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Implementation of the Guided Inquiry Learning Model Through Experiments to Improve Conceptual Understanding and Critical Thinking

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Abstract

This research aims to analyze the effect of the guided inquiry learning model through experiments on the improvement of students' conceptual understanding and critical thinking skills, as well as its correlation with dynamic electricity material. This research is an experimental quantitative study with a pretest-posttest control design. The research sample consists of students from class 9D and 9E at SMP Negeri 1 Winong Pati. The Cronbach Alpha reliability test yielded a value range of $0.60 \leq rxy \leq 0.80$, which falls into the high category. The feasibility test of the instrument material has been validated by expert validators with an average score of 4.60, falling into the very good category. The analysis results show that the N-gain test results are in the range of 0.3-0.7 with a moderate category. The results of the paired samples t-test with a sig (2-tailed) value of $0.000 < 0.05$, Ho is rejected and Ha is accepted. The results of the product moment correlation test obtained a significance value of $0.017 < 0.05$. Based on all the criteria of the analysis results, it can be concluded that the guided inquiry learning model through experiments is quite effective and has an impact on improving students' conceptual understanding and critical thinking skills, and there is a significant correlation between the improvement in conceptual understanding and students' critical thinking skills.

How to Cite

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INTRODUCTION

Natural science is a field of study that discusses natural phenomena systematically based on observations and experiments conducted by humans (Jannah et al., 2022:1065). According to Murtini, a good science or natural science learning process emphasizes providing students with direct and real experiences so that they can develop their competencies in exploring and understanding the surrounding nature scientifically (Hendri & Faradhillah, 2020:2). According to UNESCO, 21st-century education is oriented towards 4 (four) pillars of learning, namely 1) learning to know; 2) learning to do; 3) learning to be; and 4) learning to live together. To achieve these 4 pillars of learning, it is expected that students will be able to master, understand, and possess basic competencies in learning, which include: 1) creative thinking; 2) critical thinking and problem solving; 3) communication; 4) collaboration.

The old paradigm of the student learning model at SMP Negeri 1 Winong, which still uses a teacher-centered learning model with lecture methods and has not yet maximized the use of practical tools in the laboratory, causes the learning process to not run optimally and the students' learning outcomes to be suboptimal. The main goal of students in learning is how they can enhance their existing knowledge, concepts, and skills to develop further and be able to solve all problems and challenges of life in this increasingly complex era.

Conceptual understanding is the ability to grasp meaning or knowledge, interpret, translate, and express something in one's own way. Conceptual understanding one of the important competencies that students must possess in learning. By understanding a concept, students can develop their ability to express ideas and thoughts from the presented material into a more comprehensible form, provide interpretations, and apply each lesson given. Critical thinking is ability to analyze information, identify solutions, make rational and informed decisions. Critical thinking is part of the classification of Higher-Order Thinking Skills (HOTS), where students are trained to be able to identify, analyze, and evaluate arguments and truth claims, as well as formulate and present convincing reasons to support conclusions, make reasonable, and intelligent decisions. Understanding concepts and critical thinking in teaching material very important and influential students' mindsets and learning outcomes.

One of the activities in science that can develop students' conceptual understanding and critical thinking skills in learning is exploratory learning activities, namely through practical or experimental activities. Practical work or experiments will directly invite students to personally experience how to prove the truth of a theory that they previously understood only as abstract concepts, such as dynamic electricity, into a tangible form through an experiment for verification.

To support scientific work in practical activities or experiments conducted by students, one of the efforts in the learning strategy approach is learning with the guided inquiry model (Hendri & Faradhillah, 2020). According to Meliani, the guided inquiry model is a learning model that emphasizes the process of discovering a concept and the relationships between concepts (Simbolon, 2015). The advantages or benefits of the inquiry method include: 1) Capable of developing and shaping the "self-concept" in students, so that students can understand basic concepts and develop better ideas; 2) helping students' memory and knowledge transfer in new learning process situations; 3) encouraging students to think and work according to their own initiative, being objective, honest, and open; 4) encouraging students to think more intuitively and formulate their own hypotheses; 5) providing intrinsic satisfaction to students; 6) making the learning process situation more stimulating; 7) capable of enhancing and developing individual talents or skills.

This is supported by previous research conducted by Roslina et al. (2023) and research conducted by Ramdani & Sedijani (2017). Roslina, in her research, compared learning using the guided inquiry model with the scientific approach for the excretory system material. The results of the research only show that the use of the guided inquiry model in learning is influential and can improve students' ability to understand concepts and think critically without analyzing the correlation. The same thing was done in the research by Ramdani & Sedijani, using the POGIL or Process Oriented Guided Inquiry Learning model, which examined the influence of the guided inquiry model on the ability to understand concepts, science process skills, and critical thinking. The results of the research also only show that the use of the guided inquiry model in learning is influential and can improve students' ability to understand concepts, science process skills, and critical thinking without analyzing the correlation. For this reason, the researcher attempts to use this guided inquiry learning model not only to investigate its effect on improving students' conceptual understanding and critical thinking skills but also to determine whether there is a relationship and correlation

between students' conceptual understanding and critical thinking skills.

