THE EFFECTIVENESS OF GUIDED INQUIRY LEARNING ASSISTED BY PhET SIMULATION TO IMPROVE THE CAPABILITY OF REPRESENTATION IMAGE OF SCIENCE STUDENT IN JUNIOR HIGH SCHOOL

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Abstract

This study aims to describe the understanding of science concepts of junior high school students in the form of image representation through guided inquiry learning assisted with simulated PhET. This type of research is quantitative descriptive research. The study was conducted at SMP Negeri 2 Genteng. The research subjects were all students of class VIII A and VIII D with a total of 64 student respondents. The collection of data using the test, interview, observation, and documentation techniques. The data analysis technique is to use the Normalized N-Gain test to describe the ability of students' image representation. The results of data analysis showed an increase in understanding of the concept of science in the form of image representation with a value of g = 0.7. In conclusion, that the guided inquiry learning model assisted by the PhET simulation can improve the ability of students' science concepts in the form of Image Representation with high categories, which means that this learning is very effective.

Keywords*: Effectiveness, Guided Inquiry, PhET Simulation, and Image Representation.*

INTRODUCTION

Education is a conscious effort by someone to gain knowledge both from the school environment and from the community. Education that can be integrated into improving the ability of HR is one of them in the Natural Sciences (IPA) material (Widyawati & Prodjosantoso, 2015). Natural Sciences (IPA) is basic learning that must be given in education units one of which is at the junior high level. Natural Sciences (IPA) is a science that studies natural phenomena through scientific processes that emerge on the basis of students' scientific attitudes, and the results obtained in the form of scientific products that have been arranged based on three aspects namely concepts, principles, and theories universally (Trianto, 2010). Science learning aims to get to know the natural surroundings systematically, not just the mastery of knowledge in the form of facts, concepts, and principles but also a process in an invention.

Science learning can provide knowledge directly to students so that it can increase students' ability to construct, understand, and apply concepts that have been learned in daily life (Taufik et al., 2010). According to (Prasetyawati, 2019) building mastery of the science concepts of students can be done by organizing the learning process and planning learning, because science learning at this time prioritizes the sequence of subject matter rather than prioritizing students' thinking and cognitive processes so that many students experience wrong concepts and difficulties in learning science concepts one of them in the form of images (Prihatni, 2016). Therefore, to help students who have difficulty in understanding and discovering science concepts, it requires a multi-representation ability that must be possessed by each student (Damayanti et al., 2016).

Multi-representation ability is the ability of students to be able to interpret and apply various representations in explaining science concepts (Rizky et al., 2014). One representation that can be used in learning is image representation. According to Berner (Neria & Amit, 2004) states that success in solving problems depends on the ability to represent a problem. That is because students still rely on the teacher as a source of information in every class learning. Based on the results of the study (Prahani et al., 2017) there are some students whose multi-representation ability is not yet complete. Many students stated that they had difficulty in completing test questions at the point of image representation.

Alternatives in maximizing the learning process in improving students' multi-

representation skills required a learning model that can support the learning activities carried out by the teacher. The use of learning models functions to help teachers and guide teachers in selecting components of the learning activities process such as techniques, strategies and learning methods so that learning objectives are achieved (Indrawati, 2011). Therefore, we need a learning model that can lead to active student involvement in learning activities that can improve the ability of image representation. The guided inquiry learning model is suitable for application in junior high school because it can improve the ability of students' multi-representation and generate ideas in the learning process that involve students to explore and reflect on these ideas (Astuti & Setiawan, 2013).

Based on the results of the study (Yuwono et al., 2016) states that the guided inquiry learning model has not significantly affected the ability of student representation. So it needs to be given media in learning activities. Media is one of the factors that can support the success of the learning process at school. Creative use of media can increase the efficiency of learning activities so that learning objectives can be achieved to the maximum (Arda, 2013). The use of PhET media is one of the easy and cost-effective digital learning media that can help learning activities become more maximal compared to other media. Due to a large number of instructional media such as laboratory tools that are no longer suitable for use, and other learning media that require a lot of cost in making them, the use of PhET media in learning is much more flexible to maximize students' understanding of science concepts. Based on research (Sumarauw, 2017) that conducts guided inquiry learning activities assisted by a PhET simulation gets a good response from students. Students are more motivated in learning the science concepts being studied.

