

Original Research

Improving Learning Outcomes on Work and Power through Inquiry Learning

Ridha Ajeng Aprilia¹, Eka Cahya Prima^{1*}, Ika Hasanah², Agi Muhammad Sibgotillah¹

¹*Department of Science Education, Faculty of Mathematics and Science Education, Indonesian University of Education, Bandung 40154, Indonesia*

²*Department of Chemistry Education, Faculty of Mathematics and Science Education, Indonesian University of Education, Bandung 40154, Indonesia*

*Corresponding author: ekacahyaprima@upi.edu

Abstract. The purpose of this study was to see the improvement of learning outcomes of 8th-grade students in the material of Effort and Power with inquiry learning. This study contains pretest and posttest as well as LKPD work. The sample collection technique used convenience sampling with class VIII students of SMPN 35 Bandung in the 2023/2024 academic year totalling 21 people as research subjects. The research method uses quantitative research. Data collection with observation sheets of teacher activities, student activities and pretest-posttest. The data was analyzed with mean value, standard deviation, maximum value, minimum value and n-gain. Based on the results of data analysis, it shows that there has been an increase but there are still those who have not experienced an increase in learning outcomes.

Keywords: Inquiry, Learning Outcome, Work

Introduction

Education is a place to gain knowledge, skills and improve attitudes. These three things are obtained through the learning process contained in Education. In accordance with Gross & Thompson (2007) states that "Education is the influence of the environment on individuals to produce permanent changes in habits, thoughts, attitudes and behavior". If a nation wants to have good quality education, then this nation must strive to continue to improve the quality of its education. The Indonesian government has had national education goals and created a national education system. In accordance with the contents of Article 1 of the National Education System Law no. 20 of 2003, it is stated that the National Education System is all components of education that are interrelated in an integrated manner to achieve national education goals. Departing from the sound of this article, it can be seen that education is a system that is a totality of structures consisting of interrelated components and together towards achieving goals (Soetarno, 2003: 2). These components consist of the environment, facilities and infrastructure, resources and society. Education is very important because it has a central position in national development because Education is the main target in improving the quality of Human Resources (HR) (Mustaqim & Wijayanti, 2019). So it is important for every school to have good learning outcomes.

In line with this, according to Article 3 of Law Number 20 of 2003 concerning the National Education System, it states that "National education functions to develop abilities and shape the character and civilization of a dignified nation in order to educate the life of the nation. Aims to develop the potential for students to become human beings who believe in and fear God Almighty, have noble morals, are healthy, knowledgeable, capable, creative, independent, and become democratic and responsible citizens" (Sugiarni, et al., 2021).



Efforts to improve the quality of education have been carried out by the government, such as curriculum renewal, improvement of school facilities and infrastructure. A teacher is also a factor in increasing efforts to improve quality by using learning methods or models that are in accordance with their field of study.

One of the learning models that can be used is the inquiry model. The term inquiry is related to the general characteristics of questions directed at students and problem solving. In the current era, the focus is on the teaching and learning process which is rooted in the rapid development of scientific knowledge and teaching "how to learn", how to conduct research and find information, how to use that information by implementing inquiry-based learning. Along with the development of individual skills, inquiry also aims to develop teamwork and communication skills (Bogar, 2019).

According to Sanjaya (2007) the inquiry model is a series of learning activities that emphasize the process of thinking critically and analytically to find and find answers to a problem that is asked. The use of inquiry is intended for students to better understand science and science is more durable. Inquiry-based learning is a learning approach that allows students to be active throughout the learning process by making them ask questions, analyze information and ask questions. It develops skills using the scientific process (posing problems, planning experimental processes, making guesses, generating hypotheses, collecting and analyzing data and interpreting the results) and makes students use their creativity (Bass, Contant, & Carin, 2009). In inquiry-based activities, students investigate events and phenomena both individually and in groups and reach conclusions. Students manage their own research activities, ask questions, plan new activities, draw conclusions and confirm information that has been learned (Branch & Oberg, 2004). The application of the appropriate learning model will be related to student learning outcomes.

