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The Effect of Deep Learning-Based Guided Inquiry Learning Model on Students' Science Process Skills in Science Learning

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Abstract: The deep learning-based inquiry model can train students to find their own information and knowledge based on scientific methods so that learning is more conscious, meaningful, and enjoyable. This study aims to determine the effect of the deep learning-based inquiry model on students' science process skills in science learning. The research method used is a descriptive and inferential approach. With a quasi-experimental research type and using a Two Group Pretest Postest Design. Before being given treatment, the sample was first given a Pretest (initial test) to measure students' science process skills before and after treatment, then given a Posttest (final test). Descriptive analysis includes calculating the average value (mean), standard deviation, and frequency distribution. Inferential analysis includes a normality test using the Shapiro-Wilk test, a homogeneity test using Levene's Test, and a hypothesis test using the Independent Samples T-Test. Based on the research data, the conclusion that can be drawn is that the average pretest and posttest scores of the control class increased by 11.3 points while the experimental class increased by 50.02 points. The application of science process skills has a significant impact on each indicator of science process skills measured, so that in general there is a significant influence of the application of the guided inquiry learning model based on deep learning on students' science process skills in the science subject of Electrical Circuits for class XI of SMP Negeri 8 Taniwel.

Keywords: Deep Learning; Inquiry Model; Science Process Skills.

Introduction

Education in the 21st century is education that can develop students' potential so they can face and solve life's problems. Education in the 21st century relies not only on the transfer of information but also on the interaction process that takes place in the classroom, because direct learning in the classroom helps students develop learning process skills more effectively (Mantulangi et al, 2025)One important process skill in this context is science process skills. 21st-century skills help students understand science learning more easily.

Science learning aims to engage students in understanding how scientific processes are involved and encourage them to think about the socio-scientific challenges facing society. Therefore, teachers need to encourage students to interact with knowledge to strengthen their curiosity, problem-identifying skills, and develop new abilities, as well as support conscious, meaningful, and enjoyable learning through engaging learning designs.

Teachers play a crucial role in the success of the learning process in schools. One of the essential skills a teacher must possess is the ability to determine or select models and approaches appropriate to the breadth of the material and its tools (Hadi, 2017). Mismatching models and approaches with the material being taught will render the learning process unconscious, unenjoyable, and meaningless. Therefore, it is crucial for teachers to explore new, innovative models and approaches. The approach emphasized by the Minister of Primary and Secondary Education in the 2025 Independent Learning curriculum is the deep learning approach. The three principles of the Deep Learning approach: conscious, meaningful, and joyful, serve as the main foundation for creating a more holistic and effective learning experience (Syaifuddin et al., 2025). The deep learning approach is best integrated into the learning model. Some teachers

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use less innovative learning models and fail to hone students' abilities, resulting in passive learning. This situation requires adjustments or modifications to the learning model to ensure a more effective learning process (Agusniatih, 2022). A passive learning process will cause students to have difficulty expressing every thought they have (Mutia et al, 2022).

Observations and interviews at SMP Negeri 8 Taniwel revealed that during the learning process, students only developed one aspect of science process skills, namely communication skills. Furthermore, teachers had never measured science process skills due to the lack of measurement instruments. During the learning process, teachers used a Problem-Based Learning (PBL) model, the implementation of which was not syntactically correct, thus failing to improve students' science process skills.

Factors contributing to low science process skills include students not being encouraged to solve their own problems, not being directly involved, and not being trained to collaborate and discover concepts for analyzing a problem (Jaya et al., 2022). Science learning has tended to focus only on remembering and understanding (Gasila et al., 2019). During learning, students appear to be inattentive and do not take advantage of opportunities to ask questions, thus being seen as less active participants in learning, resulting in low science process skills (Gultom, 2018).

Improving science process skills can be achieved by implementing learning models that encourage students to explore, discover, and understand material concepts (Iswatun et al., 2017). One learning model that can improve students' science process skills is the guided inquiry learning model.