METHOD

This research is an experimental quantitative study. The type of experiment used is a quasi-experimental design with a pretest-posttest control design. The population of this study is all ninth-grade students of SMP Negeri 1 Winong Pati for the 2023/2024 academic year. The research sample includes students from class IX D as the experimental class and students from class IX E as the control class, each consisting of 32 students. The sampling technique in this study is the random sampling technique, where the sample members are taken from the population randomly without considering the existing strata in the population because it is homogeneous or there are no special classes.

The variables in this study are two variables, namely the independent variable and the dependent variable. The independent variable in this study is the guided inquiry learning model through experiments given to the experimental class group (class IX D) and the conventional learning model with the lecture method given to the control class group (class IX E). The dependent variables in this study are conceptual understanding and critical thinking skills.

Instrument used in this research is a written test that measures the level of conceptual understanding and critical thinking skills. The instrument used previously has measured the level of question difficulty and its distinguishing power. The indicators ability to understand concepts, among others, are shown in Table 1.

Table 1. Concept Understanding Indicators

No	Indicator
1.	Restating a concept
2.	Classifying objects according to certain characteristics based on their concept
3.	Providing examples and non-examples of a concept
4.	Presenting concepts in various forms of mathematical representation
5.	Developing necessary or sufficient conditions of a concept
6.	Using and utilizing as well as selecting certain procedures or operations.
7.	Applying concepts or algorithms to problem-solving

For the level of critical thinking ability according to Ennis, there are five indicators that must be met and can be seen in Table 2.

Table 2. Indicators of Critical Thinking Ability

No	Indicator
1.	Basic Clarification
2.	The Bases for a decision
3.	Inference
4.	Advanced Clarification
5.	Supposition and integration

The pretest is conducted before the treatment is given, and then compared with the posttest results after the treatment. The instruments used are valid and reliable based on the material feasibility test, which was evaluated by expert validators covering content feasibility, language feasibility, and appearance feasibility, tested on 125 student respondents. The results of the feasibility test by expert validators were processed using the Aiken's V formula.

The research procedure was carried out in three stages, namely: the preparation stage, the implementation stage, and the data processing and analysis stage. The initial step after conducting the feasibility test of the instrument, including validity, reliability, difficulty level, and distinguishing power, is to collect quantitative data by administering a pretest at the beginning of the learning process to measure the initial abilities of students in both the experimental and control classes. Then both sample classes were given treatment as planned in the initial research according to the implementation schedule in the lesson plan. For the experimental class, learning was conducted using the guided inquiry model through experiments, and for the control class, conventional learning was conducted using the lecture method.

The steps of learning conducted using the guided inquiry method according to Hanson consist of Orientation, Exploration, Concept Formation, Application, and Closure. For further clarification, it is presented in Table 3. Then, at the end of the lesson, a post-test is given to measure whether there is a change or improvement in students' conceptual understanding and critical thinking skills after the treatment.

The data analysis technique in this study is a quantitative analysis technique, where the data is processed numerically through several tests using specific formulas with the SPSS version 22.0 program or Excel.

Table 3. Guided Inquiry Syntax

Stages	Activity
Orientation	Preparing students to learn by providing motivation to cultivate interest, generate curiosity, and make connections with prior knowledge.
Exploration	Students complete a series of tasks that lead to the achievement of learning objectives, collect data, and conduct experiments.
Concept Formation	Students are expected to discover, introduce, or form concepts, and the teacher provides questions that prompt students to think critically and analytically while engaging in exploration. These questions, known as guided inquiry, critical thinking, or key questions, guide them in their exploration.
Application	Students apply new concepts in the form of doing exercises, solving problems, or conducting research.
Closure	Students validate the results they have achieved, reflect on what they have learned, and assess their performance in learning.

To determine whether the experimental group and the control group have the same variance (homogeneous) or not, a homogeneity test using the Levene test was used. This homogeneity test uses the initial test results (pretest) values. If the p-value $\geq \alpha = 0.05$ at a 5% significance level, then the variance is considered homogeneous.

The normality test is taken from the pretest and posttest scores of students, both from the experimental class and the control class. This normality test is conducted to determine whether a dataset is normally distributed or not using the Shapiro-Wilk test. If the Significance Value or probability value < 0.05, then the data distribution is not normal, and vice versa. If the Significance Value or probability value > 0.05, then the data distribution is normal.