Based on the description above, the question arises: how is the effectiveness of guided inquiry learning assisted by PhET simulations to improve the ability of students to represent science in junior high? To get answers, the researchers planned to conduct a study with the title, *"the effectiveness of guided inquiry learning assisted by PhET simulations to improve the ability to represent science images of students in junior high"*.

RESEARCH METHOD

The research design used in this study is a *quasi-experiment "one group pretest-posttest design"*. This design is used to see the comparison of the ability of image representation before and after being given treatment to the experimental class and the control class. The data in this study were obtained from the test item description.

Analysis of research data using the Normalized N-Gain test. This test is conducted to determine whether there is an increase between the scores *pretest* and *posttest*. The amount of increase is calculated by the Normalized N-Gain formula, namely:

$$< g > = \frac{posttest\ score - pretest}{score\ max - score\ pretest}$$

Then the results of calculations using the Normalized N-Gain formula will be categorized based on the criteria of the Normalized N-Gain effectiveness, as follows:

Table 3.1 The Effectiveness Criteria of the *Normalized Gain Value*

The value of g	Criteria
$(g \geq 0{,}7)$	High
$0{,}3 \leq (g) < 0{,}7$	Medium
$(g) < 0{,}3$	Low

(Hake, 1999)

RESULTS AND DISCUSSION

This research was carried out in SMP Negeri 2 Genteng in Class VIII even semester of the 2019/2020 academic year with a total of 64 students respondents divided into two classes. This research is a type of quantitative descriptive research that aims to examine the effectiveness of guided inquiry learning models assisted by PhET simulations to improve the ability of image representation of science students in junior high schools. This research was conducted on 10-29 February 2020 on the subject of vibration and waves. This study uses two different classes, namely the experimental class, and the control class. The experimental class was given treatment while the control class did not get treatment.

Before conducting research, researchers need to prepare a research permit. Researchers need permission from the school of SMP Negeri 2 Genteng to conduct research. After obtaining

permission from the school, the researcher then met the science teacher concerned to ask permission to research the class he was able to. After obtaining permission, the researcher then discusses several matters related to the conduct of the study, such as interviews, observations, and determining the research schedule, and requests a list of students' names.

The results of this study are quantitative data that is N-Gain data from the calculation of the values *pretest* and *posttest*. The value of the ability of image representation was obtained from the test questions on the *pretest* and *posttest*. Based on the results of the study, the data is presented in tables and bar charts. Data on the ability to represent students in the experimental class can be seen in Table 4.1.

Table 4.1 Capability of Image Representation of Experiment Classes.

Number of Students	32
Average pretest	3,3
Average Posttest	19,4
Rated	25
Value Lowest	0
N-Gain	0,7

Based on the above table it can be seen that the experimental class N-Gain of 0.7 or 70% is included in the high category.

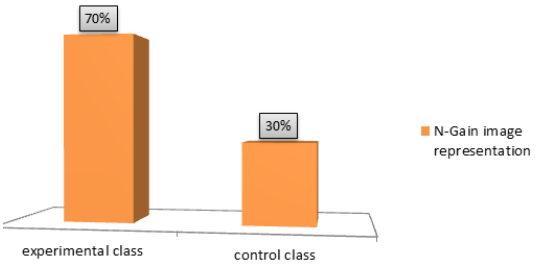
Data analysis of the results of image representation research was also carried out in the control class. Control data representation capabilities of the control class can be seen in Table 4.2.

Table 4.2 Capability Representation Image Control Class.

Number of Students	32
Average pretest	1,4
Average Posttest	7,8
Rated	20,5
Value Lowest	0
N-Gain	0,3

Based on the table above it can be seen that the N-Gain value of the representation ability of the control class is 0.3 or 30%. Improvement of the ability of the representation of control class images from the scores is *pretest* and *posttest* included in the low category. From Tables 4.1 and 4.2 graphs obtained N-Gain values represent the students' images from the experimental class and the control class, as follows:

Graph 4.1 Capability of image representation.



