

PEN III.A.1.c.1.a3  
(IOP\_JPCS\_ICTAP2020)  
*by Saiful Prayogi*

---

**Submission date:** 29-Aug-2022 07:53PM (UTC+0800)

**Submission ID:** 1888761803

**File name:** PEN\_III.A.1.c.1.a3\_IOP\_JPCS\_ICTAP2020.pdf (334.58K)

**Word count:** 3545

**Character count:** 20040

## The effect of inquiry learning model based on laboratory and achievement motivation toward students' physics learning outcomes

N Ernita<sup>1</sup>, A Muin<sup>2</sup>, N N S P Verawati<sup>3</sup> and S Prayogi<sup>4</sup>

<sup>1</sup>Physics Education Department, Universitas Islam Negeri Mataram, Jl. Gajah Mada No 100, Mataram, Indonesia 83116

<sup>2</sup>Pharmacy Department, Sekolah Tinggi Ilmu Kesehatan Kusuma Bangsa, Jl. Pariwisata No 42, Mataram, Indonesia 83122

<sup>3</sup>Physics Education Department, Universitas Mataram, Jl. Majapahit No 62, Mataram, Indonesia 83125.

<sup>4</sup>Physics Education Department, Universitas Pendidikan Mandalika, Jl. Pemuda No 59A, Mataram, Indonesia 83126

E-mail: saifulprayogi@ikipmataram.ac.id

**Abstract.** This study aims to explore the effect of the inquiry learning model based on laboratory and achievement motivation toward students' physics learning outcomes. This study is experimental research with a factorial design. The research sample used 2 class groups in one high school in the city of Mataram. The first experimental group used inquiry learning model based on real laboratory and the second experimental group used inquiry learning model based on virtual laboratory. Virtual laboratory using PhET simulation. The questionnaire of achievement motivation scale was used to measure the students' achievement motivation, and a test was used to measure students' learning outcomes focusing on cognitive aspects. The analysis of motivation scores and learning outcomes was carried out descriptively. Furthermore, the hypothesis testing use the Anova test where the prerequisite test in the form of normality and homogeneity test is conducted. The research results show that; a) there is no significant difference between the students' learning outcomes who learn using the inquiry learning model based real laboratory and virtual laboratory; b) there is no significant difference between the students' learning outcomes who have the high achievement motivation and low achievement motivation; and c) there is no interaction between inquiry learning model based real laboratory and virtual laboratory with the achievement motivation (high and low) on the students' learning outcomes.

### 1. Introduction

One of the indicator to determine the achievement of learning objectives is to see the level of learning outcomes achieved by students. By looking at the learning outcomes, the ability and quality of students will be known. In the context of learning physics, it is necessary to do renewal in learning activities, namely through the presentation of learning that provides opportunities for students to construct their own knowledge. Presentation of learning is in accordance with constructivist principles [1]. From a constructivist perspective, students are considered not as people who passively receive



Content from this work may be used under the terms of the [Creative Commons Attribution 3.0 licence](https://creativecommons.org/licenses/by/3.0/). Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

information from the teacher, but as people who are actively involved in relevant experiences and have opportunities for dialogue, so that meaning can be developed and constructed. Learning takes place not in passive classes but in a community characterized by high participation and involvement [2]. One of the learning presentations according to constructivist principles that can be applied is the inquiry learning model [3, 4].

The inquiry learning model is a learning model designed to bring students directly into the scientific process through a scientific process carried out by an experimental mechanism [5, 6]. Inquiry learning through experimental activities can be carried out in laboratories in the form of real laboratories and virtual laboratories. The inquiry model is designed to give students the experience of the scientific method, which is a pattern of thinking that emphasizes asking questions, developing hypotheses, and testing hypotheses [7]. This model is suitable for application in physics learning because physics is a part of science that focuses on experimental activities [8].

The strong reasons that make inquiry as a choice in learning are; a) inquiry provides methods to teachers in teaching investigative and systematic skills to students; b) the stages in the inquiry model give students practice in collecting and analyzing information and providing abilities that can be applied in other aspects of life; and c) inquiry provides different methods of teaching content to learners who may be overly saturated with teacher-centered and oriented techniques [9]. In addition, previous studies have shown that inquiry-based learning activities can train students' higher-order thinking skills such as critical thinking [10, 11, 12].