The hypothesis of this study states that implementation of guided inquiry learning model through experiments is capable of enhancing conceptual understanding and critical thinking skills of junior high school students in learning science for the topic of dynamic electricity.

To determine the effect of the guided inquiry learning model through experiments in improving students' conceptual understanding and critical thinking skills using the paired samples t-test formula. The paired samples t-test is used to analyze the difference in means of two paired samples before and after treatment in one group. H0 is the mean before and after the treatment is the same, while Ha is the mean before and after the treatment is different. If the probability value > 0.05 or if the calculated t < the table t, then H0 is accepted or Ha is rejected, whereas if the probability value < 0.05 or if the calculated t > the table t, then H0 is rejected or Ha is accepted.

Data analysis using the normalized N-gain score test is used to determine the improvement in students' conceptual understanding and critical thinking skills, as well as the effectiveness of the guided inquiry learning model through experiments in education. The N-gain score test aims to determine the impact and effectiveness of the success of using a method or treatment in a study. The data used and processed using the N-Gain Score are the results of the final measurement (posttest) compared to the initial measurement (pretest). The categories for dividing the N-gain score in Table 4.

Table 4. N-gain Score Distribution Categories

Score Gain	N-gain Criteria
g > 0,70	Height
0.30 < g < 0.70	Currently
g < 0.30	Low

The percentage interpretations category of N-gain score are shown in Table 5.

Table 5. Effectiveness of N-gain Score

Percentage (%)	Interpretation
< 40	Not Effective
40 – 55	Less effective
56 – 75	Quite Effective
>76	Effective

To determine the influence of the relationship between conceptual understanding ability and critical thinking ability, the Pearson product-moment correlation test is used. The Pearson product-moment correlation test is a data analysis technique used to determine the linear relationship between two interval or ratio-scaled variables, where one variable is considered to influence or is held constant (as a control variable) with res-

pect to the other variable. The Pearson product-moment correlation test can be used if variables x and y are normally distributed with the same variance. To understand the interpretation of the correlation coefficient, it is presented in Table 6.

Table 6. Interpretation Correlation Coefficients

Coefficient Interval	Relationship Level
0.00 – 0.19	Very Low
0.20 – 0.39	Low
0.40 – 0.59	Currently
0.60 – 0.79	Strong
0.80 – 1.00	Very Strong

The correlation testing criteria are as follows: If Sig < α (0.05) then H0 is rejected, Ha is accepted and If Sig > α (0.05), then H0 is rejected, Ha is accepted. H0 states that there is no relationship between the ability to understand concepts and critical thinking ability, and Ha states that there is a relationship between the ability to understand concepts and critical thinking.

RESULT AND DISCUSSION

The results of the instrument validity based on the material, which includes content, language, and appearance, were conducted by expert validators and 125 student respondents. For the instrument validity results by experts after the data were processed using the Aiken's V formula and Excel program, a score of > 4.20 was obtained, categorized as very good validity, and the average Aiken's V validity coefficient of 0.9 indicates that the instrument is very feasible to use.

For the validity results by 125 student respondents, the data obtained showed a calculated r value (Corrected Item-Total Correlation) > table r value for 125 respondents, which averaged above 0.1757, thus declared valid. The results of the reliability test of the valid items on the concept understanding instrument obtained a Cronbach's Alpha value of 0.752, and on the critical thinking ability instrument, a Cronbach's Alpha value of 0.759 was obtained, with a value range of $0.60 \leq rxy \leq 0.80$, which is interpreted as high category. Table 7 show the reliability test of the valid items on the concept understanding instrument obtained a Cronbach's Alpha.

Table 7. Conceptual Understanding Reliability

Cronbach's Alpha	N of Items
.752	20

Table 8 show the reliability test of the valid items on the critical thinking ability instrument obtained a Cronbach's Alpha.

Table 8. Results of Critical Thinking Reliability

Cronbach's Alpha	N of Items
.759	10

The initial stage data (pretest) is used as the basis for measuring that the experimental class and the control class have the same and uniform abilities, which is done through normality tests and homogeneity tests. The final stage data (posttest) is used to measure the improvement in students' conceptual understanding and critical thinking skills in the subject of electricity. Dynamic after the implementation of the learning treatment using the guided inquiry model through experiments, as seen from the changes. Pretest and posttest concept understanding score data used for analysis in both the experimental and control classes are presented in Table 9.

Table 9. Concept Understanding Score Data

Data	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of Student	32	32	32	32
Mean	56.72	81.72	56,56	68,75
Min. Value.	40	60	40	50
Max. Value.	75	95	70	90

Pretest and posttest cricical thinking score data used for analysis in both the experimental and control classes are presented in Table 10.

