The Influence of Guided Inquiry Learning Model Combined with Brainstorming Activities on Critical Thinking Ability and Student Learning Motivation

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Abstract*— Education in the 21st century teaches students to master critical thinking skills. This ability equips students to think rationally, analyze problems subjectively, and evaluate information well. The importance of critical thinking skills is supported by the motivation to learn. Motivation is the overall driving force of students to carry out learning activities. The inquiry model trains students to solve problems, make decisions, and acquire critical thinking skills in analyzing information. Students play an active role in doing practical work to solve problems, while the teacher is only in charge of guiding students when experiencing difficulties. This study aimed to determine the effect of the guided inquiry learning model combined with brainstorming activities on students' critical thinking skills and learning motivation. Analysis of the data used is a statistical test using the manova test then followed by a regression test on each aspect of critical thinking and learning motivation. The results of the analysis show the influence of the guided inquiry learning model combined with brainstorming activities on critical thinking skills and student motivation. Influential contributions to aspects of critical thinking skills, namely basic support (26.91%), elementary clarification (25.41%), advance clarification (16.81%), strategies and tactics (15.59%), and inference (15,23%). Aspects of learning motivation are interesting activities (24.57%), future aspirations (21.23%), desire to succeed (14.5%), encouragement of learning needs (13.84%), learning rewards (13.06%), and conducive learning situation (12.73%).

Indexed Terms*— Inquiry, brainstorming, critical thinking, motivation.

I. INTRODUCTION

The ability to think critically is one of the essential abilities that can be used as an indicator of learning success in achieving competency standards. Critical thinking becomes very important in learning because it can train students to make decisions from various points of view carefully, and logically (Maya, Sholikhan, and Sundaygara., 2020). The development of critical thinking skills in students will form intelligent human resources in thinking and critically in solving problems (Nugraha, et al., 2017). Based on the results of pre-research and interviews with biology teachers regarding learning at SMA N 1 Sukoharjo, the teacher stated that students were less than optimal in analyzing problems. The criticality of students in making problem-solving efforts has not been as expected. The fact that results of the critical thinking ability test which includes five aspects show that 50.46% provide a simple explanation (elementary clarification); 48.14% build basic skills (basic support); 49.2% concluded (inference); 51.85% make further explanation (advance clarification); 51.11% strategy and tactics (strategies and tactics). The average critical thinking ability test results are categorized as a low critical thinking level (Rosyada et al., 2020).

Good critical thinking skills are supported by the motivation to learn from students. Efforts made to improve critical thinking skills need to be initiated by growing student motivation in learning (Setiaji, 2021). Observations of learning carried out at SMA N 1 Sukoharjo showed that students were less responsive in following them, not enthusiastic in doing assignments, and lack of performance in doing a practicum. Based on the results of the motivation

questionnaire given to students, it shows that students' learning motivation has not been as expected, with the results of each aspect: 46.52% of the desire and desire to succeed; 51.85% there is encouragement and need in learning; 49.18% have hopes and aspirations for the future; 47.68% of the rewards in learning; 51.3% of interesting activities; and 50.34% the existence of a conducive learning environment. On average, each aspect of learning motivation is categorized as a low level of learning motivation (Syachtiyani & Trisnawati, 2021).

The cause of the problem of lack of critical thinking and student motivation in the description above requires efforts to overcome it. Problem-solving can be seen from learning models that can improve critical thinking skills and generate student learning motivation such as guided inquiry learning models combined with brainstorming activities (Fathurrohman, 2017). Guided inquiry is a learning model which in its activities involves students' ability to investigate something so that students can find their knowledge (Lovisia, 2018). The combination of guided inquiry learning models with brainstorming activities is a combination of models and learning methods. Brainstorming is a method for conveying ideas without criticism from others. Brainstorming activities are carried out at the beginning of learning to help explore students' criticality regarding the problem or phenomenon being presented. The syntax of the guided inquiry learning model includes observing, formulating problems, building hypotheses, designing and carrying out experiments, analyzing data, and making conclusions (Prasetiyo, 2021). The combination with the brainstorming method, which is added at the stage of formulating problems, building hypotheses, and analyzing data results makes students able to express their opinions without fear of criticism (Aldeirre, et al., 2018).

