriptive statistics and an independent-samples t-test at a significance level of 0.05. The results showed that the observation, communication, and classification indicators were categorized as high, whereas measurement and drawing conclusions were categorized as moderate. Prediction achieved the highest score in both gender groups. Although female students obtained a higher average SPS score (67%) than male students (63%), the difference was not statistically significant ($p = 0.337 > 0.05$). This study was limited to a single madrasah, and therefore the findings cannot be generalized to other Islamic educational settings. Nevertheless, the findings provide an empirical basis for teachers to design inquiry-oriented science instruction that strengthens students' science process skills and contributes to the improvement of science learning in Islamic educational institutions.*

Keterampilan proses sains (KPS) merupakan kompetensi penting dalam pembelajaran sains yang mendukung pengembangan kemampuan berpikir ilmiah siswa. Namun, informasi mengenai profil KPS siswa madrasah sebagai dasar pengembangan pembelajaran sains dalam konteks pendidikan Islam masih terbatas. Penelitian ini bertujuan untuk menganalisis profil KPS siswa kelas X MAN 3 Palembang berdasarkan enam indikator keterampilan proses sains dasar serta mengkaji perbedaannya berdasarkan gender. Penelitian menggunakan pendekatan kuantitatif deskriptif dengan melibatkan 230 siswa melalui teknik total sampling. Data dikumpulkan menggunakan tes *Basic Science Process Skills* (BAPS) dan dianalisis menggunakan statistik deskriptif serta uji *independent samples t-test* pada taraf signifikansi 0,05. Hasil penelitian menunjukkan bahwa indikator observasi, komunikasi, dan klasifikasi berada pada kategori tinggi, sedangkan pengukuran dan penarikan kesimpulan berada pada kategori sedang. Indikator prediksi memperoleh capaian tertinggi pada kedua kelompok gender. Meskipun rata-rata skor KPS siswa perempuan (67%) lebih tinggi dibandingkan siswa laki-laki (63%),

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tidak terdapat perbedaan yang signifikan berdasarkan gender (p = 0,337 > 0,05). Penelitian ini terbatas pada satu madrasah sehingga hasilnya belum dapat digeneralisasikan. Meskipun demikian, temuan penelitian memberikan dasar empiris bagi guru dalam merancang pembelajaran sains yang lebih berorientasi pada pengembangan keterampilan proses sains dan berkontribusi terhadap pengembangan pembelajaran sains di lembaga pendidikan Islam.

**Keywords:** *Science Process Skills, Madrasah Students, Basic Science Process Skills, Gender.*

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## I. INTRODUCTION

The quality of Islamic education in madrasahs has become an increasingly important issue in response to the demands of twenty-first century learning, which emphasize not only the acquisition of knowledge but also the development of scientific reasoning, critical thinking, creativity, and problem-solving abilities (Lisan, 2024; Lubis et al., 2022). As institutions that integrate general sciences with Islamic values, madrasahs are expected to produce graduates who possess both scientific literacy and strong moral character. Therefore, science learning in madrasahs should not merely focus on conceptual understanding but should also facilitate students' engagement in scientific inquiry through meaningful learning experiences. One of the essential competencies supporting this objective is science process skills (SPS), which enable students to investigate scientific phenomena systematically and construct knowledge through evidence-based reasoning (Siregar et al., 2025; Zamroni & Fajri, 2023).

Science process skills are recognized as fundamental competencies in science education because they reflect students' ability to observe phenomena, formulate hypotheses, design investigations, collect and analyze data, interpret findings, and draw logical conclusions. Rather than emphasizing what students know, SPS focus on how scientific knowledge is generated through inquiry and experimentation. The study is based on constructivist learning theory, which assumes that learners actively construct scientific understanding through interaction with their environment and engagement in inquiry-based investigation (Driver et al., 2013). Previous studies have also emphasized that the development of SPS is closely associated with critical thinking, metacognitive awareness, scientific reasoning, and problem-solving abilities. Furthermore, the integration of technological pedagogical knowledge, teacher facilitation, and digital learning media has been shown to strengthen students' engagement in scientific practices and improve science learning outcomes (Erizar et al., 2021; Ulin Nuha & Musyafa'ah, 2022; Zamawi et al., 2023).

Within the context of Islamic education, the development of science process skills extends beyond scientific competence and contributes to the integration of scientific knowledge with Islamic values. Islamic educational philosophy emphasizes that scientific inquiry should promote intellectual growth while simultaneously fostering ethical responsibility, honesty, and awareness of God's creation (Al-Attas & Wan Daud, 2019). Accordingly, science learning in madrasahs should develop students' scientific competence alongside the internalization of Islamic values (Amin et al., 2022; Ilma & Purbowati, 2026).

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More specifically, science process skills play a central role in improving the quality of science (IPA) instruction in madrasahs. Fauziah (2018) argues that these skills enable students to actively construct scientific concepts through direct investigation rather than memorization while fostering positive scientific attitudes and values. Empirical evidence also shows that environmental-based learning effectively enhances students' basic science process skills (Fitriah et al., 2024). However, madrasah students often demonstrate limited mastery of higher-order science process skills, particularly in formulating hypotheses and interpreting data (Wiratman et al., 2021). This gap highlights the need for more systematic efforts to develop science process skills in madrasah science learning.

