
Problem Based Learning Model Based on Culturally Responsive Teaching on Mathematics Learning Outcomes

Cahyo Hestiawati ¹⁾ *, Dian Nataria Oktaviani ²⁾ , Arie Setyani ³⁾

¹ Mathematics Study Program, Teacher Professional Education, Pancasakti University, Tegal. Halmahera Street, Km. 1, Tegal City, Central Java, 53121 Indonesia.

² Mathematics Study Field, Supervisor, Pancasakti University Tegal. Halmahera Street Km.1, Tegal City, Central Java, 53121 Indonesia.

³ Mathematics Study Fields, Supervising Teacher, State Vocational School 1 Dukuhturi. Jl. Raya Karang Anyar No. 17, Pekauman Kulon, Dukuhturi District, Tegal Regency, Central Java 52131 Indonesia.

* Corresponding author. Address, Postal code, City, Country. (9pt)

E-mail: hestiawaticahyo@gmail.com

Abstract

The application of learning models by educators is expected to improve student learning outcomes. This study is a Classroom Action Research that implements the *Problem Based Learning Model* based on *Culturally Responsive Teaching* on student learning outcomes in sequence and series material. The research subjects were students of class X TJKT 2 SMK N 1 Dukuhturi in the odd semester of the 2023/2024 academic year. The study was conducted in two cycles, each cycle consisting of planning, implementation of actions, observation, and reflection. The data collection techniques used in this study were tests, peer observation and documentation. The results showed that the application of the *Problem Based Learning model* based on *Culturally Responsive Teaching* can improve student learning outcomes, as evidenced by the percentage of students who had completed cycle I of 58.33% then cycle II increased to 88.89%. In addition, based on the N-Gain calculation between cycle I and cycle II, an increase in learning outcomes of 0.3225 or 32.25% was obtained, which means this increase is included in the moderate category .

Keywords : *Problem Based Learning , Culturally Responsive Teaching , Learning Outcomes.*

INTRODUCTION

Education in Indonesia currently aims to develop 21st-century skills in students, demonstrated by the implementation of the independent curriculum. The independent curriculum is a new idea in education that is expected to encourage better outcomes for both educators and students, encouraging continuous innovation in the learning process. To realize this, educators are required to carry out learning activities that can develop their potential and provide students with meaningful experiences in life (Arumsari et al., 2023). Mathematics is a crucial subject for students to develop, as it is a compulsory subject at all levels of education, from elementary school to university. Therefore, students require thorough preparation to master mathematics. Therefore, it is crucial to prepare mathematics learning as optimally as possible, for example through a variety of activities and various learning models. The learning model itself serves as a guide for educators when conducting the learning process. In mathematics learning, more attention is paid to student participation in the learning process or to provide active guidance to students during the learning process. Through Mathematics learning, students gain direct experience and are also trained to discover for themselves the knowledge they learn in a holistic, meaningful, authentic, and active manner (Astuti et al., 2021).

Mathematics learning where students are not actively involved causes students to be unable to use their mathematical skills optimally in solving mathematical problems. In addition, minimal mathematics learning in arousing student enthusiasm makes students not pay attention to learning in class, so that students do not understand and do not deepen mathematical

concepts. So that the impact, they cannot solve mathematics problems well which causes low mathematics learning outcomes of students. Based on observations conducted in class X TJKT 2 in pre-cycle learning, a diagnostic test was carried out with the acquisition of scores below the Minimum Completion Criteria (KKM) of 22 out of 36 in addition to that in the learning process when the teacher asked questions to students related to the material being taught, many students were still unable to answer correctly.

Sequences and series are important topics to learn. Students struggle with reasoning, particularly in determining the number of terms and formulas used to solve sequence and series problems (Hasanah et al., 2020). In a research report, As'ari (Masjudin, 2017) stated that "general formulas tend to be given first without understanding their origin." Learning by rote like this can result in students not being able to thoroughly understand the concepts of sequences and series and can also make them forget easily. Learning becomes less meaningful due to the lack of student involvement in finding solutions to existing problems.

Therefore, to overcome these problems, a learning model is needed that makes students actively use their mathematical skills to solve mathematical problems optimally to improve student learning outcomes. One model that is suitable for this problem is *Problem-Based Learning* (PBL), a learning model that is considered capable of improving student skills in this era of globalization. This learning model provides students with a real problem at the beginning of learning, which is then solved through asking questions and implemented through problem-solving (Salma et al., 2023). PBL can provide benefits to students,

namely students are able to think critically and also think analytically, used for research and must use learning resources that are suitable and tailored to student needs (Yulianti & Gunawan, 2019).

