



# EVALUATION OF THE IMPLEMENTATION OF THE SCIENTIFIC APPROACH AND PROCESS SKILLS IN GEOGRAPHY LEARNING ON THE CRITICAL THINKING ABILITY OF SENIOR HIGH SCHOOL STUDENTS IN YOGYAKARTA CITY

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## Abstract

This study aims to evaluate the implementation of the scientific approach and process skills in geography learning on the critical thinking ability of senior high school students in Yogyakarta City. The study employed the Discrepancy Evaluation Model (DEM) developed by Malcolm Provus with a descriptive quantitative approach, involving 8 geography teachers and 240 eleventh-grade students from 4 public senior high schools and 4 private senior high schools selected through purposive sampling. Data were collected through document analysis, classroom observation, questionnaires, and multiple-choice tests, which were analyzed using descriptive statistics and the Independent Samples T-Test. The results indicate that teachers' understanding and the implementation of the scientific approach and process skills ranged from 35% to 75%, with students' critical thinking ability achievements ranging from 40% to 90%. Public schools consistently demonstrated higher achievements compared to private schools, with differences statistically confirmed through a significance value of 0.001 and a mean difference of 5.773 points. These findings affirm that the quality of teachers' understanding and the appropriateness of instructional method selection are the primary determining factors in developing students' critical thinking ability, while simultaneously serving as a strategic foundation for equalizing the quality of geography education that contributes to the achievement of SDGs Goal 4.

**Keywords:** Scientific Approach; Process Skills; Critical Thinking Ability

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## INTRODUCTION

Geography learning in senior high schools in Yogyakarta City has generally demonstrated considerably encouraging dynamics. The majority of schools, particularly public schools, have genuinely integrated the scientific approach into learning activities, ranging from observing population phenomena, questioning, exploring data, analyzing, to communicating findings. This practice is reflected in the use of methods such as inquiry learning, problem-based learning, BPS data analysis, case study discussions, and projects based on local environmental conditions.

Process skills have also begun to be applied across various educational units in Yogyakarta City. Geography teachers at public schools such as SMAN 2 and SMAN 3 have facilitated students to observe, classify data, interpret population graphs, draw conclusions, and present analytical results systematically. Activities such as population distribution analysis, thematic map interpretation, and environmental interviews have become integral parts of the learning process conducted both inside and outside the classroom.

The evaluation results conducted at eight senior high schools in Yogyakarta City indicate that the overall implementation of the scientific approach and process skills has proceeded with fairly good to good outcomes. SMAN 3 Yogyakarta recorded the highest score with an average of 75% in the aspects of understanding and implementation, followed by SMAN 2 Yogyakarta with a score of 69%. Students' critical thinking ability also demonstrated positive results, with SMAN 3 achieving a score of 90% and SMAN 2 at 80%. This indicates that in the field context, geography learning based on the scientific approach and process skills has been running and has had a significant impact on students' critical thinking ability.

Ideally, the implementation of the scientific approach and process skills should be carried out completely, equitably, and consistently across all educational units without exception. Experts assert that the scientific approach demands active student involvement in all scientific stages fully and systematically, not merely in the initial stages such as observing and questioning (Hosnan, 2014). The success of a learning program's implementation is highly dependent on the alignment between program design, implementation process, and outcomes achieved comprehensively (Mukminan & Nursya'ban, 2023). Furthermore, process skills in geography learning should encourage students to be able to identify problems, collect data, classify, interpret, conclude, and communicate scientifically as an inseparable unity of thinking processes (Susilo, 2021). Without strong conceptual understanding from teachers, the scientific approach risks being implemented partially, thereby failing to optimally promote students' critical thinking ability (Setiawan, 2020). On the other hand, evaluation of learning programs needs to be conducted comprehensively so that the gap between ideal conditions and field realities can be identified and appropriately addressed (Widodo, 2020).

There is a considerably striking gap between the ideal conditions demanded by theory and the realities found in the field. Although a number of public schools have demonstrated relatively good achievements, not a single school has managed to reach the ideal score of 100% in either conceptual understanding or implementation of the scientific approach and process skills. Several schools, particularly SMA PIRI 1 and SMA Taman Madya Jetis, still recorded low implementation scores of 40% and 35% respectively, with students' critical thinking ability reaching only 50% and 40%. This indicates that the application of the scientific approach and process skills has not been equitable and has not fully met the expected ideal standards.

