



Identifying Barriers to Guided Inquiry-Based Physics: A Case Study of 21st – Century Pedagogical Gaps in Indonesian Middle Schools

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Abstract

Despite the 21st-century mandate for critical thinking, physics instruction in many developing regions remains stagnant in conventional methods. This study conducts a rigorous needs analysis for implementing the guided inquiry model at an Indonesian middle school. Using a qualitative descriptive approach with 3 physics teachers and 32 students, the study revealed a significant “pedagogical paradox”: while 75% of students expressed a high preference for experimental learning, 100% of teachers still relied on teacher-centered lectures due to a lack of operational inquiry training and laboratory kits. Thematic analysis identified three critical barriers: instructional time constraints, facility deficits, and low teacher self-efficacy in inquiry syntax. These findings offer a scalable “Needs Analysis Framework” for rural science education, providing a roadmap for policy-makers to bridge the gap between curriculum ideals and classroom reality in similar global context.

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INTRODUCTION

In the twenty-first century, education needs to be taught in a way that helps students think critically, be creative, and solve problems. These skills are very important in science, especially physics, because learning physics is all about understanding things deeply through scientific inquiry and memorizing concepts. However, several educational studies conducted in Indonesia indicate that lectures and exercises prioritizing outcomes over students' cognitive processes persist as the predominant classroom learning methodologies. This situation limits students' ability to directly observe physical events, which impedes the proper cultivation of advanced cognitive skills (Ariani & Agustini, 2018). Many teachers find it hard to use new ways of teaching. Some of these problems are that there isn't enough inquiry-based teaching training, there isn't enough lab equipment, and the curriculum often makes learning focus on quickly getting information. Because of this, learning models like guided inquiry models that could help people learn more about science and concepts are not being used to their full potential. Guided inquiry is not being used much in Indonesian physics classrooms right now, even though it has been shown to help students think more critically. Consequently, a disparity exists between current educational methodologies and modern educational requirements. (Dkk Livisia, 2018).

Education is one of the most important things that can be done to improve the quality of human resources so that they can keep up with changes in technology and the natural sciences (IPA). These rapid changes have prompted educators to develop and implement curricula that focus more on helping students understand IPA principles so they can make a difference in the world. To keep up with new discoveries in the natural sciences, it is important to improve the creativity of human resources so that they can use all of their critical thinking and teamwork skills (Ariani & Agustini, 2018). Physics, a universal science, is the basis for modern technological progress. This science is important for many academic fields and for improving critical thinking skills. In today's world, breakthroughs in physics have a big effect on how quickly information and communication technologies are growing. Students need to have a good understanding of physics concepts from the start if they want to learn and improve technology in the future. Physics helps students get ready for problems that come up in a world that is always changing. This readiness is achieved by equipping students with collaborative problem-solving skills and fostering logical, analytical, systematic, critical, and creative thinking abilities (Ariani, 2020). Physics is another important subject that helps students develop a scientific way of thinking. Physics education is meant to teach students how to think critically and solve problems, as well as how to understand natural events in a logical and methodical way (Nurhasanah et al., 2022).

Preliminary observations and interviews indicate that lectures and assignments remain the primary elements of the physics curriculum at SMP Negeri 14 Lubuklinggau. In this case, students usually just take in information and teachers are more like sources of information. Because there isn't enough lab space or time to study, practical exercises and experiments, which should be a big part of learning physics, are not done very often. Due to this condition, students have a hard time fully understanding physics topics and linking what they learn to the real world. These findings align with the research conducted by Samudra et al. (2014), which asserts that conventional teaching methods in physics may

hinder students' development of critical thinking and scientific communication skills. The Guided Inquiry learning method is one way to improve critical thinking skills while studying physics. This method gets students to actively take part in a number of activities, such as coming up with problems, making or presenting hypotheses, doing experiments to collect data, and analyzing the results and drawing conclusions from them. The teacher's job in this learning process is to organize and help, not to be in charge. Teachers help students learn by letting them figure things out on their own instead of giving them answers. Students will find it easier to remember what they learn because it is based on their own experiences. The phases of the Guided Inquiry learning model are meant to give students exercises that help them think critically (Lovisia et al., 2013). The Guided Inquiry paradigm is one way to deal with these problems. This method helps students learn concepts by using a structured scientific inquiry process with the teacher as a guide. According to Trianto in Suprijon (2010), the Guided Inquiry learning approach has the following structure: 1) Asking questions, 2) Coming up with ideas, 3) Planning experiments, 4) Collecting data, 5) Testing ideas, 6) Making conclusions, 7) Sharing results, and 8) Thinking about what happened.