Based on Graph 4.1 it can be seen that the results of the research data obtained from the N-Gain calculations, the experimental class that uses PhET-assisted guided inquiry learning simulation with a percentage of 70%, while the control class data using conventional learning with a percentage of 30%. It can be concluded that guided inquiry learning with aided PhET simulation is more effective in improving the ability of the image representation of science students in junior high compared to learning using conventional models with a percentage difference of 40%. One example of image representation on vibration and wave material used as research material is as follows:

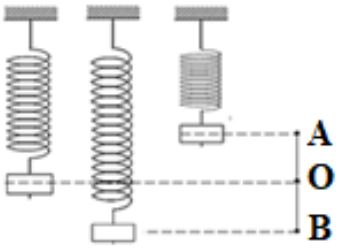


Figure 4.2 Spring with 1 vibration (O-B-O-A-O)

The experimental class before the vibration and wave material learning activities, the average value *pretest* of image representation was 3.3 and the average value of *posttest* representation of images is 19.4. Meanwhile, the average control class in the value *pretest* of image representation is 1.4 and the average value in *posttest* image representation is 7.8.values were *Pretest* and *posttest* obtained from items that contained the ability to represent images, namely 1c, 2c, 3c, and 4c. From the data after being analyzed using N-Gain, the experimental class experienced an increase in value *(g)* with the implementation of guided inquiry learning assisted by a PhET simulation

of 70% with high criteria. Whereas the control class did not experience an increase in value *(g)* by applying conventional learning by 30% with low criteria.

Analysis of the data from the results of research in the experimental class that the ability of representation of students' images before being given most treatments is pretty good, but there are still many students who are still confused describing the problems given so that the solution of the picture problem is still not optimal, then after being given treatment that is using guided inquiry learning PhET-assisted simulation ability of drawing representation of experimental class students is increasing. By the results of the study (Agustina et al., 2020) states that guided inquiry learning assisted by PhET simulation can improve the ability to solve problems in the form of image representation. That is because when learning activities students are required to analyze the results and draw their conclusions with the guidance of the teacher who is only a facilitator in learning activities. By opinions (Hajrin, *et al*., 2019) in the guided inquiry learning model the teacher guides students to carry out inquiry activities, asking questions, and directing students in solving problems. When viewed based on the operational forms of image representation ability (Jaenudin, 2008), students can solve problems by drawing pictures to easily clarify the problem that has been given. This makes students able to complete the concepts of science lessons in the form of images easily and students easily remember based on the learning outcomes that require students to understand concepts without memorization.

Data analysis of the results of research in the control class showed the ability of representation of students 'images before being given most treatments was pretty good, but after being treated using conventional learning the ability to represent students' images did not experience a good increase. When viewed based on the operational forms of image representation ability (Jaenudin, 2008) there are still many students who do not understand the purpose of the given problem, students have difficulty in solving problems in the form of images. That is because students do not get the opportunity to analyze and draw their conclusions so that students memorize more, and students consider the teacher as an information center (*teacher center* learning). It can be concluded that guided inquiry learning assisted by PhET simulation in the experimental class is effective in improving the ability of image representation. Meanwhile, conventional learning in the control class is not effective in increasing the ability of image representation. These results are by research (Rais et al., 2020) which shows that guided inquiry learning with PhET-assisted simulation is better for improving students' understanding of science concepts one of which is in the form of image representation.

CONCLUSION

Based on the results of the above research it can be concluded that guided inquiry learning assisted by PhET simulation is effective for improving the ability of the representation of science pictures of students in junior high schools. Guided inquiry learning with aided PhET simulation was considered more interesting and had higher effectiveness in the Normalized N-Gain test than conventional learning with a score of 0.7 which was included in the high effectiveness category.

REFERENCES

Agustina, K., Sahidu, H., & Gunada, IW (2020). The Effect of PhET Media Guided Inquiry Assisted Learning Model on the Problem-Solving Ability and Critical Thinking Physics of High School Students. *Journal of Technology Physics Education*, *6*(1): 17-24.

