UTILIZATION OF DATA ANALYSIS-BASED EDUCATIONAL TECHNOLOGY TO IMPROVE LEARNING PARTICIPATION OF STUDENTS WITH SPECIAL NEEDS AT SDN CIPONDOH 03

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ABSTRACT

This study aims to analyze the effectiveness of data-driven educational technology in increasing the learning participation of students with special needs in inclusive elementary schools. Many inclusive institutions in Indonesia still face challenges in increasing the active participation of students with special needs due to limited adaptive learning strategies and minimal use of learning analytics. The purpose of this study is to investigate how the integration of data-driven educational technology supports engagement, interaction, and inclusivity in the classroom. This study used the Classroom Action Research (CAR) method, conducted in two cycles at SDN Cipondoh 03, Tangerang City. Participants consisted of 20 students with special needs and one classroom teacher. Data were collected through classroom observations, interviews, documentation, and analysis of digital learning logs. Quantitative data measured participation levels, while qualitative data examined changes in behavior and motivation. The analysis combined descriptive statistics and reflective interpretations of teacher observations. The study results showed a significant increase in student participation—from 45% in the pre-cycle to 68% in the first cycle, and 82% in the second cycle. This increase was supported by the use of a learning analytics dashboard that provided personalized feedback and visual progress reports for students. These findings confirm that data-driven educational technology effectively increases participation and engagement of students with special needs by encouraging adaptive and evidence-based instruction.

Keywords   : Educational Technology; Data Analytics; Inclusive Education; Students With Special Needs; Student Participation

I. INTRODUCTION

Inclusive education is a crucial pillar in achieving equal access to education for all children, including those with special needs. Every student has the right to receive educational services tailored to their potential and challenges (Gustaman et al., 2025) . However, in practice, teachers face significant challenges in increasing the participation of students with special needs in learning activities. Many students tend to be passive, have difficulty concentrating, and lack the confidence to actively interact in class (Permana, 2025) . As a result, their potential is not fully explored.

Low participation among students with special needs is often due to a lack of adaptive learning approaches and minimal use of supporting technology (Munawir et al., 2025) . Meanwhile, conventional learning still dominates, with teachers as the center of information and students merely passive recipients (Oktaviani & Oknaryana, 2023) .

In the context of modern education, data analytics-based educational technology offers a potential solution for creating more personalized and inclusive learning (Hatmoko et al., 2024) . Through learning analytics systems, student learning activities can be monitored in real time, and teachers can adjust learning strategies based on the data obtained (Supriyatmoko et al., 2025) .

However, the implementation of data-driven technology in inclusive schools like SDN Cipondoh 03 remains limited. Most teachers use digital platforms solely as tools, without in-depth analysis of student activity data (Marpaung, 2024) . As a result, learning is not fully oriented to individual student needs.

Based on this, this study aims to increase the learning participation of students with special needs through the application of data analysis-based educational technology at SDN Cipondoh 03. This approach is believed to be able to help teachers identify student engagement patterns and provide targeted interventions.

This study uses the Kemmis & McTaggart Classroom Action Research (CAR) model which is implemented in two cycles, with each cycle including the planning, action implementation, observation, and reflection stages (Mardiana & Suharyanto, 2024) .
The objectives of this research are:
1. Explaining the application of data analysis-based educational technology at SDN Cipondoh 03.
2. Analysis of increasing learning participation of students with special needs through the use of the system.
3. Describes teacher and student responses to data-based learning in inclusive schools.

II.   METHOD

2.1.   Type and Design of Research

This type of research is Classroom Action Research (CAR) with two cycles that focus on increasing the learning participation of students with special needs through the use of data-based technology (Mardiana & Suharyanto, 2024) .

2.2.   Location and Research Subjects

This research was conducted at SDN Cipondoh 03, Tangerang City, in the even semester of the 2024/2025 academic year. The research subjects included 20 students with special needs in grades IV and V, as well as one class teacher and one special assistant teacher (GPK) who played a role in implementing learning activities (Habibah et al., 2024) .