Guided inquiry is a learning model that emphasizes student-centered learning activities, where students are expected to be active in the learning process. Through this approach, students not only understand the material cognitively but also develop morals and critical, logical, and analytical thinking skills. Furthermore, the guided inquiry model also values student individuality, enabling them to actively construct their knowledge based on their own experiences. The guided inquiry model emphasizes student-centered classroom activities, allowing students to learn to utilize various learning resources without relying solely on the teacher as a learning resource (Sudarmanto et al., 2021). Through the inquiry learning model, teachers encourage students to be more physically and mentally active in the learning process, thereby enhancing science process skills using the guided inquiry learning model. Guided inquiry is an appropriate learning model because it emphasizes the role of students in learning activities (Rais et al., 2020). Guided inquiry actively involves students in the learning process and can make students enthusiastic because learning activities are carried out in groups (Azizah et al, 2022).

Based on the introduction described above, this study aims to determine the effect of the guided inquiry learning model based on deep learning on students' science process skills in science learning at SMP Negeri 8 Taniwel.

Method

This study used a Quasi-experimental research method involving an experimental group and a control group. Experimental research uses a manipulation of at least one variable, controls other relevant variables, and observes the effect or influence on one or more dependent variables (Rukajat, 2018). This study compared a group treated with a deep learning-based inquiry model on science process skills with a group treated with a problem-based learning model often used by teachers. The design used was a pre-test post-test control group design. The research design is presented in tabular form and can be seen in Table 1.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experiment	Q1	X	Q2
Control	Q3	-	Q4

The sample in this study consisted of 40 students at SMP Negeri 8 Taniwel, with 20 students in the control class and 20 students in the experimental class. The sampling was random.

The instrument in this study was a test instrument, to assess students' knowledge of science process skills consisting of 15 questions containing each indicator of science process skills being measured. The instrument was validated by 2 validators and the instrument has been declared valid and can be tested with a reliability level of 0.674. The Science Process Skills indicators measured include; 1) Observing, 2) Identifying, 3) Formulating Problems, 4) Formulating Hypotheses, 5) Drawing Conclusions (Hartati et al., 2022; Kemendikbudristek, 2024).

Data analysis in this study was conducted using descriptive and inferential methods. Descriptive analysis includes the calculation of the average value (mean), standard deviation, and frequency distribution. Inferential analysis includes normality testing using the Shapiro-Wilk test, homogeneity testing using Levene's Test, and hypothesis testing using the Independent Samples T-Test. All inferential analyses were conducted using IBM SPSS Statistics with a significance level of $\alpha = 0.05$.

The mandatory research outputs of this research include: (1) research reports and (2) publication of 1

scientific article in the Sinta 4 journal. The research flow is presented in Figure 1.

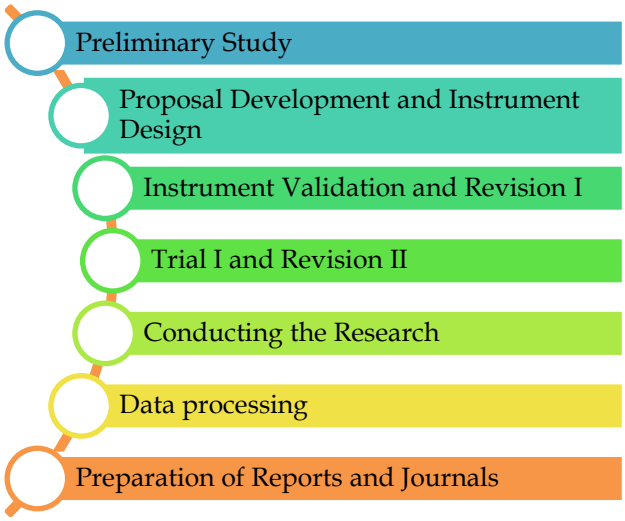


Figure 1. Research Flow

Results and Discussion

Descriptive Statistics of Pretest and Posttest

Based on the implementation of research conducted in the control class and experimental class, the following pretest and posttest statistical data were obtained:

Table 2. Descriptive Statistics of Pretest and Posttest

Criteria	Control Class		Experimental Class	
	Pretest	Posttest	Pretest	Posttest
N	20	20	20	20
Minimum	7	7	7	47
Maximum	40	67	33	87
Mean	20.37	31.67	19	69.02
Standard Deviation	10,197	16,312	8,414	12,122

Based on the data in Table 2, it was found that the results of the pretest data analysis showed that both groups had relatively homogeneous science process skills, with an average value (mean) in the control class of 20.37 and the experimental class of 19. However, after being given treatment using a guided inquiry model based on deep learning, there was a significant increase in cognitive science process skills in the experimental class with an average posttest achievement of 69.02 compared to the control class with an average of 31.67.

Comparatively, the experimental class experienced an increase of 50.02 points, while the control class only increased by 11.3 points. This is because the experimental class, when given treatment using a guided inquiry model based on deep learning, was assisted by Phet media to increase student activeness so that students were quite capable of answering test questions. Learning activeness refers to student activity or involvement during the learning process (Prasetyo et al., 2021). In addition, by using media, students can directly observe and identify series and parallel electrical circuits so that learning can be easily understood by students. This is because learning media functions as a tool or intermediary used by educators to convey learning materials in an easy-to-understand manner (Fitria et al., 2023).

The learning process incorporates the syntax of the inquiry model and emphasizes three key elements of deep learning: awareness, meaning, and enjoyment. At the beginning of the lesson, students' thinking is directed toward the material to be taught, with prompting questions relevant to their daily lives, thus directing their focus at the beginning of the lesson. This incorporates one of the pillars of deep learning: awareness. Students develop awareness of learning when they become active learners and can regulate themselves (Rahmawati et al., 2025).

During the learning process, students in groups are given worksheets that reflect a guided inquiry model to help them understand science process skills and assist in data collection in groups so that there is collaboration with peers. The guided inquiry learning model emphasizes student collaboration in solving problems in groups, building knowledge, and helping students become more independent and responsible (Puspitasari et al., 2019). The experiments carried out by students were regarding series and parallel circuits by manipulating resistance to observe the lights on, the voltage value and the current flowing in the electric circuit.

The data obtained in the experiment are connected to the provisions and formulas of series and parallel circuits so that students do not need to memorize the formulas or provisions of both circuits, this reflects the pillars of meaningful and joyful when students obtain results. Meaningful involves integrating new information with students' existing knowledge structures, so that learning becomes easier to understand and remember (Kholifah et al., 2023). Meanwhile, joyful combines elements of activeness, creativity, and a sense of enjoyment in the learning process (Mahmud et al., 2024). These findings provide an initial indication that treatment using a guided inquiry model based on deep learning can improve students' cognitive science processes compared to problem-based learning.

Achievement of Science Process Skills Indicators.

The multiple-choice test contains 15 questions that reflect each indicator being measured, including: 1) Observing, 2) Identifying, 3) Formulating Problems, 4) Formulating Hypotheses, and 5) Drawing Conclusions.

Each indicator contains 3 questions, and the achievement of each indicator is presented in Figure 2.

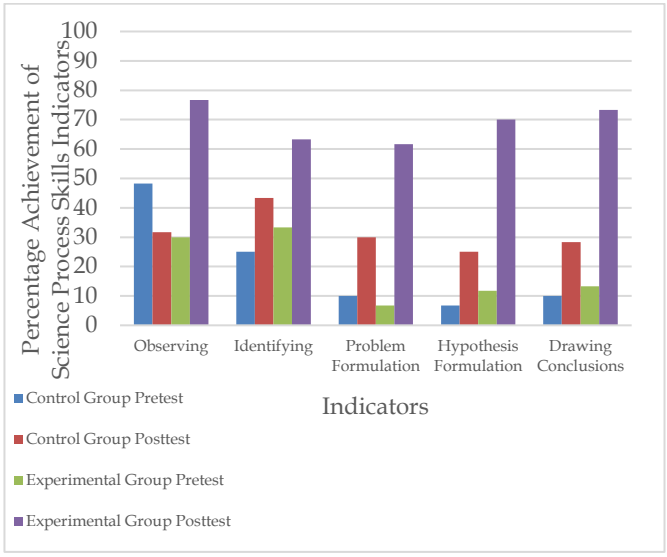


Figure 2. Science Process Skills Indicator Achievement Diagram.