It is this gap that gives rise to the research problem that needs to be examined more deeply. Why, on one hand, does implementation at some schools show good results, while on the other hand many schools have yet to carry it out optimally? What is truly at the root of these differences in achievement? These questions underscore the necessity for a systematic and comprehensive evaluation of the implementation of the scientific approach and process skills in geography learning, in order to identify the determining factors of success while formulating data-based improvement recommendations.

Previous studies have extensively examined aspects related to the scientific approach, process skills, and critical thinking ability in learning. Studies on the application of the scientific approach in geography and science learning have shown varied results, as

have program evaluations highlighting the effectiveness of its implementation in schools (Rahayu et al., 2021; Setiawan, 2020; Susilo, 2021; Widodo, 2020; Wicaksono, 2020). Several studies have also examined science process skills and their influence on learning outcomes, but remain limited to the context of science and physics learning, not yet specifically targeting geography learning holistically (Gürses et al., 2015; Rauf et al., 2013; Ongowo & Indoshi, 2013; Yulianti, 2016; Randa, 2020). In addition, a number of educational program evaluation studies have been conducted using various models, including the discrepancy model that emphasizes the gap between standards and reality, yet few have applied it specifically to evaluating the scientific approach and process skills in geography at the senior high school level (Mukminan & Nursya'ban, 2023; Akinci & Kose, 2022; Carin, 2022; Miller, 2023; Catacutan, 2023). Studies on students' critical thinking ability in the context of geography learning have also been examined more partially, not yet directly linked to the evaluation of the simultaneous implementation of both the scientific approach and process skills (Agnafia, 2019; Yulianti, 2019; Susilawati, 2020; Hidayati, 2017; Syahbana, 2024). From all of these studies, it is clearly evident that there remains an unfilled gap, namely the absence of research that specifically evaluates the simultaneous implementation of the scientific approach and process skills in relation to students' critical thinking ability in senior high school geography learning, particularly in the context of Yogyakarta City with its diversity of public and private school backgrounds.

This research gap becomes even more apparent when observing that the majority of previous studies focused on only a single variable, whether the scientific approach alone, process skills alone, or critical thinking ability alone, without integrating all three within a unified evaluation framework. Existing research has also generally not employed an evaluative approach that systematically compares actual field conditions with ideal standards using a structured evaluation model. Therefore, this study is presented to fill that void by employing a comprehensive evaluation framework that enables a sharper and empirically data-based identification of the gap between the ideal and the reality of implementation.

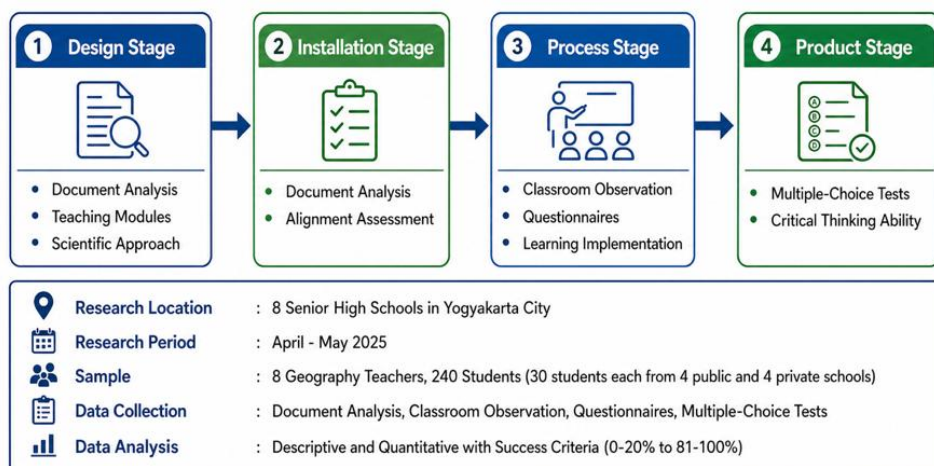
The novelty of this study lies in the integration of the evaluation of two learning approaches simultaneously, namely the scientific approach and process skills, within a unified and simultaneous evaluation framework, directly linked to students' critical thinking ability achievements in senior high school geography learning. This study not only describes the implementation, but also measures the gap between ideal standards and actual field conditions comparatively between public and private schools. This evaluative approach produces more comprehensive findings that can serve as the basis for concrete policy recommendations for improving the quality of geography learning. In the context of the SDGs, particularly Goal 4 on Quality Education, this study contributes to efforts in ensuring inclusive and equitable quality education, by ensuring that every student, regardless of school status, receives a learning experience that fosters critical thinking ability as a foundation for facing global challenges.