Student learning outcomes are influenced by two factors, namely internal factors and external factors. Internal factors are factors that come from within the students themselves, one example is motivation, logical mathematical intelligence, emotional intelligence, self-confidence, independence, attitude and others. While external factors are factors that come from outside the students themselves, such as facilities and infrastructure, environment, curriculum, teaching methods, and motivation from the teacher himself. Teachers as one of the external factors, namely by implementing the inquiry learning model, are expected to help student learning outcomes. Learning models that emphasize memory factors are still found in learning to be a weakness when students learn science (Bundu, 2006). This type of learning model is still conventional or teacher-centered. This makes learning only centered on the teacher and communication is only one way. The learning strategy used by the teacher greatly influences the success or learning outcomes of students (Zubaidah, 2017).

Learning outcomes are things that can be seen from two perspectives, namely from the teacher and the students (Dimiyanti & Mudjiono, 2002). From the student's side, learning outcomes are the level of development after learning. This development is in the form of cognitive, affective and psychomotor. From the teacher's side, learning outcomes are the results of learning that has been completed. The increase in mastery that has been achieved by students in carrying out learning activities with the stated objectives includes cognitive, affective and psychomotor aspects (Bundu, 2006). These learning outcomes can also be related to student activity.

Based on the results of interviews with teachers obtained in the learning process in the classroom, teachers found that students were less active in learning and discussions so that it could have an impact on the difficulty of improving student learning outcomes. Only around 16.67% of students are active in class. In addition, the Mid-Semester Assessment score is still at a fairly good level, around 40% of students. In relation to the learning

outcomes and character of students based on the results of the 2018 PISA survey, it was stated that Indonesian students' science scores were ranked 70th out of 78 countries (Agung, 2021) which is not in accordance with government expectations. In the application of the inquiry model for work and power material, it is hoped that students can analyze the application of work and power in everyday life. Work and power are concrete materials and occur in everyday life, so that many problems related to work and power can be used as references or guidelines in learning. Work and energy are basic concepts of physics that must be inherent in students. Therefore, understanding of effort and energy needs to be emphasized so that students are able to accept subsequent topics related to effort and power (Jhonny, et al., 2020).

In previous studies, the use of inquiry models had a positive effect on improving student learning outcomes. Inquiry learning models help students improve their science learning outcomes because students are more active in finding and analyzing problems (Udiani, 2017). The results of Sumarni et al.'s (2017) research confirmed that inquiry learning models have an effect on students' cognitive learning outcomes. According to Pratiwi et al.'s (2019) research, this inquiry model also plays a role in improving student learning outcomes. Based on previous research, inquiry models can support student learning outcomes. Similar to inquiry models, the use of learning media can also support student learning outcomes to improve. Two things that can separately help improve student learning outcomes make the combination of the two things increase the improvement in learning outcomes. So that inquiry models combined with media such as worksheets or e-modules can be a support in improving learning outcomes. I chose the combination of inquiry models with student worksheets for reasons of effectiveness of implementation in the classroom. In conditions where students are less supported by technology, the use of student worksheets can be more effective than e-modules. So the purpose of my research is to Improve Learning Outcomes on Work and Power Material through Inquiry Learning. The novelty of this research is learning supported by LKPD with contextual activities carried out by students according to the steps of inquiry learning.

Method

The type of research used is quantitative research. Qualitative is a research conducted by a teacher or a certain person with the aim of improving performance as a teacher, so that student learning outcomes increase. This research was conducted at SMPN 35 Bandung. This research was conducted at SMPN 35 Bandung in connection with the place of field experience practice. The subjects of the research were 21 students in grade VIII at one of the schools in Bandung City. The selection of students was carried out using convenience sampling techniques. Many research subjects were based on the presence of students during science learning in class within the time span of the research. This research was conducted by conducting learning with student worksheets and providing assessments in the form of pretest and posttest questions with the inquiry learning model. Validation of pretest and posttest questions was carried out by science teachers who teach at the school. The teacher validates the questions related to the suitability of the material with the junior high school level, the absence of ambiguity in the question sentence, the suitability of the questions with learning outcomes, and questions that are easy for students to understand. The teacher as a validator ensures that the questions, question indicators, learning outcomes and answers to be validated are good. The assessment in this study was used to measure students' learning outcomes on the material of work and power. This question was validated by the teacher. Students are said to have met the learning outcomes if they achieve or are more than 70 on the assessment results.