Table 10. Data on Critical Thinking Scores

Data	Experimental Class		Control Class	
	Pretest	Posttest	Pretest	Posttest
Number of Student	32	32	32	32
Mean	57.81	81.75	58.63	73.50
Min. Value.	42	70	42	54
Max. Value.	78	92	78	90

The results of the normality test for the concept understanding questions using the Shapiro-Wilk technique for the experimental class

showed a significance value of 0.245. Whereas for the control class, a significance value of 0.192 was obtained. Based on the normality test data distribution criteria, it appears that for both the experimental class and the control class, the significance values are greater than 0.05. This indicates that the pretest and posttest results on concept understanding for both the experimental and control classes are normally distributed.

The results of the homogeneity test for processing the pretest scores of the experimental class and the control class for conceptual understanding and critical thinking questions through the Levene's Test obtained significance values of 0.254 and 0.964. It appears that the p-value ≥ α = 0.05 at the 5% significance level, so it can be concluded that the initial knowledge and understanding levels of students in both the experimental and control classes before the treatment are the same or homogeneous.

The results of the paired samples t-test for the level of conceptual understanding and critical thinking skills of students both obtained a probability value of 0.000 < 0.05. The results indicate that H0 is rejected or Ha is accepted, meaning there is a difference in the average scores between the pretest and posttest for both the experimental and control classes. This confirms that there is an influence of guided inquiry learning through experiments on the improvement of students' conceptual understanding and critical thinking on dynamic electricity material. For the results of the improvement in pretest and posttest scores on conceptual understanding and critical thinking skills in both the experimental and control classes refer to Figure 1.

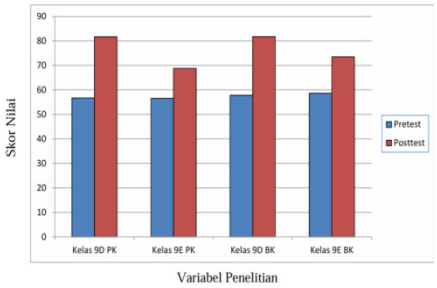

Figure 1. Graph of Pretest and Posttest Improvement Results

Based on the N-Gain test results, the gain score results from the average pretest and posttest scores for the experimental and control classes are shown in Figure 2.

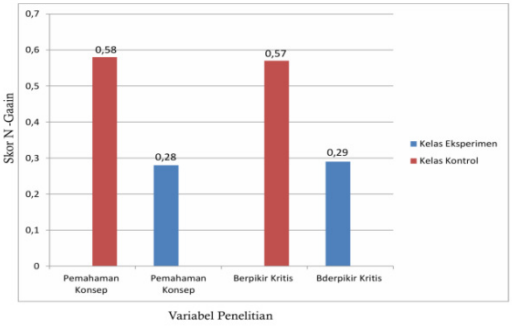

Figure 2. N-Gain Score Graph of Pretest and Posttest Results

The gain score results for the experimental class on the concept understanding question were 0.58, and for the critical thinking ability question, the gain score was 0.57. The value falls within the range of 0.30 < g < 0.70, categorized under the medium criterion of the N-gain Score index. The interpretation of the effectiveness of the N-gain calculation results for the experimental class falls within the percentage range of 56 – 75%, which is interpreted as fairly effective. Meanwhile, for the control class, the gain score from the average pretest and posttest scores was only 0.28, and for critical thinking questions, the gain score was 0.29. The value falls within the range of < 0.30 in the category of N-gain Score index distribution, which is classified as low criteria. The interpretation of the effectiveness of the N-gain calculation results falls within the percentage < 40%, which is considered a low interpretation. This shows that the use of the guided inquiry learning model through experiments is more effective and has a greater impact on improving students' conceptual understanding and thinking skills about dynamic electricity compared to learning that uses conventional methods.

For the product moment correlation test results between conceptual understanding ability and critical thinking ability, the sig (2-tailed) value is 0.017 < 0.05. Based on the existing criteria, there is a significant relationship or correlation between the level of conceptual understanding ability and students' critical thinking ability, with a Pearson product correlation coefficient of 0.418, indicating a moderate level of relationship. This means that the level of students' conceptual understanding ability significantly influences their critical thinking ability.

The implementation of the guided inquiry model in this research, which begins with the orientation stage, namely by preparing students to learn by providing motivation, will foster interest, generate curiosity, and create connections

with prior knowledge. This can stimulate students to pay more attention to the issues or topics to be studied and become more engaged in the learning process, thereby impacting the improvement of conceptual understanding and encouraging them to think critically from the outset.