The urgency of this study is further reinforced by the demands of the 21st century, which require critical thinking ability as a fundamental competency that every graduate must possess. The disparity in the implementation of the scientific approach and process skills found between public and private schools in Yogyakarta City indicates an inequity in learning quality that has the potential to widen the competency gap among students. If not promptly evaluated and addressed, this condition may lead to a decline in the quality of future human resources, which ultimately contradicts the spirit of SDGs Goal 4 on quality education that is inclusive, equitable, and supports lifelong learning for all segments of society without exception.

Based on the background described above, this study focuses on two central issues. First, this study seeks to reveal the extent to which geography teachers at senior high schools in Yogyakarta City understand the concepts of the scientific approach and process skills, given that teachers' conceptual understanding is the primary foundation that determines the quality of learning planning and implementation. Second, this study seeks to examine how the selection of geography learning methods applied by teachers reflects alignment with the principles of the scientific approach and process skills, and how this alignment impacts the critical thinking ability of senior high school students in Yogyakarta City.

## METHODS

This study is an evaluation research employing the Discrepancy Evaluation Model (DEM) developed by Malcolm Provus, which compares ideal conditions with field realities across four stages, namely design, installation, process, and product. The study was conducted at 8 senior high schools in Yogyakarta City from April to May 2025, with a sample determined through purposive sampling consisting of 8 geography teachers and 240 eleventh-grade students, with 30 students each from 4 public senior high schools and 4 private senior high schools.



**Figure 1.**  
 Research Framework

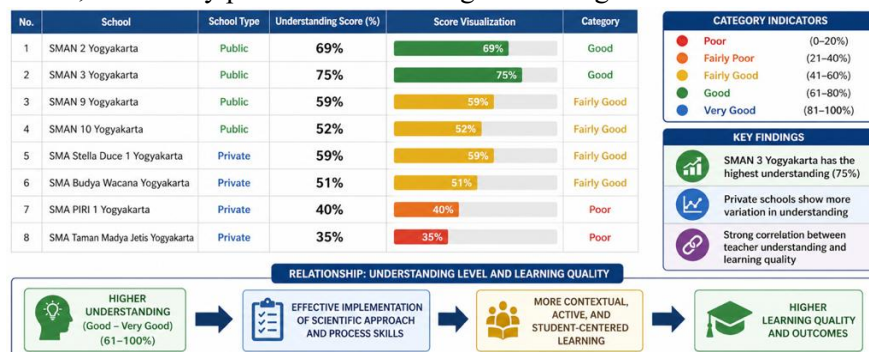
Data collection was carried out through three integrated techniques. Document analysis was used to assess the alignment of teaching modules with the principles of the scientific approach and process skills at the design and installation stages. Classroom observation and questionnaires were used to measure the implementation of the learning process at the process stage. Multiple-choice tests were administered to students to measure critical thinking ability at the product stage. All instruments were tested for validity using the Pearson Product Moment  $r$  ( $r$  table = 0.669,  $df = 5$ ) and for reliability using Cronbach's Alpha (Alpha value > 0.60). Data were analyzed descriptively and quantitatively by categorizing the percentage of achievement into five success criteria ranging from poor (0–20%) to very good (81–100%).

## RESULTS & DISCUSSION

### Results

#### Geography Teachers' Understanding of the Concepts of the Scientific Approach and Process Skills at Senior High Schools in Yogyakarta City

Geography teachers' understanding of the concepts of the scientific approach and process skills across eight senior high schools in Yogyakarta City demonstrates considerably significant variation. In general, teachers at public schools exhibit a higher level of understanding compared to teachers at private schools, although not a single teacher achieved the ideal score of 100%. This is consistent with Hosnan's (2014) view that the implementation of the scientific approach demands deep conceptual understanding from teachers, not merely procedural knowledge of its stages.



**Figure 1.**

#### Geography Teachers' Understanding of the Concepts of the Scientific Approach and Process Skills

At SMAN 2 Yogyakarta, the geography teacher obtained an understanding score of 69% categorized as "good." The teacher at this school was able to explain and operationalize the stages of the scientific approach sequentially, from observing, questioning, experimenting, analyzing, to communicating. This understanding is reflected in the teacher's ability to design learning activities that encourage students to conduct population data analysis, such as population growth graphs and their impacts, in a genuine and contextual manner. In terms of process skills, the teacher at SMAN 2 has understood that process skills are not merely physical activities, but encompass scientific thinking processes that include observing phenomena, posing questions, designing observations, interpreting results, and communicating findings systematically.

