

APPLICATION OF LKPD BASED ON GUIDED INQUIRY MODEL ASSISTED BY PHET SIMULATION TO LEARNERS' CRITICAL THINKING SKILLS

Prima Aswirna¹, Media Roza², and Riska Aldania³

^{1,2,3}UIN Imam Bonjol Padang

primaaswirna@uinib.ac.id

ABSTRACT

Learning in Indonesia does not encourage learners to think critically. Based on the results of the study states that learning in school has not been able to cultivate critical thinking skills in learners because learning still tends to be teacher-centered. The critical thinking skills of learners in the schools studied are still relatively low. Research from various researchers has previously stated that guided inquiry models can improve the ability of critical thinking pills. The purpose of this study is to find out if there is an influence on the critical thinking skills of learners who apply LKPD based on the guided inquiry learning model based on PhET Simulation compared to applying conventional PhET-assisted learning models only. This research is a pseudo-experiment using the Design Counter Balance. Data capture using the t-test. The results of the implementation of LKPD based on the PhET-assisted inquiry model show that there is an influence on the critical thinking skills of learners rather than conventional models with PhET.

Keywords: LKPD, Guided Inquiry, PhET Simulation, and Critical thinking skills.

INTRODUCTION

The 21st-century educational paradigm emphasizes the ability of learners to think critically, can develop real-world knowledge, master information technology, communication, and collaboration. (Yonata & Novitasari, 2021). The utilization of information and communication technology in aspects of daily life in the 21st-century demands changes in competencies needed in the workplace. (Aca et al., 2020). It is evident in today's society that technology continues to shape the world, especially in the field of education. (Mallari, 2020). The application of technology in education has increased knowledge in learners (Mallari, 2020). One of the technologies applied in education includes virtual laboratories. Virtual laboratories can be utilized for any school that lacks physics laboratory equipment. Virtual laboratories can replace physics laboratory equipment in collecting data, showing data, and presenting a medium for communication and coordination as well as learning assistance that can help learners (Astalini et al., 2019). Therefore, virtual laboratories can be used by teachers as a medium of learning in the learning process.

The use of media in the process of defense can not stand alone because media is only used as a tool, so the learning media must be accompanied by a proper model. (Yulianci et al., 2017). The right learning model to build a critical attitude and character in learners is needed such as the scientific discovery learning model, problem-based learning model, and other learning models that build critical attitudes and character in learners.

Learners need to be trained to have critical thinking skills using appropriate learning methods to meet the abilities to be achieved. Critical thinking is

considered an important educational skill and is understood as reflective thinking that makes sense and focuses on what decisions to make. (Patamaporn & Wannapiroon, 2015). The ability to think critically can overcome cognitive, affective, and psychomotor aspects. Critical thinking stimulates each student's cognitive structure to capture ideas, concepts and to organize the knowledge they have to enhance the development of student proficiency and readiness. (Jalmo & Ertikanto, 2018). Critical thinking targets the cognitive structure of each learner to capture ideas, concepts and organize the knowledge he has to improve the development of skills and readiness of learners. (Jalmo & Ertikanto, 2018). Critical thinking skills are assessed as skills for identifying, analyzing, and solving problems creatively and logically, to get the right decisions. (Usodo et al., 2018). This points out that it is important to develop these skills, especially through the learning of physics.

The reality in the field turns out that the media used has not been able to improve the critical thinking skills of learners, especially during the current pandemic, where learning is done with the PJJ (Distance Learning) system. So that the critical thinking skills of learners in the school are classified as lacking. The atmosphere of the physics study process looks less conducive for learners to develop critical thinking skills, especially in the current pandemic period. Such a learning process is less supportive of the potential of learners to experience themselves from the learning process. Preliminary research results identified that 80% of teachers claim that learning in school has not been able to cultivate critical thinking skills in learners because learning still tends to be teacher-centered. (Herlina et al., 2020). Physics teachers still have difficulty in designing learning strategies due to time constraints to teach in the classroom, so teachers tend to use lecture methods, which result in low learners' critical thinking skills. (Aca et al., 2020). In addition, Teachers rarely use creative and interesting learning media and more often use textbooks and sometimes use *PowerPoints* in learning. (Aswirna & Harahap, 2020). Learners tend to have difficulty understanding particular phenomena. This becomes an obstacle in the learning process, including in learning the concept of parabolic motion (Aca et al., 2020).

