

The Effectiveness of the Discovery Learning with an Ethnomathematics Focus on Ratu Boko Temple on Students' Learning Achievement and Self-Efficacy

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ARTICLE INFO	ABSTRACT
Published Online: 13 August 2026	The purpose of this study was to examine the effect of a discovery learning approach with an ethnomathematics focus on students' learning achievement and self-efficacy. This study was conducted during the 2024–2025 school year with eighth-grade students at a junior high school in Yogyakarta, focusing on the topic of plane figures. There were 30 students participating in the study. A pre-experimental strategy with a one-group pretest-posttest design was employed. The sample consisted of a single class that implemented the ethnomathematics-infused discovery learning approach. Data were collected through learning achievement tests, self-efficacy questionnaires, and observation sheets. The results showed a significant increase in the mean learning achievement score from 37.50 to 82.00, while students' self-efficacy increased from 61.53 to 73.40. Inferential analysis using the t-test showed a t-value for learning achievement of $t = -22.35 < -1.699$ with a p-value < 0.001 , while self-efficacy had a t-value of $t = -9.310 < -1.699$ and a p-value < 0.001 . These findings indicate that the discovery learning approach with an ethnomathematics focus is effective in improving students' learning achievement and self-efficacy.
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KEYWORDS: Discovery Learning, Ethnomathematics, Learning Achievement, Self-Efficacy	

I. INTRODUCTION

The complexity of life is becoming increasingly evident, as marked by the emergence of various challenges and expectations spanning diverse fields; one of these is the need for every individual to master a wide range of abilities and skills[1]. Mathematical skills can be used to solve problems in everyday life. Mathematics is not just about numbers and symbols; rather, it is about how mathematical concepts enable individuals to think critically, reason, create, and solve problems[2].

Students' success in learning mathematics is evident in the knowledge, skills, and abilities they acquire after completing a series of classroom lessons. The extent to which students succeed in mastering specific core competencies within a given timeframe is often linked to their academic performance during instruction on that material [3]. However, in reality, student academic performance in Indonesia remains relatively low. Based on the results of the 2022 PISA (Programme for International Student Assessment) study in mathematics, the average score

decreased by 366 points, making the 2022 score one of the lowest compared to previous years. When viewed year over year, Indonesia's score remains below average.

Not only on the international stage, but in classroom mathematics instruction as well, students still struggle with learning mathematics. Students' difficulties in understanding mathematics stem from a lack of in-depth understanding of formulas and how to apply them to problems [4]. One of the efforts being made is to improve students' academic performance. Achievement in mathematics is a key indicator for assessing students' success in meeting learning objectives through the mastery of knowledge and skills, as measured by tests [5].

The phenomenon of difficulties in learning mathematics is not only caused by cognitive aspects such as the ability to perform calculations or understand concepts, but is also influenced by affective factors. One affective factor that has been shown to play an important role in learning achievement is students' self-efficacy [6]. Self-efficacy is an individual's belief in their ability to perform a

specific task and achieve the expected results [7]. Several studies have shown that self-efficacy can influence students’ learning achievement [8][9]. However, the results of the PISA survey published by the OECD show that Indonesian students’ self-efficacy levels remain below the OECD average, indicating that students’ confidence in their ability to complete learning tasks needs to be improved [10]. This, of course, affects students’ academic performance.

To address the above issues, one approach teachers can take is to implement interactive and meaningful learning in the classroom. One approach to mathematics instruction that can be used to address students’ difficulties with math is the discovery learning approach. This approach fosters students’ understanding through real-world problem-solving experiences, thereby improving their academic performance and self-efficacy [11]. Currently, the Merdeka Curriculum calls for the integration of local wisdom into school-based learning [12]. This aligns with Indonesia’s educational philosophy, which emphasizes lifelong learning and the development of global citizenship [13]. Learning that connects local wisdom and culture is known as ethnomathematics. There was an improvement in student learning outcomes after using an ethnomathematics-based discovery learning model [14]. Therefore, this study aims to obtain empirical evidence regarding the effect of an ethnomathematics-infused discovery learning approach on students’ learning achievement and self-efficacy. The local wisdom selected as the context for the material to be taught is Ratu Boko Temple in the context of plane figures.