Research Flow

This research was conducted in several steps, namely initial learning reflection, learning plan, learning actions, learning observations and final learning reflection.

1. Initial learning reflection

In the initial learning reflection, the researcher conducted initial observations on learning activities such as teacher and student conditions, learning activities, and learning models used by the teacher. At this stage, the researcher analyzed the results of the observations and found problems that occurred and sought solutions. This was used by the researcher as a reference in making a learning plan.

2. Lesson plan

This learning plan is composed of the activities of compiling inquiry-based teaching modules by researchers by discussing them with colleagues. Researchers also compile student worksheets (LKPD) and assessment questions (pretest and posttest) as well as assessment question validation instruments.

3. Learning actions

At this stage, the researcher implements the previously prepared plan with the teaching module as a guideline in carrying out learning activities. At the first meeting, a pretest activity was carried out on the material of effort and power and at the last meeting a posttest activity was given.

4. Learning observation

This learning observation includes the assessment of teacher activities and student activities by colleagues and LKPD assignments completed by students.

5. Final learning reflection

In the final reflection of learning, researchers get the results of the assessment and LKPD that have been worked on by students. Researchers analyze and evaluate the results of the pretest, posttest and LKPD as considerations in preparing the next learning plan.

Research Data Collection

This study collected research data from 21 students of class VIII SMPN 35 Bandung using convenience sampling technique. This study collected data from the pretest results conducted at the beginning of learning with 5 descriptive questions. The work on LKPD is in accordance with the stages of inquiry learning and the collection of posttest data conducted at the end of learning with 5 descriptive questions on the material of work and power. The main purpose of giving pre and posttests is to evaluate the impact of learning on various types of students based on their performance (Vavasseur, 2020).

Research Data Analysis

The data collected in this study include the pretest and posttest scores of students. The research data were collected through tests or assessments. Data processing techniques consist of average values, standard deviations, maximum values, minimum values and n-gain. The mean is easily influenced by values that are too large or too small, which can provide an artificially inflated or decreased summary of the variable. The standard deviation is a good measure of dispersion. The standard deviation is the average distance between each data point and the mean. A low standard deviation indicates that the values tend to be close to the mean of the data set, while a high standard deviation indicates that the values are spread out over a wide range (Kotronoulas, 2023).

The use of n-gain analysis aims to produce empirical evidence of increased problem-solving abilities of students with inquiry models than ordinary learning models. If the results

of the average value and standard deviation are greater, then the n-gain score is more spread out (Muhammad, 2018). Finding n-gain is done with the formula:

$$\text{Normal Gain} = \frac{\text{Skor Post Test} - \text{Skor Pre Test}}{\text{Skor Ideal} - \text{Skor Pre Test}}$$

Table 1. N-gain criterion

Average	Criteria
$g > 0.7$	Tall
$0.3 \leq g \leq 0.7$	Currently
$0 \leq g \leq 0.3$	Low
$g \leq 0$	Fail

Results and Discussion

This research began with conducting observations with the aim of finding problems related to the science learning process. After identifying the problems, a solution was sought by creating a learning action plan to improve students' learning outcomes in science lessons.

The results of the learning implementation consisted of 4 meetings, learning activities on the topic of work and power. In the initial learning planning, the researcher prepared learning devices such as teaching modules, pretest and posttest questions, teacher activity observation sheets, student worksheets and teaching media. Pretest and posttest questions were validated with colleagues. The results of the question validation analysis were carried out using the average calculation technique (Arikunto, 2006). The results of the validation of questions, both pretest and posttest, obtained a total of 45 scores out of a total of 45 scores. The total value of the validation results can be seen in table 2. The calculation results show 100% which falls into the very valid criteria so that the questions are very feasible and do not need to be revised.

Table 2. Pretest and Posttest Question Validation Results

Criteria	Pretest Questions	Posttest Questions
Suitability of the test items with the learning outcomes to be achieved	5	5
Suitability of question items with material indicators	5	5
Suitability of question items with indicators of conceptual understanding ability	5	5
The limits/questions/scope being measured are clear	5	5
The formulation of the question items does not give rise to multiple interpretations	5	5
The answer to the question item does not depend on the previous answer.	5	5
The formulation of questions uses easy-to-understand language.	5	5
The formulation of the question items uses good and correct language	5	5
Total value	45	45

Implementation of learning with inquiry steps. Starting with apperception and motivation as the initial steps of learning. In the core activities, students identify problems, formulate problems, formulate hypotheses, design activities, carry out activities, collect data, and formulate conclusions. At the end of learning, learning reflection is carried out. Implementation of learning can be seen in Figure 1.