Beyond their pedagogical role, science process skills also support the broader mission of Islamic education. Integrating Islamic values into science learning helps students view science and religion as complementary while strengthening critical thinking as well as moral and spiritual development (Firmansyah et al., 2024). Despite the recognized importance of integrating science process skills with Islamic educational values, their implementation in madrasah classrooms remains challenging. Teachers often experience difficulties in connecting inquiry-based science activities with Islamic values in a coherent and systematic manner (Fajrin & Muqowim, 2020) Consequently, students' opportunities to develop science process skills within meaningful Islamic learning contexts remain limited. These challenges indicate the need for empirical evidence describing students' science process skills to support the improvement of science learning in madrasahs.

Previous literature has highlighted that holistic educational approaches integrating Islamic philosophy with contemporary curricula promote student-centered learning, critical thinking, creativity, and character development (Hermawan et al., 2024). Likewise, the reconstruction of instructional design in Islamic education has emphasized the necessity of adapting learning practices to technological developments and future educational challenges while preserving Islamic moral values (Rusman, 2023; Sofiyandi et al., 2024). Therefore, science process skills can be viewed as an important bridge connecting scientific inquiry with the broader goals of Islamic education (Azmar & Ali, 2022; Mansir, 2021; Wicaksono et al., 2023).

Several previous studies have examined different dimensions of improving educational quality in madrasahs. Ashari et al. (2022) investigated integrated curriculum management and demonstrated its contribution to students' cognitive and spiritual development in Islamic boarding schools. Hermawan et al. (2024) proposed integrating Al-Kindi's educational philosophy with the Merdeka Curriculum to strengthen student-centered learning in Madrasah Aliyah. Sofiyandi et al. (2024) discussed the reconstruction of instructional design in Islamic Religious Education to address future educational demands. Zamawi et al. (2023) found that transformational leadership of madrasah principals positively influences school quality and the implementation of value-based educational programs. Similarly, Achsin et al. (2021) reported that integrating the national curriculum with Islamic educational programs enhances students' holistic competencies. Collectively, these studies demonstrate that curriculum development, educational leadership, instructional design, and Islamic educational philosophy play important roles in improving the quality of education in madrasahs.

Despite these valuable contributions, previous studies have primarily concentrated on curriculum implementation, educational leadership, instructional management, and

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philosophical integration within Islamic education. Limited attention has been devoted to empirically profiling students' science process skills as indicators supporting the quality of Islamic education in madrasahs. Furthermore, existing studies rarely examine how each indicator of science process skills provides empirical evidence for improving science learning strategies within the unique context of Islamic educational institutions. As a result, there is still limited understanding of students' strengths and weaknesses across different dimensions of science process skills and how this information can be utilized to improve the quality of science learning in madrasahs.

The novelty of this study lies not in the research setting but in its comprehensive profiling of each science process skill indicator among madrasah students as an empirical basis for strengthening science learning within Islamic education. Specifically, this study examines students' competencies in observation, classification, hypothesis formulation, experimentation, data interpretation, and conclusion drawing. The resulting profile provides empirical evidence for designing science learning strategies that integrate scientific inquiry with the values of Islamic education. Therefore, this study contributes theoretically by expanding the understanding of science process skills within the context of Islamic education and contributes practically by providing evidence-based recommendations for improving science instruction in madrasahs. Based on these considerations, this study aims to analyze the science process skills profile of madrasah students across different science process skill indicators and to explain how the findings contribute to supporting the quality of Islamic education through more effective, inquiry-based, and contextually relevant science learning practices.

## II. METHOD

This study employed a quantitative descriptive research design to describe the science process skills (SPS) of tenth-grade students based on six basic science process skill indicators: observation, classification, measurement, prediction, communication, and drawing conclusions. In addition, the study examined whether there were significant differences in students' science process skills based on gender. The participants consisted of 230 tenth-grade students 230 tenth-grade students (137 female and 93 male) enrolled in the science program at State Islamic Senior High School 3 Palembang. Since the population was relatively small and accessible, this study employed a total sampling technique, in which all members of the population were included as research participants (Sugiyono, 2022). Data were collected using a 36-item Basic Process Skills Test (BAPS) to assess six indicators of basic science process skills: observation, classification, measurement, prediction, communication, and drawing conclusions. Each indicator was represented by several multiple-choice items to evaluate students' mastery of the corresponding science process skills. The test was administered once to all participants during the research period. The instrument employed in this study was the Basic Process Skills Test (BAPS), originally developed by Padilla et al. (1985). The Indonesian version used in this study was adapted and translated by Hartono et al. (2022) based on the original BAPS. The instrument consists of 36 multiple-choice items covering six indicators of basic science process skills: observation, classification, measurement, prediction, communication, and drawing conclusions.