II. METHOD

This study is a quantitative study using an experimental approach aimed at assessing the effectiveness of the discovery learning approach with an ethnomathematics focus on Candi Ratu Boko on students’ learning achievement and self-efficacy. The design used in this study is a one-group pretest-posttest design, in which only one group of subjects receives the treatment, and their scores before and after the treatment are compared. This design was chosen because it provides an opportunity to evaluate the direct impact of the learning intervention on the variables under study.

This study was conducted at a school in Yogyakarta, Indonesia, during the second semester of the 2024/2025 school year. The sample was selected purposively through judgmental sampling, meaning it was chosen based on specific considerations by the researcher and the supervising teacher. Based on these considerations, Class VIIIC was selected as the experimental class. The independent variable was the discovery learning approach with an ethnomathematics focus on Candi Ratu Boko, while the dependent variables were students’ learning achievement and self-efficacy. The teacher, instructional materials, duration of instruction, and classroom conditions served as control variables.

The steps of the discovery learning approach applied in this study are as follows: 1) providing a stimulus; 2) identifying a problem; 3) collecting data; 4) processing data; 5) verifying; 6) drawing conclusions using the shape or image of Ratu Boko Temple as a contextual framework for understanding plane figures. The indicators used to measure student self-efficacy are: 1) students’ belief in their ability to understand mathematics material; 2) students’ belief in their ability to complete mathematics tasks or problems; 3) students’ belief in their resilience and perseverance in overcoming obstacles when solving mathematical problems; 4) students’ belief in their success in achieving mathematics learning targets and objectives. The categorization of self-efficacy used is presented in the following table.

Table 1. Categorization of Student Self-Efficacy

Category	Interval
Very Good	$84 < X \leq 100$
Good	$70 < X \leq 84$
Fair	$56 < X \leq 70$
Not Very Good	$X \leq 56$

The research procedures included: 1) instrument development and validation; 2) administration of a pretest, implementation of a discovery learning approach incorporating the ethnomathematics of Ratu Boko Temple, and administration of a posttest; 3) data processing and analysis. Data were collected through tests and observations using three instruments: a mathematics achievement test, a student self-efficacy questionnaire, and a learning activity observation sheet. Test items were validated by experts using the Aiken index, and their reliability was assessed using Cronbach’s Alpha. Data analysis involved descriptive statistics (mean, median, standard deviation, maximum, and minimum) and inferential analysis using the Shapiro-Wilk normality test, the Levene test for homogeneity of variances, and the independent samples t-test, with the assistance of the JASP software.

This hypothesis test was used to determine whether the discovery learning approach with an ethnomathematics focus on the Ratu Boko Temple is effective in terms of students’ learning achievement and self-efficacy. To determine whether the implementation of the discovery learning approach with an ethnomathematics focus on the Ratu Boko Temple is effective, it must meet the criteria for effectiveness. The established criteria for effectiveness are as follows: 1) there is a difference between the mean pretest and posttest scores for student learning achievement and between the mean prescale and postscale scores for student self-efficacy; 2) the mean posttest score for student learning achievement exceeds the school’s minimum learning mastery criterion of 75; 3) the mean postscale score for

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student self-efficacy reaches the “good” category, which is above 70.

III. RESULT AND DISCUSSION

Data Description

The results of the study indicate that the implementation of a discovery learning approach with an ethnomathematics focus at Candi Ratu Boko had a significant impact on the learning achievement and self-efficacy of eighth-grade students at that school. Details regarding the students’ learning achievement and self-efficacy are presented in Table 2 below.

Tabel 2. Descriptive Data on Learning achievement and Self-Efficacy of Students in the Experimental Class

Descriptive	Learning achievement		Self-Efficacy	
Mean	37.50	82.00	61.53	73.40
Standard Deviation	7.754	8.828	9.198	9.205
Variance	60.12	77.93	84.60	84.73
Minimum	20.00	67.00	48.00	57.00
Maximum	53.00	100	79.00	93.00

Based on the descriptive analysis in Table 2 above, it can be seen that the experimental class showed improvement. The students’ average mathematics achievement and self-efficacy before the intervention were 37.50 and 61.53, respectively. On the pretest, not a single student met the school’s minimum learning mastery criterion of 75. After receiving the intervention, students’ average learning achievement and self-efficacy improved. Students’ learning achievement increased by 44.50, and their self-efficacy increased by 11.87.

