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Teachers' and Students' Needs in Scientific Work Skills: Guided Investigation Laboratory Module for Junior High Schools

[1,2]Dewi Muin, [1*]Ismet, [1]Leni Marlina
[1]Master Physics Education, Faculty of Education and Teacher Training, Sriwijaya University. Jl. Masjid Al Gazali, Bukit Lama, Palembang 30128, Indonesia.
[2]SMP Muhammadiyah 1 Palembang. Jl. KH. Ahmad Dahlan No. 23 B, Indonesia.
*Corresponding Author e-mail: ismet@fkip.unsri.ac.id.

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Abstract

Science practicum has an important role in fostering students' scientific skills, but its implementation at the junior high school level still faces various obstacles, such as limited laboratory equipment and practicum guidelines that are not optimal. This study aims to analyze the needs of teachers and students for the implementation of science practicum as a basis for developing guided inquiry-based guidelines. The research method used was descriptive qualitative with data collection techniques through surveys and in-depth interviews. The research subjects consisted of 219 students and 52 junior high school science teachers in the South Sumatra region. The results of the analysis showed that 98.6% of students and 98,1% of teachers stated the importance of practicum guides, while only 34.4% of students and 40% of teachers had used or made inquiry-based guides. The majority of respondents supported the use of the guided inquiry approach because it is believed to be able to improve science process skills. However, limited tools and teacher understanding are the main obstacles to implementation. Therefore, the results of this study emphasize the need to develop guided inquiry-based science practicum guides that are systematic, applicable, and relevant to the context of junior high school learning.

Keywords: Science Practicum; Guided Inquiry; Scientific Skills; Needs Analysis; Junior High School

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INTRODUCTION

Learning science at the junior high school level plays an important role in shaping students' scientific skills, such as observation, prediction, experimentation, and data analysis (Shana & Abulibdeh, 2020). In addition, it also shapes the understanding of science concepts and develops critical thinking and scientific skills to face the challenges of the 21st century (Sun et al., 2022). One of the most effective learning methods that allows students to be directly involved in the process of discovery and construction of knowledge is through science practicum (A. M. Laili & Kamaludin, 2023). Science practicum is an important component in science learning to develop students' scientific skills, such as formulating hypotheses, collecting data, and analyzing experimental results, and drawing conclusions, which are the core of scientific skills (Arnita Sari, 2019; Nurhayati et al., 2021; Socorro Gonzaga-Leong-On, 2020). Science practicum in inquirybased learning can enable students to be actively involved in the process of scientific discovery, thus improving conceptual understanding and critical thinking skills (Lin et al., 2023). Although the potential of science practicum is very large, its implementation in schools still faces various obstacles.

The obstacles to the implementation of science practicum in junior high school are both from the side of teachers and students. Teachers often experience difficulties in guiding the implementation of practicum due to the limited practical and integrated guidelines, as well as

the lack of supporting facilities and infrastructure at school (D. N. Laili & Fardhani, 2023). This is in accordance with a study by Alfiana and Fathoni (2022) revealed that 72% of junior high school science teachers in Indonesia claimed to have difficulty designing inquiry-based practicum due to limited learning resources and training. This has an impact on low science process skills and student learning outcomes (Astalini et al., 2023). Including the lack of systematic guidance, limited tools and materials, as well as low teacher understanding in applying the guided inquiry approach and low student involvement in the inquiry process (Akuma & Gaigher, 2021; Setyosari et al., 2020). Previous studies show that practicum is often carried out in a cookbook or structured manner without providing sufficient space for students to investigate independently (Atush Sholihah et al., 2020; Putri, 2021). Limited facilities, inadequate time allocation, and the availability of practicum guides that are less innovative and do not facilitate guided inquiry. The PISA 2022 survey noted that laboratory facilities in Indonesian secondary schools are still below the average of OECD countries, impacting the quality of practicum (OECD 2023, 2022).