To examine whether science process skills differed significantly between male and female students, an independent-samples t-test was conducted with a significance level

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of 0.05. Before performing the t-test, the assumptions of normality and homogeneity of variance were examined using the Shapiro-Wilk test and Levene's test, respectively. The independent-samples t-test is an appropriate statistical procedure for comparing the mean scores of two independent groups (Waruwu et al., 2025). A significance value ($p<0.05$) indicated a statistically significant difference between the two groups, whereas ($p>0.05$) indicated that no significant difference existed. All statistical analyses were performed using IBM SPSS Statistics. The data were analyzed using the percentage formula:

$$P = \frac{\text{Score Obtained}}{\text{maximum score}} \times 100\%$$

Interpretation criteria for the data after analysis are as follows

**Table 1. Categories of Science Process Skills Indicators**

| Percentage (%) | Category |
|---|---|
| 75,05 – 100,00 | Very High |
| 58,83 – 75,04 | High |
| 41,65 – 58,82 | Moderate |
| 24,95 – 41,64 | Low |
| 0 – 24,94 | Very Low |

Source: Hartono et al. (2022)

## III. RESULT AND DISCUSSION

A 36-item Basic Science Process Skills (BAPS) test was administered to 230 tenth-grade students to evaluate their achievement across six science process skill (SPS) indicators: observation, communication, classification, measurement, prediction, and conclusion drawing. The results are presented in three sections that correspond to the research questions of this study: (1) the profile of students' science process skills for each indicator, (2) the difference in overall science process skills between male and female students, and (3) the gender-based comparison of science process skills for each indicator. Each section first presents the empirical findings, followed by a discussion linking the results to relevant theories and previous studies.

### Profile of Students' Science Process Skills by Indicator

The percentage scores obtained by male and female students on each of the six SPS indicators are summarized in Table 2.

**Table 2. Profile of Science Process Skills by Indicator**

| No | Indicator | Total Score | | Percentage (%) | | Category | |
|---|---|---|---|---|---|---|---|
| | | Male | Female | Male | Female | Male | Female |
| 1 | Observation | 563 | 338 | 61 | 68 | High | High |
| 2 | Communication | 566 | 377 | 68 | 69 | High | High |
| 3 | Classification | 615 | 392 | 70 | 75 | High | High |
| 4 | Measurement | 438 | 286 | 51 | 53 | Moderate | Moderate |
| 5 | Prediction | 670 | 473 | 78 | 82 | Very High | Very High |
| 6 | Conclusion | 450 | 282 | 51 | 55 | Moderate | Moderate |

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Furthermore, illustrates this variation across indicators for male and female students:

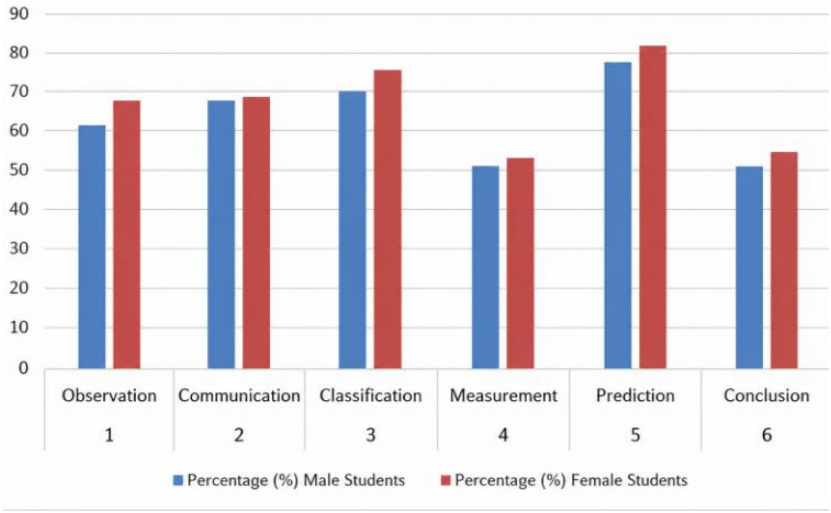


***Figure 1.*** *Gender Comparison for Each Science Process Skills Indicator*

Table 2 and Figure 1 present the descriptive analysis of students' science process skills (SPS) across six indicators for male and female students. Overall, female students obtained a slightly higher mean SPS score (67%) than male students (63%). Despite this difference, both groups demonstrated a similar pattern of achievement across all indicators. Prediction was the highest-performing indicator, with percentages of 78% for male students and 82% for female students, followed by classification (70% and 75%), communication (68% and 69%), and observation (61% and 68%), all of which were categorized as high or very high. In contrast, measurement (51% and 53%) and conclusion drawing (50% and 55%) showed the lowest percentages and were categorized as moderate. These findings indicate that students performed better on several fundamental science process skill indicators than on indicators requiring more advanced scientific reasoning. Overall, the descriptive results suggest that students have developed relatively strong competencies in recognizing scientific phenomena, organizing information, communicating findings, and predicting outcomes. However, their achievement in measurement and conclusion drawing was noticeably lower than the other indicators, indicating that these skills remain areas requiring further improvement.

