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Analysis of Problems in the Implementation of Science Practical at Junior High School, Gorontalo Regency

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Abstract. Science practicums are an essential component of the Independent Curriculum to develop students' science process skills, yet their implementation at the junior high school level still faces various obstacles. This study aims to analyze problems in the implementation of science practicums at SMPN 1 Telaga Biru, Gorontalo Regency. A qualitative approach was used, with data collected through observation, semi-structured interviews with four science teachers, and a literature review. Data were analyzed using thematic analysis involving data reduction, coding, categorization, and conclusion drawing. The results reveal three interrelated problems: (1) limited facilities and infrastructure, such as damaged tools and insufficient practicum materials; (2) limited instructional time; and (3) low teacher competency in operating practicum equipment due to minimal training. These constraints reduce the effectiveness of practicum-based learning and hinder the development of students' science process skills. This study concludes that improving practicum implementation requires integrated efforts in enhancing facilities, time management, and teacher competency. The findings provide a comprehensive basis for improving educational policy and practice, particularly through better resource allocation, flexible scheduling, and continuous professional development for teachers.

Keywords: Laboratory Facilities; Science Learning; Science Practical Problems; Science Teacher Skills.

Introduction

Natural Sciences (IPA) is a field of science that focuses on the study of natural phenomena and laws, including the origins of the universe and its components, mechanisms, processes, the properties of objects, and various events that occur within it [1]. In the context of the Independent Curriculum, science learning emphasizes not only conceptual mastery but also the development of students' science process skills and scientific literacy. Practical work or experiments play a crucial role in science learning because they are based on discoveries made through observations of physical phenomena in everyday life. However, science learning practices in schools still tend to be dominated by lectures and discussions, while the application of scientific methods, such as practical work and demonstrations, remains relatively limited [2].

Science learning should ideally be oriented towards a scientific approach that positions students as active subjects in the learning process. Practical work is an effective strategy because it allows students to explore natural phenomena firsthand, leading to meaningful, contextual learning [3]. In addition, the practical approach aligns with indicators of scientific literacy, such as the ability to explain phenomena scientifically, draw evidence-based conclusions, and develop reflective thinking patterns [4]. However, implementing practical work often faces obstacles, particularly due to limited learning time and the complexity of managing practical activities in the classroom [5].

Obstacles to implementing science practicums are not caused by a single factor but rather result from the interaction of various factors, such as limited facilities and infrastructure, low teacher competency, and a lack of familiarity with contextual learning [6]. More broadly, obstacles to implementing science practicums are multidimensional and systemic, including limited laboratory facilities, inadequate facilities and infrastructure, low teacher competency, and minimal participation in professional development. Recent research shows that the low frequency of practicums is influenced by a lack of teacher training in laboratory utilization, limited laboratory staff, and a lack of availability of practicum tools and materials. Furthermore, post-pandemic conditions have exacerbated these problems, with many school laboratories becoming poorly maintained or damaged due to prolonged disuse during online learning [7].

Other research also shows that limited facilities and suboptimal laboratory management are major obstacles to the implementation of practicum-based learning, even in schools that already have laboratories. On the other hand, issues related to teachers' educational backgrounds, limited understanding of integrated science concepts, and suboptimal pedagogical competencies are also dominant obstacles in the implementation of science learning [8].

However, most existing research remains fragmented and has not comprehensively examined science practicum issues within a unified analytical framework. Although various studies have identified barriers to implementing science practicums, these studies generally focus on a single aspect, such as limited facilities, student skills, or teacher competency, without analyzing the interrelationships between these factors in an integrative manner. Furthermore,

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research specifically examining the implementation of science practicums within the context of the Independent Curriculum and post-COVID-19 pandemic learning conditions at the junior high school level is still limited. This situation indicates a research gap in understanding how various factors, such as facilities, time constraints, and teacher competency, interact simultaneously and systemically to influence the effectiveness of science practicums [9]. Furthermore, changes in the post-pandemic learning system have also affected school readiness, facility availability, and teacher adaptability in conducting practicum activities [10].