For the exploration and concept formation stage, students are given tasks in the form of questions or problems that require further investigation, which become the focus of learning, thereby encouraging students to seek and find information that will help them understand concepts more deeply, prompting students to think analytically and critically about existing concepts, and preparing them to evaluate and verify information. The process of conducting experiments, observations, and data collection will encourage students to attempt to construct their own understanding based on empirical findings. This strengthens a more robust and contextual understanding of concepts, training students to evaluate the accuracy of data and consider various sources of information, thereby deepening their critical thinking skills.

For the application stage of the obtained data, students analyze the results and conclude what can be learned from the data. Data analysis helps students connect the information they gather with relevant concepts, deepening their understanding of the material being studied. In this process, students do not merely accept existing conclusions but are encouraged to evaluate various possible interpretations of the data and make rational decisions based on the evidence found.

For the closing stage, which is communicating the results, students present their experimental or analytical findings. This process helps students articulate their understanding, which further strengthens their mastery of the concepts they possess, consider various perspectives, and gives them the opportunity to evaluate their own ideas as well as receive constructive criticism from other lab groups.

The application of the guided inquiry learning model can enhance conceptual understanding and critical thinking because students are actively involved in the process of searching for and discovering information, understanding it, and applying it. The continuous learning process helps students to develop understanding gradually, starting with understanding the problem (stimulation), seeking answers (data collection), and finally analyzing and drawing conclusions, which reinforces their understanding of the concepts being studied. During the inquiry process, students are trained to evaluate information objectively, consider various perspectives, and make decisions based on evidence. This is very important for the development of critical thinking skills that are not only useful in learning but also in everyday life. Through the communication of results, students not only reinforce their understanding but also receive feedback that encourages them to think more critically and deeply about the concepts they are learning.

From the overall hypothesis testing and the implementation of the guided inquiry model through experiments in learning, the results have met the expected objectives of this research, namely an improvement in students' ability to understand concepts and think critically. This is identical to the research conducted by Antasari (2017) that student concept understanding experienced a significant improvement after implementing the guided inquiry learning model. The guided inquiry learning model through experiments also influences the improvement of students' critical thinking skills. This is in line with the research conducted by Cahyani & Azizah (2019) and Mulyanti & Gading (2023), which found that the guided inquiry learning model can enhance students' critical thinking skills, as evidenced by the average N-gain scores of students on the interpretation, analysis, evaluation, and inference indicators, all categorized as high.

For the correlation between conceptual understanding ability and students' critical thinking ability also occurs, meaning that when students' conceptual understanding is well-formed, their thinking ability also begins to develop well. This is in accordance with the research conducted by Nugraha et al. (2022) that students' ability to understand concepts affects their ability to think critically. The same results were also obtained from research conducted by Permana et al. (2016) and Hastari et al. (2023) that there is a significant relationship between concept understanding and students' critical thinking skills.

The comprehensive implementation of the guided inquiry learning model can enhance indicators of conceptual understanding and critical thinking because this approach facilitates active, contextual, and reflective learning. By going through in-depth and structured stages, students can develop a better understanding of the concepts being studied, while also honing critical thinking skills that are important in facing real-world challenges.

CONCLUSION

Based on the results of the analysis, data processing, and discussion, the conclusion of the

research on the implementation of the guided inquiry learning model through experiments is that the implementation of the guided inquiry learning model through experiments in science learning has an impact on improving students' conceptual understanding and critical thinking skills, and shows a correlation or relationship between the improvement of conceptual understanding and the improvement of students' critical thinking skills in science learning, meaning that when students' conceptual understanding improves, their critical thinking skills also improve.understanding improves, their critical thinking skills also improve.

REFERENCES

Aini, L., Lestari, I. D., & Syafruddin. (2019). Komparasi Model Pembelajaran Bounded Inquiry Laboratory dengan Free Inquiry Laboratory terhadap Kemampuan Berpikir Kritis Siswa kelas XI. *Jurnal Pendidikan Dan Riset Biologi,* 1(2), 12–19.

Astuti, P. S. (2018). Interactive Lesson Study as a Competence Indicator of Prospective English Teachers. *International Journal of Social Sciences and Humanities (IJSSH)*, 2(2), 15–25. https://doi.org/10.29332 /ijssh.v2n2.115

Bua, Y. (2015). Pengaruh Penerapan Model Pembelajaran Inkuiri Terbimbing (Guided Inquiry) Terhadap Hasil Belajar Siswa di Sekolah Dasar. *Jurnal Pendidikan Guru Sekolah Dasar*, 03(02), 401.

Changwong, K., Sukkamart, A., & Sisan, B. (2018). Critical Thinking Skill Development: Analysis of a New Learning Management Model for Thai High Schools. *Journal of International Studies*, 11(2).