Figure 1. Guided Inquiry Syntaxes

According to Rahayu's (2020) research, the guided inquiry learning model has been effective in improving the critical thinking and communication skills of trained students. The data shows that students who learned this way did 15% better on average than those who learned the old-fashioned way. This shows that students like this way of learning and that it helps them understand the material better. Consequently, the guided inquiry paradigm is regarded as appropriate for science education that emphasizes students' communication and critical thinking skills.

In light of this context, the objective of this study is to examine the preparedness, attitudes, and challenges faced by junior high school physics teachers and students during the implementation of guided inquiry. This initial needs analysis is necessary to confirm that the model's implementation constitutes a process appropriate for the educational environment in schools, rather than merely a temporary endeavor. Consequently, this

study was conducted to delineate the initial conditions of physics instruction at SMP Negeri 14 Lubuklinggau and to identify the prerequisites and obstacles faced by both instructors and students in the implementation of the Guided Inquiry approach. According to several previous studies, including one by Yanti et al. (2017), the guided inquiry model helps students improve their thinking skills by using higher mental processes. This paradigm can also improve students' learning outcomes and their ability to think critically (Cahyani et al., 2024).

These findings align with studies indicating that education is a crucial factor in improving the quality of human resources amidst technological progress and advancements in the natural sciences (IPA). These rapid changes have prompted educators to develop and implement curricula that focus more on helping students understand IPA concepts that will benefit society. To keep up with new developments in the natural sciences, it's important to boost the creativity of human resources (Ariani, 2020). The universal science of physics is the basis for modern technological progress. This science is important for a lot of different fields of study and for improving your ability to think critically. These days, new things in physics have a big effect on how quickly information and communication technologies grow. In order to learn and improve technology in the future, students need to understand physics concepts well from the start. Physics prepares students for the challenges of a world that is always changing. This readiness is achieved by equipping students with the ability to collaborate in problem-solving, alongside logical, analytical, systematic, critical, and creative thinking skills (Ariani & Agustini, 2018). Physics is another important subject that helps students develop a scientific way of thinking. Physics education encourages students to develop critical thinking and problem-solving skills, along with a rational and systematic comprehension of natural phenomena (Silaban et al., 2018).

The struggle to shift from rote learning to inquiry-based learning is not unique to Indonesia; recent studies in other developing countries (e.g., Tsekleves, E., 2021; Brown, S. et.al., 2022; Brown, S., et.al., 2024; Cooper, A., 2019) highlight that systemic resource scarcity often dictates pedagogical choices, regardless of national curriculum mandates. Challenges to inquiry or research in Global South countries are quite universal, with various aspects of Social and Cultural Context (Tsekleves, E., 2021; Brown, S. et.al., 2022; Brown, S., et.al., 2024), Infrastructure Limitations (Brown, S. et.al., 2022; Brown, S., et.al., 2024), and Knowledge Inequality (Cooper, A., 2019). This underpins the importance of this study, which aims to identify the needs and challenges in implementing the guided inquiry model at an Indonesian middle school. As a result, learning models that have the potential to improve conceptual understanding and scientific skills to including guided inquiry models, and then are not being used to their full potential.

METHOD

This study uses a qualitative descriptive method. According to Zellatifanny (2018), qualitative descriptive research is research that attempts to explain the object or subject being studied objectively and aims to provide facts with the aim of describing the real conditions of physics learning and the perceptions of teachers and students regarding the possibility of applying the Guided Inquiry model. This research was conducted at SMP Negeri 14 Lubuklinggau, located at Taba Jemekeh, Lubuklinggau Timur I District, Lubuklinggau City, South Sumatra, in February 2025. The research subjects consisted of

three physics teachers and 32 seventh-grade students, comprising 10 high-ability students, 12 medium-ability students, and 10 adequate-ability students.

The instruments used were interview sheets with indicators such as the Application of Learning Models, Understanding of Guided Inquiry Models, Correlation with Critical Thinking Skills, the Role of Practicum in Physics Learning, and Student Communication Skills. Meanwhile, the teacher questionnaire contained 9 questions covering aspects of the learning model, difficulties, effectiveness of methods, knowledge of guided inquiry, as well as critical thinking and communication skills. The student questionnaire contained 12 questions exploring students' perceptions of physics learning, learning difficulties, laboratory practice, critical thinking, and communication skills.

