



Application of Discovery Learning and Inquiry Learning Model in Improving Students' Mathematical Literacy Skills

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Abstract

The OECD-PISA results state that the mathematical literacy ability of students in Indonesia is relatively low. The aims of this study were: 1) To find out the increase in mathematical literacy skills by applying the *Discovery Learning* model, 2) To find out the increase in mathematical literacy skills by applying the *Inquiry Learning* model, 3) To find out whether mathematical literacy skills are increased by the application of the *Discovery Learning* model rather than *Inquiry Learning*. This study utilized a quantitative approach. The sampling technique was purposive sampling with two experimental groups in eighth-grade SMPN 1 Bae Kudus. The experimental group I applied the *Discovery Learning* model and the experimental group II applied the *Inquiry Learning* model. The data analysis technique used the t-test and the Mann-Whitney U test. The results of this study were: 1) The t-test has given a significance level of $0,00 < 0,05$. This means that there was a significant increase in the mathematical literacy skills of students in the experimental group I after the application of the *Discovery Learning* model with an increase in N-gain of 71%, 2) The t-test has given a significance level of $0,00 < 0,05$. This means that there was an increase in the mathematical literacy skills of students in experimental group II after applying the *Inquiry Learning* model significantly with an increase in N-gain of 60%, 3) The Mann-Whitney U test has given a significance level of $0,048 < 0,05$ which indicated that literacy skills students' mathematics was further improved by the application of the *Discovery Learning* rather than *Inquiry Learning* model.

Keywords: *Discovery Learning*; *Inquiry Learning*; Mathematical Literacy Ability

Abstrak

Hasil OECD-PISA menunjukkan bahwa kemampuan literasi matematika siswa di Indonesia relatif rendah. Tujuan penelitian ini adalah: 1) Mengetahui peningkatan kemampuan literasi matematika dengan penerapan model *Discovery Learning*, 2) Mengetahui peningkatan kemampuan literasi matematika dengan penerapan

model *Inquiry Learning*, 3) Mengetahui apakah kemampuan literasi matematika lebih meningkat dengan diterapkannya model *Discovery Learning* daripada *Inquiry Learning*. Penelitian ini menggunakan pendekatan kuantitatif. Teknik pengambilan sampel adalah *sampling purposive* dengan dua kelas eksperimen di kelas VIII SMPN 1 Bae Kudus. Kelas eksperimen I diterapkan model *Discovery Learning* dan kelas eksperimen II diterapkan model *Inquiry Learning*. Teknik analisis data adalah menggunakan uji-t dan uji Mann-Whitney U. Hasil penelitian ini adalah: 1) Pada uji t memberikan taraf signifikansi $0,00 < 0,05$. Artinya terdapat peningkatan kemampuan literasi matematika peserta didik kelas eksperimen I setelah diterapkannya model *Discovery Learning* secara signifikan dengan kenaikan N-gain sebesar 71%, 2) Pada uji t memberikan taraf signifikansi $0,00 < 0,05$. Artinya terdapat peningkatan kemampuan literasi matematika peserta didik kelas eksperimen II setelah diterapkannya model *Inquiry Learning* secara signifikan dengan kenaikan N-gain sebesar 60%, 3) Pada uji *Mann-Whitney U* memberikan taraf signifikansi $0,048 < 0,05$ yang menunjukkan bahwa kemampuan literasi matematika peserta didik lebih meningkat dengan diterapkannya model *Discovery Learning* daripada *Inquiry Learning*.

Kata Kunci: *Discovery Learning*; *Inquiry Learning*; Kemampuan Literasi Matematika

Introduction

In the current 5.0 era, mathematical literacy must be possessed by all students. The draft assessment framework states that mathematical literacy refers to students' proficiency in thinking mathematically and their ability to define, apply, and interpret when solving problems from various real-life contexts. According to Ojose (2011: 89), "Mathematical literacy is not only completing mathematical procedures. Mathematical literacy makes students able to estimate, interpret data, solve problems, and give reasons in various conditions related to numbers, graphics, and geometry". OECD (2016b), there are six levels of mathematical literacy proficiency in the PISA framework. OECD (2015), the first level is the ability of students to solve general questions, namely describing the information that has been provided; the second level is the ability of students to apply formulas with structured steps; the third level is the proficiency to implement problem-solving strategies; the fourth level is the proficiency to combine different representations and explain simple arguments. The fifth level is the proficiency to solve complicated problems and communicate the result obtained, and the sixth level is the proficiency to create basic concepts and apply information based on mathematical models that are arranged in a complex manner to communicate the reports obtained. The researchers focused on PISA indicators of third-level proficiency. Hence, the indicators of this study are: 1) interpreting and applying basic representations with the different sources of information, 2) choosing and implementing problem-solving strategies, 3) carrying out steps according to procedures requiring structured decisions, and 4) communicating interpretation results and providing reasons.