The high achievement in prediction indicates that students were generally able to use their prior scientific knowledge to anticipate possible outcomes of observed phenomena. Prediction reflects students' conceptual understanding because they are required to relate previous learning experiences to future events. This finding is consistent with Yumniya & Handayani (2025), who reported that students with stronger conceptual understanding tend to demonstrate better prediction skills. The very high performance in this indicator may therefore suggest that science learning has successfully facilitated students in connecting scientific concepts with everyday phenomena.

Similarly, the high performance in the classification, communication, and observation indicators demonstrates that students have mastered several fundamental science process skills. Observation is widely recognized as the starting point of scientific inquiry because it enables learners to identify relevant characteristics before conducting further investigations (Pedaste et al., 2021). Likewise, classification allows students to organize

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scientific information based on similarities and differences, while communication enables them to express scientific ideas effectively through oral or written explanations. Previous studies have shown that contextual learning, collaborative discussion, and inquiry-based instruction contribute significantly to the development of these basic science process skills (Darmaji et al., 2022; Nosela et al., 2021; Rokhimawan et al., 2022).

In contrast, measurement and conclusion drawing remained in the moderate category for both male and female students. Measurement requires procedural accuracy, experience in using scientific instruments, and the ability to interpret quantitative data. Students who have limited opportunities to conduct laboratory investigations often encounter difficulties in performing accurate measurements (Margoum et al., 2022; Rahmawati et al., 2022). Likewise, drawing conclusions is considered a higher-order science process skill because students must integrate observations, measurement results, and scientific concepts to produce evidence-based explanations. According to Apriyani et al. (2021) and Purnomo et al. (2023), students' ability to formulate scientific conclusions improves through inquiry-based learning and scientific argumentation activities that emphasize data interpretation and logical reasoning.

Taken together, these findings indicate that students have achieved stronger performance in basic science process skills than in more complex skills involving quantitative reasoning and evidence-based interpretation. This pattern supports the developmental perspective of science process skills, which suggests that learners generally acquire basic skills before mastering integrated skills requiring higher-order thinking and scientific inquiry (Darmaji et al., 2022; Pedaste et al., 2021). Therefore, greater emphasis should be placed on laboratory-based inquiry, scientific investigations, and data interpretation activities to promote a more balanced development across all science process skill indicators.

**Difference in Overall Science Process Skills Between Male and Female Students**

**Table 3. Normality Test**

| Gender | Sig | Interpretation |
|---|---|---|
| Male | 0.000 | abnormal |
| Female | 0.000 | abnormal |

Table 3 presents the results of the normality test for science process skills scores based on gender. The Kolmogorov–Smirnov and Shapiro–Wilk tests indicated that the SPS scores for both male and female students were not normally distributed ($p < 0.001$). Therefore, the assumption of normality required for a parametric independent sample *t*-test was not met. Consequently, the comparison of science process skills between male and female students was conducted using the non-parametric Mann–Whitney U test.

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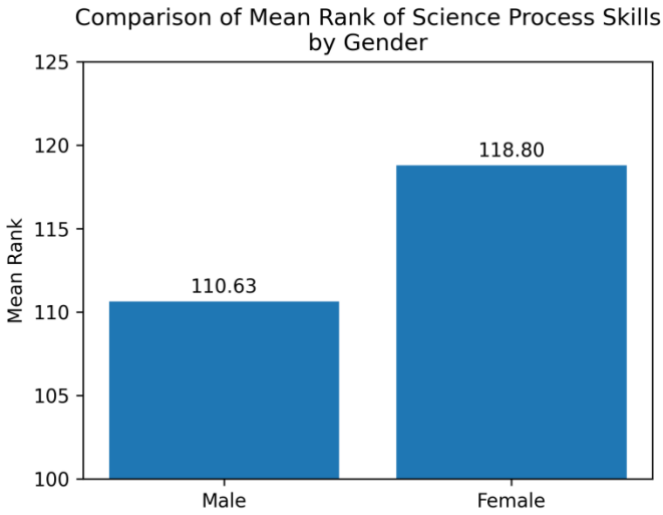


***Figure 2.*** *Comparison of Mean Rank of Science Process Skills by Gender*

Figure 2 shows that female students obtained a slightly higher mean rank (118.80) than male students (110.63), indicating a tendency for female students to achieve somewhat better science process skills scores.

**Table 4. Mann–Whitney U Test**

| | |
|---|---|
| Mann-Whitney U | 5918.000 |
| Wilcoxon W | 10289.000 |
| Z | -.916 |
| Asymp. Sig. (2-tailed) | 0.360 |

The results of the study showed no significant difference in science process skills (SPS) between male and female students ($p = 0.360 > 0.05$), although female students achieved slightly higher average scores than male students. This finding suggests that gender is not a direct determinant of mastery of science process skills. In other words, students' abilities to observe, classify, measure, predict, communicate, and draw conclusions develop relatively equally when they receive equal learning experiences and opportunities. These results indicate that variations in science process skills are more influenced by the quality of the learning process than by students' biological characteristics.