Meanwhile, students also expressed the need for a module or practicum guide that can help them understand the experimental steps in a systematic manner, especially when learning is still dominated by the lecture method and minimal hands-on practice (Arianti & Darmayanti, 2023). Furthermore, research by (Yu et al., 2024) explores the challenges students face in conducting independent scientific investigations and emphasizes the need for structured yet flexible guidance to support their skill development. These conditions indicate an urgent need for the development of practicum guides that are able to solve learning problems. One approach that can overcome these problems is the use of guided inquiry learning models.

Guided Inquiry has been recognized as an effective approach to improving students' scientific skills as it combines the structure of learning with freedom of exploration (Putri Lisa, Asrizal and Festiyed, 2023)(Idul & Caro, 2022). This model allows students to be actively involved in the scientific process with teacher guidance, so that it can increase their interest in learning, critical thinking skills, and conceptual understanding compared to conventional methods (Ruesch & Sarvary, 2024)(Kevin A. Artuz & B. Roble, 2021). Research shows that the application of guided inquiry in science learning can significantly improve students' science process skills (Muhamad Dah et al., 2024). Like, a study by shows that using guided inquiry models really helps students get better at coming up with hypotheses and collecting data during science labs ((Wen et al., 2020)(Jungho Park, 2015). So, guided inquiry models are a great way to make science learning more fun and meaningful (Purnama & Rahayu, 2023).

One solution that can be pursued is the development of a guided inquiry-based science practicum guide. The development of practical guidelines must be structured based on a guided inquiry approach (Toma, 2022). The guided inquiry model provides opportunities for students to be active in the scientific investigation process with guidance from the teacher, so that students can develop science process skills optimally (Orosz et al., 2022)(Biswal Biswajit Behera, 2023). However, the development of such guides must be preceded by a comprehensive needs assessment to ensure suitability for the classroom context (Syakur et al., 2023). Through this analysis, aspects that need to be considered in developing the guide can be identified, such as the level of difficulty of the material, appropriate learning methods, and available resources (Spernes & Afdal, 2023). In this context, the development of guided inquiry-based practical guidelines needs to be supported by a relevant theoretical framework, namely constructivism theory.

Constructivism theory asserts that learning is an active process in which students construct knowledge based on experience and social interaction (Mbonane & Mavuru, 2022). In its application, the guided inquiry approach aligns with constructivist principles that focus on learning through direct experience and independent investigation by students, enabling them to construct their own understanding through interaction with their environment and teachers (Akdag & Koksal, 2022). Referring to both theoretical frameworks, the development of guided

inquiry-based practical guidelines is expected to not only meet students' learning needs but also strengthen the pedagogical and technological aspects relevant to constructivism principles, as well as facilitate the development of teachers' competencies in integrating various disciplines and learning media.

Teacher needs analysis may include identifying difficulties in facilitating practicum, the need for resources and supporting materials, and training related to the inquiry approach. Meanwhile, studies from (Lameras et al., 2021; Ludwig, 2021) also underscore the importance of considering students' background knowledge and prior experiences in designing inquiry-based practicum activities. Students' needs analysis can focus on their understanding of science concepts, level of mastery of scientific work skills, learning preferences, as well as the challenges they face during practicum activities. Some recent findings reinforce the urgency of this study: Teacher Needs: 85% of teachers expressed the need for practicum guides that are integrated with the competency-based curriculum (Jufriadi et al., 2022). Student Interest: Guided inquiry learning is proven to increase students' learning motivation (Correia & Harrison, 2020).

Several recent studies have highlighted the importance of needs analysis in the development of effective curriculum and learning materials, including science practicum guides (Muhamad Dah et al., 2024) in their study on the needs of science teachers in implementing the inquiry approach found that many teachers felt that they needed further support in designing inquiry activities that were appropriate to the students' ability levels. Similarly, (Yuriatson Jubhari et al., 2022) highlighted the importance of understanding students' perceptions of science practicum activities to identify areas for improvement in learning design. Thus, analyzing the needs of teachers and students towards science practicum is a very important first step as a basis for developing guided inquiry-based practicum guides that are relevant and applicable to foster scientific skills of junior high school students.