Dzahabiyah, T. F., Basori, B., & Maryono, D. (2021). Pengaruh Penggunaan Model Pembelajaran PBL Dan Tutor Sebaya Terhadap Pemahaman Peserta Didik Pada Mata Pelajaran Dasar Desain Grafis Kelas X Jurusan Multimedia SMK Batik 2 Surakarta. *JIPTEK: Jurnal Ilmiah Pendidikan Teknik dan Kejuruan,* 14(2), 127-131.

Falahudin, I., Wigati, I., & Astuti, A. P. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Kemampuan Berpikir Kritis Siswa Pada Pembelajaran Materi Pengelolaan Lingkungan Di Smp Negeri 2 Tanjung Lago, Kabupaten Banyuasin. *Bioilmi: Jurnal Pendidikan*, 2(2). https://doi.org/10.19109/bioilmi.v2i2.1133

Fujika, A., Anggereini, E., & Budiarti, R. S. (2016). Analisis Kemampuan Berpikir Kritis Siswa Sma N 5 Kota Jambi Melalui Pembelajaran Berbasis Masalah Pada Konsep Pencemaran Lingkungan. *Jurnal Biodik*, 1(1). https://doi.org/10.22437/bio.v1i1.3347

Hadarawi, S., & Parsa, I. M. (2021). Peningkatan Hasil Belajar Pengendali Elektromagnetik Melalui Strategi Pembelajaran Inkuiri Terbimbing (Guided Inquiry) Pada Peserta Didik Kelas XI TITL SMK Negeri 2 Kupang. *Jurnal Teknologi*, 15(2), 41–54.

Handayati, S. (2021). Penggunaan Media Sticky Note Dengan Model Think Pair Share Bertingkat Dalam Meningkatkan Kemampuan Menjawab Pertanyaan Dan Penguasaan Konsep Interaksi Makhluk Hidup Pada Siswa Smp. *JIRA: Jurnal Inovasi Dan Riset Akademik*, 2(4), 491–504. https://doi.org/10.47387/jira.v2i4.113

Hendri, S., & Faradhillah, F. (2020). Pengembangan LKS Inkuiri Materi Listrik Dinamis. *IJIS Edu : Indonesian Journal of Integrated Science Education*, 2(1), 1. https://doi.org/10.29300/ijisedu.v2i1.2670

Irhasyuarna, Y., Kusasi, M., Fahmi, F., Fajeriadi, H., Aulia, W. R., Nikmah, S., & Rahili, Z. (2022). Integrated science teaching materials with local wisdom insights to improve students' critical thinking ability. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan,* 4(3), 328-334.

Jannah, D. R. N., & Atmojo, I. R. W. (2022). Media Digital dalam Memberdayakan Kemampuan Berpikir Kritis Abad 21 pada Pembelajaran IPA di Sekolah Dasar. *Jurnal Basicedu*, 6(1), 1064–1074. https://doi.org/ 10.31004/basicedu.v6i1.2124

Kurniahtunnisa, K., Dewi, N. K., & Utami, N. R. (2016). Pengaruh model problem based learning terhadap kemampuan berpikir kritis siswa materi sistem ekskresi. *Journal of Biology Education*, 5(3), 310–318.

Kusdiastuti, M., Harjono, A., Gunawan, G., & Nisyah, M. (2019). Respon Guru dan Peserta Didik Terhadap Pembelajaran Fisika dengan Model Inkuiri Terbimbing Dipadu Advance Organizer. *Jurnal Pendidikan Fisika Dan Teknologi,* 5(1), 150–155. https://doi.org/10.29303/jpft.v5i1 .1174

Maknun, J. (2020). Implementation of Guided Inquiry Learning Model to Improve Understanding Physics Concepts and Critical Thinking Skill of Vocational High School Students. *Jurnal International Education Studies*, 13(6), 117. https://doi.org/10.5539/ies.v13n6p117

Mardliyah, S., Herman, T., Suhendra, S., & Febrianti, E. D. (2024). Kemampuan Berpikir Kritis Matematis Siswa SMP Kelas VIII. *Jurnal Teorema: Teori Dan Riset Matematika*, 9(1).

Morissan. (2019). The influence of regulator on television content in post-authoritarian Indonesia. *Jurnal Komunikasi: Malaysian Journal of Communication*, 35(4), 229–243. https://doi.org/10.17576/JKMJC-2019-3504-14

Mulyanti, N. M. B., & Gading, I. K. (2023). Dampak Penerapan Model Pembelajaran Inkuiri Terbimbing terhadap Hasil Belajar IPA dan Kemampuan Berpikir Kritis Siswa. *Jurnal Ilmiah Pendidikan Profesi Guru*, 6(1), 109–119.

