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Design and Build a KIT Humoris (Ohm's Law for Dynamic Electricity) for Science Learning in Junior High School

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Abstract

The role of tools as educational media is crucial in facilitating the learning of scientific concepts, allowing students to master science materials and develop their skills effectively. This research aims to develop a KIT as an experimental approach to learning focused on investigating the relationships among voltage, current, resistance, and power. This study employs a research and development (R&D) approach to design and implement an impactful science learning tool for science experiments. The envisioned impact of this learning tool is to captivate students' interest and concept understanding in science education, especially in Ohm's law for the dynamic electricity topic. The design of the KIT Humoris is specifically structured to establish and illustrate the relationships between voltage, current, and resistance, as well as to calculate power based on voltage and current values. The user-friendly design and visually appealing features of the KIT Humoris make it a practical tool that enhances the tangible understanding of science concepts. Integrating this tool with the Merdeka Curriculum allows teachers to customize lessons according to the unique needs of their students. The design process involves meticulous planning, prototype development, and continuous evaluation to ensure the tool's effectiveness. Results from the trial phase indicate heightened student engagement, improved conceptual understanding, and a profound practical learning experience. KIT Humoris is a valuable science learning tool, providing an engaging and practical approach aligned with the Merdeka Curriculum. Its successful implementation increases student enthusiasm and a deeper comprehension of scientific principles. The implications are contributing to the innovation of teaching methods, especially in the context of the Merdeka Curriculum. From a practical standpoint, the tool has a positive impact on students and their understanding of science concepts.

Keywords: experiment; KIT humoris; Ohm Law; science experiment

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INTRODUCTION

The development of the Industrial Revolution requires all aspects of life to be able to make adjustments so as not to be outdated, including in the field of education. In this era, all aspects of life apply digitalization in the practice of activities in everyday society, marked by the transformation from manual to digital (Barreiro, 2022; Xu et al., 2018). Information and Communication Technology (ICT) in the current era of globalization has become a fundamental need for a digital society to support the effectiveness and quality of life.

Understanding basic concepts in science, especially in physics, focusing on voltage, current, resistance, and the application of Ohm's Law, is a crucial foundation for grasping the fundamental principles of electrical circuits. However, studies conducted by several researchers, including Setyani et al. (2017), Prastyaningrum & Pratama (2018), and Burde & Wilhelm (2020), have highlighted significant obstacles faced by some students in comprehending the mathematical relationship between voltage, current, and resistance.

Research carried out by Hamdani (2013) and Wirawan et al., (2020) illustrates a significant challenge in the learning process of basic electrical concepts among students. The results underscored that many students experienced considerable difficulty applying Ohm's Law to electrical circuits, establishing a mathematical relationship between voltage, current, and resistance. Ohm's Law, which forms the basis for understanding simple electrical circuits, was a barrier to their comprehension.

Furthermore, even something as straightforward as identifying basic components in an electrical circuit, such as resistors and voltage sources, posed a challenge for some students (Becker et al., 2021; Timmermann & Kautz, 2013). The ability to correctly identify these components is a crucial first step in understanding how each element interacts in a circuit and how Ohm's Law can be applied (Anugrah, 2022; Nugroho et al., 2023).

These constraints pose a serious barrier to understanding the basic concepts of electricity, which serve as the foundation for further scientific understanding. When students struggle to apply the concept of Ohm's Law or even identify simple components in an electrical circuit, it can hinder their grasp of more complex principles.

Meanwhile, understanding the concept of a series circuit, including the calculation of overall resistance in the circuit, is complex for some students, as revealed in a study by Li (2020) and Quezada-Espinoza et al. (2023). Furthermore, students' lack of hands-on experience in conducting experiments or observing real-world electrical circuits contributes to a decline in understanding Ohm's Law concepts, as shown by research from NSW (2017), Popat (2021), and Vavasis et al. (2022).

This challenge also indicates an urgent need to improve the learning approach to delivering basic electrical concepts. Learning methods that are more interactive, applicable, and provide direct opportunities for students to explore in real contexts are urgently needed (Akbar et al., 2023; Evayana, 2022; Irianto et al., 2015). The implementation of learning strategies that combine theory with practice, especially through experiments that allow students to see and feel how electrical circuits work in everyday life, is expected to help students gain a deeper and more contextualized understanding of the concept of Ohm's Law and the basic components in electrical circuits (Espera & Pitterson, 2019; Fan & Liang, 2023).