Based on the background and importance of this needs analysis, this study aims to comprehensively identify the needs of junior high school teachers and students for science practicum, especially as a basis for developing guided inquiry-based practicum guides that are effective in fostering students' scientific skills. The results of this needs analysis are expected to provide valuable insights for educators, curriculum developers, and researchers in designing and implementing science learning that is more relevant and meaningful for junior high school students.

METHOD

This study will adopt a mixed methods approach (qualitative and quantitative) with a focus on needs analysis, which is a fundamental step in the design and development of educational products (Dousay & Branch, 2023). This needs analysis aims to identify gaps between ideal and actual conditions related to science practicum in junior high school, as well as to formulate specifications of guided inquiry-based practicum guides that are relevant and needed.

Table 1. Guttman scale in instruments

Scale	Description
0	No
1	Yes

Subjects of the study consisted of 219 junior high school students in various cities in South Sumatra and 52 science teachers from several different schools. The research design used was a survey and in-depth interviews to collect data on the perceptions, experiences, and expectations of teachers and students regarding science practicums and the potential for developing guided inquiry guidelines. This study utilized a questionnaire that had been

consulted with two experts in the field of physics education. The questionnaire consisted of 12 questions for teachers and 9 questions for students. Respondents answered each question using the Guttman scale shown in Table 1. This design enabled in-depth data collection from multiple perspectives, as recommended for needs analysis studies in educational contexts (John W.Creswell, 2017; Demir *et al.*, 2023).

RESULTS AND DISCUSSION

The findings of the analysis of teacher and student needs for guided inquiry-based science practicum guides that have been collected through survey and interview techniques. The data obtained were then analyzed to identify the main aspects needed in the development of practicum guides, both in terms of content, implementation methods, and the completeness of media and tools. The results of the response data of 219 students can be seen in the following Table 2.

Table 2. Students' perspectives on inquiry laboratory guidelines

No	Question	Selected	
		Yes (%)	No (%)
1.	Have you ever used an inquiry-based practicum guide before?	34.4	65.6
2.	Do you think it is important to use practicum guides in learning vibration and wave material?	98.6	1.4
3.	Do you know the guided inquiry approach in science learning?	44.3	55.7
4.	Are you interested in using the guided inquiry approach in the vibration and wave practicum?	88.5	11.5
5.	Do you think the guided inquiry approach can improve your understanding of the concept of vibrations and waves?	90.8	9.2
6.	Do you think the guided inquiry approach can improve your understanding of the concept of vibrations and waves?	89.9	10.1
7.	Do you think the guided inquiry approach can improve your understanding of the concept of vibrations and waves?	90.4	9.6
8.	Do you feel there is a need for a step-by-step guide in the vibration and wave practicum?	94.9	5.1
9.	Do you need a guide with a brief theoretical explanation before the practicum begins?	95.4	4.6
10.	Is the laboratory equipment in your school adequate for practicing vibrations and waves?	71.1	28.9
11.	Do you like practicum activities at school?	89	11

No	Question	Selected	
		Yes (%)	No (%)
12.	Do you think practicum in learning is important or not?	98.2	1.8
13.	Do you think practicum in science learning is important or not?	98.6	1.4

Based on the survey data obtained, it can be seen that most students (65.6%) have never used an inquiry-based practicum guide, although 98.6% stated the importance of practicum guides in learning vibrations and waves. This is in line with research (Noer Hanifah & Budiyanto, 2023) which found that the lack of use of guided inquiry guides in schools was due to the lack of teacher socialization regarding this approach, although students showed high interest in inquiry-based experimental methods.

Only 44.3% of students were aware of the guided inquiry approach, but 88.5% expressed interest in using it in practicum. This finding is consistent with a study (Gyllenpalm et al., 2022) which showed that although students' initial understanding of guided inquiry was low, their interest increased after being introduced to this method as it was considered more interactive and encouraged active engagement. In addition, 90.8% of students believe that the guided inquiry approach can improve understanding of vibration and wave concepts, which is supported by research (Saija & Beay, 2022) that inquiry-based learning significantly improves students' conceptual understanding in physics.