SMAN 3 Yogyakarta recorded the highest score among all evaluated schools, at 75% categorized as "good." The teacher at this school demonstrated the most comprehensive understanding of both concepts. The scientific approach is understood not as a procedural routine, but as a scientific thinking framework that must enliven every learning session. Process skills are also understood holistically, where students are facilitated not only to collect data, but also to organize, interpret, and present information critically. This strong understanding enables the teacher at SMAN 3 to design problem-based learning centered

on population density case studies that demands high-order thinking engagement from students.

SMAN 9 Yogyakarta obtained a score of 59% categorized as "fairly good." The teacher at this school has actually understood the basic concepts of the scientific approach, however this understanding is not yet fully comprehensive, particularly in the associating and communicating stages which are still understood superficially. Process skills are understood more in the dimensions of observation and information collection, while aspects of interpretation and scientific conclusion drawing are not yet strongly reflected in the teacher's understanding. A similar condition was found at SMAN 10 Yogyakarta with a score of 52%, where the teacher tends to understand the scientific approach as a sequence of steps to be followed mechanically, without understanding its essence as a process of building meaningful scientific knowledge for students.

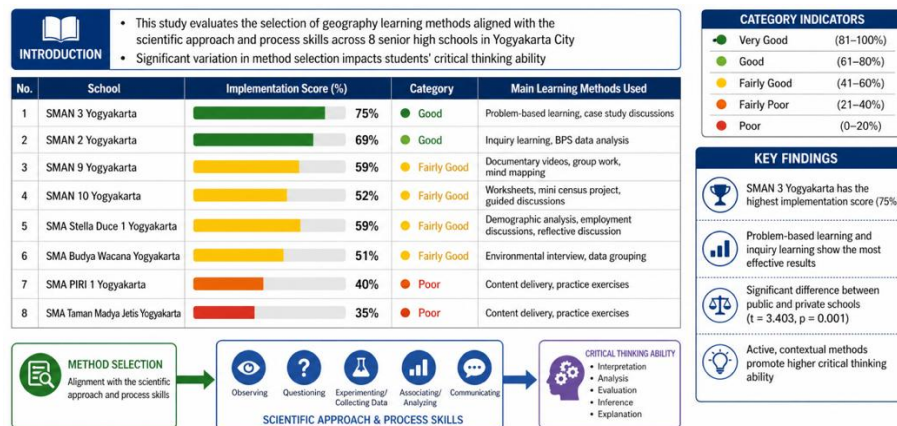
Within the private school group, there are considerably striking differences among schools. SMA Stella Duce 1 Yogyakarta obtained a score of 59% categorized as "fairly good." Although not yet optimal, the teacher at this school has demonstrated fairly good awareness of the importance of connecting learning content with contextual issues, such as demographic and employment analysis. Understanding of process skills at this school has also begun to develop, marked by the gradual incorporation of reflective discussion as part of the learning process. SMA Budya Wacana Yogyakarta obtained a score of 51% categorized as "fairly good," where the teacher has begun to understand that process skills can be developed through environmental interview activities and simple data grouping, although understanding of the overall scientific stages remains incomplete.

A more concerning condition was found at SMA PIRI 1 Yogyakarta and SMA Taman Madya Jetis Yogyakarta, which obtained scores of 40% and 35% respectively, both categorized as "poor." Teachers at both schools tend to understand the scientific approach merely as content delivery and the provision of practice exercises, without understanding that this approach fundamentally demands a transformation of the teacher's role from an information provider to a facilitator of students' scientific thinking processes. Process skills have also not been understood as an integral part of learning, but are still regarded as supplementary activities that do not always need to be implemented. This condition is consistent with Sani's (2018) view that without adequate understanding, the scientific approach risks being implemented partially and fails to optimally promote students' critical thinking ability.

Overall, the evaluation results on the aspect of teachers' understanding illustrate that there is a strong correlation between the level of teachers' understanding of the concepts of the scientific approach and process skills and the quality of learning planning and implementation they design. The stronger the teacher's conceptual understanding, the more contextual and meaningful the learning designed, and the greater the opportunity for students to develop their critical thinking ability. Conversely, shallow and procedural understanding has the potential to reduce geography learning to nothing more than information transfer without involving genuine scientific thinking processes.