The learning process needs to be changed, which is teacher-centered, into learning that engages learners and challenges them to use scientific methods in problem-solving to increase participation and arouse learners' curiosity in learning, improve understanding and mindset and help learners to develop critical thinking skills. (Jalmo & Ertikanto, 2018). The learning process should be able to make learners develop critical thinking skills by connecting learning with contextual problems that exist in everyday life. (Aswirna et al., 2020). Learning must also be more creative, interesting, and practical to attract the attention of learners in learning. During the learning process, teachers pursue the target of the subject matter in accordance with the predetermined time with less time to pursue physics subjects that contain very much material, accompanied by physics lessons that contain formulas. (Aswirna, 2017). Based on this problem, we need the right learning model and are expected to improve critical thinking skills. The results of research from various researchers previously stated that guided inquiry models can improve critical thinking skills. (Dakabesi et al., 2020).

Guided inquiry learning provides opportunities and learning experiences

for learners as well as helps learners understand concepts and solve problems through the thought process. (Sitindaon et al., 2017). The learning process will be more meaningful if learners seek the concept themselves with guidance and direction from teachers who become facilitators for learners. (Rusdi et al., 2019). Guided inquiry learning is oriented towards the activity of the class that is centered on learners and allows learners to learn to utilize various learning resources that not only make educators a source of learning. (Fahmi et al., 2021). These steps can be applied to media or teaching materials such as worksheets to optimize the ability of learners (Herlina et al., 2020). The use of worksheets in learning aims to provide opportunities for learners to engage in finding concepts through observation activities. Inquiry-based worksheets used in learning encourage learners to understand facts or phenomena. (Subali et al., 2021). Worksheets are important for improving efficiency in a learning environment, simplifying concepts for learners to construct in their minds (Kibar & Ayas, 2021). (Kibar & Ayas, 2010).

The guided inquiry learning model is designed in the form of investigation so that its application is done by exploratory means. This research can be done through computer simulations. Computer simulations are used in virtual laboratories in the form of interactive multimedia objects. (Raihanah et al., 2019). One type of virtual laboratory is *PhET Simulation*. This medium is a research-based interactive simulation that can be used in science experiments, especially physics, which provides opportunities for learners to participate in learning homework. *PhET* simulation can be a solution to help learners in understanding abstract physics concepts. (Aca et al., 2020). Teaching physics can be achieved easily when these simulations are applied in laboratory experiments to difficult concepts (Bandoy et al., 2015). (Bandoy et al., 2015). This is evident from research conducted by Bandoy and Maria who suggest that based on surveys, the use of *PhET* in the classroom is generally effective in terms of learning experiences for teachers and learners. (Bandoy et al., 2015).

Guided inquiry learning models integrated using LKPD assisted learning media *PhET Simulation* can analyze learners in critical thinking in the learning process. Therefore, the right solution so that learners can have better critical thinking skills by using LKPD based on the guided inquiry model assisted by *PhET Simulation*. Learners will engage with educators and colleagues in classes run with worksheets and discussion environments can be formed. When applied individually, worksheets make learners responsible for their learning and help in boosting learners' confidence. (Ayas & Donmez, 2017).

Research objectives include: To find out if there is an influence on the critical thinking skills of learners who apply LKPD based on guided inquiry learning model-assisted *PhET Simulation* compared to learners who apply conventional learning model-assisted *PhET Simulation*.

The hypothesis of this study is: there is an influence on the critical thinking skills of learners who apply the guided inquiry learning model by assisting *PhET Simulation* rather than learners by applying conventional learning models assisted by *PhET Simulation*.

METHODS

This type of research is quasi-experiment *research*. The design used is *Counter Balance*. The population in this study is a student of class X MA PP Daarun Nahdha Thawalib Bangkinang. The study population amounted to 23 control class learners and 23 experimental class learners. Determination of samples in this study through Cluster Random Sampling. Sampling is done by selecting two classes of population classes to assemble samples.