Picture 1. Learning implementation activities

In this Implementation Activity, students work on LKPD as shown in Figure 2. Students work on LKPD in groups according to the inquiry learning steps. The steps are in accordance with the core activities in the inquiry steps. This requires independence and collaboration of students in their work. At the end of the LKPD, students write down reflections felt during learning.

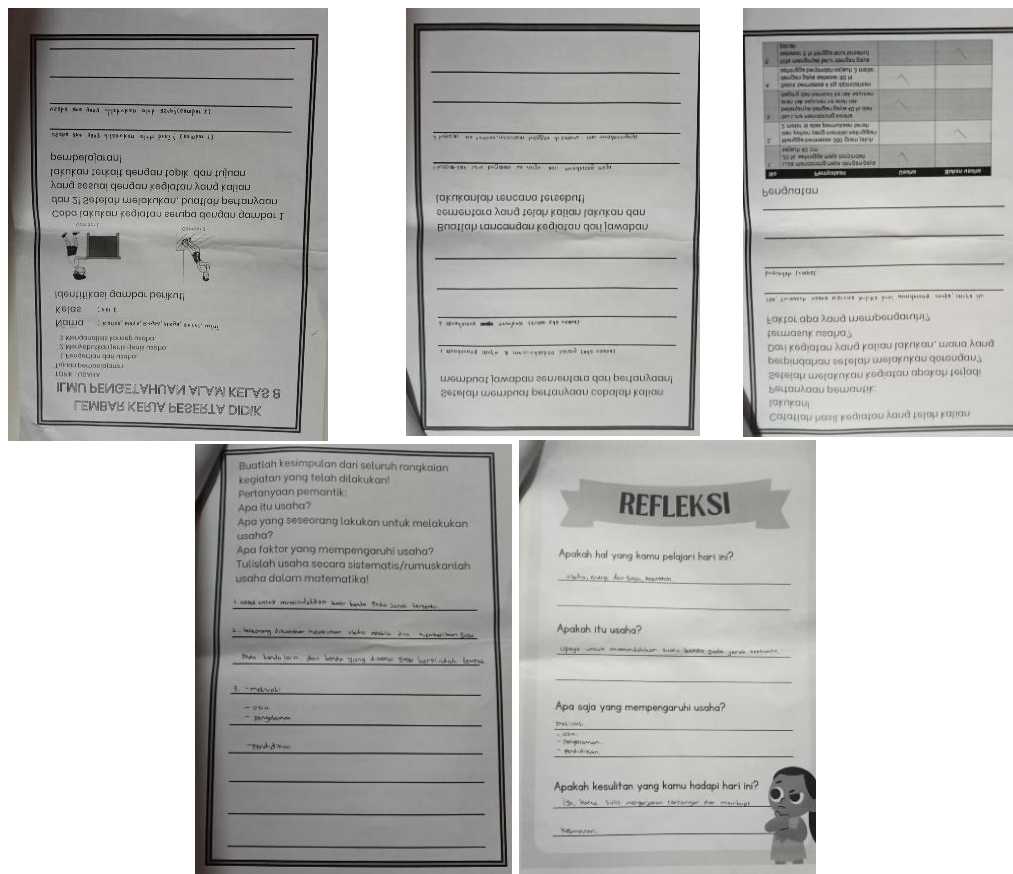


Figure 2. LKPD sheets worked on by students

In the observation activity, two activities were carried out, namely observation of teacher and student activities. The results of the observation analysis of both teacher and student activities by calculating the average. On the teacher activity observation sheet, there are 20 aspects assessed by the observer. The observer is a colleague. The results of the analysis of teacher activity observations obtained a value of 89 out of 100 values with an average of 89% can be seen in Table 3.