Data Analysis

The first step in the data analysis process before conducting a hypothesis test is to ensure that the data are normally distributed and homogeneous. This is important because the validity of the hypothesis test depends on the assumption that the sample is drawn from a normally distributed population. In this study, the normality test was performed using the Shapiro-Wilk test, and the homogeneity test was performed using the Levene test, each with a significance level (α) of 0.05. The results are shown in Table 3 and Table 4.

Table 3. Results of Normality Test

Variable	Class	W	p-value	Decision
Learning achievement	Pretest	0.934	0.061	Normal
	Posttest	0.937	0.074	Normal
Self-Efficacy	Prescale	0.941	0.094	Normal
	Postscale	0.979	0.788	Normal

Based on the results in Table 3 above, the Shapiro-Wilk normality test showed that the pretest learning

achievement data was greater than α ($0.061 > 0.05$), and the posttest learning achievement data was greater than α ($0.074 > 0.05$); therefore, H_0 is accepted. Similarly, the students’ prescale and postscale self-efficacy data show values greater than α ($0.094 > 0.05$) and ($0.788 > 0.05$), so H_0 is accepted. These results indicate that both the pretest-prescale and posttest-postscale data are normally distributed.

Table 4. Results of Homogeneity Test

Variable	F	p-value	Decision
Learning achievement	0.701	0.406	Homogen
Self-Efficacy	9.756×10^{-4}	0.975	Homogen

Based on the results in Table 4, the homogeneity test using Levene’s test showed that both sets of variable data were greater than the significance level of $\alpha = 0.05$; therefore, H_0 was accepted. It can be concluded that both the students’ learning achievement and self-efficacy data met the assumption of homogeneity.

After the assumptions of normality and homogeneity were met, hypothesis testing was conducted using two t-tests: the paired-sample t-test and the one-sample t-test, using JASP. The first test performed was the paired-sample t-test. The results are presented in Table 5 below.

Table 5. Hypothesis Testing (Paired Sample t-Test)

Variable	t	df	p-value
Learning achievement	-22.35	29	< .001
Self-Efficacy	-9.310	29	< .001

The table above shows that the calculated t-value for student learning achievement is -22.35 with a p-value < 0.001, and the same applies to the data on student self-efficacy, which is -9.310 with a p-value < 0.001. Based on the decision criteria, if the calculated t-value falls outside the range of the table t-value ($-t_{\text{calculated}} < -t_{\text{table}}$) and if the p-value is less than $\alpha = 0.05$, then H_0 is rejected. Since the students’ learning achievement scores are $-22.35 < -1.699$ and the p-value is < 0.001, and the students’ self-efficacy scores are $-9.310 < -1.699$ and the p-value is < 0.001, H_0 is rejected. This indicates that there is a significant difference between the mean pretest and posttest scores for student learning achievement and the mean prescale and postscale scores for student self-efficacy. Therefore, it can be concluded that the discovery learning approach with an ethnomathematics focus on Ratu Boko Temple has an impact on both student learning achievement and self-efficacy.

Next, a one-sample t-test was conducted to determine whether students’ posttest learning achievement scores met the school’s minimum learning mastery criterion of 75 and whether their postscale self-efficacy scores

reached the “good” category, defined as over 70. The results are presented in Table 6 below.

Table 6. Hypothesis Testing (One Sample t-Test)

Variable	t	df	p-value
Learning achievement	4.343	29	< .001
Self-Efficacy	2.023	29	0.05

The table above shows that the calculated t-value for student learning achievement is 4.343 with a p-value < 0.001, and similarly, the calculated t-value for student self-efficacy is 2.023 with a p-value = 0.026. Based on the decision criteria, if the calculated t-value falls outside the t-table range ($t_{\text{calculated}} > t_{\text{table}}$) and if the p-value is less than $\alpha = 0.05$, then H_0 is rejected. Since the students’ learning achievement score of 4.343 is greater than 1.699 and the p-value of 0.001 is less than 0.05, and since the students’ self-efficacy score of 2.023 is greater than 1.699 and the p-value of 0.026 is less than 0.05, H_0 is rejected. This indicates that the students’ average learning achievement after receiving the intervention exceeded the school’s minimum learning mastery criterion of 75, and their average self-efficacy after receiving the intervention was above 70, placing it in the “good” category.