Based on Figure 2, it was found that the application of a guided inquiry model based on deep learning had a significant impact (Riduwan, 2015) on each indicator of science process skills, including; First, the Observing Indicator which showed an increase in score of 46.7% from 30% in the pretest to 76.7% in the posttest. The observing indicator is contained in questions no. 1, 2, and 3 where in questions no. 1 and 2 students were asked to observe the combined circuit image to determine how many elements in the series and parallel circuits, and for question no. 3 students were faced with a series circuit condition where one of the lights was disconnected. Observing skills are basic skills in the science process because they are the initial step before carrying out other scientific activities (Harlen, 1992).

In the experimental class, students still found it difficult am determining parallel circuit elements in a combined circuit, this is because students are confused in seeing combined circuits between series and parallel. In addition, students must master the concept of electrical circuits so they are able to determine elements in parallel circuits even in combined circuits. This has been emphasized during the learning process, however, there are internal factors that influence. Internal factors that influence a person's learning outcomes are low student memory (Utari et al, 2026). The material provided is insufficient causing students to forget when the material given is finished because students' low memory makes it difficult for students to work on problems. Student achievement is quite significant because during the learning process students conduct experiments assembling series and parallel circuits through Phet learning media.

Second, The Identifying Indicator showed a 30% increase in scores from 33.3% in the pretest to 63.3% in the posttest. The Identifying Indicator is contained in questions 4, 5, and 6 where students are faced with an illustration of an experiment to identify the manipulation, response, and control variables of the experiment. In the experimental class, students had difficulty answering questions to identify control variables, this was because some students were passive in the experimental activities during the learning process. Whereas the guided inquiry model requires students to find and discover the core of learning themselves, so students must be active rather than passive in testing experimental variables (Maharani et al., 2026). In addition, understanding of variables is also closely related to students' knowledge of scientific methodology. Students who are less familiar with the concept of experiments may not realize that variables are important elements that must be managed so that experiments produce valid and reliable data (Ledoh et al., 2026).

*Third,*The Problem Formulation indicator showed a 55% increase in scores from 6.7% in the pretest to 61.7% in the posttest. The Problem Formulation indicator is contained in questions 7, 8, and 9, where students are presented with an illustration of an experiment to formulate a problem from the illustration. This skill is included in the category of integrated science process skills, which requires mastery of a number of basic process skills as a foundation. Therefore, to be able to master the problem formulation skill, students need a deep conceptual understanding and more complex thinking skills (Hamadi, 2018). In the experimental class, some students were still confused in formulating problems, this was due to students' lack of understanding of the problem and experimental variables. Formulating problems was felt to be difficult due to various factors, such as a lack of understanding of the problem, the problem being too general, or difficulty identifying specific and relevant problems to the research (Ikhlas, 2023).

*Fourth,*The Formulating Hypothesis indicator showed a score increase of 58.3% from 11.7% in the pretest to 70% in the posttest. The Formulating Hypothesis indicator is contained in questions 10, 11, and 12 where students are faced with an illustration of an experiment to formulate a hypothesis from the illustration. In this section the questions given are the same as the questions given when students formulate problems, this is because it is easier for students to formulate hypotheses based on the problem formulation that has been made, however, some students have difficulty in formulating hypotheses because students

are weak in identifying problems even though students have been given space to build temporary assumptions based on the problem. The opportunity to build predictions based on the concepts they have learned, so they can more easily understand and develop logical hypotheses (Sulistiyono, 2020). In addition, making hypotheses not only requires an understanding of theoretical concepts, but also the ability to connect them with empirical data (Liandari et al., 2017).