The implementation of a science practicum is integral to enhancing students' skills and deepening their

understanding and application of science in everyday life, as highlighted by Khairunnisa (2020), Kwangmuang et al. (2021), and Lestari et al. (2023). Practicum activities enable students to apply scientific process skills and cultivate attitudes that support knowledge acquisition (Darling-Hammond et al., 2019; Juhji & Nuangchalerm, 2020). However, obstacles to integrating science practicum into classrooms have been identified, such as inadequate facilities, incomplete infrastructure, and sharing laboratory space with regular classes (Jumrodah et al., 2023; Marcella et al., 2018; Marsuri, 2020). Research findings indicate that these challenges affect students' motivation for practicum, leading to less effective learning experiences. Issues such as non-conducive practicum atmospheres, insufficient equipment, a lack of laboratory assistants, and simultaneous use of laboratories for multiple subjects contribute to the hurdles faced in practical science education (Octavia et al., 2022; Wekwe et al., 2024).

Recognizing that students bring pre-existing ideas about science into the classroom, educators must address these barriers to optimize learning outcomes and experiences (Panggabean et al., 2023; Sihombing et al., 2023). Teachers are crucial in improving student engagement and managing disruptive behaviour to create a safe and productive learning environment (Nanyele et al., 2018; Pedler et al., 2020). In response to these challenges, innovative approaches to science practicum have emerged. These include computer simulations (Mardhatilla, 2021), sensor equipment and data loggers (Fathurrahmaniah et al., 2019), virtual laboratories (Astriani et al., 2021), mobile applications (Taufiq et al., 2023), project-based practicum (Nadhifah et al., 2023), collaborative team projects (Junita et al., 2021), augmented reality and virtual reality (Nadela et al., 2022), design thinking, and practicum based on local wisdom (Mukti et al., 2022). These innovations aim to make science learning more engaging, relevant, and effective for students, aligning with the dynamic and evolving nature of the scientific world. The creativity of educators plays a pivotal role in implementing these innovations to achieve the goals of science education (Manurung et al., 2021; Sihombing et al., 2022; Sihombing & Hasruddin, 2024). These constraints have serious implications for the learning process, given that this basic concept is the foundation for further understanding in science, especially regarding its application in everyday life. Therefore, special attention is needed to improve students' understanding of basic concepts in electricity through learning methods that are more interactive, applicable, and provide direct experience for students. Learning strategies that combine theory with practice, especially through direct experiments on electrical circuits in everyday life, are expected to help students better understand these concepts. The research problems in this research are as follows: (1) What are the characteristics of the KIT Humoris practical tool that has been designed and built?, (2) How is the process of designing and building the KIT Humoris practical tool?, and (3) What are the results of the trial use of the KIT Humoris practical tool?.

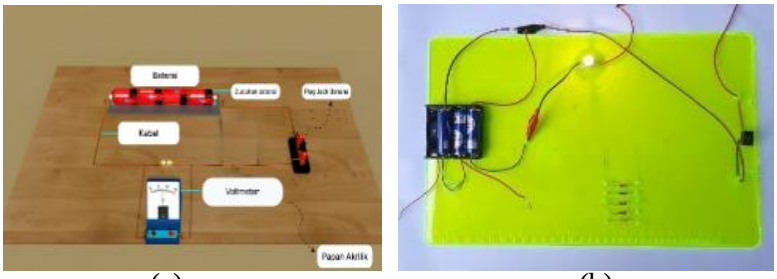
METHOD

This research aims to develop a KIT as an experimental approach focused on investigating the relationships among voltage, current, resistance, and power. The objective is understanding the underlying principles guiding technology selection in the students' environment. Through this approach, students engage in discussions and share their perspectives on various topics, applying scientific concepts acquired through

practical experience or observation (Wiiliams et al., 2017).

Design and Construction Process of the KIT Humoris Laboratory Tool

The first step before creating the KIT Humoris laboratory tool is designing the practical tool. The design of the laboratory tool depends heavily on the specific objectives, field, and context of the intended practical work. The design of this tool is expected to resemble or refer to Figure 1.