Culturally responsive teaching *can* help create an environment, curriculum, and teaching methods that recognize and reflect the diversity, identity, and experiences of all students. The concept of culturally responsive teaching demonstrates how to maximize student academic achievement by integrating cultural references (Kurniasari et al., 2023). Therefore, if a problem-based learning model is combined with culturally responsive teaching, the integration of the two is expected to improve student learning outcomes. This is because the problems that arise in learning are related to culture, customs, habits, or local wisdom that are close to the students, so it is hoped that students can easily understand the problems presented.

Based on the description of the problem explained above, the researcher was motivated to conduct a study entitled "Implementation of the *Problem Based Learning Model* Based on *Culturally Responsive Teaching* as an Effort to Improve Mathematics Learning Outcomes in the Sequence and Series Material of Class X TJKT 2 SMK Negeri 1 Dukuhturi Odd Semester of the 2023/2024 Academic Year".

METHODS

Types of research

This type of research is a classroom action research (CAR), which is a research by educators aimed at changing their performance for the better by using the steps of designing, implementing actions, observing and reflecting on their actions collaboratively so that it can have an impact on improving student learning

outcomes (Farhana et al., 2019). As the objective measured in the implementation of CAR in this study is the learning outcomes of students in mathematics lessons on the material of sequences and series.

Research setting

This research was conducted from July to August 2023 at SMK N 1 Dukuhturi. This research was divided into two cycles to determine the effect of the *problem-based* learning model based on *culturally responsive teaching* on learning outcomes. Cycle I was conducted on July 27 and August 3, 2023, and Cycle II was conducted on August 7 and 14, 2023.

Research subjects

The subjects in this classroom action research are students in the class. X TJKT 2 has 36 students, consisting of 8 male students and 28 female students.

Research Procedures

The procedures used in this study according to Kurt Lewin's model (Annisa et al., 2018) consist of: *planning*, acting, *observation* and *reflection*.

Data, Instruments, and Data Collection Techniques

According to Sugiyono (2016: 308), data collection techniques are a crucial step in research, as the primary objective of research is to obtain information. Therefore, without understanding data collection methods, researchers will not obtain data that meets the required data standards. Data collection techniques can be conducted through tests, peer observation, and *documentation*.

Data Analysis Techniques

The data used are quantitative and qualitative data. The quantitative data analyzed in the form of primary data is the analysis of learning outcomes on the material of sequences and series using comparative descriptive by weighing the pre-cycle, cycle I, and cycle II test scores

based on the agreed performance indicators as follows:

1. In this study, there are two types of learning completeness, namely individual completeness and classical completeness. The minimum completeness criteria (KKM) in mathematics at SMK N 1 Dukuhutir is 78. Therefore, those who get a score ≥ 78 can be said to have completed the KKM, and vice versa, if students get a score < 78 , they are said to have not completed it. Classical completeness is used to measure the level of student success as a whole. A class can be said to have completed learning if at least 75% of the total number of students in the class have achieved learning completeness (Widayanti & Dwi Nur'aini, 2020). To calculate the classical completeness, the formula used is:

$$p = \frac{\sum \text{Jumlah peserta didik yang mendapat nilai} \geq 78}{\sum \text{Jumlah peserta didik yang mendapat nilai} < 78}$$

2. To find out how much improvement in learning outcomes is obtained from each cycle, use the N-Gain formula which is formulated as follows.

$$N - \text{Gain} = \frac{\text{skor posttest} - \text{skor pretest}}{\text{skor ideal} - \text{skor pretest}}$$

Table 1 N-Gain Level Criteria

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

((Hake, 1999); Wahab et al., 2021) Meanwhile, qualitative data analysis is the result of observation of actions which are analyzed qualitatively descriptively and reflection is carried out on several events in the learning process.

RESULTS AND DISCUSSION

Student Learning Outcomes

- Pre Cycle

Before carrying out the learning, the educators had given an initial test to the students. Based on the test results, the mathematics learning outcomes of class X TJKT 2 students of SMK Negeri 1 Dukuhuturi in the 2023/2024 Academic Year were obtained in the initial conditions before using the Problem Based Learning (PBL) learning model based on Culturally Responsive Teaching (CRT) which can be shown in the table below.

Table 2 Learning outcomes of initial conditions (pre-cycle)

No	Rentang Nilai	Jumlah	Prosentase	Keterangan
1	< 78	22	61,11%	Belum Tuntas
2	78-90	12	33,33%	Tuntas
3	> 90	2	5,56%	Tuntas
	Jumlah	36	100%	Ketuntasan
				Klasikal 38,89%

Based on the table, it can be seen that the classical mastery learning outcome was only 38.89%. A class can be considered mastery if at least 75% of the total number of students in the class have achieved mastery. Therefore, measures are needed to improve learning, one of which is the implementation of a *problem-based learning model* based on *culturally responsive teaching* to improve student learning outcomes.

