

The Influence of Guided Inquiry Learning Model on Students' Critical Thinking Skills in Thermodynamics Material

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Accepted: May 30th 2025, Approved: June 25th 2025, Published: June 30th 2025

Abstract: This study aims to determine the effect of guided inquiry learning models on students' critical thinking skills in thermodynamics material. The type of research used is experimental research with a nonequivalent control group design. The population of this study was students of class XII MA Manba'ul Ulum in the 2024/2025 Academic Year. The research sample was taken using the cluster random sampling technique, so that 31 students of class XI MIA 1 were selected as the control class and 31 students of class XI MIA 2 as the experimental class. The experimental class was given treatment in the form of learning using the guided inquiry model, while the control class used the conventional model. Critical thinking ability data were obtained through the provision of a descriptive test of 10 questions and through a questionnaire given to students. The average value of critical thinking ability obtained during the pre-test of the two classes was the experimental class of 37.15 and the control class of 41.64. The average value after the implementation of the post-test increased in both classes, where the experimental class was 79.93 and the control class was 72.84. The critical thinking ability data of both classes were homogeneous and normally distributed. The critical thinking ability data were analyzed using the Independent Simple t test. The results of the SPSS data analysis obtained a t-count value of 3.199 with a significance level of 0.05% so that the t-table was 2.000, and the significant value obtained was 0.002, so the t-count > t-table or the significance value < significance level, then. Thus, it is concluded that there is an influence of the application of the guided inquiry learning model on students' critical thinking abilities in thermodynamics material.

Keywords— Critical Thinking; Guided Inquiry Model; Thermodynamics.

How to Cite— Sukandi, A., Rokhmat, J., & Gunada, I. W. (2025). The Influence of Guided Inquiry Learning Model on Students' Critical Thinking Skills in Thermodynamics Material. *International Journal of Contextual Science Education*, 3(2), 55-59. <https://doi.org/10.29303/ijcse.v3i2.1015>

1. Introduction

The field of education has a very important role in the progress of a nation, because education is a place to create the next generation of the nation who are innovative, superior and competent in their fields. The existence of education is expected that every individual is able to face every change that occurs due to the advancement of science and technology. As a result of this progress, human resources are required not only to have knowledge but also to have the ability to think at a high level, one of which is critical thinking.

Thinking skills are very important to develop, because they will lead to students' attitude patterns in socializing. Critical thinking according to Ennis in Fisher (2009) is "reasonable and reflective thinking that focuses on deciding what to believe or do" [1]. According to Wahyuni, critical thinking is a form of thinking that tries to understand problems in depth, has an open mind towards other people's decisions and opinions, tries to understand and correctly evaluate the information received before making a decision and is able to connect between cause and effect in finding solutions to problems faced. Based on this opinion, students are required to have high-level thinking skills so that they are able to understand and assess the truth of the information obtained [2].

Based on observations conducted in December 2024 on several students of class XI MIPA MA Manba'ul Ulum, it was found that physics learning in class was quite enjoyable, but students still found it difficult to learn physics because the material was calculated, memorized and abstract, which made many students not complete in learning physics. In the learning process, students are expected to quickly understand the lesson material without giving students the opportunity to develop their critical thinking skills, therefore students are not given time to discuss, thus inhibiting students' ability to build thoughts or ideas independently. Students feel that the learning model applied is not suitable, making students confused and difficult to understand the material being taught. Students in working on questions still refer to the solutions given by the teacher, but if the questions given are easy to understand, they will answer according to their own understanding.

Based on the results of initial observations in December 2024 conducted at MA Manba'ul Ulum against several physics subject teachers through interviews, the results generally showed that teachers had implemented learning models in accordance with the 2013 curriculum. However, in reality, the implementation of the learning model has not been carried out optimally and learning

activities are still dominated by lectures. This shows that teacher-centered learning causes students' thinking skills not to develop, thus impacting students' thinking skills. In addition, the learning model used has not been able to stimulate students' way of thinking and critical thinking skills have never been measured at school.