This finding aligns with the theory of science process skills proposed by Rezba et al. (2007), which states that science process skills are a set of abilities acquired through practice, experience, and active involvement in the scientific process. Similarly, Padilla (1990) explains that science process skills are not innate abilities, but rather competencies that develop through ongoing scientific inquiry. Therefore, students' success in mastering science process skills is determined more by the intensity of their involvement in observation, experimentation, scientific discussion, and data interpretation than by gender.

From a constructivist perspective, the results of this study can also be understood through the views of Piaget (1972) and Vygotsky (1978), who emphasize that knowledge is constructed through active interactions between students and their learning

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environment. Learning that provides opportunities for all students to investigate, solve problems, and construct knowledge will result in relatively equal development of scientific abilities regardless of gender. Therefore, when teachers provide an inclusive learning environment oriented toward scientific activity, both male and female students have equal opportunities to develop science process skills.

The findings of this study are consistent with several previous studies. Darmaji et al. (2022) reported no significant differences in science process skills between male and female students in physics learning. Similar results were also found by Puspita Sari et al. (2023), who showed that gender did not significantly influence students' science process skills when the learning process was implemented using an inquiry-based approach. Furthermore, Omolabake and Bamidele (2025) also concluded that equal learning opportunities can minimize the gender gap in mastery of scientific skills. The consistency of these findings reinforces the idea that science process skills are competencies that can be developed by all students through appropriate learning experiences.

However, the results of this study differ from several studies that report a tendency towards differences in scientific ability based on gender. Some studies found that female students tend to excel in aspects of scientific observation and communication, while male students excel more in activities involving tool manipulation or spatial reasoning. These differences are thought to be more influenced by variations in the learning environment, school culture, practical experiences, and applied learning strategies than by biological factors alone. Therefore, the differing results across studies indicate that the influence of gender on science process skills is contextual and strongly influenced by the quality of the learning students receive.

In the madrasah context, these findings suggest that science learning needs to be designed inclusively by providing equal opportunities for all students to engage in scientific activities. Teachers should not differentiate learning strategies based on gender, but rather focus on providing learning experiences that systematically develop observation, measurement, experimentation, scientific communication, and conclusion-drawing skills. Inquiry-based learning approaches, laboratory experiments, and project-based learning can be effective alternatives for developing science process skills across all students.

From an Islamic education perspective, these findings indicate that there is no difference in science process skills between male and female students, indicating that scientific thinking ability is an intellectual potential (*'aql*) that can be optimally developed through the educational process, regardless of gender. Al-Syaibani (1979) explains that the goal of Islamic education is to develop all human potential in a holistic and balanced manner, encompassing intellectual, spiritual, moral, physical, and social dimensions, enabling students to fulfill their roles as servants of Allah and vicegerents on earth (*khalifatullah*). Within this framework, the development of science process skills is not only directed at mastering scientific methods, but also serves as a means to develop critical, objective, honest, and responsible thinking skills as part of the formation of a Muslim personality. Therefore, equal opportunities for male and female students to develop science process skills are an implementation of the principle of justice (*al-'adl*) in Islamic education, namely providing equal opportunities for every student to optimize their intellectual potential in accordance with the innate nature bestowed by Allah SWT.

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These findings also reinforce the view that science learning in madrasas should not discriminate based on gender, but rather emphasize providing meaningful learning experiences through observation, experimentation, investigation, and scientific problem-solving. When all students have equal opportunities to engage in scientific activities, the development of science process skills is determined more by the quality of the learning than by their biological characteristics. This aligns with the concept of Islamic education, which places science as a mandate that must be developed by every Muslim, regardless of gender. The Prophet Muhammad also emphasized the importance of seeking knowledge for every Muslim as a religious obligation, so developing scientific competency through science learning is one way to implement this value.

Furthermore, the results of this study have important implications for the development of science learning in madrasas. Teachers need to design inclusive learning by providing equal opportunities for all students to conduct observations, measurements, experiments, scientific discussions, and draw conclusions based on empirical evidence. This kind of learning approach not only supports the mastery of science process skills, but also aligns with the goals of Islamic Education which integrate the development of reason (*'aql*), the formation of morals, and the growth of awareness of the greatness of God through the study of natural phenomena (*ayat kauniyah*). Thus, the findings of this study not only provide empirical evidence that gender is not a factor that determines students' science process skills, but also strengthen the relevance of science learning as a vehicle for developing the quality of Islamic education in madrasas through scientific, inclusive learning, and oriented towards the development of human potential holistically.

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

Research results indicate that madrasah students' science process skills (SPS) have not developed evenly across all indicators. Students achieved relatively high levels of achievement in the observation, communication, classification, and prediction indicators, while the measurement and conclusion-drawing indicators remained in the moderate category. This finding indicates that students have mastered basic science process skills more than skills requiring scientific reasoning, data analysis, and drawing conclusions based on empirical evidence. This difference in achievement indicates that the learning process has been able to develop students' basic abilities in observing and identifying scientific phenomena. However, the learning has not fully provided students with adequate experience in conducting precise measurements, analyzing observational data, and drawing systematic scientific conclusions. This situation indicates that higher-level scientific thinking skills still need strengthening.

