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Problem-Based Learning (PBL) Instructional Materials for Enhancing Mathematics Learning Outcomes of Elementary School Students

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Abstract: This study aims to 1) describe the application of Problem Based Learning (PBL)-based power point teaching materials which can improve mathematics learning outcomes for elementary students, and 2) describe the increase in mathematics learning outcomes after applying learning using Problem Based Learning power point teaching materials (PBL). This type of research is Classroom Action Research (CAR). The subjects of this research were fifth grade students at MI AL Mustofa Surabaya, totaling 23 students consisting of 11 male students and 12 female students. The results showed that 1) the application of Problem Based Learning-based power point teaching materials was carried out for two cycles according to the stages of the PBL model and 2) power point teaching materials could improve student learning outcomes, namely in the first cycle the percentage of completeness 69.56% entered good category and in cycle II the percentage of completeness 89.95% is in the very good category. Suggestions from this study are PBL-based power point teaching materials so that they can be applied to other subjects and materials.

Keywords: teaching materials; power point; Problem Based Learning; learning outcomes

Abstrak: Penelitian ini bertujuan untuk 1) mendeskripsikan penerapan bahan ajar *power point* berbasis *Problem Based Learning* (PBL) yang dapat meningkatkan hasil belajar matematika siswa SD, dan 2) mendeskripsikan peningkatan hasil belajar matematika setelah diterapkan pembelajaran menggunakan bahan ajar *power point* berbasis *Problem Based Learning* (PBL). Jenis penelitian ini adalah PTK. Subjek dari penelitian ini yaitu siswa kelas V di MI AL Mustofa Surabaya yang berjumlah 23 siswa yang terdiri dari 11 siswa laki-laki 12 siswa perempuan. Hasil penelitian menunjukkan bahwa 1) penerapan bahan ajar *power point* berbasis *Problem Based Learning* dilaksanakan selama dua siklus sesuai dengan tahapan dari model PBL dan 2) bahan ajar *power point* dapat meningkatkan hasil belajar siswa yaitu pada pada siklus I presentase ketuntasan 69,56% masuk dalam kategori baik dan pada siklus II presentase ketuntasan 89,95% masuk dalam kategori baik sekali. Saran dari penelitian ini yaitu bahan ajar *power point* berbasis PBL agar dapat diterapkan pada mata pelajaran dan materi yang lainnya.

Kata kunci: bahan ajar; *power point*; *Problem Based Learning*; hasil belajar

INTRODUCTION

Problem-based learning (PBL) is a pedagogical approach that holds significant potential for elementary school education. At this foundational stage, students are naturally curious and eager to explore the world around them (Seitenova et al., 2023). PBL capitalizes on this innate curiosity by presenting students with real-world problems, encouraging them to seek solutions through critical thinking, collaboration, and hands-on exploration (Arias et al., 2021). Instead of merely absorbing information passively, students actively engage with the content, fostering a deeper understanding and retention of knowledge (Arias et al., 2021). Moreover, PBL equips young learners with essential life skills such as problem-solving, teamwork, and adaptability, which are invaluable in our rapidly changing world (Cloude et al., 2020). Thus, integrating PBL into elementary education not only enhances academic outcomes but also prepares students for future challenges.

Recent research underscores the transformative potential of problem-based learning (PBL) in various educational contexts. Within the realm of elementary mathematics education, PBL has

2 been lauded for its ability to bridge theoretical concepts with real-world applications. Studies have shown that students exposed to PBL exhibit enhanced conceptual understanding, improved problem-solving skills, and heightened engagement in the learning process (Bastian et al., 2022). Furthermore, PBL in mathematics education has been linked to the development of critical thinking skills and the ability to apply mathematical concepts in diverse contexts, a crucial competency in our increasingly quantitative world (Willson et al., 2023).

8 While there is a growing body of literature on the integration of technology in PBL, especially at higher educational levels, there is a noticeable gap in research that specifically investigates the use of PowerPoint as an integrative tool for PBL in elementary mathematics. This gap is significant given the ubiquity of PowerPoint in educational settings and its potential as a versatile tool for presenting problems, scaffolding learning, and facilitating student presentations. The limited research in this area suggests a need for further exploration to understand the potential benefits and challenges of integrating PowerPoint in PBL for elementary mathematics education.