The results of the PISA assessment indicate that Indonesian students have a relatively low level of mathematical literacy (OECD 2018). It has also been researched by Rahmawati (2017:1), Suryaningrum (2018:22), and Larasati et al. (2019:36). According to observations made at SMPN 1 Bae Kudus, only a few pupils were able to comprehend concepts and apply systematic approaches to solve difficulties. Many students experience mistakes when solving problems with systematics procedures, even if they are not stimulated by the teacher so the students tend to be passive and do not understand the essence of the questions given. This is supported by Bidasari (2017), It is typically the case that students who struggle with comprehension of the PISA model questions are the ones who are unable to complete the questions. According to Hawa (2017: 890), PISA questions contain various abilities which tested. For example, the ability to use mathematical strategies, mathematical reasoning, methods of argument, communication, and skills in applying visual aids.

The challenge of students struggling to grasp the complexities of PISA model problems should be a focal point of attention when striving to enhance the quality of education, particularly in the realm of mathematics instruction. On the other hand, to promote the quality of learning, namely applying the appropriate learning model, which can improve students' mathematical literacy skills, according to the demands of the current era. Some skills needed to improve mathematical literacy skills are: formulating a problem, mathematical connection skills, mathematical communication, mathematical reasoning abilities, and mathematical representation skills. Furthermore, an appropriate learning model will be applied to accommodate the literacy needs above. According to Khoiril Anam (2016: 110), the *Discovery Learning* model is interpreted as teaching disclosure when the teacher provides a stimulus in the form of a problem description and several questions to students who are more concerned with individual teaching, object manipulation, up to the conclusion drawing stage. Meanwhile, according to Fransiska (2019: 2), the *Inquiry Learning* model is teaching that thoroughly involves students, formulates their formulation of the problems encountered, is independent when solving problems, and is systematic. The teacher is only tasked with assisting during the investigation process. From various learning models, *Discovery Learning* or *Inquiry Learning* models can be implemented by teachers, to foster the enhancement of mathematical literacy skills.

Method

The study was carried out during the first semester of the 2022/2023 academic year, spanning from January 10th to February 20th, 2023, at SMPN 1 Bae Kudus. This research adhered to a quasi-experimental design, wherein the allocation of subjects into experimental groups, whether group 1 or group 2 or the control group, was determined based on specific criteria and considerations. The study encompassed the eighth-grade student population of SMPN 1 Bae Kudus, comprising approximately 256 students. Purposive sampling, a method involving deliberate selection based on specific criteria, was employed. This selection process was guided by considerations related to students' uniform and balanced levels of knowledge. Aligned with the research objectives aimed at evaluating advancements in students' literacy skills through two distinct learning models, the experimental group I was subjected to the *Discovery Learning* model, while experimental group II underwent the *Inquiry Learning* model treatment. The basis for selecting the two experiment groups was that the average level of student's initial knowledge was relatively the same and balanced. Statistically, a homogeneity test was carried out on the experimental group candidates. The result was homogenous.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
NR ₁	O ₁	X ₁	O ₂
NR ₂	O ₃	X ₂	O ₄

Information:

NR₁ = Experimental group I *Discovery Learning* models

NR₂ = Experimental group II *Inquiry Learning* models

O₁ = Provision of experimental group *pretest* I

O₂ = Provision of experimental group *posttest* I

O₃ = Provision of experimental group *pretest* II

O₄ = Provision of experimental group *posttest* II

X₁ = *Discovery Learning* model treatment

X₂ = *Inquiry Learning* model treatment

The data collection techniques applied by researchers were observation and testing. The assessment method employed encompassed both pretest and posttest evaluations, meticulously designed to align with the specified Knowledge and Skills (KD) content, as well as the indicators reflecting the third-level proficiency criteria of mathematical literacy in the context of PISA. In the experimental group, data

collection readiness was ensured through the meticulous evaluation of the instrument test's validity, reliability, discriminating power, and level of difficulty. The study's data analysis encompassed essential statistical methods, including normality testing, homogeneity testing, t-test, and the Mann-Whitney U test. Researchers utilized SPSS Statistics 26 to process and analyze the collected data.