Based on interviews with science teachers at SMPN 1 Telaga Biru, Gorontalo Regency, the main challenges in implementing practicums include limited tools and materials, such as damaged microscopes and limited availability of practicum materials, which hinder the optimal implementation of practicum activities. These findings indicate a gap between curriculum demands and actual conditions in the field. Therefore, this study aims to analyze in depth the problems in the implementation of science practicums and the relationship between the causal factors. Specifically, this study seeks to answer the questions: (1) what are the main problems in the implementation of science practicums in junior high schools, and (2) how are these factors related to influencing the effectiveness of the practicums. This study is expected to contribute by providing a comprehensive problem map as a basis for formulating policies and strategies to improve the quality of practicum-based science learning.

Research Methods

This research uses a qualitative case study design to examine the contextual issues surrounding the implementation of science practicums. The study was conducted in the odd semester of the 2025/2026 academic year, with four science teachers at SMPN 1 Telaga Biru, Gorontalo Regency, selected through purposive sampling based on their teaching experience, direct involvement in practicum activities, and representativeness of information relevant to the research focus.

The primary instrument was the researcher (human instrument), with data collection techniques including semi-structured interviews, observation, documentation study, and literature review. In qualitative research, the researcher acts as the main instrument who plays a central role in determining the research focus, selecting informants, collecting and analyzing data, as well as interpreting findings, so that the quality of the data is highly dependent on the researcher's competence and understanding of the research context [11]. This is also supported by the view that the researcher, as a human instrument, must possess theoretical insight, analytical skills, and sensitivity to capture social phenomena to produce meaningful and valid data [12].

Data analysis employed thematic analysis, encompassing data reduction, coding, categorization, and interpretation to identify key themes, which aligns with the inductive and interpretative nature of qualitative data analysis in constructing meaning from empirical findings. Data validity was ensured through triangulation of sources and methods, which is recognized as an essential strategy to enhance the credibility and trustworthiness of qualitative research findings [13].

Results and Discussion

Science learning is certainly inseparable from practical activities. Practical activities are very helpful for teachers in explaining abstract science concepts to students. In addition, practical activities also train students' science skills and actively engage them in the learning process. Teachers carry out practical activities to connect theory with its application in everyday life [14]. In the context of science learning, supporting activities, such as practical work or laboratory experiments, are essential. Practical work is considered important because it can deepen students' understanding of the science concepts being studied [15].

Based on interviews with four science teachers at SMPN 1 Telaga Biru, the respondents consider the implementation of science practicums to be very important. This was stated by G-01 that "*Practical work is very important for students because by doing practicums, students understand more deeply what we explain, and the implementation of practicums depends on the material we provide. If there is a practicum, we automatically have to try to do the practicum so that students understand the material better*." A similar point was made by G-03: "*Science practicums are very important, because they can support science learning, where they can increase students' motivation and curiosity*." G-02 also added that "*Through practicums, students who initially did not understand can become more understanding of the material being taught*." These teachers' views align with the theory that practicum activities are an important part of science learning, as students need to study theory and conduct direct observations to gain real knowledge and experience. However, the implementation of practicums in schools varies, depending on the availability of facilities, infrastructure, and resources [16]. Through practical learning, students' psychomotor skills can be assessed, including the use of practical materials and equipment. This activity also helps students implement the learning objectives [17].

However, implementing science practicums in schools often faces various obstacles. Similar findings also emerged from interviews conducted with four science teachers at SMPN 1 Telaga Biru, Gorontalo Regency, with the following respondent codes: G-01 (teaching science for grades 7 and 8), G-02 (teaching science for grades 7 and 8), G-03 (teaching science for grade 9), and G-04 (teaching science for grade 8). During the interview session, several problems were identified in the implementation of science practicums, namely, limited facilities and resources, which were the most dominant, as expressed by all science teachers who were respondents. In addition, other problems emerged, including limited teaching time and teacher competence in applying the Science KIT, as shown in Figure 1.

Based on the results of interviews and data analysis, and supported by Figure 1, this study identified three main problems in the implementation of science practicums at SMPN 1 Telaga Biru: (1) limited facilities, (2) limited learning time, and (3) teacher competence in using the Science KIT. Quantitatively, Figure 1 shows that limited facilities are the most dominant problem (100%), followed by limited time and teacher competence (each 50%).

To strengthen the interview findings regarding the limited practical facilities, direct observations were conducted on the condition of the science laboratory facilities and infrastructure at SMPN 1 Telaga Biru. The results of these observations are presented in Table 1.