15 In the contemporary educational landscape, the utilization of PowerPoint as a learning medium has emerged as particularly salient at the primary school level. As a visual presentation tool, PowerPoint facilitates the conveyance of complex concepts in a manner that is both engaging and comprehensible for young learners. The amalgamation of text, imagery, and animation caters to diverse learning styles, ensuring that information is not only retained but also internalized. Furthermore, in an age where digital literacy is paramount, introducing students to such platforms at an early stage equips them with essential skills for the future. Thus, the integration of PowerPoint in primary education serves not only as a pedagogical tool but also as a foundation for digital competence.

In light of the aforementioned discussions, the objectives of this research are: 1) to elucidate the application of PowerPoint-based instructional materials grounded in Problem Based Learning (PBL) that can amplify the mathematical learning outcomes of elementary school students, and 2) to delineate the elevation in mathematical learning outcomes post the adoption of teaching methods using PowerPoint instructional materials anchored in Problem Based Learning (PBL).

METHOD

3 The nature of this research is a Classroom Action Research (CAR). The subjects of this study comprise all Grade V students at MI AL Mustofa, Surabaya. In total, there are 23 participants, with 11 male and 12 female students. The research was conducted at MI AL Mustofa, Surabaya, situated on Jalan Tambak Deres V, Surabaya.

1 The Classroom Action Research design, based on the Kemmis & McTaggart model, encompasses four stages: planning, action, observation, and reflection. The planning phase entails a comprehensive outline of the activities to be executed during the action stage. Notably, the action phase is contemporaneously performed with the observation stage. Educators both implement the action and concurrently observe the unfolding events. Following the action and observation phases, research data is collected. This data is then analyzed to determine whether the research objectives and outcomes have been optimally achieved. This stage of data analysis is termed reflection. If the research goals are not entirely met and to validate the findings, researchers embark on a second cycle, initiating from the planning phase and progressing to reflection once more. These iterative cycles continue until the researcher discerns that the investigated issue has been addressed and there's an enhancement in the process or learning objectives. This interconnected, spiral system, where each stage is intrinsically linked to the subsequent one, is illustrated in Figure 1.

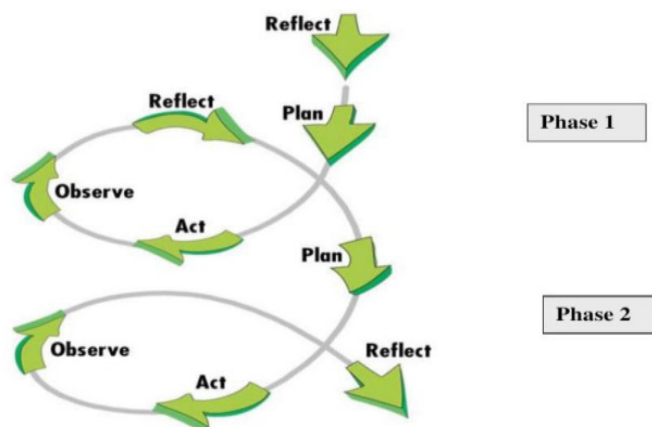


Figure 1. Classroom Action Research Design Based on the Kemmis & McTaggart Model

The four stages within Cycle I encompass: 1) **Planning**, which involves initial observations, determining research schedules, designing learning tools, and preparing research instruments to analyze data; 2) **Implementation**, at which point the researcher executes the learning process in accordance with the pre-planned Learning Implementation Plan (RPP); 3) **Observation**, undertaken concurrently with action implementation to discern which measures need enhancement in the learning process. This can be gauged from the procedural implementation carried out with the application of a PBL-based PowerPoint teaching material; and 4) **Reflection**, which critically re-examines the outcomes of actions imposed on students in Cycle II. The proceedings of the Cycle II stage resemble those of Cycle I, the distinction lies only in the findings of the reflections from Cycle I.

The data collection techniques employed in this study include observation and testing. Observations are leveraged to ascertain teacher and student activities, while tests are utilized to determine student learning outcomes. The research instruments to be used in this study comprise an observation sheet of teacher and student activities and a test question sheet.

Data analysis techniques are executed to determine the success of the actions taken during the study. This is inferred from the success rate percentage achieved by the MI AL Mustofa Surabaya students. The data analysis techniques adopted are both qualitative and quantitative. Qualitative data analysis aims to depict how PBL-based PowerPoint teaching materials are applied, whereas quantitative data analysis aims to observe the enhancement in individual and classical student learning outcomes.