2.3.   Research Variables

Independent variable: Data analysis-based educational technology (learning analytics system). Dependent variable: Learning participation of students with special needs, measured through indicators of involvement, interaction, and learning initiative (Mulya & Fauziah, 2024) .

2.4.   Techniques and Data Sources

Data were collected through participant observation, teacher and student interviews, digital activity logs, and action reflections. Quantitative data came from system recapitulation, while qualitative data came from observation logs and interviews (Firdaus et al., 2023) .

2.5.   Data Analysis Techniques

The analysis was conducted using quantitative descriptive and qualitative reflective methods. The participation percentage was calculated using the formula:

Description:

$$P = \frac{n}{N} \times 100$$

(P) = percentage of participation,

(n) = number of active students,

(N) = total number of students.

2.6.   Research Success Indicators

Classroom Action Research (CAR) is considered successful if the application of data analysis-based educational technology is able to continuously increase the learning participation of students with special needs in each action cycle (Kemmis & McTaggart, 2014). Indicators of research success include:

1. Increasing Student Learning Participation

   The research was declared successful if ≥75% of students showed active participation in learning and there was an increase in the percentage of participation from pre-cycle to cycle I and to cycle II (Mardiana & Suharyanto, 2024) .

2. Student Involvement and Active Interaction

   The success of the action is demonstrated through increased student involvement in participating in learning, responding to teacher instructions, and participating in technology-based activities (Susanto, 2016) .

3. Utilizing Data for Learning Improvement

   Research is considered successful if teachers are able to use learning analytics data as a basis for reflection and improvement of learning strategies in each cycle (Praseno, 2024) .

III. RESULTS AND DISCUSSION

3.1. Research Results

Before the intervention (pre-cycle), participation of students with special needs at SDN Cipondoh 03 was still low, at 45% (9 out of 20 students). After implementing data analysis-based technology, there was a gradual increase, reaching 82% (16 out of 20 students) in cycle II.

Table 1. Improving Learning Participation of Students with Special Needs

Research stage	Number of active students	Participation percentage %	Information
Pre-Cycle	9 of 20	45%	Students are not yet familiar with digital media.
Cycle 1	14 of 20	68%	The students started to be active, some needed guidance.
Cycle 2	16 of 20	82%	Students are independent and active in discussions.

The table shows a 37% increase in overall participation. In the pre-implementation cycle, students were still passive due to their unfamiliarity with digital systems. After implementing learning analytics in Cycle I, students became more accustomed to using the learning application and demonstrated greater engagement. In Cycle II, the increased participation was supported by visual feedback, activity notifications, and personalized guidance from teachers.

This finding is consistent with research by Azhar & Wahyudi (2024) , which states that analytical data provides an opportunity for students to understand their progress independently, thereby encouraging learning motivation and self-confidence.
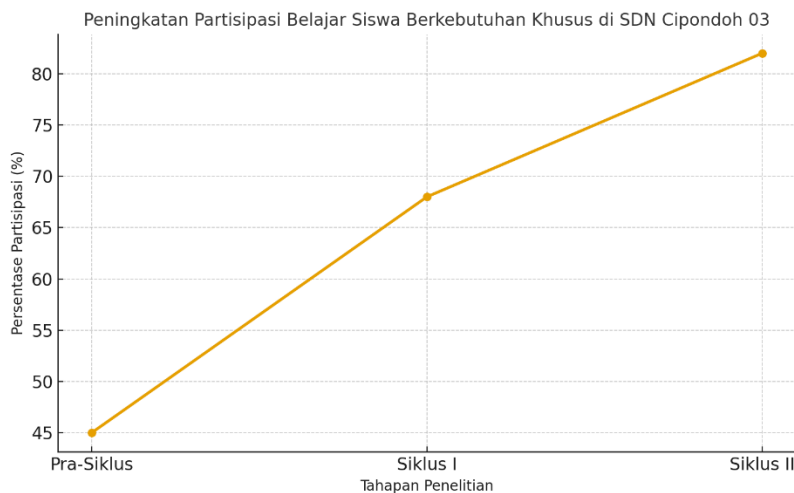
Figure 1. Graph of Increase in Student Participation at Cipondoh 03 Elementary School

The graph shows a trend of increasing participation from the pre-cycle (45%), increasing to 68% in cycle I, and reaching 82% in cycle II. This significant increase indicates that the use of data-driven technology helps create student-centered learning (Darlian et al., 2025) .