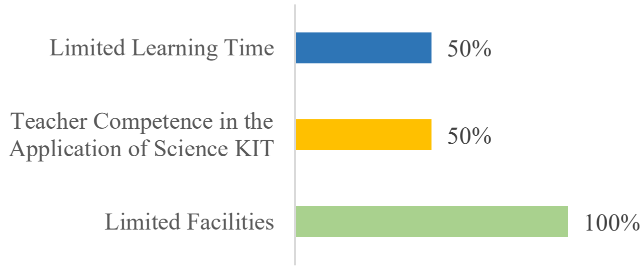

Figure 1. Results of interviews with four science teachers at SMPN 1 Telaga Biru

Table 1. Condition of Science Laboratory Facilities and Infrastructure at SMPN 1 Telaga Biru

No	Tool/Facility Name	Condition
1	Lab table	Damaged
2	Tool storage cabinet	Damaged
3	Shelf	Damaged
4	Microscope	Damaged
5	Balance	Good
6	Thermometer	Damaged
7	Human skeleton	Damaged
8	Measuring cylinder	Good
9	Beaker	Good
10	Chair	Good
11	Vernier caliper	Good
12	Micrometer screw gauge	Good

Limited Facilities as a Dominant Problem in Science Practicums

Based on the interview results regarding problems in the implementation of science practicums, limited facilities and resources are the most dominant problem. In more detail, all participants emphasized the limited tools and materials for practicums as the main obstacle, such as the condition of the microscope being damaged or inadequate, so that practicum activities are limited and hampered. G-01 revealed that, "*When practising the cell material, the tool (microscope) was not available, which could clearly affect the explanation of the practice of plant cells and animal cells; the microscope was no longer usable, and it was not suitable for use*." G-04 also continued by stating that "*Maybe for the availability of light practicum materials, the school can still provide them, such as filter paper, but for large practicum tools such as scales, the microscope was not available, so this greatly affected the effectiveness of the science practicum*."

This is in line with various literature studies on similar problems in science practicums, which show that the lack of laboratory equipment leads to practicum activities being rarely carried out, is perceived as inadequate by students, and impacts low mastery of science concepts [18]. A similar finding indicates that limited laboratory facilities hinder the routine implementation of science practicums, leading to a learning process that relies primarily on theoretical approaches [19].

In addition, limited laboratory facilities affect the implementation of science practicums, which are not running optimally: the application remains lecture-based, less contextual, and hinders the development of science process skills and students' understanding of self-concept [20]. Furthermore, teachers in Nekamese Regency face practical obstacles due to a lack of tools and materials, as well as the ability to design practicum activities, so that assistance and improvements to laboratory facilities are necessary to support science learning [21]. Similarly, limited facilities and practicum tools make practicum activities difficult to implement, leading to a more theory-oriented learning experience [22].

These findings are reinforced by the quantitative data in Figure 1, which shows that 100% of respondents identified limited facilities as a major problem. This confirms that facility issues are not unique to individuals but represent a consistent pattern across the research context.

The results of this study also indicate that limited facilities are associated with suboptimal laboratory management, including the completeness of facilities, layout, and administration, resulting in suboptimal practical activities. The limited facilities condition reduces students' experimental experiences, leading to more theoretical learning and failing to support the development of science process skills [23]. In this situation, teachers tend to use conventional learning methods as an alternative, which causes learning to be more teacher-centered and less interactive. In addition, limited facilities also have implications for aspects of student safety and behavior during practicals, because the use of limited or non-standard tools can increase the risk of procedural errors [24].

Further analysis revealed that these limited facilities were not merely technical issues, but rather systemic factors influenced by internal and external dynamics at SMPN 1 Telaga Biru. G-04, also the treasurer, explained that the school had actually received Science Kits from the Ministry of Education, which were relatively complete before the COVID-19 pandemic and adequately supported practicums. However, most of these tools suffered significant damage during the pandemic, due to distance learning and minimal maintenance of practicum equipment. This situation reflects national post-COVID challenges in regional public schools, such as those in Gorontalo Regency, where limited maintenance budgets and hybrid learning reduced supervision. Although the school provided lightweight materials such as filter paper, the lack of larger equipment, such as microscopes, still hampered in-depth practicums. Furthermore, student behavior, often careless during practicums, also contributed to the high rate of damage, resulting in a suboptimal inventory of Science Kits [25].