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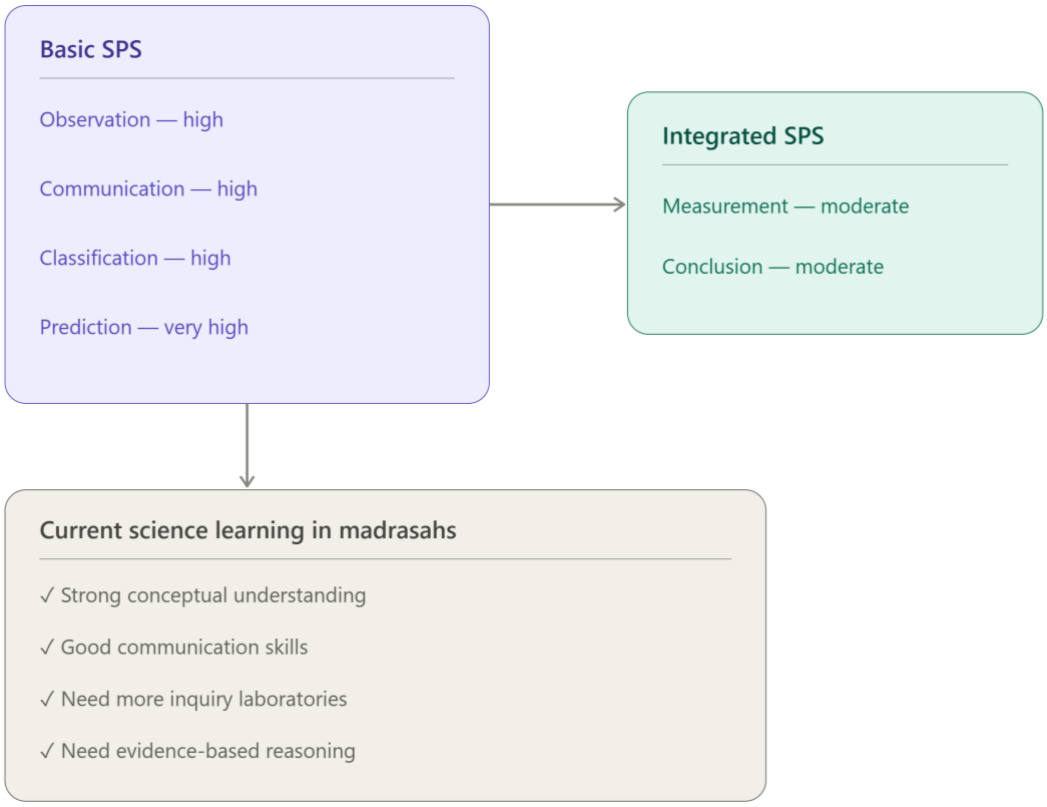


***Figure 3.*** *Synthesis of Science Process Skills Profile in Madrasah Science Learning*

This finding aligns with the Science Process Skills theory proposed by Padilla (1990) and Rezba et al. (2007). According to these two experts, science process skills develop gradually, from basic science process skills to integrated science process skills. Observation, classification, communication, and prediction skills are the foundation for the development of more complex scientific skills such as measurement, data interpretation, variable control, and conclusion drawing. Therefore, lower achievement in the measurement and conclusion drawing indicators does not indicate a general lack of student ability, but rather indicates that the learning process has not fully provided students with the opportunity to develop complex scientific skills. Both indicators require repeated practice through experimental activities, data collection, and analysis of investigative results.

This finding can also be explained from a constructivist perspective. According to Piaget (1972), knowledge is constructed through a process of assimilation and accommodation based on students' learning experiences. Meanwhile, Vygotsky (1978) emphasized that the development of thinking skills is influenced by social interaction, teacher scaffolding, and collaborative activities. Therefore, science process skills will develop optimally if students receive learning experiences that position them as key actors in the scientific inquiry process. This view is supported by Pedaste et al. (2021) explained that inquiry-based learning enables students to develop skills in observing, formulating problems, formulating hypotheses, conducting experiments, analyzing data, and communicating the results of investigations. In other words, science process skills

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develop through authentic scientific experiences, not simply through verbal presentation of concepts.

The results of this study also showed no significant differences in science process skills between male and female students. Although female students achieved slightly higher average scores than male students, the Mann–Whitney test showed that this difference was not statistically significant ($p = 0.360 > 0.05$). Thus, gender is not a determining factor in mastery of science process skills. These findings indicate that scientific thinking skills can develop relatively equally when all students receive the same learning opportunities, practical experience, and access to scientific activities. Therefore, variations in science process skills are more influenced by the quality of instruction, the intensity of student engagement, and experience conducting investigations than by students' biological characteristics.