(a) (b)

Figure 1 KIT Humoris Design (a) and (b) Initial Modification of KIT Humoris

The parts of the KIT Humoris that will be designed are as follows:

1. Battery: The battery serves as the power source for the experiments. It provides the necessary electrical energy to enable the functioning of various components within the KIT. This is crucial for conducting experiments that require a stable and reliable power supply.
2. Connecting Cables: These cables are essential for establishing connections between different components of the KIT. Specifically, they connect the voltmeter, the battery, and the banana jack plug. High-quality, insulated cables ensure the electrical connections are safe and efficient, preventing potential short circuits or electrical hazards.
3. Voltmeter: The voltmeter is pre-connected with cables to the battery and the banana jack plug. This setup allows for easy measurement of the electrical potential difference in various parts of the circuit. The voltmeter is an essential diagnostic tool that helps users understand and analyze the electrical properties of the components they are working with.
4. Battery Holder: The battery holder is equipped with pre-connected cables, providing a secure and stable mount for the battery. This holder ensures the battery is properly aligned and connected, which is critical for maintaining a consistent power supply throughout the experiments.
5. Banana jack plug: The banana jack plug has been carefully designed and integrated into the system. It allows for easy and secure connections between the various components of the KIT. The design ensures that the plugs fit snugly, preventing any loose connections that could disrupt the flow of electricity.
6. Acrylic Base Board: The acrylic base board is shaped and crafted to serve as the foundational platform for the KIT. It organizes and supports all the components, providing a stable and durable base. The acrylic material is chosen for its strength and transparency, allowing users to clearly see and understand the layout and connections of the KIT.

After completing the design stage, the next step in the development process of the KIT Humoris Laboratory Tool is

producing or manufacturing the tool based on the prepared design. This step involves a detailed series of actions to materialize the design into a physical form that can be used. Producing the KIT Humoris Laboratory Tool requires a set of tools and materials. The tools and materials for the KIT Humoris Laboratory Tool are presented in Table 1.

Table 1 Tools and materials for the creation of the KIT humoris

No	Name of Tools/Materials	Amount
1	Various-sized resistors	10 pcs
2	Cables	6 m
3	6-Watt Light Bulb	2 pcs
4	Battery	8 pcs
5	Battery holder	2 pcs
6	Mica board	1 pcs
7	Alligator clips	8 pcs
8	Acrylic glue	1 pcs
9	Multitester	2 pcs
10	Kit box	1 pcs
11	Soldering tin	2 m
12	Round rubber feet	4 pcs
13	Small light switch	2 pcs
14	Red and black banana jack cables	4 mm
15	Styrofoam	50 cm x 50 cm
16	Acrylic board	50 cm x 50 cm
17	Banana jack plug	20 pcs

a

The Manufacturing Process of the KIT Humoris Laboratory Tool

Manufacturing the KIT Humoris involves several crucial stages to ensure the success of the tool development. These stages are detailed in Figure 2.

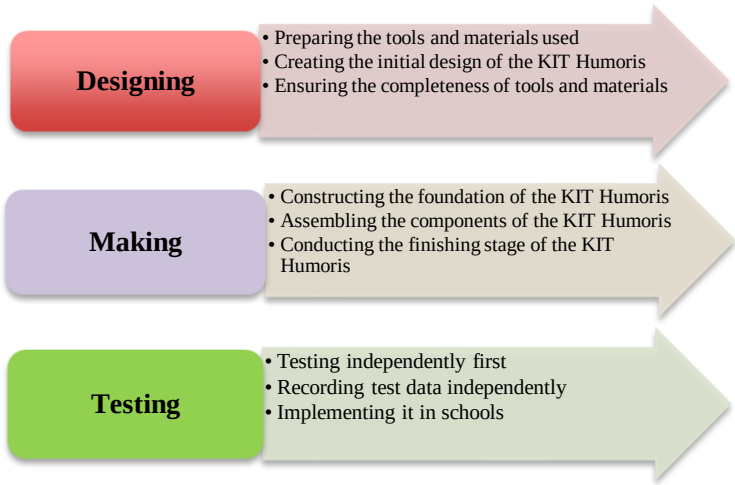


Figure 2 Flow chart of development KIT humoris practical tools

RESULTS AND DISCUSSION

The Characteristics and The Process of Desiging and Building KIT Humoris

Design Phase

The first step in creating the KIT Humoris practical tool is designing it. The steps are as follows:

- Preparing the Tools and Materials: Gather all the necessary tools and materials for making the KIT Humoris.