Qualitative data analysis is gleaned from observational results and is analyzed descriptively to portray the application of PBL-based PowerPoint teaching materials throughout the learning process. After each observation session, the observer and researcher discuss the results of each session and analyze them to discern and identify shortcomings and impacts of the learning process conducted by the researcher. Identified shortcomings necessitate the crafting of new action plans as an improvement endeavor for the subsequent learning session. An action is deemed successful if the application of PBL-based PowerPoint teaching materials exhibits progressive improvement in every session. Quantitative data analysis is derived from student test results and is analyzed using the subsequent formula.

- Academic Performance of Students

$$S = \frac{R}{N} \times 100$$

Explanation:

- S = The value being sought
- R = The score obtained by each student
- N = The cumulative score of all students

100 = Constant

- The Mean Academic Performance of the Cohort

$$\bar{x} = \frac{\sum xi}{N}$$

Explanation:

\bar{x} = Represents the mean value or average

$\sum xi$ = Denotes the summation of all the values

N = Corresponds to the total number of teachers or students under consideration

The academic performance of students is calculated based on the overall class mastery with a Minimum Mastery Criterion (KKM) of 75 or above, utilizing the following formula:

$$NP = \frac{R}{SM} \times 100$$

Explanation:

NP = Desired percentage value

R = Number of students achieving a score of 75 or higher

SM = Total number of students in the cohort

Table 1. Criteria for Learning Mastery

Percentage of Learning Mastery	Kriteria
80-100	Exceptional
66-79	Proficient
56-65	Satisfactory
40-45	Limited
≤40	Very Limited

Source: (Purwanto, 2010)

The success indicators for this research are as follows:

1. The implementation of the teaching materials is deemed successful if there is an enhancement in learning outcomes and the teacher's proficiency in utilizing PowerPoint-based PBL (Problem-Based Learning) materials, and
2. Students are considered to have succeeded if their average score achieves or exceeds 65, and the classical completeness is achieved by 80% or more of the students in the class.

RESULT AND DISCUSSION

Result

The Implementation of PBL-Based PowerPoint Instructional Materials

The implementation of mathematics learning at the pre-cycle stage is the stage where PBL-based PowerPoint teaching materials have not yet been applied. At this pre-cycle, the material taught is Spatial Figures. This stage aims to determine how active and capable students are in mathematics learning in the classroom before applying PBL-based PowerPoint teaching materials. At this pre-cycle, information was obtained about the mathematics learning of Spatial Figures for fifth-grade students at MI AL Mustofa Surabaya. Information about mathematics learning of Spatial Figures was obtained from the initial observation during mathematics learning. The teacher used WhatsApp as a communication tool for students. The results of the observation

were 1) The teacher greeted, 2) The teacher asked students to study the Spatial Figures material in the textbook, and 3) The teacher distributed questions in the form of a Google form.

Learning in cycle I with the application of PBL-based PowerPoint teaching materials was carried out according to the previously established plan. The results of observations at the first meeting or cycle I discussed Spatial Figures material. Learning activities began with the teacher asking one student to lead prayer. Then the teacher asked about the students' news and checked their attendance, but when taking attendance there were still students who did not listen because they were busy talking with their classmates in the back of the class, so the teacher had to call that child several times to take attendance. The teacher gave an apperception and explained the learning objectives. In the PBL (Problem-Based Learning) learning model, there are several phases, namely: Phase I finding problems: in the first phase, the teacher displays an image and students are asked to analyze it. In this phase, there are deficiencies. The lack of teachers in encouraging students to think more critically and lack of teachers in guiding students to be able to explore information contained in that image. After completing phase I, the teacher briefly explained about Spatial Figures, about various types of Spatial Figures. Phase II Building a work structure: in this phase, the teacher displays various types of Spatial Figures and asks "what are the various objects that belong to Spatial Figures (that the teacher displays)?" The response given by students was only a few who answered and there were also students who just stared blankly without paying attention to the teacher standing in front. After completing phase II, the teacher explained about Spatial Figures and formulas on those Spatial Figures. In this phase, the teacher focused too much on giving explanations without asking questions to students, resulting in some students not listening when the teacher explained learning material.

