

Meta-Analysis of the Influence of the Inquiry Model on Student Learning Outcomes

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Article Info

Article history:

Received August 11, 2023

Revised December 19, 2023

Accepted December 25, 2023

Keywords:

Meta-Analysis

Learning model

Inquiry learning

Leaning outcomes

ABSTRACT

Student success in learning is very necessary to see the extent to which students are able to solve problems. However, it turns out that student learning outcomes are still low. The solution to overcome this problem is to apply the inquiry learning model during learning. This research aims to determine the effect of the inquiry learning model on student learning outcomes. The application of the inquiry model is seen from the level of education and physics and science lessons. This type of research is meta-analysis. Meta-analysis is research carried out by summarizing research data, reviewing and analyzing research data from several previously existing research results. This research article consists of 11 articles that have ISSN. The instruments used are category codes and effect size calculations. The steps of meta-analysis are conducting a literature review, collecting data, researching and assessing articles, analyzing and interpreting articles, and compiling report results. The data analysis technique in this research is to calculate the magnitude of the effect using a formula based on the mean. From the data analysis carried out, two research results can be stated. First, the application of the inquiry learning model has a significant effect on the level of education and subject matter, especially physics and science.



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INTRODUCTION

Education is not only seen as an effort to provide information and the formation of skills, but is expanded to include efforts to realize individual desires, needs and abilities so that a satisfactory personal and social lifestyle is achieved, education is not merely a means of preparing for future life, but for the lives of children now who are experiencing development towards their maturity level. Education is a learning process obtained by

students to be able to make that students understand, understand and be more mature and able to make students more critical in thinking (BP. et al., 2022).

Education is very important to realize quality resources. Education is expected to produce human resources who have better character and broad insights to advance the nation and state. Seen in Indonesia, education in Indonesia can be said to be still low. The low level of education in Indonesia can be seen from the learning outcomes obtained. There are still many low learning outcomes from various subjects. The learning process occurs when students acquire new knowledge, or changes from old knowledge through experiences. Using a teacher-centered teaching approach students understand concepts or low scientific literacy and misunderstandings occur among students (Mufit, 2020)

Learning outcomes must show a change in behavior or the acquisition of new behavior from students that is permanent, functional, positive and conscious (Kosilah and Septian, 2020). Learning outcomes have an important role in the learning process. The process of assessing learning outcomes can provide information to teachers about student progress in an effort to achieve learning goals through teaching and learning activities. Furthermore, from this information the teacher can arrange and foster further student activities, both for the whole class and individually.

According to M. Gagne (1988) there are five kinds of learning outcomes: (1) intellectual skills; (2) cognitive strategies; (3) verb information; (4) motor skills; (5) attitudes and values. Cognitive value is to regulate one's way of learning in the broadest sense, including the ability to solve problems. According to Benjamin S. Bloom 2017), intellectual learning outcomes in the cognitive domain consist of rote knowledge, understanding, application or application, analysis, synthesis, and evaluation. The results of this cognitive learning are usually in the form of numbers that indicate the completeness and incompleteness of students in learning.

Learning outcomes are influenced by several environmental factors, instrumental factors, Physiological Conditions, Psychological Conditions Meanwhile, factors outside the student include family, school and community factors (Anggraini et al., 2020). Revealed that the learning outcomes obtained by students were influenced by two main factors, namely: students and factors that came from outside the student or environmental factors, where 70% were influenced by the students' own abilities, and 30% were influenced by the environment. Learning outcomes which are often referred to as "scholastic achievement" or "academic achievement" are the overall efficiency and results achieved through the learning process in schools which are expressed in numbers or grades based on learning achievement tests (Briggs, 1979). Everything has a very strong influence on learning outcomes. Especially what often affects is that teachers still use conventional methods in the teaching and learning process. This phenomenon often occurs during the process of learning activities in this country, most students are more passive, reluctant, afraid or embarrassed to express their opinions, this situation will certainly interfere with the smooth learning and creativity of students in learning activities. In addition, the learning process is still teacher-centered, teachers tend to communicate in one direction by providing a lot of material and giving little opportunity for students to interact through performance or verbal communication. If this is allowed to continue, it will cause more and more students to experience difficulties in learning so that the expected learning outcomes are not in accordance with what is expected.