A total of 94.9% of students agreed on the importance of a step-by-step guide, and 95.4% needed a brief theory explanation before the practicum. This result is in line with the findings of (Shofiana & Melisa, 2022) which emphasizes that a structured practicum guide with supporting theory increases learning effectiveness and reduces student confusion during experiments.

Although 71.1% of students stated that their school laboratory equipment was adequate, there were still 28.9% who felt the facilities were inadequate. This can be an obstacle in the implementation of guided inquiry practicum, as revealed by (Rahmah et al., 2023) that limited laboratory equipment reduces the optimization of the inquiry approach. However, 89% of students liked practicum activities, and 98.6% considered practicum important in science learning, indicating that students' interest in experimental learning is very high, in accordance with research (Susanti & Hadi, 2022) which found that practicum increases student motivation and learning outcomes. this is in accordance with the results of previous research that guided inquiry is effective in science learning (Susanti & Hadi, 2022), but its success is highly dependent on the support of facilities and teacher readiness. Thus, the implementation of this approach needs to be supported by school policies in providing facilities and teacher training.

In addition to the perspective of students, this study also collected perspectives according to science teachers as many as 52 respondents. The results of the teacher respondent data can be seen in Table 3.

Table 3. Science teachers' perspectives on the inquiry practice guide

No	Question	Selected	
		Yes (%)	No (%)
1	Do you do practicum in science learning?	96.2	3.8
2	Do you need a practicum guide during the practicum?	98.1	1.9
3	In your opinion, is the Practicum guide important in the implementation of the practicum?	98.1	1.9

No	Question	Selected	
		Yes (%)	No (%)
4	Have you ever heard of the term Guided Inquiry?	75	25
5	According to you, can the guided inquiry syntax help improve students' scientific work in conducting practicum?	78.4	20.6
6	Have you ever made a guided inquiry-based practicum guide?	40	60
7	Do you think the guided inquiry approach is suitable for use in practicum activities to improve students' scientific work skills?	84.3	14.7
8	Do you think that the available practicum guides are effective in guiding students?	92.2	7.8
9	Is there a limitation of practicum tools and materials as an obstacle in the implementation of practicum in your school?	67.3	32.7

Based on the results of a survey of science teachers, it was found that 96,2% of respondents had implemented practicum in science learning and all (98,1%) viewed practicum guides as an important component. This finding is consistent with research (Silitonga & Tangkin, 2023) which states that practicum is an essential method in science learning to develop students' scientific process skills. However, although 75% of teachers were familiar with the term guided inquiry, only 40% had ever made a practicum guide based on this approach. This indicates a gap between conceptual understanding and practical implementation, as revealed by (Rosminah et al., 2023) that many teachers are still constrained in designing guided inquiry guides due to lack of training.

A total of 78,4% of teachers believed that the guided inquiry syntax could improve students' scientific work, and 84,3% agreed on the suitability of this approach for practicum. These results are in line with the findings of (Öztürk et al., 2022) which proved that guided inquiry significantly improved the skills of formulating hypotheses, collecting data, and analyzing student experimental results. However, the low percentage of teachers who have made guided inquiry guides (40%) indicates the need for intervention in the form of training in the design of inquiry-based practicum guides, as recommended by (Damayanti et al., 2022).

Although 92,2% of teachers considered the available practicum guides to be effective, 67,3% also recognized the limitations of tools and materials as the main obstacle. This finding reinforces the results of the study that identified the availability of laboratory facilities as a determining factor for the success of the practicum, especially for the inquiry approach that requires independent exploration by students. On the other hand, 7,8% of teachers who disagree about the effectiveness of the guide may be due to the mismatch of the guide with the needs of students or the curriculum, as revealed in the study (Ratela, 2020). There are ways that can be done, namely, evaluating the quality of practicum guides. Existing guides need to be reviewed regularly to ensure their suitability for the curriculum and the cognitive level of students. This finding supports the argument (Ong et al., 2020) that guided inquiry is an effective strategy for science learning, but its success depends on supporting facilities and teacher readiness. In addition, the survey results reinforce the finding that limited laboratory facilities are still a

common problem in Indonesian schools, especially in areas with limited education budgets. Table 4 shows the gaps in practical needs from the opinions of teachers and learners.