Consistent improvement also reflects teachers' ability to utilize learning outcome data to refine teaching strategies in each cycle. This aligns with research (Praseno, 2024), which found that the use of learning analytics increases teachers' awareness of student learning patterns and the effectiveness of teaching interventions.

3.2. Findings of Each Cycle Based on the Kemmis & McTaggart Model
3.2.1. Pre-Cycle

In the pre-cycle phase, learning still proceeded conventionally without the use of data analysis-based technology. Observations showed that student participation was low, with an active percentage of 45%. Most students were passive, unresponsive to teacher questions, and did not demonstrate initiative in learning activities. These findings underpin the need for corrective action through the implementation of data-based educational technology.

This Classroom Action Research was conducted using Kemmis and McTaggart's spiral model, which emphasizes a continuous reflective process through the stages of planning, action implementation, observation, and reflection. This model allows researchers to systematically improve actions based on empirical findings in each cycle, allowing improvements in learning outcomes to be explained methodologically, not merely descriptively. (Stephen Kemmis & Robin McTaggart, 2014) .

3.2.2. Cycle I

The implementation of data analysis-based educational technology has begun to have a positive impact on the learning participation of students with special needs, as demonstrated by an increase in active participation from 45% in the pre-cycle to 68%. However, observations indicate that the use of learning data remains primarily informative and has not yet been fully utilized as a basis for pedagogical decision-making. Teacher feedback remains predominantly classical, thus failing to optimally accommodate individual student needs (Susanto, 2016) .

3.2.3. CYCLE II

Reflections on Cycle I formed the basis for action planning in Cycle II, with a primary focus on optimizing the use of learning analytics data as a learning decision-making tool. At this stage, student participation data was analyzed in more depth to identify patterns of activity, levels of support needs, and student responses to learning activities. This approach reinforces the shift in the teacher's role from mere technology users to data-driven learning facilitators (Praseno, 2024; Hatmoko et al., 2024).

The implementation of actions in Cycle II demonstrated an improvement in the quality of learning interventions. Teachers provided data-based individual feedback, provided adaptive mentoring, and designed more interactive and contextual learning activities. Observations showed that students became more independent, responsive, and exhibited greater learning initiative. The impact of these improvements was reflected in the increase in student engagement to 82%, exceeding the research success indicator (Witasari, 2023) .

3.3. Discussion

The increased learning participation of students with special needs at SDN Cipondoh 03 demonstrates the effectiveness of implementing data analytics-based technology in inclusive learning. This system helps teachers conduct evidence-based monitoring, resulting in increased student motivation and engagement (Surwuy et al., 2024) .

In addition to increasing participation, this system also shifts the teacher's role from information provider to data-driven learning facilitator. Teachers can adapt learning methods to individual student needs (Purnawanto, 2023) . This aligns with Vygotsky's constructivist theory, which emphasizes the importance of social interaction and adaptive support in the learning process (Witasari, 2023) .
However, this study also identified obstacles such as limited digital literacy among teachers and inadequate technological infrastructure. Training and technical support are needed to ensure optimal implementation of this technology (Harianto, 2024) .

IV. CONCLUSION

The implementation of data analytics-based educational technology at SDN Cipondoh 03 has proven effective in increasing the learning participation of students with special needs from 45% to 82% in two cycles. This technology helps teachers accurately monitor student progress, provide adaptive interventions, and increase student engagement in the learning process.

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