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Student Perceptions Of The Teslameter Tool Using Arduino Nano With A Hall Effect Sensor For Magnetic Field Material As A Support In Physics Learning

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ABSTRACT

The purpose of this study was to analyze student perceptions of teslameter tools using arduinonano with hall effect sensors for magnetic field material as support in physics learning. This research method uses a descriptive qualitative approach. The subjects of this research are students majoring in science / who take physics lessons at SMAN 1 Jambi City. The instrument used in this study was an interview with 8 questions. The results of research on student perceptions of teslameter tools using arduinonano with hall effect sensors for magnetic field material as support in physics learning, show that the use of teslameter tools really helps students in understanding magnetic field material in physics learning directly, so that it can increase student interest in learning physics and make learning more effective and can improve student learning outcomes. It can be concluded that teachers have an important role in learning, so teachers should more often use practicum tools, especially teslameter as a tool in the physics learning process of magnetic field material. It is expected that teslameter tools are sufficiently available in school physics laboratories and more practicum or experiments that use teslameter tools to help students better understand magnetic field material.

1. INTRODUCTION

Natural Science learning in high school involves several fields, including physics. According to Utomo cited by Winda (2019), physics is the result of a combination of various principles and concepts that depend on physical quantities. However, physics is often considered abstract and difficult to understand. To facilitate student comprehension, these abstract concepts need to be explained concretely, for example, through practical experiments (Logo et al., 2023; Rizaldi et al., 2020). One of the essential physics concepts is the magnetic field, which describes the forces acting on moving charges in addition to electrostatic forces (Pambuka & Rahardjo, 2018; Qolbi et al., 2023; Yovan & Kholiq, 2022).

The difficulty in understanding magnetic fields arises because human sensory organs are limited in perceiving these phenomena. Consequently, students often struggle to grasp the concept when relying solely on verbal explanations from teachers (Dewi et al., 2021; Rahim, 2023). While students may attempt to visualize magnetic fields, individual perceptions vary significantly (Ariyani et al., 2019). The dominant use of conventional teaching methods, such as lectures and memorization, further exacerbates the problem, preventing students from developing a deep conceptual understanding (Kamilah, 2022).

Therefore, physics instruction should move beyond rote learning, as abstract physics concepts require active engagement and visualization tools (Fitri & Putra, 2023; Ikbal, 2022; Ramadani & Nana, 2020).

To bridge this gap, appropriate learning support tools are necessary to enhance students' understanding of magnetic fields and improve learning outcomes (Caesaria et al., 2020; Fathoni et al., 2019; Hendratno, 2019). The lack of engaging and interactive learning approaches often leads to boredom among students, as they struggle with problem-solving accuracy, passive learning environments, and teacher-centered instruction (Masrifa et al., 2023; Susanti, 2023). Thus, an innovative learning approach that actively involves students is essential to overcome these issues.

One promising approach is STEM-based learning (Science, Technology, Engineering, and Mathematics), which emphasizes hands-on experiences and real-world applications. Studies have shown that STEM learning effectively enhances 21st-century skills among Generation Z students and significantly improves science learning quality (Ichsan et al., 2023; Kaniawati, 2021; Sumarni et al., 2019). By incorporating STEM principles, students can engage in high-level problem-solving by integrating scientific and technological concepts into physics learning (Davidi et al., 2021; Emilidha et al., 2024; Rahmatina et al., 2020). Additionally, high-quality learning materials can enhance student engagement, promote independent learning, and reduce reliance on teachers (Suryani et al., 2020).

In learning magnetic field concepts, the availability of practicum tools plays a crucial role. Without proper measurement tools such as a teslameter, students may struggle to visualize and quantify magnetic fields, hindering their understanding (Putri et al., 2022). A teslameter is a device that measures magnetic field strength at a specific point in space (Marzuki et al., 2023; Mukhlizar et al., 2018). It not only provides precise measurements but also helps students understand the interaction between magnetic fields and natural phenomena (Saraswati et al., 2018). By using teslameters in learning activities, students can directly observe and measure magnetic fields, reducing the gap between theoretical physics concepts and practical applications.

While previous studies have explored STEM-based learning and physics teaching strategies, few researchers have focused on student perceptions of using teslameters in physics education. There is also a lack of research on how teslameter tools can enhance students' conceptual understanding and engagement in magnetic field learning. Therefore, this study aims to fill this gap by analyzing student perceptions of teslameter tools using Arduino Nano with Hall effect sensors as a learning aid for magnetic field concepts in physics education.

This study aims to analyze student perceptions of the effectiveness of teslameter tools utilizing Arduino Nano and Hall effect sensors in facilitating a better understanding of magnetic field concepts in high school physics learning.

2. METHOD

This study employs a descriptive qualitative approach, aiming to analyze students' perceptions of teslameter tools using Arduino Nano with Hall effect sensors as a learning aid in understanding magnetic field concepts.

The participants in this study were students of SMAN 1 Jambi City who took physics lessons. The total population consisted of approximately X students (mention the actual number if available). The sample selection followed a purposive sampling technique, where three students were chosen based on the recommendation of their physics teacher. The selection criteria included students from the science major (MIPA)

with good communication skills, allowing them to express their perceptions clearly during interviews.

The research instrument used was an interview sheet consisting of 8 open-ended questions. These questions were designed to explore students' understanding, experiences, and perceptions of the teslameter tool in physics learning. The interviews focused on students' familiarity with teslameters, their experience in using the teslameter during physics lessons, perceived benefits and challenges of using teslameters, and suggestions for improving physics learning with teslameters.