Figure 3 Tools and materials needed to make the KIT humoris

- Creating the Basic Design Drawing: Make a basic design drawing of the KIT Humoris practical tool.

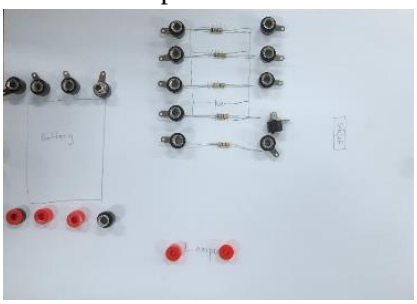


Figure 4 Basic design drawing for making the KIT humoris practical tool

- Ensuring Completeness of Tools and Materials: Verify that all tools and materials are complete and have a discussion with the workshop staff at FPMIPA UPI.

Figure 5 Discussing with workshop staff at FPMIPA UPI

Construction Phase

The second step in the process of making the KIT Humoris practical tool is construction, with the following steps:

- Making the Base of the Tool: Cut a 50 cm x 50 cm acrylic board into a suitable shape to support the components of the practical tool. Drill holes in the acrylic board to accommodate the placement of the KIT Humoris components.

Figure 6 Making the base of the KIT humoris tool

- Arrangement of Banana Jacks & Banana Jack Cables: Assemble and arrange the banana jacks and their cables on the pre-drilled acrylic board by attaching banana sockets to each banana plug jack.

Figure 7 Assembling and arranging banana jacks

- Installing the Resistor: Install the resistor by soldering it between the banana jacks using tin to form a series circuit.

Figure 8 Installing the resistor between arranged banana plug jack

- Battery Installation: Arrange 2 battery holders on the acrylic board and connect them to the banana plug jacks using soldering techniques. Install 4 batteries in their holders, aligning the poles accordingly.

Figure 9 Soldering battery installation components

- Finishing Stage: Neatly organize all the constructed components, attach rubber feet to the acrylic. Add styrofoam to the KIT Humoris box to cover parts that may potentially come into physical contact.

Figure 10 Finishing stage of the KIT humoris practical tool

Testing Phase

The final step in the process of making the KIT Humoris practical tool is testing it with the following steps:

- Testing Process: This testing process aims to ensure that the Ohm's Law practical tool functions properly to demonstrate Ohm's Law, which proves the proportionality of voltage (V) and electric current (I).

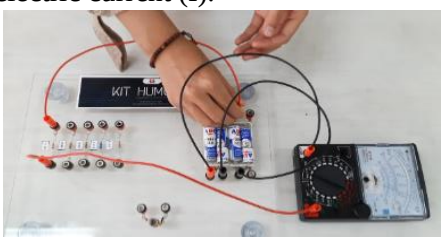


Figure 11 Relationship between voltage, current, and resistance

- Switch On and Check: Turn on the switch and check if the 6-watt bulb lights up. Use a multimeter to measure voltage and current in the circuit. Ensure everything functions correctly.

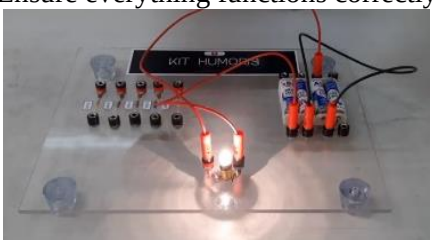


Figure 12 Determine power from the values of voltage and current

- Subsequently, if possible, implement it in schools and make it available for students to use during Ohm's Law practicals.
-

Humoris Experiment (Dynamic Electric Ohm's Law)

A.1 Experiment Objectives:

1. Participants are able to formulate Ohm's Law.
2. Participants are able to determine the relationship between R, I, and V with I.
3. Participants are able to create graphs illustrating the relationship between R and I, as well as the relationship between V and I.
4. Participants are able to calculate electrical energy.

B. Problem Formulation:

1. How can the electric current flowing in a circuit be measured?
2. What is the relationship between voltage, current, and resistance?
3. How is power determined from the quantities of voltage and current?
4. How can electrical energy be measured from the power and time variables?