Thus, limited facilities are not only a technical obstacle in the implementation of practicums, but also have a systemic impact on the quality of science learning, so that integrated efforts are needed through improving laboratory management, maintaining facilities, and optimizing the use of available facilities so that practicum-based learning can run effectively and sustainably.

Limited Teaching Time as an Obstacle to Supporting Science Practicums

In addition to the limited facilities, which are the main problem in implementing science practicums, two of the four science teachers at SMPN 1 Telaga Biru also reported further obstacles, including a lack of time during class hours. For example, G-03 stated that "*Besides broken lab equipment, sometimes preparing students also takes a long time, so the time to carry out science practicums is limited, so I usually focus more on the learning objectives to be achieved that day to make the most of the limited practicum time*." G-02 also explained that "*Students are absent when explaining the material, so I have to explain the material again. Then, if the lesson time is over, then I will end it at the specified time and continue it in the next meeting*". This situation illustrates how a practicum originally planned for only one meeting, due to time constraints, has to be extended to two or more meetings, which can affect the overall effectiveness of science learning.

This situation indicates that the practicum, initially planned for only one meeting, had to be extended to two or more meetings due to time constraints, which could impact the overall effectiveness of science learning. In relation to the results in Figure 1, limited teaching time was one of the obstacles experienced by 50% of teachers, thus categorizing it as a significant obstacle in implementing the practicum.

This finding is also in line with a number of literature studies that discuss similar challenges in science practicums, where the time available for practicum activities is relatively limited, leading the lecture method to be more often used in the learning process. This condition indicates that implementing practicums in the laboratory is difficult, one reason being time constraints [26]. Furthermore, constraints such as limited time and limited ability to apply complex materials make some teachers reluctant to carry out practicum activities [27]. A similar finding shows that science teachers at the junior high school level, both in Jayapura and in Gowa Regency, face three main obstacles in implementing practicum-based learning: managing time for practicum activities, difficulties with using tools and materials, and challenges in preparing practicum guidelines [28]. Limited teaching time means that practicals are rarely conducted, so teachers tend to focus on theoretical explanations, making learning less interactive and students' understanding of concepts less effective [29; 30].

In a more specific context, limited learning time not only affects the frequency of practicums but also their quality. Limited time, especially in adapted learning environments such as during the pandemic, makes it difficult for teachers to optimally implement all stages of practicums, from planning to implementation [31]. Furthermore, limited time also poses a significant obstacle to the implementation of inquiry-based practicums at the junior high school level, as activities that should involve exploration, experimentation, and reflection cannot be conducted in depth. This ultimately impacts students' low science process skills [32].

Further analysis of the problematic time constraints in the science practicum at SMPN Telaga Biru revealed that the limited facilities were the cause. As G-03 explained, the initial stages, such as preparing students and checking for damaged or incomplete equipment, took up valuable time. G-02 also mentioned that students who were absent during material explanations required repetition. Consequently, the allocated learning time was reduced. This explains the challenge of varying learning levels among students.

This situation is also evident in the implementation of science practicums at SMPN Telaga Biru, where time constraints are closely related to the limited facilities available. As explained by G-03, the initial stages, such as preparing students and checking for damaged or incomplete equipment, require considerable time. Furthermore, G-02 mentioned that student absences during material presentations require teachers to repeat explanations, reducing the allocated learning time. This indicates that time constraints are influenced not only by the allocation of class hours but also by technical factors and student conditions, ultimately creating challenges in addressing differences in student understanding levels during practicum activities.

Overall, the limited learning time favours lecture methods and limits the implementation of practical work.

Lack of Teacher Competence in Utilizing Science KITs

Furthermore, two of the four science teachers at SMPN 1 Telaga Biru highlighted another equally crucial issue, namely the lack of self-competence in utilizing the Science Kit to support practical activities, as depicted in Figure 1, with a frequency of 50% of participants. G-03 revealed that "*My understanding of applying the Science Kit is only the material according to the class I teach, for example, I teach Science in grade 9, so my understanding of the application of the Science Kit is limited to the class I teach. This is because we still lack training related to the use of the Science Kit*." A similar thing was conveyed by G-04 that "*I can use the Science Kit, but only according to the class material I teach*". Conditions like this limit teachers' abilities to access existing resources, ultimately weakening the integration of cross-material practicums and reducing students' overall conceptual understanding.

