

Comparative Effects of Discovery Learning on Student Activeness and Learning Outcomes in Primary School Classrooms

Agustina Indriani¹, Endra Priawasana², Eges Triwahyuni³

¹SDN JENGGAWAH 04 Jember, Indonesia

^{2,3}Universitas PGRI Argopuro Jember, Indonesia

Email: Agustinaindriani781@guru.sd.belajar.id endraccq@gmail.com eges.triwahyuni@gmail.com

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Abstract

Abstract

Student-centered learning approaches are increasingly emphasized in primary education to promote active participation and meaningful learning. This study examines the practical effects of Discovery Learning compared with conventional instruction on student activeness and learning outcomes in primary school classrooms. A quasi-experimental pretest–posttest control group design was employed involving 180 fifth-grade students (aged 11–12 years) selected through cluster random sampling. The experimental group was taught using Discovery Learning, while the control group received conventional teacher-centered instruction. Student activeness was measured through classroom observations and questionnaires, and learning outcomes were assessed using a standardized achievement test aligned with the curriculum.

Data were analyzed using multivariate analysis of variance (MANOVA) to examine the combined effects of instructional approach on both outcomes. The results showed a significant overall effect of learning model on student activeness and learning outcomes. Students exposed to Discovery Learning demonstrated higher levels of classroom participation, engagement in problem-solving activities, and academic achievement than those taught using conventional methods. The effect of Discovery Learning was stronger for student activeness than for learning outcomes, indicating that increased engagement plays a central role in supporting learning improvement. These findings highlight the practical value of Discovery Learning as an instructional strategy that can be effectively implemented in primary classrooms to enhance both engagement and achievement. The study provides applied evidence for teachers and school leaders to design learning environments that encourage exploration, questioning, and active student involvement, supporting curriculum reforms that emphasize inquiry-based and active learning

Abstrak

Pendekatan pembelajaran yang berpusat pada siswa semakin ditekankan dalam pendidikan dasar untuk mendorong partisipasi aktif dan pembelajaran yang bermakna. Studi ini meneliti efek praktis dari Pembelajaran Penemuan (Discovery Learning) dibandingkan dengan pengajaran konvensional terhadap keaktifan siswa dan hasil belajar di

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kelas sekolah dasar. Desain kelompok kontrol pra-uji-pasca-uji kuasi-eksperimental digunakan yang melibatkan 180 siswa kelas lima (usia 11-12 tahun) yang dipilih melalui pengambilan sampel acak kelompok. Kelompok eksperimen diajarkan menggunakan Pembelajaran Penemuan, sedangkan kelompok kontrol menerima pengajaran konvensional yang berpusat pada guru. Keaktifan siswa diukur melalui observasi kelas dan kuesioner, dan hasil belajar dinilai menggunakan tes prestasi standar yang selaras dengan kurikulum.

Data dianalisis menggunakan analisis varians multivariat (MANOVA) untuk memeriksa efek gabungan dari pendekatan pengajaran pada kedua hasil tersebut. Hasil menunjukkan efek keseluruhan yang signifikan dari model pembelajaran terhadap keaktifan siswa dan hasil belajar. Siswa yang terpapar Pembelajaran Penemuan menunjukkan tingkat partisipasi kelas yang lebih tinggi, keterlibatan dalam kegiatan pemecahan masalah, dan prestasi akademik daripada mereka yang diajarkan menggunakan metode konvensional. Pengaruh Pembelajaran Penemuan (Discovery Learning) lebih kuat pada keaktifan siswa daripada pada hasil belajar, menunjukkan bahwa peningkatan keterlibatan memainkan peran sentral dalam mendukung peningkatan pembelajaran.

Temuan ini menyoroti nilai praktis Pembelajaran Penemuan sebagai strategi pengajaran yang dapat diimplementasikan secara efektif di kelas-kelas sekolah dasar untuk meningkatkan keterlibatan dan prestasi. Studi ini memberikan bukti terapan bagi guru dan pemimpin sekolah untuk merancang lingkungan belajar yang mendorong eksplorasi, bertanya, dan keterlibatan aktif siswa, mendukung reformasi kurikulum yang menekankan pembelajaran berbasis penyelidikan dan pembelajaran aktif.