This study uses a descriptive qualitative method to describe the actual conditions of physics learning and the readiness to implement the Guided Inquiry model at SMP Negeri 14 Lubuklinggau. This method was chosen because it allows researchers to examine in depth the perceptions, experiences, and obstacles felt by teachers and students. This research was conducted at SMP Negeri 14 Lubuklinggau, located at Taba Jemekeh, Lubuklinggau Timur I District, Lubuklinggau City, South Sumatra, in February 2025. The research subjects consisted of three physics teachers and 32 seventh-grade students, comprising 10 high-ability students, 12 medium-ability students, and 10 adequate-ability students.

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Data validity in this study compared data from teachers and students and combined interview sheets and documentation. Data collection techniques were gathered through initial observations related to the physics learning process in the classroom and data analysis techniques using thematic analysis. To ensure the rigor and validity of the qualitative findings, this study employed triangulation of techniques and member checking. Technical triangulation was conducted by cross-referencing data obtained from initial observations, semi-structured interviews, and questionnaires. This process allowed for the verification of consistency between what was observed in the classroom and what was reported by teachers and students in their respective instruments. Furthermore, member checking was performed by presenting the transcribed interview results back to the participating teachers to ensure that the data accurately reflected their perspectives and experiences regarding physics instruction.

Table 1. Teacher interview instrument grid

No	Question Indicators	Question Number
1.	Learning Model	1
2.	Difficulties And Effectiveness of Methods	2, 3
3.	Knowledge of Guided Inquiry	4, 5, 6
4.	Critical Thinking and Communication Skills	7,8,9,10, 11

Table 2. Teacher Interview Instrument Grid

No	Question Indicators	Question Number
1.	Physics Learning	1,2, 3
2.	Learning Difficulties	4,5, 6
3.	Laboratory Practice	7,8,9, 10
4.	Critical Thinking and Communication Skills	11, 12

The qualitative data collected were analyzed using Thematic Analysis as proposed by Miles and Huberman. The analysis followed three systematic steps: (1) Data Reduction: The process of selecting, focusing, and transforming the raw data from interviews, observations, and questionnaires into meaningful clusters. (2) Data Display: Organizing the reduced data into structured formats, such as thematic tables (e.g., Table 1.3 and Table 1.4), to facilitate the identification of patterns and relationships. (3) Conclusion Drawing and Verification: Interpreting the displayed data to identify the core needs and barriers to implementing the Guided Inquiry model, ensuring that the conclusions were consistently supported by the evidence gathered.

RESULT AND DISCUSSION

From further interviews, several key requirements were identified to support the implementation of the Guided Inquiry Model in schools. First, teachers need training focused on developing inquiry steps: (1) orientation, (2) problem formulation, (3) data collection, (4) data analysis, and (5) conclusion. Teachers act as facilitators, while students are active in observation and group discussions.

Table 3. Results of Teacher Interviews

No.	Main Question	Teacher 1	Teacher 2	Teacher 3	Thematic Analysis
1.	The learning model used	Lectures and discussions Lec	Lectures, demonstrations of simple	Questions and answers, practice questions	Learning is still teacher-centered, with low student activity.
2.	Teaching challenges	Limited time, passive students	Laboratory equipment is lacking	It is difficult to motivate students.	Active strategies and supporting measures are needed.

No.	Main Question	Teacher 1	Teacher 2	Teacher 3	Thematic Analysis
3.	Effectiveness of the method	Quite effective for diligent students	Not very interesting	Students get bored quickly	The method is unable to foster activity
4.	Knowledge about guided inquiry	Heard of it, never applied it	I don't know the details.	Not yet familiar with	Teachers do not yet understand the concepts and steps of this model.
5.	Potential application of the model	Very interesting, suitable for physics	Can increase interest	Suitable for topics on motion and force	There is interest in implementing it, but guidance on implementation is needed.
6.	Barriers to implementation	Lack of practical tools	Time and training	Class management	Teacher readiness and facilities are the main obstacles.
7.	Critical thinking knowledge	Aware of its importance, not yet measured	Understand but not yet integrated	Don't know the indicators	Teachers recognize the importance, but it has not been implemented.
8.	Effectiveness of practical training	Very effective	Students are more enthusiastic	Attracts students' attention	Practical work is considered important but is rarely done.
9.	The relationship between critical thinking and learning outcomes	Highly influential	Improving understanding	Helping to solve problems	Critical thinking is essential for understanding physics concepts.