- Cycle I

At the end of the first cycle of learning, a written evaluation was held at the second meeting. It turned out that the learning outcomes of the sequence and series material for class X TJKT 2 students of SMK Negeri 1 Dukuhuturi in the odd semester of the 2023/2024 academic year after using the Problem Based Learning learning model based on Culturally Responsive Teaching

experienced an increase as shown in the table below:

Table 3 Learning outcomes of cycle I

No	Rentang Nilai	Jumlah	Prosentase	Keterangan
1	<78	15	41,67%	Belum Tuntas
2	78-90	6	16,67%	Tuntas
3	>90	15	41,67%	Tuntas
Jumlah		36	100%	Ketuntasan Klasikal 58,33%

From the data of learning outcomes of cycle I, it can be seen that there has been an increase from the learning outcomes of the pre-cycle, which initially had a classical completeness of only 38.89%, while in cycle I it increased to 58.33%. However, the percentage of classical completeness has not reached 75% so the researcher decided to carry out cycle II to re-implement the *problem-based learning model* based on *culturally responsive teaching* in classroom action research.



Figure 1 Implementation of Cycle I

In the process of learning sequences and series using the *problem-based learning* (PBL) model based on *culturally responsive teaching* (CRT), the teacher begins the lesson with a greeting and continues with a prayer. Next, they provide motivation, apperception, and explain the learning flow. Then, students are formed into groups of 3-4 students. Heterogeneous group members are determined by the teacher based on the cognitive diagnostic assessment during the pre-cycle. Groups consist of students with high, medium, and low abilities. Next, the teacher distributes student worksheets and also presents problems on PowerPoint for group discussion. Students listen to the teacher's

explanation regarding the given problem, then conduct group discussions to investigate and find solutions to the problem. Students can use any source they find easy to understand. Students mostly use printed books and browsers on their respective devices. During the investigation and completion of student worksheets, the teacher circulates to help groups that are having difficulty.

During the investigation, many students experienced difficulty finding and understanding the references they used. This was because they lacked prior learning materials. After students completed their discussions, several groups presented their findings. Other groups responded to the presentations. The next activity after the presentations was for the teacher and students to summarize the material they had learned. After concluding the material, the teacher and students reflected on the learning.

The reflection material from this first cycle is to overcome students who have difficulty finding and understanding the references they use. As a follow-up plan, educators will add the *flipped classroom method*, namely students before learning in class study the material first at home according to the teacher's instructions. The day before the lesson, educators send teaching materials in the form of text and learning videos that students can use to study at home. This can also be an alternative aid that can be used at home because students do not have a textbook for studying at home. In addition, in class learning during the investigation process can be used as a source to find solutions to problems given by the teacher.

- Cycle II

After cycle II was completed and a written independent evaluation test was held at the end of the second meeting, it turned out that the learning outcomes of

the sequence and series material of class X TJKT 2 students of SMK Negeri 1 Dukuhturi in the odd semester of the 2023/2024 academic year experienced an increase which can be shown in the table below:

Table 4 Learning outcomes of cycle II

No	Rentang Nilai	Jumlah	Prosentase	Keterangan
1	<78	4	11,11%	Belum Tuntas
2	78-90	11	30,56%	Tuntas
3	>90	21	58,33%	Tuntas
	Jumlah	36	100%	Ketuntasan
				Klasikal 88,89%

From the data on learning outcomes in cycle II, it can be seen that there has been an increase from the learning outcomes in cycle I, where initially the classical completeness only reached 58.33%, whereas in cycle II the classical completeness reached 88.89%, which means that the classical



completeness that was set at 75% has been achieved.

Figure 2 Implementation of Cycle 2

In cycle II, learning in all areas was more structured. Based on observations, students were more prepared and more enthusiastic about learning. Nearly all students were actively involved in the discussion process. The addition of the *flipped classroom method* significantly facilitated the students' inquiry process. Furthermore, it served as an alternative learning aid that could be used at home, as students lacked textbooks for learning. Therefore, when learning took place, students already had the understanding they had learned at home.

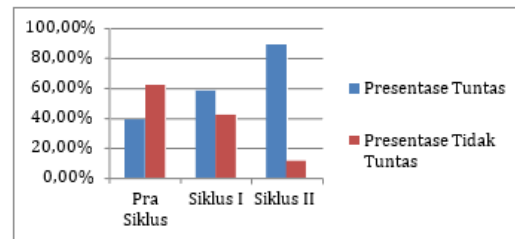


Figure 3 Percentage of Learning Outcomes

Judging from the graph above, between the pre-cycle, cycle I, and cycle II, the use of the *problem-based learning model* based on *culturally responsive teaching* can provide an increase in student learning outcomes. However, the increase in learning outcomes can be said to be successful not immediately in cycle I, but managed to achieve the set classical completeness of 75% in cycle II which has achieved a classical completeness percentage of 88.89%. The increase in the number of classical completeness percentages in each cycle indicates that the application of the *problem-based learning model* has an impact on student learning outcomes.