C. Hypotheses:

1. Measuring electric current in a circuit is done using an ammeter connected in series.
2. Voltage is directly proportional to current and inversely proportional to resistance.
3. Power can be measured by multiplying voltage and current.

4. Electrical energy can be calculated by multiplying power and time.

Relationship Between Voltage, Current, and Resistance

By utilizing a Voltmeter application, the experiment results measuring resistance (R, in ohms Ω), voltage (V, in volts), and current are systematically presented in Table 2. The application of the Voltmeter facilitates accurate measurements and data collection for a comprehensive analysis of electrical parameters.

Table 2 Observation results I (Relationship between voltage and current)

Number of Experiment	R-Value (Ohm Ω)	Voltage (V volt)	Current (I ampere)	V/I (V/A)
1		1.1	0.005	220
2	220	2.7	0.012	225
3		4.4	0.192	228

Table 2 presents the results of an experiment measuring resistance (R, in ohms Ω), voltage (V, in volts), and current (I, in amperes) in three different trials. The resistance values (R) in these experiments remain constant at 220 ohms and do not change.

- Trial 1: The voltage (V) is 1.1 V, and the current (I) is 0.005 amperes. Using the formula V/I to calculate resistance (R), we obtain a resistance value of 220 ohms (Ω). This aligns with the predetermined R-value.
- Trial 2: Despite the constant resistance (R) of 220 ohms, the voltage (V) in this trial is 2.7 V, and the current (I) is 0.012 A. When applying the V/I formula (voltage divided by current), we get a value of around 225 ohms (Ω). This value is slightly higher than the expected resistance value (220 ohms), possibly due to measurement uncertainties or other factors.
- Trial 3: In this experiment, the voltage (V) is 4.4 V, and the current (I) is 0.192 A. Using the V/I formula, the result is approximately 228 ohms (Ω). Once again, this value slightly deviates from the expected resistance value (220 ohms).

While the measured resistance values in trials 2 and 3 differ slightly from the expected values, this could be attributed to measurement uncertainties, variations in experimental conditions, or tolerances in the measurement equipment used. In ideal conditions, these values should ideally match the predetermined resistance value (220 ohms), but slight variations in measurement results can occur in practical experiments. Next, students are prompted to answer questions related to the observed data. The questions are as follows:

1. What is the relationship between V and I?
2. Create a graph of V versus I!
3. Compare the value of R with V × I, then formulate the equation!

Students are expected to answer these questions based on the observational data. The anticipated answers from the students are as follows:

1. The observed data in Table 2 shows a noticeable relationship between voltage (V) and current (I) in the experiments. Calculated V/I values for each trial show a nearly constant or consistent resistance value, ranging from approximately 220 to 228 ohms. Despite slight differences in calculations, these values indicate a relatively constant proportion between voltage (V) and current (I), suggesting an almost linear relationship. In ideal conditions, according to Ohm's Law, in a homogeneous and conductive

electrical circuit, the relationship between voltage (V), current (I), and resistance (R) should follow the equation V = I × R. However, minor differences in measurement results or other factors can lead to slight variations from the expected values in practice.

2. Graph of V against I in Figure 12.

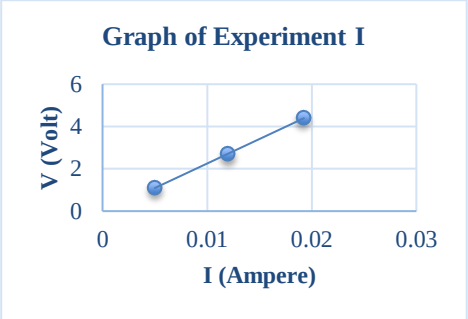


Figure 12. Experimental graph of observation I (Graph of V against I)

3. The value of R (resistance) can be calculated using Ohm's Law formula, which is R = V/I. On the other hand, the multiplication of voltage (V) and current (I) can also yield a value similar to resistance (R). Comparing the values of R with the products of V and I for each experiment from Table 2.
   - Experiment 1: R = V/I = 1.1 volt / 0.005 ampere = 220 ohm
   - Value of V x I = 1.1 volt x 0.005 ampere = 0.0055 volt-ampere ≈ 0.0055 watt
   - Experiment 2: R = V/I = 2.7 volt / 0.012 ampere = 225 ohm
   - Value of V x I = 2.7 volt x 0.012 ampere = 0.0324 volt-ampere ≈ 0.0324 watt
   - Experiment 3: R = V/I = 4.4 volt / 0.192 ampere = 228.33 ohm
   - Value of V x I = 4.4 volt x 0.192 ampere = 0.8448 volt-ampere ≈ 0.8448 watt
   -