Inquiry learning through experimental activities in the laboratory aims not only to achieve learning results in product aspects, but also to emphasize aspects of process and attitudes. Laboratory activities that are carried out can take advantage of real laboratory facilities and virtual laboratories, one of the simplest ones is by using PhET simulations. By looking at the increasingly rapid development of science and technology, the use of these two types of laboratories can be chosen as a means of carrying out laboratory activities. Depends on the suitability with the learning material. One of the physics materials which in laboratory activities can use these two types of laboratories is dynamic electricity. With the availability of practicum tools in the laboratory and PhET simulations, it is possible to apply dynamic electrical material through both real and virtual laboratory activities.

Several previous studies have shown that experimental activities in the laboratory can improve students' understanding and science process skills [13], guided inquiry models can improve students' physics learning outcomes [14], information technology-based laboratory inquiry learning models can improve generic science skills and skills. creative thinking of students [15], computer simulation can improve students' understanding of physics concepts [16], the use of PhET simulation is more effective than the lecture or demonstration method [17], PhET simulation can train science process skills in learning physics [18] and aspects of knowledge [19].

Apart from the use of a learning model, another aspect that affects learning outcomes is achievement motivation, which includes the motive or desire for success (hope for success) and the desire to avoid failure (fear of failure). The separation of these two motives shows that students differ not only in their desire to achieve success, but also in their desire to avoid possible failures [20]. The level of achievement motivation of students is determined by the level of these two motives. Students who have high achievement motivation tend to always try to achieve what they want, including to achieve high learning outcomes, despite experiencing obstacles and difficulties. As found by several previous researchers that achievement motivation affects student learning outcomes [21], achievement motivation affects intellectual talent [22], and there is a relationship between achievement motivation and critical thinking [23].

This study aims to explore the effect of inquiry learning models based on laboratory and achievement motivation toward students' physics learning outcomes. In this study, the learning process uses an inquiry model based on real and virtual laboratories. Virtual laboratory using PhET simulation. Learning outcomes focus on the cognitive aspects.

## 2. Method

This study is experimental research with a factorial design (Figure 1). The research sample used 2 class groups in one high school in the city of Mataram, each class of 28 students. The first experimental group used inquiry learning model based on real laboratory and the second experimental group used inquiry learning model based on virtual laboratory. Virtual laboratory using PhET simulation.

Achievement motivation (Y) \ Inquiry Lab (X)	Real Lab. (X <sub>1</sub> )	Virtual Lab. (X <sub>2</sub> )
High (Y <sub>1</sub> )	X <sub>1</sub> Y <sub>1</sub>	X <sub>2</sub> Y <sub>1</sub>
Low (Y <sub>2</sub> )	X <sub>1</sub> Y <sub>2</sub>	X <sub>2</sub> Y <sub>2</sub>

Figure 1. Research Design

The questionnaire of achievement motivation scale (AMS) was used to measure the students' achievement motivation, this contains a series of statements related to the drive for individuals to hope for success (HS) and fear of failure (FF). The questionnaire consists of 35 statement items arranged based on the AMS grid developed by researchers adapted from Lang & Fries [20]. The test instrument was used to measure students' learning outcomes focusing on cognitive aspects. The test instrument consists of 20 multiple choice questions and 5 essay questions, which are arranged based on the written test instrument grid developed by the researcher referring to the related material indicators. Cognitive learning outcomes measured through this test are the dimensions of cognitive processes including the ability to remember (C1), understand (C2), apply (C3), analyze (C4), evaluate (C5), and create (C6).

The learning tools and instruments in this study were each validated by two validators. The result is that the lesson plan is very valid criteria, as well as the achievement motivation questionnaire instrument and the cognitive learning outcome test, both of which are very valid criteria. The analysis of motivation scores and learning outcomes was carried out descriptively. Furthermore, the hypothesis testing use the Anova test where the prerequisite test in the form of normality test (Kolmogorov-Smirnov's test) and homogeneity test (Levene's test) are conducted.

## 3. Results and Discussion

Description of students' physics learning outcomes data based on achievement motivation for both classes and physics learning outcomes data of students based on treatment classes are presented in Table 1, Table 2, and Table 3.