The study design was divided into two groups, namely the experimental group by was treated using LKPD based on guided inquiry assisted *PhET simulation*, and the control group using conventional methods with *PhET Simulation media*.

Table 1. Counter Balance Design

Class	Treatment	Posttest
A	X_a	T
B	X_b	T
A	X_b	T
B	X_a	T

Information:

A: Class A

B: Class B

X_a : Learning with LKPD-based
guided-assisted inquiry model
PhET Simulation

X_b : Conventional learning with PhET
Simulation

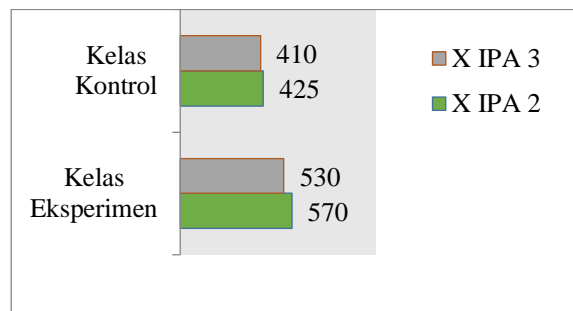
Q: Test of critical thinking skills.

Data collection methods are used in the form of objective tests for math thinking skills. Data analysis techniques use the Independent Sample t-Test. Before conducting the *Independent Sample t-Test*, first conduct a normality test, homogeneity test, and average similarity test.

RESULT & DISCUSSION

Description of objective test data for critical thinking skills given in both sample classes is presented in the form of learners' scores with a value range of 0-35. The highest score a learner earned in an experimental class was 35 and the lowest was 10. Meanwhile, the highest score in the control class was 30 and the lowest value was 10.

The average value of students' critical thinking skills with the application treatment of LKPD with guided inquiry model assisted by learning media. *PhET Simulation* scores are higher than classes that are treated with conventional learning models based on PhET Simulation learning media.



Critical Thinking Skills Test Results.

The hypothesis test is conducted using the SPSS 20 program with the Independent Sample T-Test. After the t test obtained the result of the value t calculated $> t$ table or $3.835 > 2.093$ means H_0 received Horejected. Based on these results, it can be seen that learning with the LKPD-based guided inquiry model assisted by PhET Simulation affects the critical thinking skills of learners compared to learning with the PhET Simulation-assisted convention model only.

At the time of research, learners are involved in the learning process where learners fill in some questions and follow the instructions and steps in solving a problem. LKPD can be used to know the learning process as well as the activities of learners in teaching and learning activities and as practicum instruction that is easy for teachers and learners to use. (Safitri & Sinuraya, 2020). LKPD can be used optimally when combined with learning models, one of which is the guided inquiry learning model. (Safitri & Sinuraya, 2020). Guided inquiry learning allows learners to experience learning, help understand concepts and solve problems through the thought process. (Sitindaon et al., 2017). One of the right learning models to apply in improving critical thinking is the guided learner inquiry model. This is supported by research conducted by Meltem and Ilbilge in 2016 which states that *Inquiry-Based Learning* is more effective in improving the critical thinking level of learners. (Duran & Dokme, 2016). This is because guided inquiry learning learners are faced with situations that demand the independence of thinking so that's when students experience the process of developing critical thinking skills more advanced than previous learning. (Nasution, 2018). While another study conducted by Sari Wahyuni in 2018 stated that the *guided inquiry model had a significant effect on the critical thinking skills of students of class X at Sma Negeri 3 Padang Sidempuan*. (Nasution, 2018). This is because in guided inquiry learning learners are faced with situations that demand the independence of thinking so that at that time learners experience the process of developing more advanced critical thinking skills from previous learning. (Nasution, 2018). In addition, according to research conducted by Nathalie and Zalpha in 2020, the application of inquiry methods is proven to improve the critical thinking skills of learners, especially analytical, interpretation and argumentation skills. (Farah & Ayoubi, 2020).

The inquiry learning model is designed in the form of investigation so that its application is done by experimental means. This investigation can be done in a virtual laboratory in the form of interactive multimedia. (Raihanah et al., 2019). One type of virtual laboratory includes PhET Simulation. The use of PhET Simulation can improve learners' critical thinking skills. This is in accordance with research

conducted by Faiz Hashim in 2020 which states that IPA learning with the help of Android-based *PhET* starts can improve the critical thinking of MTs students. (Faiz Hashim, 2020).