An explanation of the urgency of critical thinking skills and student learning motivation in the description above requires research on the influence of the guided inquiry learning model combined with brainstorming activities on critical thinking skills and student motivation. This study aimed to determine the effect of the guided inquiry learning model combined with brainstorming activities on 1) critical thinking skills and learning motivation, 2) aspects of critical thinking skills and 3) aspects of learning motivation.

II. RESEARCH METHODS

This study is a quasi-experimental study that aims to determine the effect of the model or treatment given. Implementation at SMA Negeri 1 Sukoharjo in the 2021/2022 academic year. The research design used a pretest-posttest nonequivalent control group design (Rusmana and Suprihatin, 2019). Determination of the sample to determine the experimental and control classes using purposive sampling technique based on consideration of certain criteria (Siyoto, 2015). The experimental class was treated with a guided inquiry learning model combined with brainstorming activities, namely class X MIPA 5, while the control class used a conventional model with class X MIPA 6 SMA N 1 Sukoharjo. Data collection techniques using tests and questionnaires (Mardapi, 2012). The research instrument used 25 items of critical thinking skills and 36 items of student motivation questionnaire. The results of the data obtained were analyzed using the manova test and regression with the help of SPSS 26.

III. RESULTS AND DISCUSSION

Data collection on critical thinking skills and students' learning motivation was carried out at X MIPA 5 and X MIPA 6. The critical thinking ability test was carried out before and after the application of the learning model. Motivation is measured by using a questionnaire consisting of 36 positive and negative statement items that are carried out after learning. The value data obtained are then searched for the average value, standard deviation, maximum value, minimum value, and median which are presented in Table 1.

Table 1. Data Description of Critical Thinking Ability and Student Learning Motivation

Statistical results	Critical Thinking *Pretest*		Critical Thinking *Postest*		Motivation *Post-test*	
	Experiment	Control	Experiment	Control	Experimen	Control
Average	56.78	56.67	87.78	81.11	79.42	72.94
Standard deviation	15.70	15.58	8.333	8.204	7.77	7.49
Minimum	32	24	56	60	65	52
Maximum	88	88	100	96	94	92
Median	56	56	88	80	81	72

The results of students' critical thinking skills and learning motivation in the post-test experimental class were higher than in the control class. The experimental class got 87.78 results while the control class got 81.11 results. The standard deviation of the experimental and control classes has a difference of 6.47 which means the level of diversity of the experimental class is higher. The conclusion obtained is that the experimental class that was given the treatment showed a significant difference from the control class. The significant difference in the data obtained cannot be concluded that the learning model has an effect. Statistical tests are needed to further analyze the data obtained. The first is the manova test to determine the effect of the guided inquiry learning model combined with brainstorming activities on critical thinking skills and student motivation. The following results of manova are presented in Table 2.

Table 2. Manova Test Results

Indicator	F	Sig.	Details	Decision
Critical Thinking	14,232	0,000	Sig. < 0.05	H_0 is rejected H_1 is accepted
Learning Motivation	12,928	0,001	Sig. < 0.05	

Manova test of critical thinking ability and student learning motivation obtained a significance value of <0.05, which means that there is a significant difference between critical thinking ability and student learning motivation in experimental and control classes. The results of this study are in accordance with Solihin, et al., (2018) who state that the guided inquiry learning model makes students get real learning experiences. Students can solve problems independently and have critical thinking skills in analyzing problems (Sulistiyono,2020). Brainstorming also has an influence on critical thinking, which is in accordance with research by Aldeirre, et al., (2018) which states that the brainstorming method can affect critical thinking skills because of new problems that arise during the learning process that trigger students to think more deeply. Based on this research, the influence of the learning model on critical thinking skills is due to the syntax of the guided inquiry learning model combined with brainstorming activities emphasizing the learning experience in problem-solving (Yuliana, et al., 2020).