This finding is in line with various literature studies that emphasize similar challenges in teacher competency toward Science KIT. The lack of teacher and student knowledge about laboratory equipment makes practicums less effective, whereas the systematic introduction of equipment has been shown to improve students' science process skills from 45% to 83.6% and strengthen their understanding of science [33]. Furthermore, most teachers experience difficulties in using Science KIT, resulting in suboptimal implementation of practicums [34]. In addition, teachers' limited understanding of science competency standards often hinders the smooth implementation of practicum activities. Meanwhile, the main problems identified in partner schools include low understanding of science practicum concepts, limited availability of equipment, and teachers' insufficient mastery in using the Science KIT, which ultimately restricts their ability to optimize practicum activities [35].

Furthermore, similar findings emerged in research on junior high school science teachers in the Riau Islands, which revealed that many teachers faced significant obstacles in designing and implementing Physics KIT effectively, leading to suboptimal teaching and greater reliance on conventional lecture methods. Most teachers had never received specific training in KIT use, leaving them less familiar with appropriate experimental procedures. This condition is consistent with the context of SMPN 1 Telaga Biru, where the lack of workshops was identified as a competency weakness, as expressed by G-03 [36].

Similarly, a number of studies indicate that science teachers at the junior high school level often experience difficulties in conducting practicums due to limited mastery of integrated science concepts. This limitation leads to confusion in understanding terminology, functions, and procedures for operating practicum equipment, as well as low creativity in organizing simple practicum activities. In addition, the lack of adequate training to optimize the use of available science kits further constrains efforts to improve the quality of practicum implementation [37].

Further analysis shows that these competency limitations are not just individual issues, but rather systemic factors influenced by the structure of teacher education at SMPN 1 Telaga Biru, where class-specific specialization, as acknowledged by G-03 and G-04, limits cross-subject understanding, coupled with minimal ongoing training at the regional level that often does not cover comprehensive KIT utilization.

In the context of the Independent Curriculum, which demands the integration of Science KIT for the development of 21st-century skills such as critical thinking and experimentation, teachers' reliance on specific materials can hinder effective implementation, as a lack of familiarity with KIT procedures, including terminology and operational aspects, makes practicums feel unfamiliar and suboptimal [37].

The implication is that students not only experience shallow conceptual understanding but also miss out on significant improvements in science process skills. This reflects a national challenge: KIT training remains rare, hindering the achievement of overall science competency standards [38].

To address this, several recommendations are needed, such as regular workshop programs by the Education Office (e.g., 2–3 day sessions for cross-grade KIT), collaboration between teachers to share knowledge, and the integration of independent training modules for continuous competency improvement, so that practicums can be more inclusive and based on real experiences. Overall, this analysis suggests that the three problems (facilities, time, and competency) are interrelated, which requires holistic interventions to optimize science practicums in schools such as SMPN 1 Telaga Biru

Conclusion

This study aims to analyze the problems in the implementation of science practicums at SMPN 1 Telaga Biru, Gorontalo Regency, and concludes that the practicum implementation still faces three main interrelated problems, namely limited laboratory facilities, limited implementation time, and low teacher competency in operating practicum equipment, which impact the effectiveness of learning and the development of students' science process skills. This study contributes by providing a comprehensive mapping as a basis for improving educational practice and policy. At the school level, practical efforts include regular maintenance and procurement of laboratory equipment, flexible scheduling of practicum sessions, and structured, continuous teacher training programs. At the policy level, support is needed through dedicated budget allocation, systematic teacher professional development programs, and monitoring of practicum implementation. Further research is recommended to broaden the scope and examine the effectiveness of specific interventions or innovative learning models in enhancing the quality of science practicums.

Author's Contribution

T. Abdjul: conceived and supervised the study, provided academic and methodological guidance, reviewed the research findings, and contributed to the critical revision of the manuscript. N. A. Dj. Junus: conducted the literature review, collected and analyzed the data, interpreted the findings, and prepared the manuscript. N. Sriastuti and R. H. Panyo: assisted in data collection, literature review, and manuscript preparation. All authors read and approved the final version of the manuscript.

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