Table 4. Practical needs from the opinions of teachers and students can be seen as follows.

Variables	Students (%)	Teacher (%)	Interpretation
Need a practicum guide	98.6	98.1	High agreement.
Laboratory equipment constraints	28.9	67.3	Teachers feel this problem more.
Never use inquiry	34.4	40	Implementation is still low.

The high percentage of students and teachers who expressed the need for practicum guides shows that both students and educators realize the importance of structured instructions in the practicum process. This data reflects that the inquiry approach, although recommended in the Merdeka Curriculum and the 2013 Curriculum, has not been optimally implemented in the field. Lack of teacher training on the application of inquiry learning. Limited time and facilities to carry out in-depth inquiry activities. Limited understanding of students in conducting independent exploration without intensive assistance. Teachers have more awareness of laboratory facility standards. They realize the limited tools as an obstacle in the implementation of practicum-based learning.

Gap between Awareness of the Importance of Guidelines and Limited Experience in Guideline Development (Teachers)

The survey results showed that all teachers expressed the importance of practicum guides (T1, T4), but only 40% of them had developed guided inquiry-based guides (T2). This raises the question of why there is a gap between the perceived importance of the guide and its practical implementation. According to Chadwick et al (2023) one of the main reasons is the lack of training in guided inquiry guide design, which causes teachers to feel less confident in designing and adapting guides to student needs. Teachers' ability to design effective guides is strongly influenced by experience and training, as revealed by Damayanti et al. (2022), that practicum guide design training can improve teacher competence and encourage wider use of the guided inquiry approach.

The lack of adequate training and resources leads to a lack of teacher competence in developing the guide, and limited laboratory facilities (T1, T3) also add to the practical barriers. If the facilities are inadequate, teachers find it difficult to adjust the guide to the real conditions in the field, resulting in low implementation of the inquiry guide. There is a need for continuous training and development of practicum guide modules that can be accessed and applied by teachers in various facility conditions. It also suggests a technical assistance program so that teachers are more confident and able to overcome practical obstacles in the field.

Teacher Perceptions of the Effectiveness of Laboratory Facility Guidelines and Constraints

Most teachers considered the available guidelines to be effective (T2), however, the main obstacle still arises from the lack of practicum tools and materials (T2, T3, T4). This phenomenon can be related to the results of (OECD, 2022) which shows that laboratory facilities in Indonesian schools are generally still low. This mismatch between the perceived effectiveness of the guide and facility constraints indicates that teachers' perceptions of the guide may be based on the theoretical validity and content of the guide, rather than the reality in the field.

Teachers may think that the guidelines are ideally effective or complete, but the reality on the ground shows a lack of tools and materials that hinder their implementation. This is in line with the findings of Spernes & Afdal (2023) who emphasize the importance of considering available resources in the development of guidelines to suit real conditions. The development

of practicum guidelines must take into account these limitations, for example by providing more flexible and adaptive guidelines, as well as improving laboratory facilities as a long-term effort. Schools need to get assistance and procure adequate equipment so that the guidelines can be implemented optimally.

Use of and Knowledge of the Guided Inquiry Approach (Students)

In terms of students, only 44.3% were aware of the guided inquiry approach, indicating that their knowledge was still low, although most (88.5%) were interested and stated that this approach could improve their understanding (T6). This phenomenon can be explained through Piaget's theory of constructivism, where students' understanding of learning methods depends on direct experience and socialization from the teacher. If the teacher is not familiar with or has not actively introduced this approach, then the students' low knowledge is reasonable.