Fase III menetapkan masalah: pada fase ini guru menampilkan kuis atau soal-soal yang terdapat kehidupan nyata. misalkan "Terdapat sebuah penghapus papan tulis berbentuk balok mempunyai panjang 8 cm, lebar 4 cm, dan tinggi 5 cm, berapakah volume pada penghapus papan tulis tersebut?". Pada fase ini terdapat siswa yang kurang memahami dan terdapat siswa yang merasa kesulitan terlihat pada ekspresi siswa yang merasa kebingungan saat berikan pertanyaan. Setelah melakukan beberapa fase di atas guru memberikan kesimpulan dan menutup pembelajaran. Dari beberapa kekurangan diatas menurut observer I dan II dapat disimpulkan kurang berhasilnya guru dalam menrapkan bahan ajar powerpoint berbasis PBL.

Pembelajaran pada siklus II dengan diterapkannya bahan ajar *power point* berbasis PBL, dilaksanakan sesuai perencanaan yang sudah ditetapkan sebelumnya. Hasil observasi pada siklus II guru telah mengalami peningkatan dalam segi pelaksanaan kegiatan pembelajaran. pada siklus II proses belajar mengajar tetap membahas materi bangun ruang. kegiatan pembelajaran yang diawali dengan guru meminta salah satu siswa untuk memimpin berdo'a. kemudian guru menanyakan kabar siswa dan mengecek kehadiran siswa, pada siklus II ini siswa sudah mulai dapat terfokuskan dengan apa yang dilakukan guru. Kemudian guru memberikan apersepsi dan menjelaskan tujuan pembelajaran. Pada model pembelajaran PBL terdapat beberapa fase, yaitu:

Fase I menemukan masalah: pada fase pertama guru menampilkan sebuah gambar siswa diminta untuk menganalisis gambar tersebut. Pada fase ini guru telah melakukan perbaikan, saat siswa menanggapi tentang gambar yang ditampilkan guru selalu mencoba menggali dan membantu siswa untuk menemukan informasi-informasi baru. Setelah melakukan fase I guru menjelaskan secara singkat tentang pengertian bangun ruang, tentang macam-macam bangun ruang.

Fase II Membangun struktur kerja: pada fase ini guru menampilkan macam-macam bangun ruang dan guru memberikan pertanyaan "sebutkan macam-macam benda yang termasuk ke dalam bangun ruang (yang guru tampilkan)?" pada siklus I hanya terdapat beberapa siswa yang menanggapi pertanyaan guru beda dengan siklus II karena semua siswa di tuntut untuk mengeluarkan pendapat mereka, jika terdapat salah satu siswa yang tidak menanggapi guru akan merespon atau bertanya kepada siswa yang tidak menanggapi. Setelah melakukan fase II guru menjelaskan tentang bangun ruang dan rumus pada bangun ruang tersebut. Pada fase ini di

sela-sela guru menjelaskan materi sesekali guru menanyakan apakah siswa sudah paham tentang materi yang telah di jelaskan.

4 Fase III menetapkan masalah: pada fase ini guru menampilkan kuis atau soal-soal yang terdapat kehidupan nyata. misalkan “Terdapat sebuah penghapus papan tulis berbentuk balok mempunyai panjang 8 cm, lebar 4 cm, dan tinggi 5 cm, berapakah volume pada penghapus papan tulis tersebut?”. Pada fase ini jika terdapat siswa yang kurang mengerti guru akan membimbing siswa agar memudahkan siswa dalam mencerna materi dan soal yang telah di berikan guru. Setelah melakukan beberapa fase di atas guru memberikan kesimpulan dan menutup pembelajaran. Dari beberapa kekurangan yang terdapat pada siklus I telah di perbaiki oleh guru pada siklus II menurut observer I dan II dapat disimpulkan, Guru telah berhasilnya dalam menerapkan bahan ajar powerpoint berbasis PBL (*Problem based Learning*).

Phase III defining problems: in this phase, the teacher displays quizzes or questions that exist in real life. For example, “There is a blackboard eraser in the shape of a block with a length of 8 cm, a width of 4 cm, and a height of 5 cm, what is the volume of the blackboard eraser?” In this phase, there are students who do not understand and there are students who have difficulty as seen in the expressions of students who feel confused when asked questions. After completing several phases above, the teacher gave a conclusion and closed the learning. From several deficiencies above, according to observers I and II, it can be concluded that the teacher was unsuccessful in applying PBL-based PowerPoint teaching materials.