The results show that teachers are in dire need of training and practical guidance on the application of Guided Inquiry. In addition, limited resources are a major obstacle to creating experiment-based learning.

Table 4. Student Interview Results

Interview Aspect	Summary of Student Responses (32 Students)
Opinion about physics	19 students like physics, while 13 find it difficult due to many formulas and abstract theories.
Learning difficulties	Students find it hard to understand formulas, teacher explanations are too fast, and there is a lack of hands-on practice.
Practicum experience	26 students say they rarely go to the laboratory; practical activities are mostly teacher demonstrations.
Learning interest	24 students want more experiments and group discussions.
Importance of practicum	31 students believe practicum is necessary because it makes learning more concrete.
Preferred learning method	20 students prefer learning through group discussions and experiments.
Understanding of critical thinking	27 students do not know the term, but understand it as asking questions and investigating 'why'.
Communication barriers	18 students feel shy speaking in front of the class, 10 feel nervous, and only 4 feel confident.
Question-asking preference	25 students prefer asking friends, while 7 prefer asking teachers.
Communication skills importance	29 students agree that practicing speaking during presentations is important.
Ways to improve communication	Group discussions, presentation practice, and building confidence to speak in front of the class.

The interviews conducted at SMP Negeri 14 Lubuklinggau provide a clear picture of the current state of physics instruction, which is still mostly based on lectures and exercises. The study's results show that teachers are still not fully ready to use the Guided Inquiry method. Teachers are very interested in this idea, but they still don't fully understand it. Two out of three teachers said they had only "heard of" guided inquiry and didn't know how it worked yet. Teacher 3 said, "To be honest, I don't know the steps," and Teacher 1 said, "I've heard of this model, but I've never used it in class." This lack of knowledge shows that we need to do a better job of organizing lessons. These findings align with the research conducted by Khartaningtyas & Rosdiana (2020), which identified low teacher comprehension as a significant obstacle to the implementation of inquiry-based learning. Despite this, teachers showed a strong desire and emotional readiness to try using this model in their teaching. Teacher 2 said, "This model looks interesting and good for

teaching motion and force." This indicates robust psychological readiness as a foundation for execution. However, when looking at the learning activities that took place, it was clear that the teaching methods used were still traditional and focused on the teacher. It was still normal to have exercises, lectures, and short Q&A sessions. Teacher 1 said, "I usually use lectures and a little discussion," and Teacher 2 said, "If kids only hear explanations, they get bored quickly." This situation shows that learning still doesn't have enough activities that require students to get involved. These results align with the findings of Samudra et al. (2014), which indicated that teaching physics via lectures induces passivity in students and inhibits the development of higher-order thinking skills.

Putting inquiry-based frameworks into action is also hard for teachers. The main problems are not having enough lab equipment, not having enough time to learn, and not being able to keep the class in order during experiments. Teacher 2 said, "Practical tools are very lacking," and Teacher 1 said, "Time is limited, it is difficult if we have to do long practical work." These problems show that institutional support and the availability of extra facilities are just as important for successful implementation as teacher readiness. These findings corroborate Rahayu's (2020) assertion that a major impediment to experiment-based physics education is the deficiency of laboratory resources. The study found that most students are interested in physics, but they have trouble when the lessons go too fast and there aren't enough hands-on activities. Student 7 said, "If I just write down the formulas, I forget them easily," and Student 12 said, "The teacher's explanations are sometimes too fast." These claims show how useless lectures are for helping students understand abstract physics concepts that use a lot of math symbols. Also, most students said they hardly ever did practical work, which made it harder for them to connect theory to reality. Student 3 said, "We hardly ever do practical work," and Student 15 said, "I would understand more quickly if we could do experiments more often." These results support the findings of Silaban et al. (2018), who determined that direct learning experiences and hands-on activities are essential for improving the understanding of physics concepts.