The results of this study support the theories of Padilla (1990) and Rezba et al. (2007), who explain that science process skills are a set of abilities acquired through continuous practice and learning experiences. The ability to observe, measure, classify, predict, communicate results, and draw conclusions is not innate but develops through students' active involvement in the scientific process. These findings also reinforce constructivist theory, which states that every student has an equal opportunity to develop thinking skills if they are provided with a supportive learning environment. Both Piaget (1972) and Vygotsky (1978) emphasized that the quality of learning experiences is a greater determinant of cognitive development than individual characteristics such as gender. Therefore, learning that provides all students with opportunities to observe, experiment, discuss, and reflect will result in relatively equal development of science process skills.

These results are consistent with research by Darmaji et al. (2022), Puspita Sari et al. (2023), and Omolabake and Bamidele (2025), which reported that gender differences in science process skills tend to be insignificant when students receive equal learning experiences. These various studies demonstrate that inquiry-based learning and laboratory experiments provide equal opportunities for all students to develop scientific thinking skills. Furthermore, gender differences in science process skills are contextual and cannot be generalized as biological factors determining students' scientific abilities. In the madrasah context, these findings suggest that the development of science process skills should be directed more towards improving the quality of learning rather than differentiating learning strategies based on gender. Teachers need to provide learning experiences that provide equal opportunities for all students to conduct observations, experiments, measurements, data analysis, scientific discussions, and draw evidence-based conclusions.

From the perspective of Islamic education, these findings demonstrate that scientific thinking skills are part of the development of the intellectual potential ('aql) possessed by every student, regardless of gender. According to Al-Syaibani (1979), the goal of Islamic education is to develop all human potential in a balanced manner, encompassing intellectual, spiritual, moral, physical, and social aspects, so that humans can fulfill their functions as 'abdullah and khalifatullah. Therefore, providing equal learning opportunities for male and female students to develop science process skills is an implementation of the principle of justice (al-'adl) in Islamic education. Science learning in madrasas not only aims to develop scientific competence but also fosters an objective, honest, meticulous, responsible attitude, and an awareness of the greatness of God through the study of the verses of kauniyah (Islamic verses).

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Overall, this study shows that science learning in madrasas has successfully developed most basic science process skills, but has not fully optimized higher-level scientific skills, particularly in the areas of measurement and conclusion-drawing. Therefore, strengthening inquiry-based learning, laboratory experiments, scientific investigations, and authentic assessments is necessary to ensure a more balanced development of all indicators of science process skills. These findings also confirm that improving the quality of science learning in madrasas does not depend on differences in student gender, but rather on the quality of learning experiences designed by teachers that are scientifically sound, inclusive, and aligned with the goals of Islamic education.

**Implications of the Science Process Skills Profile for Science Learning Development in Madrasahs**

The findings indicate that students have developed strong performance in several basic science process skills but continue to experience challenges in measurement and conclusion drawing. Furthermore, the absence of significant gender differences suggests that all students possess similar potential to develop science process skills when provided with appropriate learning opportunities. These findings provide an empirical basis for improving science instruction in madrasahs by focusing on strengthening integrated science process skills rather than differentiating instruction based on gender.

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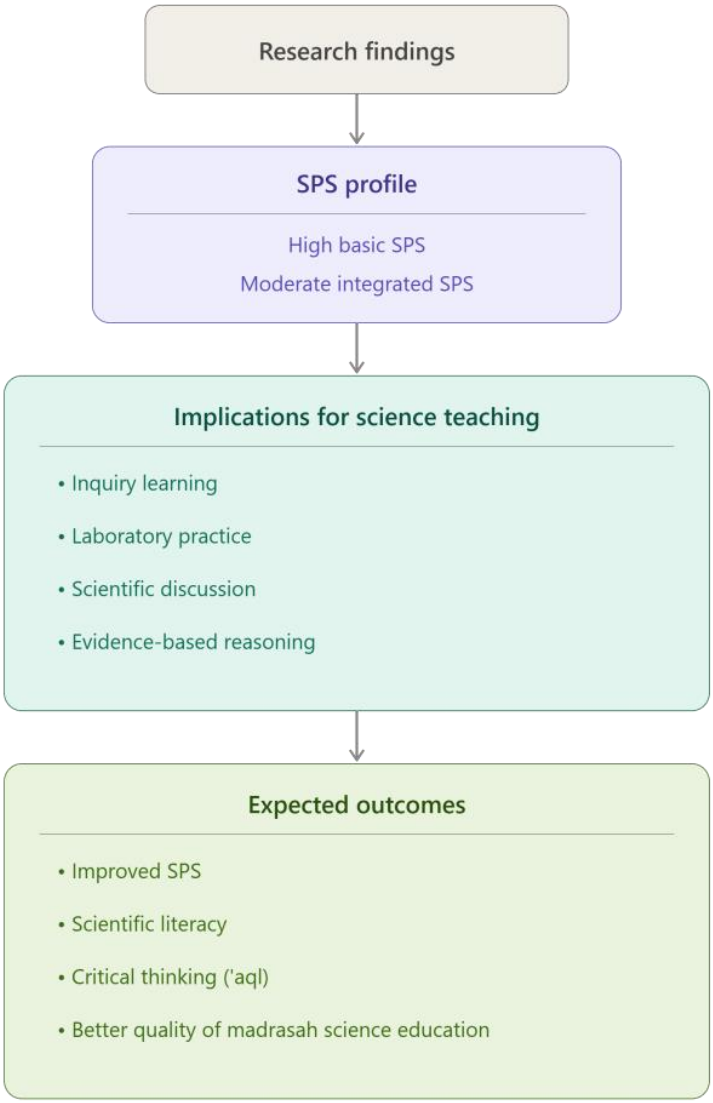