The validity and reliability of the instrument were assessed through expert judgment by physics education lecturers and teachers, ensuring that the interview questions were clear, relevant, and capable of capturing students' perceptions accurately.

3. RESULTS AND DISCUSSION

Based on the results of interviews conducted with students at SMAN 1 Jambi City, the following data were obtained:

Table 1. Interview Questions and Results

No	Question	Answer
1	What is your previous experience in using practicum tools in physics learning?	My experience using practicum tools in physics learning is fun, and I can try it directly.
2	What do you think about using the teslameter tool for magnetic field material in physics learning?	The use of a teslameter with Arduino Nano is very helpful in understanding magnetic field material in physics learning.
3	Do you think this teslameter tool is easy to use? Why is that?	Yes, this teslameter tool is easy to use. The instructions were clear, and I was able to put it into practice right away after a little practice.
4	How do you respond to the accuracy of the magnetic field measurement results using this teslameter tool?	The magnetic field measurement results with this teslameter are quite accurate, although not as good as more expensive laboratory equipment.
5	Does the use of this teslameter tool increase your interest in learning physics?	Yes, of course. The use of a teslameter makes learning physics more interesting and practical.
6	Do you feel that using this teslameter tool makes it easier for you to understand the concept of magnetic field?	Yes, the use of this teslameter tool really helps me understand the concept of magnetic field because I can see and measure it directly.
7	How does learning using a teslameter compare with conventional methods?	I think learning by using the teslameter tool is much more effective than conventional methods because I can be directly involved in physics practicum.
8	Do you have any suggestions or input to improve the use of this teslameter tool in physics learning at school?	I think it is important to ensure that there are enough of these in the school physics lab. Also, more practicums or experiments involving this teslameter can help us deepen our understanding of magnetic field materials.

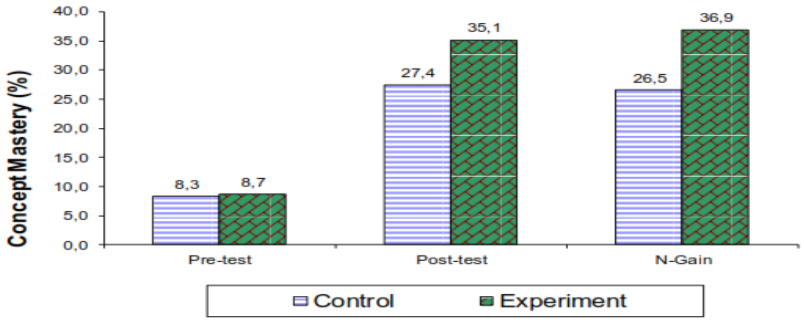

Figure 1. Theexample of an image of the spectrum absorption coefficients of organic semiconductor materials[Center, Sentence case, Times New Roman, Font 10, 1 Space]

The findings indicate that students strongly support the use of teslameters as a learning tool for magnetic field concepts. The practical experience provided by the teslameter helps students bridge the gap between theoretical concepts and real-world applications (Marzuki et al., 2023).

Several studies have shown that interactive and practical learning methods enhance students' understanding of physics concepts (Saraswati et al., 2018). This research supports previous findings that technology integration, such as Arduino Nano-based teslameters, can increase student engagement and motivation in physics learning (Putri et al., 2022).

Despite its advantages, the accuracy of the teslameter is noted as a limitation. Students acknowledge that while the device is helpful, its measurement accuracy is lower compared to professional laboratory equipment. This is in line with previous research that suggests affordable teaching tools may have trade-offs in precision (Dewi et al., 2021).

The results of this study suggest that schools should consider providing more teslameter devices in physics laboratories to enhance student understanding and interest in magnetism topics. Furthermore, the integration of STEM-based learning approaches using interactive tools like teslameters can improve students' problem-solving and analytical skills.

This study has some limitations:

1. Limited sample size – The study was conducted with a small number of students at one school, which may not represent all high school students.
2. Accuracy of measurement tools – The teslameter used in this study may not provide high-precision measurements, limiting its applicability for advanced physics experiments.

Future research should expand the sample size and explore the use of higher-accuracy teslameters.

Some suggestions like Schools should increase the availability of teslameters in physics laboratories, further research should compare different teslameter models to evaluate their accuracy and ease of use, teachers should integrate more practical experiments using teslameters to reinforce conceptual understanding in physics learning.

4. CONCLUSION

Based on the results and discussion above, with interviews with students at SMAN 1 Jambi City, it can be concluded that the use of teslameter tools really helps students in understanding magnetic field material in physics learning, so that it can improve student learning outcomes. Practical experience with the teslameter tool is considered fun and provides a better understanding directly. The teslameter tool is relatively easy to use by students after understanding the instructions from the teacher. The use of a teslameter tool

can increase student interest and make learning more interesting and practical in learning physics, especially in magnetic field material. Learning by using the teslameter tool is more effective than conventional methods, and students feel more prepared in facing real situations involving magnetic fields after using this tool. It is expected that the teslameter tool is sufficiently available in school physics laboratories and more practicums or experiments that use teslameter tools to help students better understand magnetic field material. The use of the teslameter tool in physics learning provides a useful experience for students in understanding the concept of magnetic field directly, increases students' interest in learning physics, and makes learning more effective and relevant.

AUTHOR CONTRIBUTION STATEMENT

DPR provided the background, including problem identification and study rationale. MH validated the research instrument. NA conducted data collection. All authors reviewed and approved the final manuscript.

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