Table 1. Learning outcome data based on achievement motivation

Achievement motivation	n	Highest score	Lowest score	Average
High	28	73,88	34,88	56,71
Low	28	70,25	34,88	54,86

Table 2. Data on the number of students with high and low achievement motivation

Class	n	High Achievement Motivation	Low Achievement Motivation
Real Lab.	28	15	13
Virtual Lab.	28	13	15

Table 3. Learning outcome data based on treatment class

Treatment classes	n	Lowest score	Highest score	Average
Real Lab.	28	34,88	73,88	53,45
Virtual Lab.	28	41,75	72,25	58,36

The prerequisite test results show that the data variants are homogeneous (sig. = 0.21 greater than 0.05) and normally distributed (sig. = 0.20 greater than 0.05). Furthermore, hypothesis testing was carried out using the two-way ANOVA technique. The Anova test results for statistical analysis of hypothesis testing can be seen in Table 4.

**Table 4.** The test results of Anova

Source	df	F <sub>hitung</sub>	Sig.
Inquiry lab. (X)	1	3,63	0,06
Achievement motivation (Y)	1	0,93	0,34
Interaction (X*Y)	1	2,24	0,14

ANOVA results in the laboratory inquiry class group (real lab and virtual lab) showed a sig value (0.06) greater than 0.05, which indicates that the cognitive physics scores of students between the two class groups (real lab and virtual lab) were not significantly different. Achievement motivation in the two-class groups showed a sig value (0.34) greater than 0.05, meaning that the cognitive physics values of students between the two groups (high achievement motivation and low achievement motivation) were not significantly different. The interaction of the inquiry model with motivation shows that the sig value (0.14) is greater than 0.05, meaning that there is no interaction between the use of inquiry learning models based on real laboratories and virtual laboratories with achievement motivation on students' physics learning outcomes.

Learning activities that have been carried out by students, both using real laboratories and virtual laboratories, both have shown the results of learning in the cognitive domain through the final tests given to students where the use of real laboratory-based inquiry learning models and virtual laboratories does not make a significant difference to learning outcomes. Based on the initial analysis by looking at the characteristics of the laboratory-based inquiry learning model, the researcher predicted that the laboratory-based inquiry learning model by utilizing real laboratories and virtual laboratories would have a significant effect on the learning outcomes of students in the cognitive realm, where the virtual laboratory-based inquiry learning model would provide a better effect of the real laboratory-based inquiry learning model, where the learning outcomes using virtual laboratories will be higher than the learning outcomes using real laboratory facilities. This is based on several considerations, among others, the virtual laboratory-based inquiry learning model, which in this case utilizes the PhET simulation program, is able to display simulations that can reduce real situations from scientific symptoms that can increase the absorption and concentration of students, as revealed by Wiyono and Taufik [16] stated that a virtual laboratory is able to provide an interactive environment so that it will effectively describe the causal relationship and related representations of a number of experimental parameters carried out by students. PhET simulation programs are also capable of displaying phenomena that are not visible in the real world, for example, the flow of electrons in an electrical circuit [17]. However, from the results of the research that has been done, there was no significant difference in the cognitive physics learning outcomes of students using both real and virtual laboratories.

Other results revealed in this study were those related to the effect of achievement motivation on students' physics learning outcomes in the cognitive domain. From the research, it was found that the average score for the cognitive domain of students who had high achievement motivation was 56.71, while the average score of students who had low achievement motivation was 54.86. This data shows no significant difference between groups of students who have high or low achievement motivation. In addition, the results of this study indicate that there is no interaction between the inquiry learning model based on real and virtual laboratory with the achievement motivation on students' learning outcomes. Therefore, has inquiry learning model based on real and virtual laboratory has no different effects on students' learning outcomes in the cognitive domain who have high or low achievement motivation. Achievement motivation is an important area in developing skills or abilities. However, high achievement is not achieved only with high motivation but also by ability [24].

The inquiry learning model base on the laboratory is a series of activities designed to bring students directly into the scientific process to give students the experience of the scientific method through experimental activities carried out in the laboratory. Meanwhile, achievement motivation is a boost from within students, in the form of encouragement to achieve success and avoid failure, which allows students to achieve better achievements or results by applying a certain measure of excellence, either themselves or others. Achievement motivation is relatively stable and already exists in each student. Achievement motivation is influenced by intrinsic and extrinsic factors [25], while the inquiry learning model is a series of activity steps that the teacher gives to students, which students get during learning activities. Although in practice it is influenced by extrinsic factors such as achievement motivation, this learning model is not inherent in students, as achievement motivation. In the achievement of learning outcomes, the inquiry learning model and achievement motivation have separately. Real and virtual laboratory-based inquiry models as a regulator of learning activities according to its syntax, while achievement motivation is a psychological process.