20 Learning in cycle II with the application of PBL-based PowerPoint teaching materials was carried out according to the previously established plan. The results of observations in cycle II showed that the teacher had improved in terms of implementing learning activities. In cycle II, the teaching-learning process still discussed Spatial Figures material. Learning activities began with the teacher asking one student to lead prayer. Then the teacher asked about the students’ news and checked their attendance, in this cycle II students were already starting to be able to focus on what the teacher was doing. Then the teacher gave an apperception and explained the learning objectives. In the PBL learning model, there are several phases, namely:

Phase I finding problems: in the first phase, the teacher displays an image and students are asked to analyze it. In this phase, the teacher has made improvements when students respond to the image displayed by always trying to explore and help students find new information. After completing phase I, the teacher briefly explained about Spatial Figures, about various types of Spatial Figures.

Phase II Building a work structure: in this phase, the teacher displays various types of Spatial Figures and asks “what are the various objects that belong to Spatial Figures (that the teacher displays)?” In cycle I there were only a few students who responded to the teacher’s question unlike cycle II because all students were required to express their opinions if there was one student who did not respond, the teacher would respond or ask the student who did not respond. After completing phase II, the teacher explained about Spatial Figures and formulas on those Spatial Figures. In this phase, while explaining material occasionally, teachers ask whether students have understood about material that has been explained.

11 Phase III defining problems: in this phase, the teacher displays quizzes or questions that exist in real life. For example, “There is a blackboard eraser in block form with a length of 8 cm, width 4 cm and height 5 cm, what is the volume of that blackboard eraser?” In this phase if there are students who do not understand, teachers will guide students to make it easier for students to digest material and questions given by teachers. After completing several phases above, teachers gave conclusions and closed learning. From several deficiencies found in cycle I that have been corrected by teachers in cycle II according to observers I and II it can be concluded that teachers have succeeded in applying PBL-based PowerPoint teaching materials (*Problem-Based Learning*).

Enhancing Mathematics Learning Outcomes through the Application of Problem-Based Learning (PBL) PowerPoint Instructional Material

The assessment of learning outcomes was bifurcated into two evaluative categories: a post-test and a pretest during the first cycle. From the examination undertaken with 23 students, it was discerned that the academic achievement rate in the first cycle was 69.56%. When transposed onto a student learning outcome criterion table, the outcomes for this cycle ranged from 66-79%, classifying it under the 'good' category. Following the derivation of these learning outcomes, the first cycle proceeded to the reflection phase. Reflections elucidated several limitations in the teaching approach, including the educator's insufficient prompting for critical thinking, inadequate guidance for students in information sourcing, observable confusion in students when queried, and a palpable lack of understanding regarding the learning expectations. In a bid to optimize the learning process and augment student outcomes, the research subsequently advanced to the execution of the second cycle.

The implementation of the second cycle mirrored that of the first, albeit with refinements tailored for enhanced student learning. From the tests administered to the 23 students in this cycle, the collective learning achievement rate soared to 86.95%. Converting this to the same criterion table, the learning outcomes of this cycle spanned 80-100%, placing them in the 'excellent' category. Reflections from the second cycle suggested noticeable improvements in the teaching execution, and students better grasped the educational demands. Drawing from the feedback of both first and second observers, it was inferred that the educator successfully incorporated PBL-based PowerPoint instructional materials. Comparative analysis of both cycles revealed an initial student outcome of 69.56% in the first cycle, which witnessed an elevation by 17.39% in the second cycle, culminating in an 'excellent' rating of 86.95%.

Discussion

Application of PBL-Based PowerPoint Instructional Material in Mathematics Education

The instruction of mathematics to students is of paramount importance, as it directs learners towards honing their logical, analytical, systematic, critical, and creative thinking skills, as well as fostering collaboration. This aligns with the 21st-century demands of mathematics education which emphasize the cultivation of creativity, critical thinking, teamwork, and communication capabilities.

Research findings indicate an enhancement in the implementation of PowerPoint instructional materials anchored on Problem Based Learning (PBL). Such a finding meets the expectations set by the researchers. The improved aptitude of students in utilizing PBL was evident in their capacity to elucidate facts about certain issues, employ critical thinking skills to derive answers (Lapuz & Fulgencio, 2020), and engage in iterative questioning (Miller & Krajcik, 2019) and responsive dialogue.