The lecture method used in learning causes boredom in students who in the teaching and learning process only sit, listen, see and receive lessons from the teacher passively. Cognitive abilities in students are only given at the level of knowledge, understanding and application while at a higher level, namely analyzing, evaluating and creating, have not been given so that high-level thinking skills, one of which is the critical thinking skills of students, are still lacking.

In response to these problems and the expectations to be achieved in physics learning, an appropriate learning model is needed to improve students' critical thinking skills and in accordance with the 2013 curriculum. A learning model that has the characteristics of a scientific approach and is used to improve students' critical thinking skills is a guided inquiry learning model. Guided inquiry learning can direct students to solve problems given by connecting or applying their physics knowledge to improve critical thinking skills.

Guided inquiry learning is an investigative learning, where the teacher only provides materials and problems to be solved. Students decide for themselves how to solve the problem [2]. The series of learning activities in this model emphasizes the process of thinking critically and analytically to find and find answers to a problem in question [3]. Previous research revealed the influence of guided inquiry learning model on students' critical thinking skills on colloid material showing that there is an influence of the use of guided inquiry learning model on students' critical thinking skills [4]. In addition, other research also revealed the influence of guided inquiry learning model on critical thinking skills of class X MIA students on environmental pollution material in Surakarta showing that guided inquiry learning model influences critical thinking skills in biology learning in aspects of interpretation, analysis, explanation, evaluation, and self-regulation but not significant in the inference aspect. This means that guided inquiry learning model has a real effect on students' critical thinking skills [5]. Based on other research, it was also obtained about the Application of Guided Inquiry Learning Model to Improve Students' Critical Thinking Skills in Learning Dynamic Fluid Material showing that the application of guided inquiry learning model has been proven to be able to significantly improve students' critical thinking skills in learning dynamic fluid material, with an average pretest value of 14.6 to 94.6 on the posttest. Another finding from the study was that students were very enthusiastic when learning using the pHet simulation that was taught so that the guided inquiry learning method could run smoothly, thereby improving students' critical thinking skills [6].

In this study, the material taught is thermodynamics because in thermodynamics material there are several simple experiments and its applications in everyday life are more diverse so that students can conduct experiments or prove directly its application in everyday life so that students are able to provide their own descriptions of the meaning of thermodynamics. The main material of thermodynamics requires students' ability to solve physics problems which are applications of related concepts. Learning material like this requires a learning strategy that stimulates students' critical thinking skills. One of the learning models that is appropriate for thermodynamics material is guided inquiry, by implementing the guided inquiry learning model it is expected to be able to produce students who have critical thinking skills through experiments guided by the teacher.

Based on the background described above, the researcher is interested in conducting research with the title "The Influence of Guided Inquiry Learning Model on Critical Thinking Skills in Thermodynamics Subject Matter of MA Manba'ul Ulum Students".

2. Research Methods

This research is an experimental research with a quasi-experimental design. The research design used is nonequivalent control group design, in this design two groups are not selected randomly. The research was conducted in two classes, namely one class as a control class and one other class as an experimental class. This research, in learning in the control class using a conventional learning model, while in the experimental class using a guided inquiry learning model. Each class is given a pretest and posttest which are calculated using SPSS 21 to determine students' critical thinking skills after the application of the two models.

The population in this study were all students of class XI MA Manba'ul Ulum in the 2024/2025 Academic Year. The sample in this study was cluster random sampling and obtained class X MIA 1 as the control class and class X MIA 2 as the experimental class.

Data collection methods include observations on the implementation of learning, ets and critical thinking ability assessment rubrics, and documentation. Furthermore, data analysis was carried out on students' critical thinking ability scores to test the hypothesis that the use of guided inquiry learning models is better than conventional learning models. Pretest and posttest scores were analyzed using the t-test with Independent sample t-test. Before the test was carried out, a homogeneity test and a normality test were first carried out.

3. Research Results and Discussion

This study began with a trial of the instrument, namely giving a test to class XII IPA MA Mamba'ul Ulum. This test aims to determine the validity, reliability, discrimination power and level of difficulty of the test instrument that has been made. The instrument made is in the form of descriptive questions used to measure students' critical thinking skills.