Table 3. Results of teacher activity observations

Aspects observed	Mark
Preparing students to take part in the learning process before starting learning activities	5
Carrying out apperception activities	4
Providing motivation for learning activities	4
Delivering learning objectives	4
The teacher guides students to identify problems based on existing phenomena.	4
The teacher guides students to formulate the problems that have been identified.	4
The teacher guides students to formulate hypotheses from the problem formulations that have been made.	5
The teacher guides students to create activity plans based on the hypotheses they have created.	4
The teacher gives students the opportunity to carry out activities based on the activity plans that have been made.	5
The teacher gives students the opportunity to collect data from activities and guides in reinforcement.	4
The teacher guides students to draw conclusions after carrying out a series of activities.	4
The learning process is centered on students	5
The teacher gives students the opportunity to ask questions and express their opinions.	5
Students are enthusiastic in giving answers	4
Use of sources/media according to learning materials	5
Sources/media help students get interesting messages	4
Students are involved in the use of resources/media	4
Using language both spoken and written clearly, well and correctly	5
Reflecting at the end of learning	5
Carry out follow-up by providing direction or activities or tasks	5
Amount	89

On the student activity observation sheet, there are 18 aspects assessed by the observer. The observer is a colleague. The results of the analysis of student activity observations obtained a value of 81 out of 90 with an average of 90% can be seen in table 4.

Table 4. Results of observations of student activities

Aspects observed	Mark
Students enter class on time	5
Students prepare learning equipment	5
Students do not do other work that will interfere with the learning process.	5
Students listen to all the information conveyed by the teacher	5
Students do not chat with friends in groups except when discussing learning materials.	5
Students provide responses to whatever the teacher says.	4
Students submit opinions during group discussions	4
Students carry out group discussions until the specified time limit.	5
Students show the results of their group discussions to the teacher.	4
Students work on the LKPD given through discussion.	5
Students ensure that all group members have mastered the material in the LKPD	5
Students ask questions about things they don't understand about the problems in the LKPD	4
Students work on all the questions given	5
Students come forward to present the results of their discussion.	4
Students provide responses to the answers to questions that have been worked on by other groups.	3
Students make conclusions about the material that has been given	5
Students correct or add to other groups' conclusions if they are considered incomplete.	4
Students take notes or summarize the material given	4
Amount	81

In the reflection activity, the results of the students' pretest and posttest scores were obtained as well as the results of the statistical analysis which can be seen in table 5.

Table 5. Pretest and Posttest Results

Results	N	Min	Max	Mean	Std. Dev
Pretest	21	0	87	42.43	25,426
Posttest	21	34	96	63.10	23,763

Standard deviation is the best measure of dispersion, because it describes the magnitude of the dispersion of each observation unit (Ghozali, 2016). The standard deviation value is a value used to determine the distribution of data in a sample and see how close the data is to the mean value (Sekaran & Bougie, 2016). Based on table 5, the pretest standard deviation value is 25.426 and the mean is 42.43, meaning that the data is less varied because the standard deviation value is smaller than the mean. The posttest standard deviation value is 23.763 and the mean is 63.10, meaning that the data is less varied because the standard deviation value is smaller than the mean. So both the pretest and posttest values have less varied data.

In the final reflection activity, an analysis and evaluation of the pretest and posttest work were carried out. The analysis was carried out with the help of Microsoft Excel. The pretest is a practice test before the material is studied. Due to the lack of prior knowledge, many answering errors often occur during the pretest (Pan, 2021). The posttest is an assessment to measure student performance after learning takes place (Vilhunen, 2022). There are several students who have scores above completion, which means that the students have studied the previous material. However, students who had high scores during the pretest experienced a decline during the posttest due to lack of accuracy in answering. The pretest and posttest scores were calculated using the N-gain method, the results of which are as shown in Table 6.

Table 6. Results of N-gain Pretest and Posttest Values

Learners	Pre	Post	N-gain score	Criteria
P1	81	87	0.315789474	Currently
P2	25	37	0.16	Low
P3	15	37	0.258823529	Low
P4	43	81	0.666666667	Currently
P5	81	78	-0.15789474	Fail
P6	25	43	0.24	Low
P7	28	96	0.944444444	Tall
P8	25	40	0.2	Low
P9	40	71	0.516666667	Currently
P10	59	34	-0.6097561	Fail
P11	34	96	0.939393939	Tall
P12	59	84	0.609756098	Currently
P13	37	87	0.793650794	Tall
P14	87	53	-2.61538462	Fail
P15	21	34	0.164556962	Low
P16	21	75	0.683544304	Currently
P17	18	50	0.390243902	Currently
P18	46	87	0.759259259	Tall
P19	0	34	0.34	Currently
P20	84	37	-2.9375	Fail
P21	62	84	0.578947368	Currently