Mutiara, T. (2019). Pengaruh Strategi Pembelajaran Guided Inquiry Berbasis Self-Assesment Ter-

hadap Ketrampilan Proses Sains di Tinjau dari Sikap Ilmiah Peserta Didik Kelas XI di SMA Negeri 6 Bandar Lampung. *(Doctoral Dissertation, UIN Raden Intan Lampung)*.

Ndruru, S., & Harefa, Y. (2023). Analisis Metode Pembelajaran Inquiry Terbimbing Terhadap Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Dan Konseling (JPDK)*, 5(4), 686–702. https://doi.org/10.31004/jpdk.v5i4.18058

Ningsih, D. S. (2019). Meningkatkan Pemahaman Konsep IPA Melalui Metode Demonstrasi Di Kelas VB SDN 61/X Talang Babat. *Jurnal Gentala Pendidikan Dasar*, 4(1), 22–40. https://doi.org/10.22437/gentala.v4i1. 6849

Nofianti, E., Nurhidayanti, A., Handayani, N. A., Rosana, D., & Wilujeng, I. (2022). Profil Berpikir Kritis Peserta Didik SMP pada Materi Sistem Ekskresi Manusia. *Jurnal Pendidikan Sains Indonesia*, 10(3), 479–491. https://doi.org/10.24815/jpsi.v10i3.23877

Nopitasari, W. (2020). Analisis Kesesuaian Lembar Kerja Peserta Didik (Lkpd) Dengan Rencana Pelaksanaan Pembelajaran (Rpp) Guru Biologi Berdasarkan Kurikulum 2013. *In (Doctoral dissertation, FKIP UNPAS)* (Issue April, pp. 5–24). http://repository. unpas. ac.id/49863/%0Ahttp://repository.unpas. ac.id/49863/2/BAB II.pdf

Nugraha, M. S., Rosdianto, H., & Sulistri, E. (2022). Korelasi Antara Pemahaman Konsep Terhadap Kemampuan Berpikir Kritis Siswa SMA. *Jurnal Phi Jurnal Pendidikan Fisika Dan Fisika Terapan*, 3(3), 29. https://doi.org/10.22373/p-jpft. v3i3.14843

Paoziah, I. (2016). Implementasi Model Guided Inquiry Laboratory Berbasis Blended Learning Untuk Meningkatkan Berpikir Kritis Siswa Pada Materi Transport Membran. *In repository Unpas* (Issue 1986, p. 22). https://docplayer.info/170538991-Bab-ii-kajian-teori-dan-kerangka-pemikiran.html

Partono, P., Wardhani, H. N., Setyowati, N. I., Tsalitsa, A., & Putri, S. N. (2021). Strategi Meningkatkan Kompetensi 4C (Critical Thinking, Creativity, Communication, & Collaborative). *Jurnal Penelitian Ilmu Pendidikan,* 14(1), 41–52. https://doi.org /10.21831/jpipfip.v14i1.35810

Permana, N. A., Widiyatmoko, A., & Taufiq, M. (2016). Pengaruh Virtual Laboratory Berbasis Flash Animation Terhadap Pemahaman Konsep dan Keterampilan Berpikir Kritis Peserta Didik Tema Optik Kelas VIII SMP. *Unnes Science Education Journal,* 5(3).

Rahim, F. R. (2019). Implementasi Research Based Learning (RBL) pada Mata Kuliah IPA Terpadu di Pro-gram Studi Pendidikan Fisika. *Jurnal Eksakta Pendidikan (Jep)*, 3(1), 82. https://doi.org/10.24036/jep/ vol3-iss1/321

Ramdani, A., & Sedijani, P. (2017). Pengaruh Model Pembelajaran Process Oriented Guided Inquiry Learning (POGIL) Terhadap Pemahaman Konsep IPA, Keterampilan Proses Sains dan Kemampuan Berpikir Kritis Siswa SMP Negeri 3 Pringgabaya Lombok Timur. *Jurnal Penelitian Pendidikan IPA*, 3(2), 33–41. https://doi.org/10.29303/jppipa.v3i2. 90

Ramdani, A., Syukur, A., Gunawan, G., Permatasari, I., & Yustiqvar, M. (2020). Increasing Students' Metacognition Awareness: Learning Studies Using Science Teaching Materials Based on SETS Integrated Inquiry. *International Journal of Advanced Science and Technology*, 29(5), 6708–6721.

Rifai, R. (2023). A Studi pemahaman konsep energi dalam penyelesaian berbagai persoalan fisika pada perkuliahan fisika dasar: Studi Pemahaman Konsep Energi. *Al-Ikmal: Jurnal Pendidikan*, 2(1), 17–26.