Validity test for critical thinking ability test instrument of students was conducted by giving questions to students who had studied thermodynamics material. Based on the calculation results that have been done, it was obtained that all question items have a value so that they are included in the valid category. Questions that are declared valid will be used for pre-test and post-test, but if there are questions that are declared invalid then the questions cannot be used as pre-test and post-test, so that all question items in this research instrument can be used as pre-test and post-test. The results of the analysis of the instrument reliability test obtained that all questions are included in the reliable category because they have a value $> r$ table. The level of difficulty of the questions

based on their classification is divided into three, namely easy, moderate and difficult, there are 4 question items included in the easy category and 6 question items included in the moderate category. The discrimination power of questions based on their classification is divided into five, namely very bad, bad, sufficient, good and very good, there is 1 question item included in the sufficient category, 2 question items in the good category and 7 question items in the very good category. Based on the results of the instrument test, it was concluded that all question items can be used for pre-test and post-test because they have met the instrument requirements, namely the instrument must be valid and reliable. A summary of the instrument trial results can be seen in Table 1.

Table 1. Summary of instrument trial results

No Item	Validity			Reliability		Different Power		Difficulty Level		Information
	r_{tabel}	r_{xy}	Information	r_{11}	Information	DB	Information	Kinder garten	Information	
1	0.5368	0.751	VALID	0.911	RELIABLE	0.699	Good	0.660	Currently	Accepted
2	0.5368	0.784	VALID	0.909	RELIABLE	0.733	Very good	0.675	Currently	Accepted
3	0.5368	0.856	VALID	0.905	RELIABLE	0.798	Very good	0.695	Currently	Accepted
4	0.4227	0.464	VALID	0.926	RELIABLE	0.372	Enough	0.685	Currently	Accepted
5	0.5368	0.843	VALID	0.905	RELIABLE	0.791	Very good	0.685	Currently	Accepted
6	0.5368	0.828	VALID	0.906	RELIABLE	0.776	Very good	0.660	Currently	Accepted
7	0.5368	0.606	VALID	0.919	RELIABLE	0.533	Good	0.740	Easy	Accepted
8	0.5368	0.793	VALID	0.908	RELIABLE	0.741	Very good	0.740	Easy	Accepted
9	0.5368	0.824	VALID	0.906	RELIABLE	0.772	Very good	0.690	Currently	Accepted
10	0.5368	0.816	VALID	0.907	RELIABLE	0.756	Very good	0.705	Easy	Accepted

Based on the results of the pre-test analysis, it shows that the initial ability of students in critical thinking skills is still very low. The average value obtained by the experimental class was 37.15 and for the control classes it was 41.64. This is because students have not studied the material being tested. Students only rely on their initial knowledge of physics and their experiences in everyday life to answer the tests given.

Table 2. Pre-test result data

	Experimental Class	Control Class
The highest score	65.00	65.00
Lowest value	20.00	30.00
Average	37.15	41.65

After being given a pre-test, students were then given treatment in the form of learning with a guided inquiry model in the experimental class and a conventional learning model in the control class and then continued with a post-test after the treatment was completed. The meeting during the study used a learning plan along with LKPD that had been prepared by the previous researcher for the experimental class and the control class. Based on Table 3, it can be seen that there was an increase in the average post-test score from the pre-test that had been carried out, this increase in the average score occurred in both sample classes, in the experimental class that was given treatment using a guided inquiry learning model had an average score of 79.93 and in the control class that was given treatment with a conventional learning model had an average score of 72.84, although both had an increased average score, the class that applied the guided inquiry learning model was much better than the class that applied the conventional learning model, as evidenced by the difference in the average post-test scores in the two classes.

Table 3. Post-test results data

	Experimental Class	Control Class
The highest score	98.00	85.00
Lowest value	65.00	53.00
Average	79.93	72.83

The results of the study indicate that the guided inquiry learning model has an influence as shown in Table 4 where the results are less or smaller than 0.050. In addition, this study also shows that there is an influence on students' critical thinking skills. This study was assisted by LKPD that the researcher designed to increase student activity, with the help of the researcher they can improve their critical thinking skills.