In addition, to strengthen the conclusions of this classroom action research, an N-Gain calculation was performed using Ms. Excel. The goal was to determine the effectiveness of using certain methods or treatments in the research. The calculation between the values of cycles I and II can determine whether the implementation of the method that has been done can be said to be effective or not. So from the results of the N-Gain calculation obtained a figure of 0.3225 or 32.25%, which means the *Problem Based Learning model* based on *Culturally Responsive Teaching* is said to be effective and falls within the medium criteria.

CONCLUSIONS AND SUGGESTIONS

Based on the research results and discussions presented previously, the following conclusions can be drawn:

- 1) *Problem Based Learning* model based on *Culturally Responsive Teaching* can increase students' enthusiasm for learning so that it has an impact on improving students' learning outcomes on the material of sequences and series in class X TJKT 2 SMK Negeri 1 Dukuhturi in the odd semester of the 2023/2024 academic year.
- 2) With the implementation of the *Problem Based Learning* model based on *Culturally Responsive Teaching*, it improves students' learning outcomes on the material of barisna and deret in class X TJKT 2 SMK Negeri 1 Dukuhturi in the odd semester of the 2023/2024 academic year. This is evidenced by an increase in the number of classical completeness percentages in each cycle, namely pre-cycle by 38.89%, increasing in cycle II by 58.33%, which then in cycle II by 88.89% which has achieved the specified classical completeness. In addition, the increase in student learning outcomes between cycles was obtained by 0.3225 or 32.25% from the results of the N-Gain calculation.

REFERENCES

- Annisa, R., Subali, B., & Heryanto, WP (2018). Improving Students' Memory and Learning Outcomes with the Mind Mapping Method on Dynamic Electricity Material. *Journal of Education (Theory and Practice)*, 3 (1), 19. <https://doi.org/10.26740/jp.v3n1.p19-23>
- Arumsari, A., Falensi, YA, & Santri, DJ (2023). *Implementation of the Problem Based Learning (PBL) Learning Model on Student Learning Outcomes in Class X Biology Lessons at State Senior High School 1 Palembang . IX* (1), 52–64.
- Astuti, PHM, Bayu, GW, & Aspini, NNA (2021). Application of Problem-Based Learning Model to Improve Students' Mathematics Learning Outcomes. *Mimbar Ilmu*, 26 (2), 243. <https://doi.org/10.23887/mi.v26i2.36105>
- Farhana, H., Awiria, & Muttaqien, N. (2019). Classroom Action Research. *Smart Hope*.
- Hasanah, H., Nugraheni, P., & Purwoko, RY (2020). Analysis of Constraints in Applying the Scientific Approach in Learning Geometric Sequences and Series. *Kreano, Journal of Creative-Innovative Mathematics*, 11 (1), 16–26. <https://doi.org/10.15294/kreano.v11i1.20663>
- Kurniasari, IF, Dwijayanti, I., Roshayanti, F., & Handayani, S. (2023). *Implementation of Culturally Responsive Teaching on the Material of Spatial Shapes of Grade 1 SDN Pandean Lamper 04 Semarang . 6*, 5364–5367.
- Masjudin, M. (2017). Investigative Cooperative Learning to Improve Students' Understanding of Sequences and Series. *Journal of Mathematics and Science Education*, 4 (2), 76. <https://doi.org/10.25273/jems.v4i2.687>
- Salma, IM, Eurika, N., & Wulandari, F. (2023). *Efforts to Improve Science Literacy of Grade XI MIPA 6 Students with PBL Based on Culturally Responsive Teaching at SMAN Balung. 7* (2), 220–230.

- Sugiyono. (2016). *Educational Research Methods* . Alfabeta.
- Wahab, A., Junaedi, J., & Azhar, M. (2021). Effectiveness of Educational Statistics Learning Using the N-Gain Improvement Test in PGMI. *Basicedu Journal* , 5 (2), 1039–1045. <https://doi.org/10.31004/basicedu.v5i2.845>
- Widayanti, R., & Dwi Nur'aini, K. (2020). Application of Problem Based Learning Model to Improve Mathematics Learning Achievement and Student Activity. *Mathema: Journal of Mathematics Education* , 2 (1), 12. <https://doi.org/10.33365/jm.v2i1.480>
- Yulianti, E., & Gunawan, I. (2019). Problem Based Learning (PBL) Model: Its Effect on Conceptual Understanding and Critical Thinking. *Indonesian Journal of Science and Mathematics Education* , 2 (3), 399–408. <https://doi.org/10.24042/ijsme.v2i3.4366>