Rosidah, K., & Rosdiana, L. (2019). Efektivitas KIT Rangkaian Listrik Sebagai Media Pembelajaran Untuk Meningkatan Hasil Belajar Siswa SMP. *Jurnal Pendidikan Sains*, 7(1), 5–9.

Roslina, jamili, M. (2023). Pengaruh Model Pembelajaran Inkuiri Terbimbing (Guided Inquiry) Terhadap Pemahaman Konsep Dan Keterampilan Berpikir Kritis Siswa Kelas XI MIA SMA Negeri Amonggedo Pada Materi Sistem Ekskresi. *Jurnal Biofiskim: Pendidikan Dan Pembelajaran IPA*, 5(2), 1–11.

Syafitri, E., Armanto, D., & Rahmadani, E. (2021). Aksiologi kemampuan berpikir kritis (kajian tentang manfaat dari kemampuan berpikir kritis). *Journal of Science and Social Research*, 4(3), 320-325.

Umboh, S. I. (2018). Pelatihan Merancang Alat Praktikum Dan Pemantapan Materi Fisika Smp Bagi Guru-Guru Fisika. *Abdimas: Jurnal Pengabdian Kepada Masyarakat*, 10(01). https://doi.org/10.36412/abdimas.v10i01.564

Uswatun, U., Suryani, L., Liza, M. El, & Saputra, N. I. (2022). Analisis Deskriptif Penerapan Model Pembelajaran Bcct Dalam Mengembangkan Kemampuan Berpikir Kritis Pada Anak Usia Dini. *Atthufulah : Jurnal Pendidikan Anak Usia Dini*, 3(1), 26–36. https://doi.org/10.35316/atthufulah. v3i1.2425

Vieira, R. M., & Tenreiro-Vieira, C. (2016). Fostering Scientific Literacy and Critical Thinking in Elementary Science Education. *International Journal of Science and Mathematics Education*, 14(4), 659–680. https://doi.org/10.1007/s10763-014-9605-2

Wardani, K. U., & Mulyani, S. (2018). Intertextual learning strategy with guided inquiry on solubility equilibrium concept to improve the student's scientific processing skills. *Jurnal IOP Conference Series: Materials Science and Engineering*, 349(1), 12031. https://doi.org/10.1088/1757-899X/349 /1/012031

Warsita, B. (2018). Teori Belajar Robert M. Gagne Dan Implikasinya Pada Pentingnya Pusat Sumber Belajar. *Jurnal Teknodik*, 064–078. https://doi.org/10.32550/teknodik. v12i1.421

Waruwu, M. (2023). Pendekatan penelitian pendi-

dikan: metode penelitian kualitatif, metode penelitian kuantitatif dan metode penelitian kombinasi (Mixed Method. *Jurnal Pendidikan Tambusai*, 7(1), 2896–2910.

Widyasari, R. (2023). Pengaruh Model Predict-Observe Explanation (POE) Dengan Metode Eksperimen Terhadap Peningkatan Mutu Hasil Belajar Fisika Materi Dinamika Rotasi (Eksperimen Terhadap Siswa Kelas 11 SMA Negeri 2 Tasikmalaya).

Wihartanti, L. V., Prasetya Wibawa, R., Astuti, R. I., & Pangestu, B. A. (2019). Penggunaan Aplikasi Quizziz Berbasis Smartphone Dalam Membangun Kemampuan Berpikir Kritis Mahasiswa. *In Seminar Nasional Pendidikan dan Pembelajaran 2019 (pp. 362–368)*.

Yeni, S. (2017). Pembelajaran Berbasis Praktikum Sebagai Sarana Siswa Untuk Berlatih Menerapkan Proses Sains Dalam Materi Biologi. *Jurnal Bio Educatio*, 2(2), 49–57.

Yulianci, S., Gunawan, G., & Doyan, A. (2017). Model Inkuiri Terbimbing Berbantuan Multimedia Interaktif Untuk Meningkatkan Penguasaan Konsep Fisika Peserta Didik. *Jurnal Pendidikan Fisika Dan Teknologi*, 3(2), 146–154. https://doi.org/10.29303/jpft.v3i2.365

Yulisa, A. (2023). Pengaruh Model Pembelajaran CIRC (Cooperative Integrated Reading and Composition) Terhadap Pemahaman Konsep Dan Minat Baca Siswa Pada Materi Sistem Reproduksi Siswa Kelas XI. *(Doctoral Dissertation, UIN Raden Intan Lampung).*

Zainal Arifin, M., Setiawan, A., & Susanto. (2020). Strategi Belajar Dan Mengajar Guru Pada Abad 21. *Jurnal Indonesian Journal of Instructional Technology*, 1(2), 40. http://journal.kurasinstitute.com/index.php/ijit