Based on the results of the analysis, which were tested against the established criteria for effectiveness, the following conclusions can be drawn: i) the discovery learning approach with an ethnomathematics focus on the Ratu Boko Temple is effective in terms of student learning achievement; ii) the discovery learning approach with an ethnomathematics focus on the Ratu Boko Temple is effective in terms of student self-efficacy. In line with the learning process conducted in the classroom, before the intervention, students were unable to solve the pretest questions; however, after receiving instruction using the discovery learning approach with an ethnomathematics focus, students were able to solve the posttest questions related to the material. This was also accompanied by an increase in students’ self-efficacy, which reached the “good” category after receiving the intervention. Therefore, the results of this study indicate that the discovery learning approach with an ethnomathematics focus on the Ratu Boko Temple is effective in terms of both students’ learning achievement and self-efficacy.

This finding is consistent with the results of other studies indicating that the use of discovery learning in mathematics instruction has an impact on student learning achievement [15] [16] Furthermore, learning that incorporates local wisdom and culture influences students’ self-efficacy in mathematics [17] [18] [19] [20] [21]

IV. RESULT AND DISCUSSION

The results of this study confirm that the use of a discovery learning approach incorporating the ethnomathematics of Ratu Boko Temple effectively improves students’ learning achievement and self-efficacy. The discovery learning approach is also supported by simultaneous cognitive and affective engagement. This approach not only enhances students’ cognitive development but also fosters their affective growth. This is further evidenced by students’ active participation throughout the learning process—from initially being unable to solve problems and listening to the instruction provided to eventually being able to solve the problems. Of course, the discovery learning approach has become very popular in mathematics education because it is discovery-based; it is highly recommended to incorporate contextual elements such as local wisdom and culture so that students not only understand mathematical concepts but also develop good character and a broad understanding of local wisdom and culture itself. The idea that mathematics is full of formulas and abstract concepts can also help shift students’ mindset to recognize that mathematics is closely connected to their real lives. Mathematics is all around students. For future research, it is recommended that this approach be tested within a quasi-experimental research design framework that includes a control group to broaden the generalizability of the findings. Future research is expected to further explore the mathematical skills that students need to improve. The research focus can be directed toward problem-solving, reasoning, communication, representation, and mathematical connections in order to obtain a more comprehensive picture of students’ learning needs and the appropriate measures to enhance their mathematical competencies.

REFERENCES

- Putri, A. D., Juandi, D., & Turmudi. (2024). Realistic mathematics education and mathematical literacy: a meta-analysis conducted on studies in Indonesia. *Journal of Education and Learning*, 18(4), 1468–1476. <https://doi.org/10.11591/edulearn.v18i4.21650>
- Campanilla, N. S. (2025). Self-Efficacy in Mathematics: A predictor in the Mathematics performance of grade 8 learners. *Journal of Social, Humanity, and Education*, 5(2), 87–103. <https://doi.org/10.35912/jshe.v5i2.2228>
- Agus, I. (2019). Efektivitas guided discovery menggunakan pendekatan kontekstual ditinjau dari kemampuan berpikir kritis, prestasi, dan self-efficacy. *Jurnal Riset Pendidikan Matematika*, 6(2), 120–132. <https://doi.org/10.21831/jrpm.v6i2.14517>
- Primrose, T, A., & Masamah. (2025). Kesalahan Siswa dalam Menyelesaikan Soal Transformasi Geometri pada Etnomatematika Batik Kawung