Table 4. Results of the t-test of critical thinking skills

Variables	Significance	Significance Level	Criteria
Critical thinking	0.002	0.050	$H_{aaccepted}$

The guided inquiry learning model requires students to be more active in the classroom, the activeness of students in the classroom has an impact on students' critical thinking skills, this is evidenced by the results of the post-test, classes that apply learning with this model get higher scores than classes that are given treatment in the form of learning with conventional models. This model also trains students to work together to solve problems or achieve desired goals.

Based on the research that has been done, it can be concluded that the guided inquiry learning model can improve students' critical thinking skills, this is indicated by students remembering and being able to relate the material they are currently studying. They can also understand the laws of thermodynamics in addition, students can apply their knowledge when the practicum is carried out. Students can also evaluate the learning that has been carried out. This can be seen in the increasing learning outcomes of students.

This study is in line with previous studies which state that the selection of this guided inquiry learning model improves students' critical thinking skills in each action cycle. One of the factors that influences the improvement of critical thinking skills is the quality of learning that is getting better. Teachers make improvements to learning in each cycle through the reflection and re-planning stages as an effort to improve for the next cycle, so that the achievement of each aspect of critical thinking skills becomes higher [7]. Other studies also state that the learning process using guided inquiry learning is different from conventional learning because in the guided inquiry learning process, the learning stages are carried out individually and in groups, so that there is an exchange of information to solve problems submitted by the teacher. This causes students to be able to think broadly and learn from experience (conducting experiments) and learn from friends about the concepts being studied. Thus, the learning process using the guided inquiry learning model [8].

The implementation of the guided inquiry learning model not only improves the individual abilities of students, but also has an impact on students' critical thinking skills. The impact of the implementation of the guided inquiry learning model, students are more courageous in expressing ideas, questions and answers to problems given during teaching and learning activities, this increases their fluent thinking skills. Students also produce various ideas, answers or questions when conducting experiments or practicums, this increases their flexible thinking skills. The increase in their original thinking skills is marked by the birth of new and unique expressions after conducting practicums, in addition to the increase in their detailed thinking skills which are marked by students being able to enrich and develop an idea that is used to conclude the results of the practicum that has been carried out. This can be seen when the group makes a presentation and responds to the group that is presenting.

Based on previous research, it was stated that students' cognitive learning outcomes increased on average and students' learning completeness was met after the implementation of the guided inquiry learning model because students were more active in gaining knowledge through direct experience, and not just listening and receiving knowledge or information from what the teacher conveyed [9]. Other studies also show that the use of a guided inquiry learning model with an experimental method can increase student activity and learning outcomes in physics subjects [10]. Furthermore, research in 2018 stated that the guided inquiry learning model had a significant effect on students' critical thinking skills in global warming material for class XI SMA Negeri Plus Sukowono. The value of critical thinking skills using the guided inquiry learning model was greater than that of classes that did not use the learning model on the indicators of inference, interpretation, evaluation, and self-regulation [11]. Meanwhile, research in 2022 also stated that the application of the guided inquiry learning model was proven to be able to significantly increase students' critical thinking skills in studying fluid dynamic material, with an average pre-test score of 14.6 to 94.6 on the post-test. Another finding from this study was that students were very enthusiastic when learning using the pHet simulation that was taught so that the guided inquiry learning method could run smoothly, thus improving students' critical thinking skills [6].

4. Conclusion

Based on the results of the research that has been carried out in class XI Mipa MA Manba'ul Ulum, data analysis, and the results of the t-test analysis with the basis of decision making using a significance level of 0.050 and discussion, it can be concluded that the Guided Inquiry learning model has an effect on students' critical thinking in thermodynamics material.

Acknowledgement

The author would like to express sincere gratitude to the Physics Education Study Program, Faculty of Teacher Training and Education, University of Mataram, and MA Manba'ul Ulum for granting permission to conduct the research and for the facilities provided. Special thanks are also extended to both lecturers who consistently provided guidance and direction throughout the writing of this research report.

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