One of the factors that affect the results of this study is that students are not familiar with experimental activities carried out in laboratories or virtual ones. One of the requirements for inquiry activities to run well is that students must be familiar with science process skills that are trained continuously. In addition, the teacher should as much as possible control the process of learning activities using inquiry models [26, 27, 28] and scaffolding students [18], wherein this study it is an unobserved variable. This deficiency can become a recommendation for further research in the future.

#### 4. Conclusion

The research results show that; a) there is no significant difference between the students' learning outcomes who learn using the inquiry learning model based real laboratory and virtual laboratory; b) there is no significant difference between the students' learning outcomes who have the high achievement motivation and low achievement motivation; and c) there is no interaction between inquiry learning model based real laboratory and virtual laboratory with the achievement motivation (high and low) on the students' learning outcomes.

#### Acknowledgment

The authors would like to thank those who have contributed to this research, the research team, research partners, and also the institutions where the research was carried out. We hope that this study can provide benefits for the advancement of education and learning.

#### References

- [1] Schunk D H 2012 *Learning theories: An educational perspective* (Boston: Pearson)
- [2] Arends R 2012 *Learning to teach* (New York: McGraw-Hill)
- [3] Prayogi S, Yuanita L and Wasis 2018 Critical-inquiry-based-learning: A model of learning to promote critical thinking among prospective teachers of physic *J. Turkish Sci. Edu.* **15** 1 43-56
- [4] Prayogi S, Yuanita L and Wasis 2017 Critical-inquiry-based-learning: Model of learning to promote critical thinking ability of pre-service teachers *J. Phys. Conf. Ser.* **947** 1-6
- [5] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2018 Development of inquiry-creative-process learning model to promote critical thinking ability of physics prospective teachers *J. Phys. Conf. Ser.* **1108** 1-6
- [6] Wahyudi, Verawati N N S P, Ayub S and Prayogi S 2019 The effect of scientific creativity in inquiry learning to promote critical thinking ability of prospective teacher *Int. J. Emer. Tech. Lear.* **14** 14 122
- [7] Eggen P and Kauchak D 2012 *Strategi dan model pembelajaran: Mengajarkan konten dan keterampilan berpikir* (Jakarta: PT. Indeks)
- [8] Gredler M E 2011 *Learning instruction: Teori dan aplikasi* (Jakarta: Kencana Prenada Media Group)