- Berdasarkan Teori Newman. *Jurnal E-DuMath*, 11(1), 1–12.
5. Rangkuti, N., Turmudi, T., & Abdussakir, A. (2021). Pengaruh Efikasi Diri dan Motivasi Belajar terhadap Hasil Belajar Matematika Siswa Sekolah Dasar. *Ideas: Jurnal Pendidikan, Sosial, Dan Budaya*, 7(3), 283. <https://doi.org/10.32884/ideas.v7i3.415>
 6. Majid, A., Pasinggi, Y. S., Syarifuddin Rahman, M., & Tuken, R. (2025). Penguatan Konsep Trigonometri melalui Kegiatan Edukasi Matematika Kontekstual pada Siswa di MAS DDI Baru-Baru Tanga Pangkep, 6(4), <https://madaniya.biz.id/journals/contents/article/view/1583>
 7. Bandura, A. (1997). *Self-efficacy - The Exercise of Control*, New York: W.H.Freeman and Company.
 8. Aprilianti, S. W., & Dewi, D. K. (2022). Hubungan antara self-efficacy dengan prestasi belajar siswa di SMA X. *Jurnal Psikologi Teori dan Terapan*, 13(2), 195-213 <https://doi.org/10.26740/jptt.v13n2.p195-213>
 9. Indah Maulani, F., Amalia, R., & Sylviana Zanthi, L. (2020). Kontribusi Self Efficacy Terhadap Prestasi Belajar Matematika pada Siswa SMA. In Maret 7(1).
 10. OECD. (2019). *PISA 2018 results (Volume III): What school life means for students' lives*. OECD.Publishing. doi.org.
 11. Nugraha, D. A., & Wulansari, T. (2023). Analisis Peningkatan Prestasi Belajar dan Self-efficacy Siswa pada Pembelajaran Matematika dengan Model Discovery Learning. *Pasundan Journal of Mathematics Education: Jurnal Pendidikan Matematika*, 13 (1), 68–82. <https://doi.org/10.23969/pjme.v13i1.7376>
 12. Badan Standar, Kurikulum, dan Asesmen Pendidikan. (2022). *Panduan pengembangan proyek penguatan profil pelajar Pancasila*. Kementerian Pendidikan, Kebudayaan, Riset, dan Teknologi.
 13. Pujiastuti, E. E., Ratnawati, R., Koraag, S. T. G., Hapsari, N. R., Utomo, H. J. N., Hermawanto, A., Akbar, H., & Kurniawati, E. (2024). Muslim Friendly Tourism sebagai Alternatif Strategis Pengembangan Desa Wisata. *Jurnal Pengabdian Masyarakat Bangsa*, 2(8). <https://doi.org/10.59837/jpmba.v2i8.1467>
 14. Khomsah, M. & Trimurtini (2025). Keefektifan Model Discovery Learning Berbasis Etnomatematika Berbantuan Media Batik Rifa'iyah terhadap Hasil Belajar, *Numerical: Jurnal Matematika dan Pendidikan Matematika*, 9 (1), <https://doi.org/10.25217/numerical.v9.i1.5843>
 15. Dhanicargo, A., Handayanto, A., & Aini, A. N. (2021). Implementasi Model Problem Based Learning dan Discovery Learning. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, 3(3), 272–281.
 16. Rahmawati, S., & Saraswati, S. (2023). Efektivitas Discovery Learning dengan Eksplorasi Rumah Adat Bangka Belitung. *MAXIMA: Jurnal Pendidikan Matematika*, 1 (1), 6-14. Retrieved <https://ejournal.iaida.ac.id/index.php/maxima/>
 17. Simamora, R. E., Saragih, S., & Hasratuddin, H. (2018). Improving Students’ Mathematical Problem Solving Ability and Self-Efficacy through Guided Discovery Learning in Local Culture Context. *International Electronic Journal of Mathematics Education*, 14(1). <https://doi.org/10.12973/iejme/3966>
 18. Harahap, A., Surya, E., & Syahputra, E. (2018). Differences between Mathematics Representation Ability and Students’ Self-Efficacy by Using Learning Cycle 7E and Discovery Learning Based on Batak Angkola Culture in SMAN 1 Sipirok. *American Journal of Educational Research*, 6(11), 1497–1504. <https://doi.org/10.12691/education-6-11-8>
 19. Andriyani, S., Pratikno, B., Ramdhani, S., & Barat, J. (2024). Peningkatan pemahaman konsep matematis dan self-efficacy siswa melalui permainan tradisional “new damdaman.”. *PYTHAGORAS: Jurnal Program Studi Pendidikan Matematika*, 13(1): 1-9.
 20. Arifin, N. (2023). Efektivitas Model Problem Based Learning Berbasis Etnomatematika Dayak Bentian Ditinjau Dari Kemampuan Literasi Matematika Dan Self-Efficacy Mahasiswa Pgsd.
 21. Rahman, A. A., Mushlihuddin, R., Afifah, N., Refugio, C. N., & Zulnaidi, H. (2024). Problem-based learning innovation through realism and culture: Impact on mathematical problem solving and self-efficacy in primary school students. In *Jurnal Pendidikan Matematika*, 15 (1). <http://ejournal.radenintan.ac.id/index.php/al-jabar/index>