## The Selection of Geography Learning Methods in Accordance with the Implementation of the Scientific Approach and Process Skills at Senior High Schools in Yogyakarta City

The selection of learning methods is a direct reflection of the extent to which teachers understand and internalize the principles of the scientific approach and process skills. The evaluation results indicate that there is considerably striking variation in method selection among schools, which directly impacts the quality of implementation and students' critical thinking ability achievements. Daryanto (2013) asserts that the selection of appropriate methods is the key to the success of the scientific approach, as the methods chosen must be capable of facilitating all scientific stages actively and meaningfully.



**Figure 1.**

### The Selection of Geography Learning Methods in Accordance with the Implementation of the Scientific Approach and Process Skills

SMAN 3 Yogyakarta demonstrates the most aligned method selection with the principles of the scientific approach and process skills, with the highest implementation score of 75%. The teacher at this school chose problem-based learning as the primary method, combined with case study discussions based on real-time data on population density. This method directly facilitates all scientific stages, from observing data, questioning problems, collecting information, associating findings, to communicating analytical reports systematically. Process skills also develop naturally through these activities, where students are trained to classify data, interpret population trends, draw logical conclusions, and present results with evidence-based arguments.

SMAN 2 Yogyakarta obtained a score of 69% using inquiry learning combined with BPS data analysis and population growth graphs. The inquiry method applied encourages students not merely to receive facts, but to actively formulate research questions, collect data, analyze, and draw conclusions independently. This approach is highly consistent with the stages of process skills as it demands students to observe carefully, organize information systematically, and interpret data critically. As a result, students' critical thinking ability at SMAN 2 reached a score of 80%, indicating that the selected method was capable of significantly promoting the development of higher-order thinking competencies.

SMAN 9 Yogyakarta with a score of 59% employed a combination of documentary videos, group work, and mind mapping on migration. These methods are sufficiently relevant

to the scientific approach, particularly in facilitating the observing stage through videos and the questioning stage through group discussions. However, limitations are evident in the minimal activities that encourage students to actively collect and process data independently, so that the associating and communicating stages have not yet been optimally facilitated. The process skills that develop are also still limited to the aspects of observation and simple information organization, not yet reaching the deeper capacities of interpretation and scientific conclusion drawing. SMAN 10 Yogyakarta with a score of 52% employed worksheets, a mini census project, and guided discussions. Although the census project has the potential to genuinely facilitate process skills, its highly guided and tightly structured implementation causes students' independent exploration space to become limited, so that the scientific stages have not yet proceeded fully and organically.

Within the private school group, SMA Stella Duce 1 Yogyakarta obtained a score of 59% using methods of demographic analysis, employment issue discussions, and reflective discussion. These methods are sufficiently effective in building students' analytical ability toward social population phenomena, and the reflective discussions implemented provide space for students to communicate their perspectives critically. Nevertheless, primary data collection activities that directly involve students remain minimal, so that several process skill stages such as designing observations and interpreting field data have not yet been fully facilitated. Students' critical thinking ability achievement at this school reached 75%, indicating that the selected methods were sufficiently capable of promoting the development of critical thinking competencies, although not yet optimal.

SMA Budya Wacana Yogyakarta with a score of 51% employed environmental interview methods and data grouping. The interview method applied is actually highly potential in developing process skills, as it demands students to design questions, collect primary data, and organize information independently. However, limitations in the data processing and interpretation stages have caused the potential of this method to not yet be maximally utilized. Students' critical thinking achievement of 62% reflects that the selected method provides a positive contribution, yet still requires deepening in the stages of analysis and more structured scientific communication. A different condition was found at SMA PIRI 1 Yogyakarta and SMA Taman Madya Jetis Yogyakarta, which obtained scores of 40% and 35% respectively. Both schools still dominate with content delivery and practice exercise methods as the primary strategy in geography learning. These highly conventional method choices do not adequately facilitate scientific stages or process skills, as students are positioned only as passive information recipients without being involved in active scientific thinking processes. Consequently, students' critical thinking ability at both schools reached only 50% and 40%, the lowest among all evaluated schools.

The hypothesis testing results using the Independent Samples T-Test reinforce the descriptive findings above. The value of  $t = 3.403$  with a significance of  $0.001 (< 0.05)$  indicates that there is a statistically significant difference between students' critical thinking ability at public and private senior high schools in Yogyakarta City. The mean score difference of 5.773 points with a 95% confidence interval ranging from 2.427 to 9.119 further affirms that this difference did not occur by chance, but rather represents the genuine impact of differences in the quality of method selection and the implementation of the scientific

approach and process skills between the two school groups. Schools that consistently select active, contextual, and data exploration-based learning methods have proven to produce higher students' critical thinking ability, while schools that still rely on conventional methods demonstrate considerably lower achievements.