According to Gagne and Driscoll (1988) is the result of students' learning abilities as a result of learning actions and can be observed through student performance (student performance). Obtaining learning outcomes as expected to achieve learning objectives can be done in various ways. One of the ways to do this is by using a learning model. Learning model is, a plan or pattern that we can use to design face to face teaching in classrooms or tutorial settings and to shape instructional materials including books, films, tape, computer mediated programs, and curricula (Joyce, B. et al., 1992). According to this understanding, the learning model functions more as a framework for designing face-to-face activities, determining teaching materials, and learning support media.

Learning model is a conceptual framework that can be used as a guide by teachers in learning. Learning models can become a reference for teachers and students regarding what should be done to achieve learning goals. The learning model is also used by the teacher in an effort to bring students to the desired behavioral changes. Learning models can help improve teaching and learning process activities while improving student learning outcomes. One learning model that can be used to improve student learning outcomes is the inquiry model.

The inquiry model is a series of learning activities that emphasize the process of thinking critically and analytically to seek and find answers to a problem in question. The inquiry model is built on the assumption that from birth humans have the urge to find their own knowledge. In the inquiry model students are directly involved in the learning process. The teacher is no longer the center of learning but rather as a promoter or companion. With the inquiry method will train students to dare to express opinions and find their own knowledge that is useful for solving problems. Using inquiry learning methods efficiently and effectively will reduce the teacher's monopoly in controlling the course of the learning process, and students' boredom in a lesson will decrease. In the learning model students are very guided to find concepts (Mufit, 2019).

Meta-analysis is a form of quantitative research that uses numbers and statistical methods from several research results to organize and extract as much information as possible from the data obtained, so as to approach comprehensiveness with other purposes. One of the requirements needed in conducting a meta-analysis is an assessment of the results of similar studies. Sutjipto (1995) defines meta-analysis as an attempt to summarize various research results quantitatively. In other words, meta-analysis as a technique is intended to re-analyze research results that are processed statistically based on primary data collection. (Samsidar et al, 2019), argues that meta-analysis is a study by analyzing data from primary studies. The results of the primary study analysis are used as a basis for accepting or supporting the hypothesis, and can also be used to reject/abort the hypothesis proposed by several researchers. Besides that, Soekanto (1988) says that the nature of meta-analysis includes quantitative, and uses statistical analysis to obtain a series of information derived from a number of data from previous studies.

According to Glass (1981) meta-analysis is a quantitative analysis and uses a large amount of data and applies statistical methods by practicing them in organizing a number of information derived from large samples whose function is to complement other purposes. According to Borg (1983) meta-analysis is the latest development technique to help researchers find consistency or inconsistency in cross-assessment of results from similar research results. Syagiah et al (2023) concluded that meta-analysis according to Anwar and Festiyed (2023) is a technique used to summarize various research results quantitatively by looking for effect size values. The effect size is sought by finding the difference in the average experimental class with the average control class, then divided by the standard deviation of the control class. Thus, meta-analytic research is an activity of collecting,

processing, and presenting data that is carried out systematically and objectively to solve a problem or test a hypothesis by conducting investigations of existing studies by describing and examining the parts of each study. as well as the relationship of each study to obtain conclusions and in-depth understanding of the research being studied.

Effect size is a quantitative index used to summarize study results in a meta-analysis. That is, the effect size reflects the magnitude of the relationship between variables in each study. The choice of effect size index depends on the type of data used in the study. According to Borenstein, et al (2009), there are four types of data in research, namely: a) dichotomy; In data that is constructed in a dichotomous manner, such as life/death, success/failure, yes/no, the effect sizes used include relative risk or risk ratio (RR), odds ratio (OR), or risk difference (RD). Suppose a meta-analysis consists of k studies. These studies have dichotomous or binary outcome variables. The results of each study can be presented in a 2x2 contingency table. This table provides information on the number of participants divided into two groups, i.e. a). the experimental and control groups experienced both events and no events, b) Continuous; For data that is constructed continuously, such as loss of weight and blood pressure, the effect size used includes the mean difference (MD) or standardized mean difference (SMD), c) Time-To-Event Or Survival Time; For this type of data, for example relapse time, recovery time, a hazard ratio is used, d) Ordinals; A result categorized by a certain category, eg mild/moderate/severe, e) Time-To-Event or Survival Time; For this type of data, for example relapse time, recovery time, a hazard ratio is used, f) Ordinals; A result categorized by a certain category, eg mild/moderate/severe. c) Time-To-Event Or Survival Time; For this type of data, for example relapse time, recovery time, a hazard ratio is used, and g) Ordinals; A result categorized by a certain category, eg mild/moderate/severe.