The results of the implementation of LKPD based on the guided inquiry model in *PhET Simulation* obtained the average final test score for critical thinking skills in the experimental class was 23.91 and the control class was 18.15. The data showed that the application of LKPD-based guided model by *PhET Simulation* media had a significant effect on learners' critical thinking skills than conventional learning model based on *PhET Simulation*. This is by research conducted by Syarifah together with his design in 2016 stating that there is an influence and improvement after the use of *PhET* simulations through a guided inquiry approach to the critical thinking skills of learners. (A. Halim et al., 2016). While another study by Kurnia Agustina and his colleagues stated that there is an influence of the guided inquiry learning model assisted by *PhET Simulation* media on problem-solving and critical thinking skills of state high school students 1 Jereweh in the 2018/2019 school year. The effect in question is an increase in the experimental class both in terms of critical thinking skills. (Hairunisyah, S et al., 2020).

CONCLUSION

Based on the results of hypothesis tests that have been conducted, it can be concluded that there is an influence on the results of critical thinking skills of learners in MA PP Daarun Nahdhah Tawalib Bangkinang who use LKPD with a guided inquiry model guided by *PhET Simulation* media rather than conventional models assisted by *PhET Simulation*. This is seen from the results of the independent sample *t-test* analysis for critical thinking skills that the value of t calculated $> t$ table or $3.835 > 2.093$. It is recommended that educators should use LKPD with a guided inquiry model assisted by *PhET Simulation* in learning because it has a significant influence on critical thinking skills.

BIBLIOGRAPHY

- as, A., & Donmez, N. (2017). Worksheet Enriched with Computer-Assisted Activities Based on the Constructivist Learning Theory: An Example of Half-Life and Radioactive Decay. *Journal of Education and Practice*, 8(35), 75-89.
- , A. L., Maruto, M., & Sulisworo, D. (2020). The Critical Thinking Skills Impacts of The Utilization of PhET Simulation In The Flipped Classroom Setting. *Atlantis Press*, 477(1), 104-108.
- ali, B., Muskita, M., & Djukri. (2021). Effects of Worksheets Base the Levels of Inquiry in Improving Critical and Creative Thinking. *International Journal of Instruction*, 13(2), 520-532.
- doy, J. V. B., Pulido, M. T. R., & Sauquillo, D. J. (2015). The Effectiveness of using PHET Simulations for Physics Classes: A Survey. *Research Gate*, 4.
- ata, B., & Novitasari, I. (2021). Student Worksheet Development to Practice Critical Thinking Skill Using Blended Learning on Reaction Rate. *International Journal of Chemistry Education Research*, 5(1), 12-21.
- abesi, D. R. I. S., Reginaldis, & Sado, I. (2020). Effectiveness of The Guided Inquiry