In table 6, the results show that four students have high criteria, eight students have medium criteria, five students have low criteria and four students have failed criteria. Results like this are influenced by different pretest and posttest implementation factors. During the

pretest, students do it in class by being given test questions on paper and students work on them on paper. While during the posttest, students work using Google Form. The difference in test implementation makes it difficult to see improvements. The low posttest score is not because students have not mastered the work and power material but because students tend to answer only numbers without working steps. This causes students not to get maximum scores during the posttest. This can be seen in the work on P14 through figure 3.

The use of an online platform in the post-test process should make it easier for students. One of the conveniences is in writing steps and answers. On an online platform, students should get convenience if they make mistakes in writing, the time needed to rewrite the answer is less than erasing and rewriting on paper. Students who are still not used to working on descriptive questions on an online platform is another factor that causes no increase in grades. According to Toma (2021), the use of an online platform helps students in the learning process and is more motivated in learning and working on questions. Compared to the reality during the study, students tended to be less enthusiastic and did not write down the steps when working on it with an online platform compared to when working by writing on paper. This causes a reduction in points in the assessment of descriptive questions. It can be seen that 80% of students get scores above the minimum criteria set by the school. So ideally students experience an increase in learning outcomes if they work on paper and are also reviewed from the LKPD work. In a total of 5 questions given, each question has a different weight. This difference is based on the assessment rubric of writing known, asked, correct work steps, correct calculation results and writing units. The tendency of students who only write calculation results and units makes them get low scores even though students have answered each question correctly because it is still not in accordance with the existing assessment rubric.

The importance of having an assessment rubric can help see how deep the students' understanding of the material being studied. Assessments that still maintain traditional assessments such as writing known, asked, correct work steps, correct calculation results and writing units help teachers observe students' understanding. Students who only write down the calculation results can be interpreted that the answer is not based on their own understanding but see the answers from their friends. An early indicator of students who have understood is by seeing students in writing what is known and asked in the questions given.

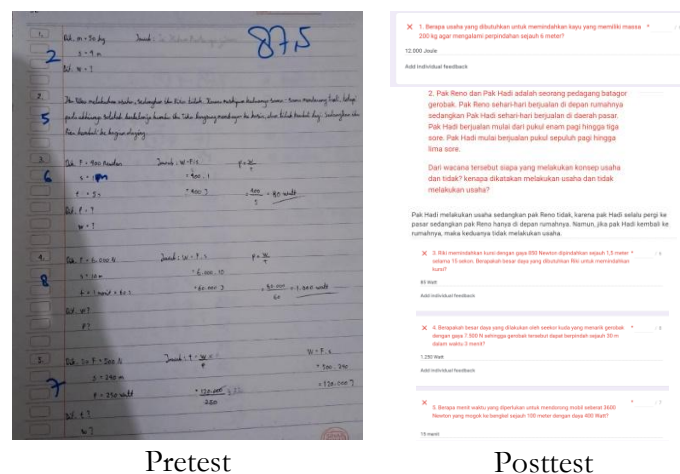


Figure 3. Results of pretest and posttest

Conclusion

Learning is carried out with an inquiry model on the material of effort and power carried out in one of the VIII classes of SMPN 35 Bandung showing that there are students

who have improved and some who have not. This result is because students only write down the results of calculations and their units, ignoring the steps of the work. The results of the analysis of teacher activity observations obtained a value of 89 out of 100 values with an average of 89% and the results of the analysis of student activity observations obtained a value of 81 out of 90 with an average of 90%. The results of the pretest standard deviation value were 25.426 and the mean was 42.43, meaning that the data was less varied because the standard deviation value was smaller than the mean. The posttest standard deviation value was 23.763 and the mean was 63.10, meaning that the data was less varied because the standard deviation value was smaller than the mean. The N-gain value obtained the results of four students having high criteria, eight students having medium criteria, five students having low criteria and four students having failed criteria.

Based on the research conducted, researchers are required to conduct further research by considering the results of reflection on this research.

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