Moreover, the evidence suggests that children possess the potential to develop critical thinking skills, yet they have not been afforded the opportunity to do so. Student 21's comment, "I don't know the term, but it's like finding out why an event happened," shows that students have an instinctive understanding of what it means to investigate, even if they haven't had any formal training. A learning strategy that encourages group discussions and presentations is very important because many students have trouble talking in front of the class. These findings align with Pujiana et al. (2024), who assert that guided inquiry, through its integration of debate, reasoning, and the presentation of research findings, significantly improves students' scientific communication skills. When looking at what this model needs to be put into action, problems within the institution are a big part of the picture. Both teachers and students agree that the laboratory facilities are not good enough and cannot fully support experimental work. Student 10 said, "We want to do practical work, but there aren't always any tools," and Teacher 1 said, "There aren't enough practical tools." There are also other problems that need to be fixed right away, such as the lack of Guided Inquiry-based learning materials like modules, workbooks, and experiment manuals, as well as the short amount of time available for learning. Teacher 2 said, "This model is good, but there isn't enough time for long experiments." These findings are relevant to the conclusions drawn by Harahap & Harahap (2021),

which demonstrate that institutional support, characterized by adequate facilities, time, and learning planning, significantly impacts the efficacy of inquiry-based learning implementation.

Synthesis of Pedagogical Barriers: Teacher Beliefs and Professional Development Gaps

The findings indicate a significant "awareness-implementation gap" among physics educators. Even though teachers know about 21st-century learning models, they still use teacher-centered lectures as the main way they teach in the classroom. The Professional Development Gap and Teacher Beliefs could be employed to examine this discrepancy.

The interviews reveal that teachers often view inquiry-based learning as a "time-consuming" endeavor that may hinder the achievement of the comprehensive national curriculum. As a result, teachers are mentally blocked and put "curriculum coverage" ahead of "conceptual depth." Teachers now only have a basic understanding of the idea because they aren't getting any professional development that is specifically for teaching physics through inquiry. They "know" the paradigm, but they don't have the confidence in their teaching skills to deal with the unpredictability of a classroom where students are supposed to guide their own learning.

Targeted Needs Analysis: Bridging Specific Competency Gaps

A more in-depth look at the results shows that the "need" for implementation goes beyond just providing equipment and includes addressing specific teaching skills. The data from observations and interviews shows that teachers have the most trouble with the technical syntax of guided inquiry, especially when it comes to making hypotheses and analyzing data.

Most of the practical work these days is "cookbook-style" or strictly deductive, with students just proving what they learned before. The primary requirement identified is a specialized training framework that emphasizes: (1) Transitioning from Deductive to Inductive Reasoning: instructing educators on how to facilitate student-led discovery rather than providing immediate answers; (2) Instructional Scaffolding: cultivating the ability to offer sufficient guidance (scaffolding) during the inquiry process without reverting to direct instruction; and (3) Resource-Adaptive Inquiry: empowering teachers to develop inquiry modules that leverage local resources to address the constraints of inadequate laboratory facilities.

CONCLUSION

The conclusion section should provide a synthesis of the key findings based on the research problems, highlighting their significance and implications. It should help the reader understand why the research matters after they have finished reading the paper. The conclusion is not merely a summary of the main topics covered or a re-statement of the research problem but should integrate and synthesize the key points. It is essential that the conclusion does not leave any questions unanswered.

Additionally, the conclusion should address the limitations of the study. Acknowledge any constraints, potential sources of bias, and factors that may affect the generalizability

of the findings. Being transparent about these limitations enhances the credibility of your research.

Furthermore, provide recommendations for further research. Suggest areas that require more investigation, based on the findings and limitations of your study. These recommendations should be practical and feasible, guiding future researchers in continuing to explore the topic.

CONCLUSION

The study's results show that SMP Negeri 14 Lubuklinggau really wants to switch to inquiry-based physics, but there are still a lot of structural problems that need to be fixed. Based on these findings, this study proposes a "Resource-Adaptive Needs Analysis Framework" for science educators in other resource-limited regions globally. This framework is based on three strategic pillars: (1) Dual-Perspective Perception Mapping, which systematically finds the gap between how students like to learn and how teachers think they should teach; (2) Minimum Essential Facility Audit, which realistically checks the laboratory infrastructure to see which levels of inquiry (e.g., guided vs. structured) can be done with the equipment that is already there; and (3) Pedagogical Competency Mapping, which finds specific technical gaps in inquiry syntax, such as how to form a hypothesis and how to interpret inductive data.

In conclusion, this study emphasizes that the transition to 21st-century science education will persist as a theoretical discussion rather than a practical implementation without strategic policy intervention, especially through the provision of affordable laboratory kits and sustained pedagogical support. To make Guided Inquiry work, it is just as important to close the gap between what the curriculum requires and what the local school infrastructure can provide as it is for teachers to be willing to do so.

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