***Figure 4.*** *Educational Implications of the Science Process Skills Profile for Madrasah Science Learning*

The science process skills profile identified in this study has several implications for improving science learning in madrasahs. First, science instruction should provide more opportunities for students to participate in inquiry-based laboratory investigations that require them to perform measurements, analyze data, and formulate scientific conclusions. Such learning experiences enable students to construct knowledge through direct investigation rather than passive information acquisition, thereby supporting the development of higher-order thinking skills (Pedaste et al., 2021; Rahmawati et al., 2022). Second, the findings may serve as an evaluation framework for science teachers in identifying which science process skill indicators require greater instructional attention. While observation, communication, classification, and prediction have been relatively well developed, greater emphasis should be placed on activities involving quantitative analysis, scientific reasoning, and evidence-based argumentation. Integrating project-based investigations, guided inquiry, and collaborative laboratory

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activities may contribute to more balanced development of all science process skill dimensions (Darmaji et al., 2022; Setiawan et al., 2023).

Science learning in madrasahs is expected not only to develop students' scientific knowledge but also to cultivate intellectual, moral, and spiritual competencies in accordance with the goals of Islamic education. From the perspective of Islamic educational philosophy, the pursuit of knowledge (talab al-'ilm) is regarded as both an intellectual and religious responsibility. Consequently, science learning should encourage students to observe natural phenomena, investigate empirical evidence, and formulate rational conclusions while strengthening their awareness of Allah's creation. This perspective is consistent with constructivist and inquiry-based learning theories, which emphasize that meaningful knowledge is constructed through active investigation, reflection, and evidence-based reasoning (Pedaste et al., 2021; Rahmawati et al., 2022).

The findings of this study indicate that students demonstrated relatively strong achievement in observation, communication, classification, and prediction, whereas measurement and conclusion drawing remained at the moderate level. These findings suggest that science learning in the participating madrasahs has successfully supported the development of students' fundamental science process skills. However, greater opportunities are still required for students to engage in laboratory investigations, quantitative data analysis, and evidence-based reasoning to strengthen higher-order science process skills (Margoum et al., 2022; Rahmawati et al., 2022).

These findings imply that science instruction in madrasahs should place greater emphasis on inquiry-oriented learning experiences. Inquiry-based laboratory activities, guided scientific investigations, collaborative discussions, and reflective learning enable students not only to acquire scientific concepts but also to develop critical thinking, problem-solving skills, and scientific attitudes. Previous studies have consistently reported that inquiry-based instruction improves students' science process skills, scientific literacy, and conceptual understanding more effectively than teacher-centered approaches (Pedaste et al., 2021; Darmaji et al., 2022; Puspita Sari et al., 2023).

The findings of this study further demonstrate that integrating inquiry-based science learning with the educational goals of madrasahs provides opportunities for students to develop scientific reasoning alongside Islamic values. Through laboratory investigations, reflective discussions, and evidence-based problem solving, students are encouraged not only to understand scientific concepts but also to develop honesty, responsibility, and critical thinking in accordance with the broader objectives of Islamic education. These learning experiences support the holistic development of learners by integrating cognitive, affective, and scientific competencies within authentic learning contexts (Pedaste et al., 2021; Rahmawati et al., 2022).

Overall, the findings of this study indicate that strengthening science process skills in madrasahs requires learning environments that integrate inquiry-based instruction, laboratory activities, and scientific discussions. Rather than emphasizing gender differences, teachers should provide equitable learning opportunities that enable all students to observe, investigate, analyze evidence, and communicate scientific explanations. Such instructional practices are expected to improve students' science process skills, scientific literacy, critical thinking, and the overall quality of science learning in madrasahs (Pedaste et al., 2021; Rahmawati et al., 2022; Darmaji et al., 2022).

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## IV. CONCLUSION

This study concludes that the science process skills (SPS) of tenth-grade students at State Islamic Senior High School 3 Palembang were generally at a satisfactory level, with observation, classification, communication, and prediction demonstrating relatively strong performance, while measurement and drawing conclusions require further improvement. Although female students obtained a slightly higher average SPS score than male students, the difference was not statistically significant, indicating that gender does not substantially influence students' science process skills. These findings suggest that science learning in madrasahs should prioritize instructional strategies that actively engage all students in developing basic science process skills, regardless of gender, thereby supporting the improvement of science education within the context of Islamic education. This study is limited to a single madrasah and focuses only on basic science process skills; therefore, the findings cannot be generalized to broader educational settings. Future research is recommended to involve larger and more diverse samples, examine integrated science process skills, and explore instructional approaches that strengthen science process skills in Islamic educational institutions.

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