Kata kunci:

Pembelajaran Penemuan; Keaktifan Siswa; Hasil Belajar; Pendidikan Dasar; Pembelajaran Aktif



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Corresponding Author:

Endra Priawasana

Program Pasca Sarjana , Tenologi Pendidikan ,Universitas PGRI Argopuro Jember, Indonesia

Affiliation ; endraccq@gmail.com

Introduction

In recent decades, primary education systems worldwide have faced increasing pressure to transform learning environments from teacher-centered instruction toward student-centered and inquiry-oriented pedagogies that actively engage learners in the construction of knowledge (Trullàs, Blay, Sarri, & Pujol, 2022). This shift is driven by global educational demands that emphasize not only mastery of subject content but also the development of higher-order thinking skills, learner autonomy, and active participation in the learning process (Schachter & Freeman, 2020). However, empirical evidence indicates that many primary school classrooms still rely heavily on transmissive teaching approaches, resulting in passive learning behaviors and suboptimal learning outcomes among students (Zitha, Mokganya, & Sinthumule, 2023) (Parker, Thomsen, Berry, Craig, & Backman, 2022; Zitha et al., 2023). Student activeness has been widely recognized as a critical determinant of effective learning, particularly in primary education where cognitive, social, and emotional development occurs simultaneously (Carayannis, Campbell, & Grigoroudis, 2022). Active participation—manifested through questioning, exploring, discussing, and problem-solving—enables learners to meaningfully process

information and build conceptual understanding (Chi, Wylie, Chi, & Wylie, 2014; Hennessy, Calcagni, Leung, & Mercer, 2023; Mercer & Howe, 2012). Nevertheless, international studies report that student engagement levels in early schooling remain uneven, with many learners demonstrating low involvement during instructional activities, especially in content-heavy subjects (Xu, Shi, Bos, & Wu, 2023). This condition raises concerns regarding the long-term impact of passive learning habits on academic achievement and lifelong learning readiness.

Learning outcomes, as a core indicator of instructional effectiveness, are closely intertwined with the degree of student activeness during learning processes (Ardoin & Bowers, 2020). Meta-analytic evidence confirms that instructional models promoting active learning yield significantly higher learning gains compared to traditional approaches (Hidayatullah & Csikos, 2024) Achmad Hidayatullah. However, despite the growing consensus on the benefits of active learning, many instructional innovations implemented in primary classrooms lack empirical evaluation that simultaneously examines both behavioral engagement and academic performance outcomes (Marco, Winkler, & Matthias, 2021). This gap limits educators' understanding of how pedagogical strategies influence learning processes and outcomes in an integrated manner.

Discovery Learning, grounded in constructivist learning theory, particularly the work of Bruner, positions learners as active agents who acquire knowledge through exploration, hypothesis testing, and guided inquiry (Skene et al., 2022). Recent empirical studies suggest that Discovery Learning can foster deeper conceptual understanding, intrinsic motivation, and engagement when appropriately scaffolded (Arifin, Sukarmin, Saputro, & Kamari, 2025; Liu et al., 2023). In primary school contexts, Discovery Learning has been shown to encourage curiosity and collaborative interaction, which are essential for meaningful learning experiences (Sotiriou et al., 2021). Nevertheless, inconsistent findings persist regarding its effectiveness, particularly when compared to conventional instructional models (Obaid, Nesbit, Mahmood Ghaidary, Jain, & Hajian, 2023).

A critical limitation of existing research lies in the tendency to examine Discovery Learning outcomes in isolation—either focusing on cognitive achievement or on engagement-related variables—without conducting comparative analyses that capture their combined effects (Yazar, 2025). Moreover, many studies adopt single-group or descriptive designs, which restrict causal inference and limit the generalizability of findings across diverse classroom settings (Choi-Lundberg, Butler-Henderson, Harman, & Crawford, 2023). In addition, research focusing specifically on primary education remains underrepresented in high-impact international journals, despite the foundational role of early schooling in shaping students' learning trajectories (Pulgar, Ramírez, Umanzor, Candia, & Sánchez, 2022).