- Learning Model on Critical Thinking and Problem Solving Skills. *Journal of Education*, 5(6), 844-851.
- tri, D & Sinuraya. (2020). Feasibility Test of Student Activity Sheet (LKPD) Dynamic Fluid Based on Guided Inquiry Assisted PhET Simulation. *Journal of The Physics Alumni Association of Medan State University*, 6(2), 5-8.
- him, F. (2020). The Use of Android-Based PhET Simulations as an Effort to Improve Student's Critical Thinking Skills During The Covid-19 Pandemic. *IJIM*, 14(19), 31-41.
- runisyah, S., Kurnia, A., & Gunada, I. W. (2020). The Influence of Phet Media Assisted Inquiry Learning Model on The Ability to solve problems and Critical Thinking of High School Students' Physics. *Journal of Physics and Technology Education*, 6(1), 17-24.
- lina, Kartini, T. S., & District, I. W. (2020). Guided Inquiry-Based Students' Worksheet To Grow Students' Critical Thinking And Communication Skills. *Indonesian Journal of Science and Mathematics Education*, 3(1), 19-26.
- an, M & Dokme, I. (2016). The Effect of the Inquiry-Based Learning Approach on Student's Critical Thinking Skills. *Eurasia Journal of Mathematics Science & Technology Education*, 12(12), 2887-2908. <https://doi.org/10.12973>
- ah, N., & Ayoubi, Z. (2020). Enhancing the Critical Thinking Skills of Grade 8 Chemistry Students Using an Inquiry and Reflection Teaching Method. *Journal of Education in Science, Environment and Health*, 6(3), 207-219. <https://doi.org/10.21891>
- maporn & Wannapiroon, P. (2015). Enhancing Student's Critical Thinking Skills Through Teaching and Learning By Inquiry-Based Learning Activities Using Social Network and Cloud Computing. *Elsevier*, 174, 2137-2144. <https://doi.org/10.1016>
- virna, P. (2017). Application of Advance Organizer Learning Model to Understanding Student Concepts in Class VIII Physics IPA Material at SMPN 02 Sintuk Toboh Gadang, Padang Pariaman. *Natural Science Journal*, 3(2), 399-407.
- virna, P., Sabri, A., & Tusa'diah, H. (2020). Development of Interactive Modules Based on Trait Treatment Interaction (TTI) Using Adobe Flash To Critical Thinking Skills Learners. *Red White Press*, 6. <https://doi.org/10.32698>
- virna, P., & Harahap, K. (2020). The Android-Based Learning Media Using The Trait Treatment Interaction Model as Implementation of Industrial Era 4.0. *Journal of Physics: Conference Series*. <https://doi.org/10.1088>
- virna, P., Wahyudi, Hurriyah, & Amalina. (2020). Adobe Flash Application-Based Learning Media Development on Heat Matter, Heat Transfer and Kinetic Gas Theory to Improve Understanding of Student Concepts. *Natural Science Journal*, 6(1), 66-80.
- anah, S., Susilowati, E., & Salam, A. (2019). Increasing Students' Activity and Learning Outcome Using Guided Discovery Model Assisted by PhET. *Periodic Scientific Physics Education*, 7(2), 123. <https://doi.org/10.20527/bipf.v7i2.6406>
- lari, R. (2020). The Effectiveness of Integrating PhET Interactive Simulation-Based Activities in Improving the Student's Academic Performance in Science. *International Journal for Research in Applied Science & Engineering Technology*, 8(9), 1150-1153.
- mi, R., Aswirna, P., Amelia, R., & Nurhasnah. (2021). Development of Guided

- Inquiry-Based E-Learning Assisted By Edmodo Application For 21st Century Skills Learners. *Natural Science: Journal of Research in the Field of IPA and IPA Education*, 7(1), 62-74.
- di, Sari, R.M., & Maulidiya, D. (2019). Application of Guided Inquiry Learning Model to Increase the Mathematical Activity of Students of Class VII State Junior High School 2 Bengkulu City. *Journal of School Mathematics Learning Research (JP2MS)*, 3(1), 31-39.
- ution, S. W. R. (2018). Application of Guided Inquiry in Improving Critical Thinking Skills in Physical Learning. *Journal of Education and Development*, 3(1), 1-5.
- daon, S. F., Bukit, N., & Turnip, B.M. (2017). The Effect of Guided Inquiry Learning Using PhET Media on Student's Problem Solving Skill and Critical Thinking. *Journal of Education and Practice*, 8(21), 129-134.
- ianci, S. Gunawan, & Doyan, A. (2017). Guided Inquiry Model Assisted Interactive Multimedia to Improve Mastery of Student Physics Concepts. *Journal of Physics and Technology Education*, 3(2).
- Usodo, B, Syarifah, & Riyadi. (2018). Higher Order Thinking (HOT) Problems To Develop Critical Thinking Ability And Student Self Efficacy In Learning Mathematics Primary Schools. *National Seminar on Elementary Education*, 1(1), 917-925.
- no, T. H. N., & Ertikanto, C. (2018). Effectiveness of Guided Inquiry Model Student Worksheet to Improve Critical thinking Skill on Heat Material. *International Journal of Advanced Engineering, Management, and Science (IJAEMS)*, 4(7), 564-573.
- ar, Z.B., & Ayas, A. (2010). Implementing Of A Worksheet Related to Physical and Chemical Change Concepts. *Elsevier*, 733-738. <https://doi.org/10.1016>.