Results

This study describes the following hypotheses:

1. H_0 : There is no increase in mathematical literacy skills with the application of the *Discovery Learning* model.
 H_1 : There is an increase in mathematical literacy skills with the application of the *Discovery Learning* model.
2. H_0 : There is no increase in mathematical literacy skills with the application of the *Inquiry Learning* model.
 H_1 : There is an increase in mathematical literacy skills with the application of the *Inquiry Learning* model.
3. H_0 : The ability of students' mathematical literacy does not increase with the application of the *Discovery Learning* model rather than the *Inquiry Learning* model.
 H_1 : The ability of students' mathematical literacy is further increased by the application of the *Discovery Learning* model rather than the *Inquiry Learning* model.

Prerequisite Test

First, prerequisite tests were carried out in the form of normality and homogeneity of the pretest and posttest data. Summary of the normality tests in Table 2.

Table 2. The Results of the Normality Test for Experimental Group I and II

<i>One-Sample Kolmogorov-Smirnov Test</i>		
	Experimental Group I	Experimental Group II
Question	<i>Asymp sig</i>	<i>Asymp sig</i>
Identification		
<i>Pretest</i>	0,128	0,200
<i>Posttest</i>	0,197	0,200

Based on Table 2, the pretest and posttest data for experimental group I and II were normally distributed because each *Asymp-Sig* is greater than 0,05. Furthermore, the homogeneity test results are in Table 3.

Table 3. The Results of the Homogeneity test of Experimental Group I and II

	<i>Levene Statistics</i>	F count	Sig.
<i>Pretest</i>	0,034	3,99	0,855
<i>Posttest</i>	4,068	3,99	0,048

Based on Table 3, the pretest homogeneity test indicated homogeneity. Since *Asymp-Sig* was greater than 0,05, it indicated that the selection of the experimental group was correct, namely that the variance of the initial abilities of the two experimental groups was relatively the same. On the other hand, the *posttest* homogeneity test was not homogeneous because the *Asymp-Sig* < 0,05.

Testing Hypothesis One and Two

The following are the results of the test of the two hypotheses in this research. Testing hypotheses 1 and 2 used a paired sample t-test because the data was normally distributed. Hence, the N-gain formula was employed to ascertain the percentage of improvement or decline observed before and after the implementation of the treatment.

Table 4. The Results of the Paired Sample t-Test

	Reference	Experimental Group I	Experimental Group II
T	$t_{table} = -1,693$	-21,350	-14,059
Sig (2-tailed)	0,05	0,00	0,00
N-Gain		71%	60%

Based on Table 4, in the experimental group I can be concluded that H_0 was rejected because it obtained a significance value $0,00 < 0,05$ with an increase of N-gain of 71%. While in the experimental group II can also be concluded that H_0 was rejected because it obtained a significance value $0,00 < 0,05$ with an increase in N-gain of 60%.

Testing Hypothesis Three

Testing hypothesis 3 used the Mann-Whitney U test because the data was normally distributed but not homogeneous. The result of the Mann-Whitney U test for the third hypothesis is in Table 5.

Table 5. Description of the *Man-Whitney U*

		<i>Uji Man-Whitney U</i>				
<i>Posttest-</i>		<i>Mean Rank</i>	<i>U_{count}</i>	<i>z_{count}</i>	<i>z_{table}</i>	<i>Asymp sig (2-tailed)</i>
<i>posttest</i>	Experimen Group I	37,09	365.000	- 1,977	1,645	0,048
	Experimental Group II	27,91				

H_0 was rejected because in this test obtained the *asyp sig* < 0,05.

Discussion

Three major topics are discussed in order to address the hypotheses that were formulated in the definition of the study problem. These include identifying improved mathematical literacy abilities by applying the *Inquiry Learning* and *Discovery Learning* methods. Furthermore, a comparative study was carried out comparing these two teaching approaches.