- [9] Jacobsen, Eggen P and Kauchak D 2009 *Methods for teaching* (Yogyakarta: Pustaka Pelajar)
- [10] Verawati N N S P, Prayogi S, Gummah S, Muliadi A and Yusup M Y 2019 The effect of conflict-cognitive strategy in inquiry learning towards pre-service teachers' critical thinking ability *J. Pend. IPA Indonesia* **8** 4 529
- [11] Prayogi S, Muhali, Yuliyanti S, Asy'ari M, Azmi I and Verawati N N S P 2019 The effect of presenting anomalous data on improving student's critical thinking ability *Int. J. Emer. Tech. Lear.* **14** 133
- [12] Prayogi S and Verawati N N S P 2020 The effect of conflict cognitive strategy in inquiry-based learning on preservice teachers' critical thinking ability *J. Edu. Cul. Psych. Stud. (ECPS)* **21** 1 27
- [13] Jayadinata A K 2010 Penerapan model pembelajaran inkuiri untuk meningkatkan pemahaman siswa tentang peristiwa benda padat dalam air melalui kegiatan praktikum *J. Pend. Das.* **13**
- [14] Rapi N K 2008 Implementasi model pembelajaran inkuiri terpimpin dalam pembelajaran fisika untuk meningkatkan hasil belajar pada siswa kelas X SMA Negeri Singaraja *J. Pend. Peng. UNDIKSHA* **1** 170-185
- [15] Liliyasi, Abdurrahman, Rusli A and Waldrip B 2011 Student's representations preference in learning physics and thematic pre-conceptions in quantum physics concept (Proceeding of the Third International Seminar on Science Education)
- [16] Wiyono K and Taufik 2011 Using computer simulation to improve concept comprehension of physics teacher candidates students in special relativity (Proceeding of the Third International Seminar on Science Education)
- [17] Finklestein N D, Adams W K, Keller C J, Kohl P B, Perkins K K, Podolefsky N S and Reid S 2006 When learning about the real world is better than virtually: A study of substituting computer simulation for laboratory equipment *Phys. Rev. Spec. Top.:Phys. Edu. Res.* **1** 010103.
- [18] Ardiyati T K, Wilujeng I, Kuswanto H and Jumadi 2019 The effect of scaffolding approach assisted by PhET simulation on the achievement of science process skills in physics *J. Phys. Conf. Ser.* **1233** 1-10
- [19] Sari D P, Tjandrakirana and Kuntjoro S 2018 Applying science learning PhET simulation to improve process skill and knowledge aspect of junior high school student *J. Pen. Pend. Sains* **7** 2 1496-1500
- [20] Lang J W B and Fries S 2006 A revised 10-item version of the achievement motives scale: Psychometric properties in German-speaking samples *Eur. J. Psych. Assess* **22** 216-224
- [21] Sappaile B I 2008 Pengaruh tipe tes dan motivasi berprestasi terhadap hasil belajar matematika peserta didik SMAN 30 DKI Jakarta *J. Pend. Keb.* **72**
- [22] Al-Shabatat M A, Abbas M and Ismail H N 2010 The direct and indirect effect of the achievement motivation on nurturing intellectual giftedness *Int. J. Hum. Soc. Sci.* **5** 9
- [23] Semerci Ç 2011 The relationships between achievement focused motivation and critical thinking *African J. Bus. Manag.* **5** 15 6180-6185
- [24] Ridgell S D and Lounsbury J W 2004 Predicting academic success: General intelligence, "big five" personality traits, and work drive *Coll. Stud. J.* **38** 4 607-619
- [25] Koeswara 1995 *Motivasi, teori dan penelitiannya* (Bandung: Penerbit Angkasa)
- [26] Verawati N N S P, Hikmawati and Prayogi S 2019 Conceptual framework of reflective-inquiry learning model to promote critical thinking ability of preservice physics teachers *J. Phys. Conf. Series* **1397** 1
- [27] Verawati N N S P and Hikmawati 2019 Validitas model inkuiri yang diintervensi proses reflektif untuk melatih kemampuan berpikir kritis mahasiswa calon guru *Prisma Sains: J. Peng. Ilmu Pemb. Mat. dan IPA IKIP Mataram* **7** 1 38
- [28] Verawati N N S P, Hikmawati and Prayogi S 2020 The effectiveness of inquiry learning models intervened by reflective processes to promote critical thinking ability in terms of cognitive style *Int. J. Emer. Tech. Lear.* **15** 16 212-220

ORIGINALITY REPORT

15%

SIMILARITY INDEX

12%

INTERNET SOURCES

9%

PUBLICATIONS

8%

STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to School of Business and Management ITB Student Paper	7%
2	<a href="http://journal.trunojoyo.ac.id">journal.trunojoyo.ac.id</a> Internet Source	2%
3	<a href="http://je-lks.org">je-lks.org</a> Internet Source	1%
4	Nokadela Basyari, Cecep E. Rustana, Bambang Heru Iswanto. "The effect of inquiry models and motivation to study on students' cognitive learning outcomes in straight motion learning at senior high school (A case study)", AIP Publishing, 2021 Publication	1%
5	<a href="http://jurnaldikbud.kemdikbud.go.id">jurnaldikbud.kemdikbud.go.id</a> Internet Source	1%
6	Dedi Holden Simbolon, Sahyar --. "Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Eksperimen Riil dan Laboratorium	1%



Virtual terhadap Hasil Belajar Fisika Siswa",  
Jurnal Pendidikan dan Kebudayaan, 2015

Publication

- 
- 7 Flaviana Claudia Andayani, Raharjo Raharjo, Widowati Budijastuti. "The critical thinking skills on animal tissue learning: Inquiry based student activity sheets development", JP BIO (Jurnal Pendidikan Biologi), 2021  
Publication 1 %
- 
- 8 Submitted to Middle Georgia College  
Student Paper 1 %
- 
- 9 Kade kAyu Astiti. "The Effect of Group Investigation Learning Model with Brainstroming Technique on Students Learning Outcomes", SHS Web of Conferences, 2018  
Publication 1 %
- 
- 10 [jurnal.unimed.ac.id](http://jurnal.unimed.ac.id)  
Internet Source 1 %
- 
- 11 [media.neliti.com](http://media.neliti.com)  
Internet Source 1 %
- 

Exclude quotes On

Exclude matches < 1%

Exclude bibliography On