Based on these calculations, it is evident that the product of voltage (V) and current (I) in each experiment is not exactly equal to the resistance (R) value. However, we can formulate an equation that considers the relationship between V, I, and R in the form:

V x I ≈ R (volt-ampere ≈ ohm)

Although the value of V x I is not precisely equal to the resistance value in ohms, there is a connection between these two values expressed by the equation above.

Relationship Between Resistance and Current

Table 3 presents the results of experiments involving voltage (V, in volts), resistance (R, in ohms), current (I, in amperes), and the product of current and resistance (I x R, in volts) in five different trials.

Table 3 Table of observation results II (Relationship between resistance and current)

Number of Experiment	Voltage (V volt)	R-Value (Ohm Ω)	Current (I ampere)	I X R (V)
1		98.7	0.013	1.28
2		119.7	0.010	1.25
3	1.1	149.5	0.082	1.23
4		178.2	0.007	1.24
5		218.5	0.055	1.20

Description:

- Experiments 1 to 5: Each experiment's voltage values (V) remain different.
- Resistance (R): The resistance values in the table are predetermined and constant for each experiment.

- Current (I): The measured current values for each experiment are calculated using the formula I = V/R (current equals voltage divided by resistance).

Additionally, Table 3 includes the results of the multiplication of current and resistance (I x R), providing values that match the voltage (V) used in the experiments. This aligns with Ohm's Law, which states that voltage in an electrical circuit is directly proportional to the product of current and resistance (V = I x R).

In each experiment, the value of I x R consistently approaches the voltage value used. Although there is a slight difference between the voltage values and the calculated I x R values, this may be due to measurement uncertainties or other factors in the experimental conditions. Thus, the results of these experiments support Ohm's Law, indicating a direct relationship between voltage (V), current (I), and resistance (R) in an electrical circuit. Next, students are prompted to answer a series of questions related to the results of Observation II. The questions are as follows:

1. Compare the values of R with I!
2. Create a graph illustrating the relationship between R and I!

The expected answers from students are as follows:

1. In Ohm's Law, an electrical circuit's resistance value (R) is directly proportional to the current value (I) flowing through it. As the resistance value increases, the current flowing through the circuit tends to decrease. Table 3 shows resistance (R) and current (I) values for each experiment. To compare the values of R with I, we can observe how changes in the resistance value affect the current value in each experiment.
   - Experiment 1: R = 98.7 ohms, I = 0.013 A
   - Experiment 2: R = 119.7 ohms, I = 0.010 A
   - Experiment 3: R = 149.5 ohms, I = 0.082 A
   - Experiment 4: R = 178.2 ohms, I = 0.007 A
   - Experiment 5: R = 218.5 ohms, I = 0.055 A

This data shows that as the resistance value (R) increases, the current value (I) tends to decrease. For instance, in Experiment 1, with a resistance of 98.7 ohms, the current is 0.013 A. However, in Experiment 5, with a resistance of 218.5 ohms, the current decreases to 0.055 A. This reflects a relationship consistent with Ohm's Law, where an increase in resistance in the circuit corresponds to a decrease in the current flowing through it. Therefore, from the given data, there appears to be an inverse relationship between the resistance value (R) and the current value (I). The larger the value of R, the smaller the value of I.

2. Create a graph illustrating the relationship between R and I. Figure 13. is the Graph of Experiment II Observations (Graph of Relationship Between R and I).

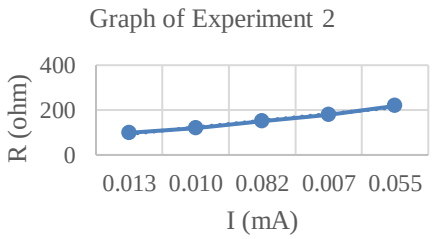


Figure 13 Graph of experiment II observations (Graph of relationship between R and I)

Determining Power from Voltage and Current and Measuring Electrical Energy from Power and Time

Determining power from voltage and current, and measuring electrical energy

from power and time is presented as follows: Power in an electrical circuit can be calculated using the electrical power formula (P), which is the result of multiplying voltage (V) and current (I). The formula to calculate power is:

$$P = V \times I \quad \ldots (1)$$

The experiment table shows values for voltage (V) and current (I) for each trial. To determine the power for each trial, we can use the above formula by multiplying the voltage value by the corresponding current value for each trial. Power calculations for each experiment are described in Table 4.