Application of The Discovery Learning Model in Improving Mathematical Literacy Skills

From testing of the first hypothesis obtained that H_0 was rejected. It means there is a significant increase in mathematical literacy skills with the application of the *Discovery Learning* model. From the N-gain, we got or obtained the increase of mathematical literacy skills in the experimental group I was 71%. There are reasons for the acceptance of alternative hypothesis I. First, learning with the *Discovery Learning* model is more focused on students, thus providing facilities to play an active role during learning activities. Second, this model makes the student grow curious. In the learning process (with the worksheet), students carry out small discussions to find their knowledge through observations with their groups. Further, students also record important information that will be used during the learning process. Hypothesis I is also accepted in agreement with research conducted by Ozi Pernandes and Adi Asmara (2020:47), namely that there is an increase in mathematical literacy skills using the *Discovery Learning* model compared to the Conventional model. Apart from that, research conducted by Urny Babys (2017:45), shows that 1) the mathematical literacy skills and independence of high school students using the *Discovery Learning* model with the RME-PISA approach are better than the RME model, 2) mathematical literacy skills and

independence of high school students with the RME model are better than the Conventional model, 3) mathematical literacy skills and independence of high school students with the *Discovery Learning* model are better than the Conventional model.

Application of The Inquiry Learning Model in Improving Mathematical Literacy Skills

From testing of the second hypothesis obtained that H_0 was rejected. It means there is a significant increase in mathematical literacy skills after applying the *Inquiry Learning* model. Then the N-gain was about 60%, so the mathematical literacy skills increase in the experimental group II was 60%. The acceptance of the alternative hypothesis II has reasons. First, the *Inquiry Learning* model is capable of strengthening memory and increasing confidence for the students during learning. Second, in this model, students can play an overall role in exploring the material during the study. Third, students can develop "self-concepts", so they can understand the basic concepts that are learned independently. Students get knowledge independently with the help of worksheets and small groups provided by the teacher, so it is easier to understand and generates students' learning motivation. Hypothesis II is also accepted in agreement with research conducted by Dian Eka and Mawardi (2020:291), which shows that the average result proves that students critical thinking abilities using the *Discovery Learning* are 17,45 and *Inquiry Learning* 23,36. This means that *Inquiry Learning* is better than *Discovery Learning* in improving critical thinking skills.

Comparison of The Discovery Learning and Inquiry Learning Model in Improving Mathematical Literacy Skills

From testing of the third hypothesis obtained H_1 wasn't rejected. It means the students' mathematical literacy skills by applying *Discovery Learning* is increased than *Inquiry Learning*. If we notice the mean rank value, the *Discovery Learning* model got 37,09 while the *Inquiry Learning* model got 27,91. So the mean rank value of *Discovery Learning* is higher than *Inquiry Learning*. Implementation of the *Discovery Learning* model in the early step, the students are given stimulation and questions by the teacher so that students more easily understand the concept to further develop during the learning process. In the early step of *Inquiry Learning*, the teacher only presented the problems to be studied but the questions made by the students at the problem formulation step. Thus, providing stimulation in early learning can stimulate students to be more enthusiastic about exploring the material during study. In addition, it is also evidenced by increasing the N-gain score of each

group experimental. The N-gain score of the experimental group I was 71% and the experimental group II was 60%.

Conclusion

The results of the research data analysis provide the following conclusions. There was a significant increase in the mathematical literacy skills of the experimental group I students after the *Discovery Learning* model was applied based on a significance result of $0,00 < 0,05$ with an increase in N-gain of 71%. There was a significant increase in the mathematical literacy skills of the experimental group II students after the *Inquiry Learning* model was applied based on a significance result of $0,00 < 0,05$ with an increase in N-gain of 60%. There is a significant increase in mathematical literacy skills in the *Discovery Learning* model rather than the *Inquiry Learning* model in increasing mathematical literacy skills with a significance result of $0,048 < 0,05$.

References

- Amelia, I., Syamsuri, S., Santosa, C. A. H. F., & Fatah, A. (2022). Meta Analisis: Pengaruh Model Pembelajaran Terhadap Kemampuan Literasi Matematis Siswa. *Jurnal Cendekia: Jurnal Pendidikan Matematika*, 6(2), 1720-1730.
- Anam, K. (2016). *Pembelajaran Berbasis Inkuiri Metode dan Aplikasi*, Yogyakarta: Pustaka Pelajar.
- Arikunto, S. (2013). *Dasar-Dasar Evaluasi Pendidikan*. Jakarta: Bumi Aksara.
- Babys, U. (2017). Kemampuan Literasi Matematis Space And Shape Dan Kemandirian Siswa SMA Pada Discovery Learning Berpendekatan RME-PISA. *JPMI (Jurnal Pendidikan Matematika Indonesia)*, 1(2), 43-49.
- Bagiyono. (2017). Analisis Tingkat Kesukaran dan Daya Pembeda Butir Soal Ujian Pelatihan Radiografi Tingkat I. *Widyanuklida*, 16 (1).
- Bidasari, F. (2017), Pengembangan Soal Matematika Model PISA pada Konten Quantity untuk Mengukur Kemampuan Pemecahan Masalah Matematika Siswa Sekolah Menengah Pertama. *Jurnal Gantang*.
- Fakhriyana, D., Mardiyana., Dyah , R. A. (2018). Analisis Kemampuan Literasi Matematika Dalam Memecahkan Masalah Model Programme For International Student Assessment (PISA). *Jurnal Pendidikan Matematika Dan Matematika*, 2