The results of the study showed the influence of the guided inquiry learning model combined with brainstorming activities on critical thinking skills and learning motivation followed by regression testing on each aspect. The summary of the results of the regression test for critical thinking aspects can be seen in table 3.

Table 3. Critical Thinking Regression Test Results

Aspects of Critical Thinking	R^2	Sig.	Beta Value	Correlation Coefficient	Effective donation (%)
Basic support	1,00	0,000	0,377	0,714	26,91%
Elementary clarification		0,000	0,430	0,591	25,41%

Advance clarification	0,000	0,337	0,499	16,81%
Strategies and tactics	0,000	0,342	0,456	15,59%
Inference	0,000	0,247	0,617	15,23%

The results of the regression test on aspects of students' critical thinking skills. The value of the effective contribution is seen to determine how much influence the guided inquiry learning model combined with brainstorming activities has on students' critical thinking skills. The order of aspects that are affected from high to low are aspects of basic support (26.91%), elementary clarification (25.41%), advance clarification (16.81%), strategies and tactics (15.59%), and inference (15.23%).

Basic support has the highest effective contribution of 26.91%. This aspect is grown at the stage of designing and conducting experiments. Students design their own practicum steps that will be carried out based on the problems obtained in each group and then do it to prove the hypothesis (Leicester and Taylor, 2010). The teacher's job is to guide and answer questions from students. The highest contribution was due to the guided inquiry learning model using scientific skill methods in finding problem-solving (Irianto, et al., 2018). Practical activities provide opportunities for students to practice and develop investigative skills and get real experience to find a concept.

Elementary clarification received an effective contribution of 25.41%. Guided inquiry learning fosters students' critical thinking gradually through the habit of formulating problems and answering questions that require explanation. The combination of brainstorming activities allows students to express their opinions on the questions given without fear of criticism (Hidayati dan Sinaga, 2019). The activity of formulating problems with brainstorming allows for new problems that arise during learning so that students think more critically (Adiputra, 2017). The stage of formulating problems and analyzing data fosters aspects of elementary clarification.

Advance clarification obtained an effective contribution of 16.81% which is in the third level. This aspect is grown in the stages of formulating hypotheses and analyzing data (Tseng et al., 2013). Experimental results teach defining terms, considering definitions using appropriate criteria, and identifying assumptions. In these two stages, students conduct discussions with their group members, so that each student can convey their ideas. The experimental class in the advanced clarification aspect can develop well when working on these questions.

Strategies and tactics has an effective contribution of 15.59%. Inquiry learning teaches students to decide on an action to prevent and control environmental pollution. Each group analyzes the impact of the pollution obtained, then looks for efforts to overcome and prevent the pollution. This aspect is grown at the stage of analyzing guided inquiry data (Fascione, 2015).

The inference aspect has an effective contribution of the fifth order, namely 15.23%. The ability to be trained is to identify the elements needed to make reasonable conclusions. Conclusions are made by adjusting to the objectives and problems that have been formulated. Experimental activities allow students to prove the hypothesis with the guidance of the teacher, then choose the elements needed to make conclusions based on the data obtained. Making inferences is fostered in the last stage of guided inquiry (Ennis, 2011).

The ability to think critically is grown with the motivation to learn in students (Setiaji, 2021). Motivation is the overall driving force in students in learning activities. Students try to solve and make efforts to solve problems when supported by strong motivation. Aspects of learning motivation obtained different results which can be summarized in Table 4.