Fifth, The Drawing Conclusions indicator showed a 60% increase in scores from 13.3% in the pretest to 73.3% in the posttest. The Drawing Conclusions indicator is contained in questions 13, 14, and 15 where students are faced with experimental data. In the experimental class, this indicator is the indicator with the highest achievement because students have been taught during the learning process how to draw conclusions based on hypotheses and experimental data. It is known that the guided inquiry learning model can improve inferencing skills, but students need more structured practice to get used to writing experimental results systematically and accurately (Pramesti et al., 2020). To improve this skill, students need to be encouraged to reflect after the experiment and given guidance to analyze the relationship between data and theory in more depth (Nasrudin, 2019).

In general, the results of each indicator of science process skills measured indicate that the guided inquiry model based on deep learning can encourage students to develop science process skills.

Independent T-test

In order to determine the significance of the differences in science process skills between the two groups, a hypothesis test was conducted using the Independent Samples T-Test preceded by prerequisite tests, namely the Shapiro-Wilk normality test and the Levene's Test homogeneity test, which respectively showed that the data were normally distributed (Sig.> 0.05) and had homogeneous variance (Sig.> 0.05). The Normality and Homogeneity Test data are presented in Tables 3 and 4.

Table 3. Homogeneity Test Results

Homogeneity Test Results	Levene Statistics	Sig.	Note
Based on mean	2,379	0.131	Homogeneous

Table 4. Normality Test Results

Normality Test Results	Sig.	Note
Control Class Pretest	0.062	Normal
Control Class Posttest	0.1	Normal
Experimental Class Pretest	0.74	Normal
Experimental Class Posttest	0.17	Normal

Based on Tables 3 and 4, it was found that the data were normally distributed and homogeneous so that it could be continued to the independent T-Test to determine the difference in the average of the control class and the experimental class. The T-test was conducted on the post-test scores of the control class and the experimental class. The difference was considered significant if the significance value (Sig. < 0.05), the results of the T-test are presented in Table 5.

Table 5. Independent T-test Results

Variables	t count	t table	Sig. (2-tailed)
Science Process Skills	8,219	2,024	0.00

Based on Table 5, it was found that the results of the Independent Samples T-Test analysis showed that the calculated t-value of 8.219 was greater than the t-table value of 2.024 with a significance value of 0.00 which was smaller than the significance level of α = 0.05 so that there was an effect when given treatment, this is because the guided inquiry learning model is very effective in improving students' science process skills. This model allows students to be more active in the learning process, so that they not only understand concepts theoretically, but are also able to apply them in a systematic scientific process (Nur Hasnah et al., 2022). Previous studies stated that the guided inquiry model not only improves conceptual understanding but also helps students develop critical and analytical thinking skills (Widiya & Radia, 2023). The results of this study are supported by other findings that show the effectiveness of the guided inquiry learning model (Sarifah & Nurita, 2023). In addition, deep learning-based learning emphasizes meaningful, conscious, and enjoyable learning so that when connected with the guided inquiry model, students are quite good at understanding the material through emphasizing science process skills. Thus, it can be concluded that there is a significant influence of the application of the guided inquiry learning model based on deep learning on students' science process skills in the subject of Electrical Circuits for class XI of SMP Negeri 8 Taniwel.

Conclusion

Based on the research data, the conclusion that can be drawn is that the average pretest and posttest scores for the control class increased by 11.3 points, while the experimental class increased by 50.02 points. The application of science process skills had a significant impact on each indicator of science process skills measured, so that in general there was an influence.significant impact of the application of a guided inquiry learning model based on deep learning on students' science process skills in the subject of

Science on Electrical Circuits for class XI of SMP Negeri 8 Taniwel.

The suggestion that can be given is that it would be good for teachers to often provide experiments through learning media so that students are continuously honed to carry out scientific steps so that science process skills are directly developed even though there is no LAB.

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The authors declare no conflict of interest.

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