Overall, these findings affirm that the selection of learning methods is not merely a matter of technical administration, but rather a pedagogical decision that is highly determinative of the quality of students' learning experiences. Methods aligned with the principles of the scientific approach and process skills will create space for students to actively construct their knowledge, develop analytical abilities, and strengthen critical thinking patterns that are relevant to real-life challenges. Therefore, enhancing teachers' competence in selecting and implementing appropriate learning methods becomes a primary priority that needs to be promptly addressed, particularly at schools that still face challenges in optimally applying the scientific approach and process skills.

### ***Discussion***

#### **Geography Teachers' Understanding of the Concepts of the Scientific Approach and Process Skills at Senior High Schools in Yogyakarta City**

The research findings indicate that geography teachers' understanding of the concepts of the scientific approach and process skills across eight senior high schools in Yogyakarta City ranges from 35% to 75%, with not a single teacher achieving the ideal score. This finding reinforces Hosnan's (2014) view that the scientific approach demands deep conceptual understanding from teachers, not merely procedural knowledge of its sequential stages. Teachers at SMAN 2 and SMAN 3 who obtained the highest scores have proven capable of operationalizing scientific stages completely and contextually, reflecting that extensive teaching experience and the intensity of involvement in professional development have collectively shaped the maturity of their understanding.

This is consistent with Ayuni's (2015) finding that teachers' understanding of the scientific approach is largely influenced by teaching experience, given that the steps of this approach have frequently been practiced in daily learning activities. Accordingly, the findings of this study do not merely reaffirm existing theory, but also provide a new nuance that teaching experience alone is insufficient if it is not accompanied by critical reflection on the learning practices being carried out.

#### **The Selection of Geography Learning Methods in Accordance with the Implementation of the Scientific Approach and Process Skills at Senior High Schools in Yogyakarta City**

The research findings reveal that the selection of geography learning methods across eight senior high schools in Yogyakarta City is highly diverse and directly reflects the level of teachers' understanding of the principles of the scientific approach and process skills. Schools that select active methods such as inquiry learning, problem-based learning, and actual data analysis have proven to produce implementation achievements and critical thinking ability that are considerably higher compared to schools that still rely on conventional methods. This finding is consistent with Daryanto's (2013) view that the selection of appropriate methods is the key to the success of the scientific approach, as the

methods chosen must be capable of facilitating all scientific stages actively and meaningfully.

More specifically, SMAN 3, which employed problem-based learning with real-time population data, successfully achieved the highest critical thinking score of 90%, proving that contextual and real problem-based methods are capable of optimizing all scientific stages while simultaneously cultivating students' process skills. This reinforces Rahayu et al.'s (2021) argument that the application of the scientific approach to geography demography content accompanied by statistical data validation activities has proven to produce students who are more critical in evaluating data while also being more creative in formulating social implications of demographic phenomena.

## CONCLUSION

The evaluation results of the implementation of the scientific approach and process skills in geography learning across eight senior high schools in Yogyakarta City indicate that teachers' understanding and the selection of learning methods fall within a highly varied range, namely between 35% and 75%, with not a single school reaching the ideal standard. Teachers at public schools, particularly SMAN 2 and SMAN 3, demonstrate stronger conceptual understanding and method selection that is more aligned with scientific principles, thereby producing significant students' critical thinking ability achievements of 80% and 90% respectively. Conversely, a number of private schools still rely on conventional methods with shallow understanding of both approaches, which directly impacts the low level of students' critical thinking ability, reaching as low as 35% and 40%. This difference in achievement is statistically confirmed through the Independent Samples T-Test with a significance value of 0.001 and a mean difference of 5.773 points, proving that the quality of the implementation of the scientific approach and process skills is the primary determining factor in shaping students' critical thinking ability.

The findings of this study have broad implications for the achievement of the Sustainable Development Goals (SDGs), particularly Goal 4 on Inclusive and Equitable Quality Education. The disparity in the quality of implementation of the scientific approach and process skills found among schools reflects the persisting gap in educational quality that has the potential to widen the competency divide among graduates. If not promptly addressed through sustained capacity building for teachers and the equalization of access to professional development, this gap will continue to impede the realization of quality education for all students regardless of their school status and background. Therefore, enhancing teachers' pedagogical competence in implementing the scientific approach and process skills consistently and equitably across all educational units becomes a strategic step that cannot be deferred in realizing a generation that is critical, adaptive, and globally competitive in accordance with the spirit of the SDGs.

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