Table 4. Learning Motivation Aspect Regression Test

Aspects of Learning Motivation	R^2	Sig.	Beta Value	Correlation Coefficient	Effective Donation (%)
Interesting activities in learning		0,000	0,308	0,798	24,57%
Future hope and aspirations		0,000	0,258	0,823	21,23%
Desire to succeed	1,00	0,000	0,213	0,681	14,5%
Encouragement and need for learning		0,000	0,219	0,632	13,84%
Appreciation in learning		0,000	0,209	0,625	13,06%
Conducive learning situation		0,000	0,174	0,732	12,73%

The aspect of the existence of interesting activities has the highest effective contribution, namely 24.57%. This highest result is because the guided inquiry model uses scientific activities in learning, such as students expressing opinions during observations and problem formulation, investigating a problem through experiments, and students finding facts to be explained and compared with scientific theory (Solihin, et al., 2018). This experimental activity in the form of practicum makes students active in learning so as to increase students' motivation and enthusiasm (Rahmawati, et al., 2016).

Future hopes and aspirations have an effective contribution of 21.23%. Guided inquiry learning that fosters this aspect is the data analysis stage. This stage is carried out after the students conduct the experiment. Students get the results of data from experiments to make students know the benefits of the material for the lives of students now or for the future. Based on these benefits, students' motivation increases so that they can make efforts to prevent a problem (Bayram, et al., 2013).

The desire to succeed has an effective contribution of 14.5%. This study received a high contribution because motivation is more grown with the brainstorming method which makes students more varied in raising problems so that motivation increases. The next stage to grow this aspect is the third and fourth syntax. Guided inquiry stimulates students to do something optimally in achieving goals. After formulating the problem, students continue to build hypotheses and design experimental designs. This stage is carried out with discussions between group members to solve problems that have been given by the teacher. The ability to be trained is a sense of responsibility for students to answer questions so that they have a strong desire and desire to solve a problem (Safitri, et al., 2020).

The drive and need for learning have an effective contribution of 13.84%. This aspect is grown at the stage of conducting experiments. Practical activities are carried out by students to find answers to the problems given. Guided Inquiry Syntax engages students independently to discover the concepts of their knowledge. The role of students as independent learners encourages students' needs in learning so that they can increase their motivation (Ruli, et al., 2018). Rewards in learning have an effective contribution of 13.06%. The guided inquiry model applies the skills of giving appreciation to students. This aspect is grown in the last syntax, namely making conclusions. At this stage, the representatives of each group of students convey the experimental data in front of the class. The teacher expresses appreciation to students after they present their results and invites other students to give praise. Another appreciation given by the teacher is if there are students who answer questions correctly. Giving extrinsic motivation from the teacher during learning makes students motivated to be active in the activities carried out (Sukma, et al., 2016).

A conducive learning environment has an effective contribution of 12.73%. This aspect is grown at the stage of conducting experiments. Guided inquiry learning conducts group experiments in the classroom. The practicum is discussed by groups with their respective themes. This activity makes students more conducive to participating in learning because by working together they will be more effective in time and can collaborate with each other.

CONCLUSION

The guided inquiry learning model combined with brainstorming activities has an effect on critical thinking skills and students' learning motivation. Influential contributions to aspects of critical thinking skills, namely basic support (26.91%), elementary clarification (25.41%), advance clarification (16.81%), strategies and tactics (15.59%), and inference (15, 23%). Aspects of learning motivation are interesting activities (24.57%), future aspirations (21.23%), desire to succeed (14.5%), encouragement of learning needs (13.84%), learning rewards (13.06%), and conducive learning situation (12.73%).

REFERENCES

[1] Aldeirre, Dzaalika., dll. (2018). Pengaruh Metode Pembelajaran Brainstorming Terhadap Kemampuan Berpikir Kritis Materi Vertebrata pada Siswa SMA. *Jurnal Biologi dan Pembelajarannya*, 5(2) : 110-116

[2] Amalia, et al. (2020). Analisis Tingkat Kemampuan Berpikir Kritis Siswa Sekolah Dasar Ditinjau dari Tingkat Kemamampuan Matematika. *Jurnal Ika : Ikatan Alumni PGSD UNARS*, 8 (01) : 97-107

[3] Bayram, Z., Erdem, E., Oskay, Ö. Ö., & Özgür, S. dinçol. (2013). Effect of Inquiry based Learning Method on Students ' Motivation ScienceDirect. Procedia - Social and Behavioral Sciences, 106, 988–996.