- (6) 421–34. <https://doi.org/10.20961/jpmm%20solusi.v2i6.37672>
- Hawa, A. M. (2017). Analisis Kemampuan Siswa Menyelesaikan Soal PISA Bertipe PISA. *Seminar Nasional Evaluasi Pendidikan*.
- Kencana, S., Fransisk, A. F., Firosalia, K., Indri, A. (2019). Keefektifan Model Pembelajaran Inquiry Dan Discovery Learning Bermuatan Karakter Terhadap Keterampilan Proses Ilmiah Siswa Kelas V Dalam Pembelajaran Tematik. *JPDI (Jurnal Pendidikan Dasar Indonesia)* 4(1). <https://doi.org/10.26737/jpdi.v4i1.929>
- Mawardi., Diah, E. P. (2020). Penerapan Model Pembelajaran Inquiry Dan Discovery Learning Ditinjau Dari Keterampilan Berpikir Kritis. *Jurnal Basicedu*, 4 (2) 288–94.
- Masfufah., Risma., Ekasatya, A. A. (2021). Analisis Kemampuan Literasi Matematis Siswa Melalui Soal PISA. *Mosharafa: Jurnal Pendidikan Matematika* 10 (20). <https://doi.org/10.31980/mosharafa.v10i2.825>
- OECD. (2009). “*The PISA 2009 Assessment Framework: Mathematics, Reading, Science, and Problem Solving Knowledge and Skills*”. Paris: OECD.
- OECD. (2015). “*PISA 2015 Draft Mathematics Framework*”.
- OECD. (2016a). “*Assessment and Analytical Framework: Mathematics, Reading, Science, Problem Solving and Financial Literacy*”. OECD Publishing.
- OECD. (2018). “*PISA 2018 Result Combine Executive Summaries*”. I, II, & III. Inggris: OECD.
- OECD. (2019). “*PISA 2018 Insights and Interpretations*”. In OECD Publishing. OECD Publishing.
- Ojose, B. (2011). “*Mathematics Literacy: Are We Able to Put The Mathematics We Learn into Everyday Use?*” *Journal of Mathematics Education, Education for All*, June 2011, Vol.4, No. 1, pp.89-100. Diperoleh 23 Desember 2022 dari http://educationforatoz.com/images/8.Bobby_Ojose_-_Mathematics_Literacy_Ae_We_Able_To_Put_The_Mathematics_We_Learn_Into_Everyday_Use.pdf
- Pernandes. Ozi. Adi, A. (2020). Kemampuan Literasi Matematis Melalui Model Discovery Learning Di SMP. *Jurnal Pendidikan Matematika Raflesia*, 5 (1) 140–47. Diunduh dari <https://ejournal.unib.ac.id/index.php/jpmr/article/view/10724/5341>
- Rahmawati, N. I. (2018). Pemanfaatan ICT Dalam Meningkatkan Kemampuan Literasi Matematika. *Prisma*, 1 381. Diunduh dari <https://journal.unnes.ac.id/sju/index.php/prisma/article/view/19606/9529>
- Rahmawati, P. (2017). Mengenal Kemampuan Penalaran Matematika Siswa. Ponorogo: Uwais Inspirasi Indonesia.
- Sugianto., Hendry., Amin, S., Tri, S. N. A. (2022). Pengaruh Metode Pembelajaran Discovery Menggunakan E-Learning Terhadap Kemampuan Literasi Matematis MTs. *JNPM (Jurnal Nasional Pendidikan Matematika)*, 6 (1) 145. Diunduh dari

<https://doi.org/10.33603/jnpm.v6i1.6264>

- Sugiyono. (2017). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D)*. Bandung: Alfabeta, 14.
- Sudijono, A. (2006). *Pengantar Evaluasi Pendidikan*. Jakarta: Raja Grafindo Persada, 389.
- Wardhani, A. K. (2018). Pengembangan soal matematika model PISA level 5 untuk program pengayaan SMP. *Journal Pendidikan Matematika RAFA* 3(1).

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