Lack of socialization and training on the guided inquiry approach at the school level leads to students' lack of initial understanding. Unsupportive or unavailable media or guides also reinforce this gap. As expressed by Eshetu et al (2022) the importance of developing modules and guides that are integrated with the curriculum is key so that students understand and are able to follow this approach. Intensive efforts are needed to introduce the guided inquiry approach to students through active and sustainable learning activities. Teachers need to get adequate training and teaching materials to improve students' knowledge and skills in using this approach independently and effectively.

High Interest in Practicum and Structured Practicum Guide

In general, almost all students considered the practicum important and they needed step-by- step guidance and theoretical explanations (T5). This phenomenon shows that students see the direct benefits of a structured practicum, in accordance with Vygotsky's theory of scaffolding, which emphasizes the importance of support in the learning process.

Students are usually more confident and understand concepts well if guided systematically. The reliance on guidance is also related to the lack of previous experience conducting independent scientific investigations due to facilities, teacher experience, and conventional approaches to practicum implementation. The development of the guide should emphasize aspects of clear steps, theoretical explanations, and visual support/supporting media to make the practicum process more interesting and effective. In addition, increasing the capacity of teachers and laboratory facilities should be a priority so that the guidelines can really overcome students' practical and conceptual challenges.

The limitations of the research

The most significant limitation that emerged in this study was related to the limited laboratory facilities, equipment, and practical materials available in junior high schools in Indonesia. Data from the survey showed that despite the high demand for guided inquiry-based practical guidelines, constraints such as the lack of adequate laboratory facilities were significant barriers to the implementation of effective and innovative practical work. Additionally, teachers' understanding and experience in developing and implementing inquiry-based laboratory guides also show limitations, particularly due to the lack of training and learning resources related to this approach. Therefore, although the need for systematic and practical guides is very high, the limitations of facilities and teacher competencies remain the main challenges in the implementation of inquiry-based science education practices in the field.

CONCLUSION

Based on the results of questionnaire data analysis of teachers and students, it can be concluded that there is a high need for the development of guided inquiry-based practicum guides in science learning at the junior high school level. All teachers stated that they had conducted practicum and recognized the importance of practicum guides in its implementation. Similarly, the majority of students stated that practicum guides are needed, especially those

that are organized systematically and equipped with theoretical explanations before implementation. Most teachers and students showed understanding and interest in the guided inquiry approach, and believed that this approach could improve students' scientific skills. However, not all teachers have experience in developing guided inquiry-based practicum guides, and there are still obstacles in the form of limited practicum tools and materials in schools.

This research can be expanded by developing and testing the effectiveness of the guided inquiry-based laboratory manual that has been compiled, through a quantitative experimental approach in various junior high schools with different facility backgrounds and teacher competency levels. In addition, further research can also explore the influence of using this manual on improving students' scientific skills in the long term and developing their scientific character. This research could also integrate aspects of teacher training and empowerment in developing and implementing the guide, to enhance their pedagogical and professional competencies in conducting guided inquiry-based laboratory activities in a more innovative and contextual manner. Thus, it can be concluded that the development of guided inquiry-based practicum guides is a relevant and urgent need in supporting meaningful science learning. The guide is expected to be an effective tool in fostering the scientific skills of junior high school students and assisting teachers in carrying out practicum that is structured and in accordance with the syntax of inquiry.

RECOMMENDATION

In light of the findings, the subsequent phase of this research will entail the formulation of a guided inquiry-based practicum guide, meticulously tailored for junior high school science classes. The development process will entail the creation of systematic instructions, theoretical explanations, and practical activities that are aligned with the needs of students and the resources available at their educational institutions. To ensure its relevance and effectiveness, the guide will undergo validation by experts and testing in authentic classroom settings.

Potential barriers that could influence the results include limited laboratory facilities and resources in schools, which could hinder the implementation of the practicum. Furthermore, teachers' insufficient training or familiarity with guided inquiry approaches may impede their capacity to employ the guide effectively. The extent to which students are engaged in the research process, in addition to their aptitude for independent investigation, may present certain challenges. These challenges have the potential to influence the overall success and outcomes of the research endeavor.

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