Table 4 Table of power calculations

Number of Experiment	Voltage (V volt)	Current (I ampere)	Power (P) (V x I)
1	1.1	0.013	0.0143
2	119.7	0.010	1.197
3	149.5	0.082	12.259
4	178.2	0.007	1.2474
5	218.5	0.055	12.017

To measure electrical energy, we can use the basic formula that relates power (P) to energy (E) and time (t). The formula used is:

$$E = P \times t \quad \ldots (2)$$

In the experiment, values for voltage (V) and current (I) were provided for each trial, and we calculated the power (P) for each trial earlier. However, the time value (t) is not available in the table. The time value (t) during the measurement is needed to calculate the electrical energy consumed by each trial. Without time information, we cannot calculate the amount of energy used.

If we have the time value (t) in hours or seconds for each trial, we can multiply the previously calculated power value by that time value to obtain the total energy used. For example, if the measurement time is in hours, we can use the formula:
Energy (joules) = Power (watts) × Time (hours)
Or if time is in seconds:
Energy (joules) = Power (watts) × Time (seconds)

Therefore, to measure the electrical energy consumed from the power and time values in the experiment, the time value (t) during the measurement is required for each trial.

The Importance of Practicum KIT Tools in Learning Physics Ohm's Law

The KIT laboratory equipment holds undeniable urgency in physics education, especially when studying Ohm's law. Firstly, these tools allow students to bridge the gap between theoretical concepts and practical applications (Malicoban & Castro, 2022; Satria et al., 2024). Although Ohm's law can be explained mathematically, a profound understanding often only comes through direct experience. Through experiments with KIT laboratory equipment, students can observe how voltage, current, and resistance are tangibly interconnected in an electrical circuit (Hartanto et al., 2023).

Furthermore, the use of KIT laboratory equipment promotes active learning in the classroom. Students aren't just passive listeners but actively engaged in learning (Khumraksa, 2021). They hone practical skills such as measurement and data analysis by conducting experiments. This activity also encourages students to inquire, investigate, and independently discover

the physics principles underlying Ohm's law (Zoker et al., 2022).

Lastly, KIT laboratory equipment strengthens the understanding of physics concepts and facilitates the development of social and collaborative skills. When working in groups, students learn to discuss, share ideas, and collaborate to achieve common goals (Atun & Latupeirisa, 2020; Carli & Pantano, 2023). This creates an environment conducive to exchanging ideas and a deeper understanding of Ohm's law, enriching their learning experience. Thus, KIT laboratory equipment is crucial in shaping a solid and sustainable understanding of physics concepts such as Ohm's law.

CONCLUSION AND IMPLICATION

The KIT Humoris practical tool possesses user-friendliness, visually appealing aspects, and a focus on interactive learning. Designed with an innovative approach, this tool provides an enjoyable learning experience and facilitates a practical understanding of natural sciences concepts. The integration of the Merdeka Curriculum with science learning through the use of the KIT Humoris practical tool has been successfully achieved. This tool offers learning that allows teachers to adapt teaching to students' needs, enabling the exploration of science concepts in line with a flexible curriculum. Designing and constructing the KIT Humoris practical tool involves careful planning, prototype development, adjustments based on learning needs, and continuous testing and evaluation to ensure alignment with learning objectives. The results of the trial use of the KIT Humoris practical tool have been positive. Its utilization enhances student engagement in science learning, facilitates a better understanding of concepts, and provides students with a deeper practical experience.

The implications of the design of the KIT Humoris practical tool are significant both theoretically and practically. Theoretically, the design of this tool contributes to the development of theories related to innovation in teaching methods, particularly concerning the Merdeka Curriculum. This contribution can serve as a foundation for further research into designing more effective practical tools integrated with flexible curricula. Additionally, this design also enriches the literature on innovative teaching methods in the context of science and technology.

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