Enhancement in Mathematics Learning Outcomes Post Implementation of PBL-Based PowerPoint Instructional Material

Classroom action research was conducted to assess the enhancement of students' mathematical learning outcomes via the PBL model. The results revealed a classical increase, wherein the learning outcomes rose from 69.56% in the first cycle to 86.95% in the second cycle, denoting a 17.39% improvement. This significant leap in learning outcomes can be attributed to the integration of the PBL model in the pedagogical process.

The PBL instructional model is an engaging pedagogical approach that maximizes student involvement, promoting mutual collaboration and interdependence towards achieving specific learning objectives (Cancino & Avila, 2021; Larsen et al., 2019). Fundamentally, PBL confronts students with practical problems, often in ill-structured or open-ended formats, coupled with relevant stimuli. This accentuates that the PBL model centers on problem-based learning, providing students with direct experiences that enhance and expand their knowledge, ensuring its applicability in daily life (Karagianni & Drigas, 2022; Khandakar et al., 2020; Sulistiyono et al.,

2021). This problem-centric approach resonates deeply with the nature of mathematics education, which seeks to nurture students' problem-solving mental models. Mathematics fundamentally delves into conceptual thinking represented through symbols and patterns.

Considering the low learning outcomes or the limited percentage of students achieving classical learning completeness in mathematics, specifically among the fifth-grade students of MI AL Mustofa Surabaya, researchers collaborated with classroom teachers to introduce PBL-based PowerPoint instructional material during mathematics instruction. This was envisioned as a strategy to elevate students' learning outcomes. The conclusive findings from the two-cycle research in mathematics instruction affirmed an increase in student activity. Data suggest that the learning process, utilizing the PBL-based PowerPoint instructional materials, has bolstered students' academic achievements. This indicates that incorporating PBL-based PowerPoint materials in mathematics instruction has a positive influence, notably in the enhancement of student learning outcomes.

The Classroom Action Research (CAR) conducted at MI AL Mustofa, Surabaya, offers valuable insights into the application of PBL-based PowerPoint teaching materials. However, its limitations should be acknowledged. The study's focus on a single class of 23 students raises concerns about the generalizability of the findings to broader educational contexts. Without a control group, attributing observed changes solely to the intervention becomes challenging. The dual role of the teacher as both the implementer and observer may introduce observational bias, potentially skewing the results. Furthermore, the primary reliance on test scores as a measure of success might not encapsulate the multifaceted nature of learning, overlooking aspects like student engagement or critical thinking. Lastly, the study does not address the long-term sustainability of the intervention, nor does it consider potential cultural or institutional factors that could influence outcomes.

Building on the findings from the Classroom Action Research (CAR) at MI AL Mustofa, Surabaya, future research should consider expanding the sample size and incorporating multiple classrooms or schools to enhance the generalizability of the results. Introducing a control group would provide a clearer comparison, helping to isolate the effects of the PBL-based PowerPoint teaching intervention. To mitigate potential biases, it would be beneficial to involve third-party observers or employ mixed-method approaches, integrating interviews or focus groups alongside observations. This would offer a more holistic understanding of the learning process. Additionally, researchers should explore alternative metrics beyond test scores to evaluate the multifaceted nature of student learning and engagement. Longitudinal studies could also be conducted to assess the long-term impacts and sustainability of the intervention, while also delving into the cultural or institutional factors that might influence its effectiveness.

CONCLUSION AND SUGGESTIONS

This research explores the efficacy of PowerPoint teaching materials anchored in Problem-Based Learning (PBL) to bolster mathematics achievement among elementary pupils. The PBL-driven PowerPoint approach underwent two cycles, adhering to PBL's distinct phases, and showcased marked improvement in the mathematical mastery of MI AL Mustofa's fifth graders in Surabaya. Initial results indicated a commendable 69.56% mastery, which impressively escalated to 89.95%—an exemplary performance—in the subsequent cycle. However, while the Classroom Action Research (CAR) at MI AL Mustofa offers valuable insights, it grapples with challenges such as limited generalizability, potential biases, and a predominant focus on test scores. To further enrich this line of inquiry, future endeavors should diversify their sample, incorporate control groups, and integrate varied methodologies. A deeper dive into alternative evaluation metrics and sustained impacts, coupled with an understanding of cultural and institutional nuances, would be instrumental.

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