[4] Ennis, R. H. (2011). The Nature of Critical Thinking; An Outline of Critical Thinking Dispositions and Abilities. Chicago: University of Illinois

[5] Facione P A. 2015. Critical Thinking: What It Is and Why It Counts. CA: Measured Reason and The California Academic Press

[6] Hidayati, Y., dan P Sinaga. (2019). The profile of critical thinking skills students on science learning. Journal of Phisics, 14(02) : 1-5

[7] Irwanto, et al. (2018). Promoting Critical Thinking and Problem Solving Skills of Preservice Elementary Teachers through Process-Oriented Guided-Inquiry Learning (POGIL). *International Journal of Instruction*, 11 (04) : 777-794

[8] Leicester and Taylor. (2010). Critical thinking Across the Curriculum. New York: McGraw-Hill Open University Press

[9] Lovisia, Endang. (2018). Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Hasil Belajar Siswa. *Science and Phsics Education Journal*, 2 (01) : 1-10

[10] Maknun, Johar. (2020). Implementation of Guided Inquiry Learning Model to Improve Understanding Physics Concepts and Critical Thinking Skill of Vocational High School Students. *International Education Stuedies*, 13 (06) : 117-130

[11] Maya, S., Sholikhan., dan Chandra Sundaygara. (2020). Pengaruh Model PBL terhadap Berpikir Kritis Ditinjau dari Kemandirian Belajar. *Jurnal Terapan Sains & Teknologi*, 2(01) : 9-16

[12] Prasetiyo, Mochammad Bagas. (2021). Model Pembelajaran Inkuiri Sebagai Strategi Mengembangkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Administrasi Perkantoran (JPAP)*, 9 (01) : 109-120

[13] Ruli, Fitha F., dkk. (2018). Pengaruh Penerapan Model Pembelajaran Inkuiri Terbimbing Terhadap Motivasi dan Hasil Belajar Siswa pada Mata Pelajaran Biologi Kelas X SMA Negeri 3 Tana Toraja. Journal Biology Teaching and Learning, 1 (02) : 151-159

[14] Setiaji, dkk., (2021). Pengaruh Kemandirian Belajar Terhadap Kemampuan Berfikir Kritis Diintervening Motivasi Belajar E-learning Ekonomi. *Jekpend*, 4 (01) : 56-63

[15] Siyoto, Sandu. (2015). *Dasar Metodologi Penelitian*. Yogyakarta: Literasi Media Publishing

[16] Solihin, Mohammad., dkk. (2018). Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Kemampuan Berpikir Kritis Siswa SMA, 7 (03) : 299306

[17] Sulistiyono. (2020). Efektivitas Model Pembelajaran Inkuiri Terbimbing terhadap Keterampilan Proses Sains dan Pemahaman Konsep Fisika Siswa MA Riyadhus Solihin. Jurnal Pendidikan Fisika Undiksha, 10(2) : 61-73

[18] Syachtiyani, W. R., & Trisnawati, N. (2021). Analisis Motivasi Belajar Dan Hasil Belajar Siswa Di Masa Pandemi Covid-19. *Prima Magistra: Jurnal Ilmiah Kependidikan*, 2(1), 90–101. https://doi.org/10.37478/jpm.v2i1.878

[19] Tseng , C. H., Tuan, H. L., & Chin, C. C. (2013). How to help teachers develop inquiry teaching: Perspectives from experienced science teachers. Research in Science Education, 43(2), 809-825. https://doi.org/10.1007/s11165-012-9292-3

[20] Yuliana, dkk. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbantuan Peta Konsep Terhadap Kemampuan Berpikir Kritis Peserta Didik. *Jurnal Program Studi Pendidikan Fisika*, 4 (01) : 85-92