Based on this description, this study aims to analyze the effect of using the inquiry learning model on student learning outcomes and in terms of educational level and the influence on the subjects obtained by comparing the effect sizes obtained. Based on the phenomena that often occur during the process of learning activities, the lack of student learning outcomes is very concerning As is generally the case with similar research, it is hoped that this meta-analysis will be useful in the field of education, especially teachers who will apply the inquiry model.

METHODS

This study uses a meta-analysis method by reviewing several articles in national and international journals. Meta-analysis is quantitative because it uses the calculation of numbers and statistics for practical purposes, namely to compile and extract information from a large amount of data that is not possible with other methods.

Coding in meta-analysis is an important requirement in order to facilitate the collection and analysis of data. Because of this, the instrument in this meta-analysis study was carried out using coding categories. The variables used are student learning outcomes in the form of pre-test and post-test scores.

Step-data tabulation steps are (1) identification of research variables. Once found, enter into the appropriate variable column, (2) identify the mean and standard deviation of the experimental and control group data for each subject/sub-study, (3) calculate the effect size using the Glass formula (4) based on the mean and standard deviation by finding the effect size (Δ) by dividing the difference between the experimental group's mean (XE) and the control group's mean (XK), with the standard deviation of the control group (SK). The formula is:

$$\text{Effect size} = \frac{\bar{x} \text{ eksperiment} - \bar{x} \text{ kontrol}}{SD \text{ kontrol}}$$

Table 1. The Effect Size Criteria [5]

No	Effect size	Category
1	≤ 0.15	Negligible Effect
2	$0.15 < \text{effect size} \leq 0.40$	Small Effect
3	$0.40 < \text{effect size} \leq 0.75$	Moderate Effect
4	$0.75 < \text{effect size} \leq 1.10$	High Effect
5	$1.10 < \text{effect size} \leq 1.45$	Very High Effect
6	1.45	Effect Size High Influence

RESULTS AND DISCUSSION

Results

Effect size

This meta-analytic research uses 11 articles about the use of the inquiry model to improve student learning outcomes. This article consists of several levels of education. Below is the article used.

Table 2. The average value of the control class and experimental student learning outcomes.

No	Title	Average value	
		Control Class	Experiment Class
1	The Effect of Inquiry-based Learning Method on Students' Academic Achievement in Science Course	4.65	5.22
2	The Effectiveness of Inquiry Learning Method to Enhance Students' Learning Outcome: A Theoretical and Empirical Review	43.76	65.65
3	The Influence of the Inquiry Learning Model on Student Learning Outcomes in the Subject Matter of Measurement	41.11	55.10
4	Implementation Of Levels of Inquiry on Science Learning To Improve Junior High School Student's Scientific Literacy	3.04	7.94
5	Application of the Inquiry Learning Model to Improve Student Learning Outcomes in the Competence to Maintain Gasoline Fuel System Components	62.47	76.89
6	The Role of the Guided Inquiry Learning Model on Science Process Skills in Class X Students of SMA Negeri 2 Polewali	24	47
7	The Use of Inquiry Models to Improve Student	66.19	76

	Learning Outcomes on Material Properties of Magnets in Class V SDN Sukajaya, Jatinunggal District, Sumedang Regency		
8	The Influence of the Guided Inquiry Learning Model to Improve Learning Outcomes and Student Learning Activities	62.04	70.54
9	The Influence of the Guided Inquiry Learning Model Using the Experimental Method on the Physics Learning Outcomes of Xi IPA Class Students of Sman 2mataram Year 2016/2017	54.70	60.33
10	The Effect of the Guided Inquiry Learning Model on Physics Learning Outcomes in High School	57.59	87.34
11	The Influence of the Inquiry Learning Model on Learning Outcomes in terms of Student Learning Independence	16.50	21.96

This research summarizes 11 articles about the application of the inquiry model to learning outcomes obtained from online journals. It was found that the average effect size value was 0.89. The details are as follows:

Table 3. Average Effect Size Values

No	Journal	Effect size	Category
1	JK1	1.372	Very high effect
2	JK2	0.870	High effect
3	JK3	0.528	Moderate effect
4	JK4	1.21	Very high effect
5	JK5	0.4	Small effect
6	JK6	1.27	Very high effect
7	JK7	0.37	Small effect
8	JK8	0.717	Moderate effect
9	JK9	0.363	Small effect
10	JK10	1.414	Very high effect
11	Jk11	1.313	Very high effect

Moderator Variable that Affects the Effect Size

a. Effect size of moderator Variable at Educational Level

Based on the education level of the research subjects regarding the effect of applying the inquiry learning model on learning outcomes can be seen in Table 3.

Table 4. Effect Size Values at Educational Level

No	Educational level	Number of journals	Effect size	Category
1	Elementary School	2	0.971	High effect
2	Junior High School	2	0.869	High effect
3	Vocation School	2	0.856	High effect
4	Senior High School	5	1.203	Very high effect

b. Effect size on Subject Variables

In the subjects studied, calculations are carried out and can be grouped into two, they

could be grouped into two namely physics and science. Each effect size can be seen in the table below. In the subjects studied, calculations were carried out in Table 5.

Table 5. Effect Size On Subject Variables

No.	Eye Lesson	N Journal	Average Effect Size	Category
1	Physics	5	0.678	Moderate
2	Science	6	1.072	Very high

Discussion

Effect Size of The Implementation of The Inquiry Model to Student Learning Outcomes

Effect size is a part that plays an important role in meta-analysis research. Effect size indicates the magnitude of the influence of a treatment relationship between two variables. In addition, the effect size also provides information related to the results of the journal summary being analyzed. By determining the effect size of each study, the overall average effect size can be determined. In this study, the calculation of the effect size value uses the Cohen formula.

The relationship between the variables described in this study is the relationship between the influence of the inquiry model on students' cognitive learning outcomes. In addition, it also explains the relationship between the influence of the inquiry learning model on several levels of education. The influence of the inquiry model at the elementary school level, the inquiry model affects students' cognitive learning outcomes. At the vocation school education level, it has the lowest influence from all levels of education studied.

The average effect size value of the 11 journals which are summarized by 5 articles has a very high effect category, namely JK1, JK4, JK6, JK10, and JK11. Two articles with medium category JK3 and JK8 and three articles with small effect, namely JK5, JK7 and JK9. The calculation of the effect size value produces an average effect size value of 0.89 so with this value it can be said that the application of the inquiry model to student learning outcomes is included in the high category. Where does this value mean that the application of the inquiry model is effective in learning.

The Moderator Variable that Influence the Effect Size

Effect Size in Each Education Level

Overall, the inquiry model has a positive effect on students' cognitive learning outcomes. The difference in the average value of student learning outcomes in this cognitive aspect indicates that there is an influence from the revision of the actions taken on the application of the inquiry model (Asrizal 2018). From the subject of different levels of education where the inquiry model is used, the research findings show that the application of the inquiry model is more effective at all levels of education. Judging from the value of the effect size the inquiry model is more effectively used at the high school level. According to Piaget's theory, the cognitive development of junior and senior high school students, between the ages of 11-18 years, is capable of thinking abstractly and logically (Budiningasih, 2004). This means that the inquiry model can be applied to students at all levels of elementary, junior high, vocational and high school education.

Effect size on Subject Variables

based on the price of the effect size generated in the application of the inquiry learning model in Physics and Science subjects, it has a moderate and very high effect category. Overall a positive effect. In science subjects it has a high effect because this inquiry model is

very suitable for science subjects. The model syntax resembles the steps of scientific work so it is very suitable to be applied to science subjects, In the inquiry model students are directly involved in the learning process in accordance with natural science subjects that can be ponded directly in everyday life.

CONCLUSION

The results of the meta-analysis in this study concluded that the use of the inquiry model greatly influenced students at the senior high school education level. The lowest influence effect is at the vocational education level, this can be due to internal and external factors that influence such as the environment, conditions of lack of tools and so on. Overall the inquiry model gives a positive influence on learning outcomes. In inquiry-based education, students become involved in many activities and thought processes that students use to generate new knowledge. From the calculation of the effect size using the Glass comparison formula and its derivative formula, it produces 0.89. This price shows that the application of the inquiry model in learning is well used.

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