Arda, et al. (2013). Development of Interactive Computer-Based Learning Media For Junior High School Students Grade VIII. *Science Partners E-Journal*, *3*(1), 69–77.

Astuti, Y., & Setiawan, B. (2013). Development of student worksheets (LKS) based on a guided inquiry approach in cooperative learning on heat material. *Indonesian Natural Sciences Education Journal*, *2*(1), 88–92. https://doi.org/10.15294/jpii.v2i1.2515

Damayanti, S., Mahardika, I., & Indrawati, I. (2016). Application of Discovery Learning Model Assisted by Macromedia Flash Animation Media Accompanied by LKS Integrated with Multirepresentations in Physics Learning in High School. *Journal of Physics Learning*, *4*(4), 357-364–364.

Hajrin, M., Sadia, W., & Gunandi, IGA (2019). The effect of guided inquiry learning

models on students' critical thinking skills in physics learning in class X IPA of SMA Negeri. *JPPF. 9 (1)*, 63–74.

Hake, R. (1999). *Analyzing Change / Gain Score*. Indiana University.

Indrawati. (2011). *Learning models*. University of Jember.

Jaenudin (2008). *The Effect of Contextual Approaches on the Mathematical Representation Ability of Various Middle School Students*. Department of Mathematics Education, Indonesian University of Education.

Neria, D., & Amit, M. (2004). Students' preferences of non-algebraic representations in mathematical communication. *Proceedings of the 28th Conference of the International Group for the Psychology of Mathematics Education*, *3*, 409–416.

Prahani, BK, WW, S., & Yuanita, L. (2017). Development of Guided Inquiry Model Physics Learning Tools to Practice the Multi-Representative Abilities of High School Students. *JPPS (Journal of Science Education Research)*, *4*(2), 503. https://doi.org/10.26740/jpps.v4n2.p503-517

Prihatni, Y., Kumaidi, K., & Mundilarto, M. (2016). Development of cognitive diagnostic instruments in science subjects in junior high school. Journal of Educational Research and Evaluation. 20 (1), June 2016 (111-) Online: http://journal.uny.ac.id/index.php/jpep. Journal of Educational Research and Evaluation, 20 (1), 111–125.

Prasetyawati, IW, Subiki. & Budiarso, USA (2019). the effect of guided inquiry-based Ix with the snakes and ladders game on the motivation and learning outcomes of high school students in the district of Jember. *Journal of Physical Education. Vol 8 (3)*, 137–143.

Rais, AA, Hakim, L., & Sulistiawati, S. (2020). Understanding of Student Concepts through the PhET Simulation-Guided Guided Inquiry Model. *Physics Education Research Journal*, *2*(1), 1. https://doi.org/10.21580/perj.2020.2.1.5074

Rizky, G., Tomo, D., & Haratua, T. (2014). Multirepresentation Ability of High School Students in Solving Newton's Law Questions. *Journal of Education and Learning*, *3*(8), 1–10. http://jurnal.untan.ac.id/index.php/jpdpb/article/view/6733/6967

Sumarauw, JM, Ibrahim, M., and Prastowo, T. (2017). Development of guided inquiry-based learning tools assisted with PhET simulation in natural science learning. J*urnal Education Research. 34 (1)*, 978–979.

Taufik, M., Sukmadinata, NS, Abdulhak, I., & Tumbelaka, BY (2010). Design Learning Models to Improve Problem Solving Ability in Learning Science (Physics) Middle School in Bandung. *Periodical Physics*, *13*(2), 31–44.

Trianto. (2010). *Designing Innovative-Progressive Learning Models.* Kencana.

Widyawati, A., & Prodjosantoso, AK (2015). Development of Ipa Comic Media to Increase Learning Motivation and Character of Junior High School Students. *Journal of Science Education Innovation*, *1*(1), 24. https://doi.org/10.21831/jipi.v1i1.4529

Yuwono, G., Mahardika, I., & Gani, A. (2016). The Effect of Guided Inquiry Learning Model on Student Physics Learning Outcomes (Verbal Representation Ability, Images, Mathematics, and Graphics) in High School. *Journal of Physics Learning in Jember University*, *5*(1), 60-65.