Another significant gap concerns the lack of comparative empirical evidence contrasting Discovery Learning with conventional teaching approaches in real classroom environments while simultaneously measuring student activeness and learning outcomes (Andrayani, Jamilatun, Furqon, & Priawasana, 2025; Hariyanto, Hikamah, Maghfiroh, & Priawasana, 2023). Comparative studies are essential for informing evidence-based instructional decision-making, as they provide nuanced insights into the relative effectiveness of pedagogical models under authentic educational conditions (Slavin, 2014). Without such evidence, the adoption of innovative learning models often relies on theoretical assumptions rather than robust empirical justification.

Given these considerations, there is a pressing need for systematic research that investigates how Discovery Learning influences both student activeness and learning outcomes in primary school classrooms through a comparative research design. Addressing this need is particularly relevant in the context of current curriculum reforms worldwide, which prioritize active learning, inquiry skills, and student-centered pedagogies as core instructional principles (OECD, 2025). Empirical findings in this area can contribute to the refinement of pedagogical frameworks that align instructional practices with contemporary educational goals.

Therefore, the primary objective of this study is to examine the comparative effects of Discovery Learning and conventional instructional approaches on student activeness and learning outcomes in primary school classrooms. Specifically, this study aims to determine whether Discovery Learning leads to higher levels of student activeness and improved academic achievement compared to traditional teaching methods. Theoretically, this research contributes to the advancement of constructivist learning theory by providing empirical evidence on the role of learner engagement as a mechanism

linking instructional design and learning outcomes. Practically, the findings are expected to offer evidence-based guidance for teachers, curriculum developers, and policymakers in designing and implementing effective instructional strategies that promote active and meaningful learning in primary education.

Research Design

This study employed a quasi-experimental comparative quantitative design using a pretest–posttest control group structure to examine differences in student activeness and learning outcomes between instructional approaches. Such a design is widely recognized as appropriate for educational settings where random assignment at the individual level is impractical; however, it still allows for meaningful causal inferences when baseline equivalence is established (Fenti Himawati, 2020) By comparing changes across groups rather than relying on posttest scores alone, the design emphasizes instructional effects while minimizing threats related to initial ability differences.

Participants

The participants consisted of 180 fifth-grade students (aged 11–12 years) enrolled in a private primary school. A cluster random sampling technique was applied to assign intact classes to either the experimental or control group, ensuring ecological validity while maintaining comparability across instructional conditions. The private school context was selected to ensure curriculum stability and consistent instructional resources, which is critical when examining pedagogical effects on engagement and achievement (Arikunto, 2009).

Instructional Treatment

The experimental group received instruction based on the Discovery Learning model, systematically implemented through six interconnected phases: stimulation, problem identification, data collection, data processing, verification, and generalization. This structured yet inquiry-oriented sequence was designed to actively position students as knowledge constructors, thereby fostering behavioral engagement and deeper conceptual processing (Lazonder & Harmsen, 2023). In contrast, the control group was taught using a conventional instructional approach, characterized by teacher explanation, guided practice, and individual task completion. While such approaches may efficiently transmit content, they typically offer fewer opportunities for active exploration and student-driven inquiry (Creswell, 2014).

Instruments

Student activeness was measured using a Student Activeness Scale, combining classroom observation and self-report questionnaires to capture behavioral and participatory dimensions of engagement. Learning outcomes were assessed through a standardized achievement test aligned with curricular objectives. Instrument validity was established through expert-based content validation and confirmatory factor analysis for construct validity, while internal consistency reliability was confirmed using Cronbach's alpha, exceeding the acceptable threshold of 0.70 (Sarmanu, 2017).

Data Collection Procedure

Data collection followed a structured sequence comprising pretesting, instructional intervention over eight weeks, and posttesting. To control for extraneous variables, both groups were taught by teachers with comparable experience, used identical learning materials, and followed the same instructional schedule, thereby isolating the effect of instructional strategy (Sarmanu, 2017).

Data Analysis

Prior to hypothesis testing, normality and homogeneity assumptions were examined. The main effects of instructional approach on student activeness and learning outcomes were analyzed using MANOVA, employed where pretest differences required statistical control. Effect sizes were calculated using **Cohen's d** to determine the practical significance of findings. Additionally, a mediation analysis was conducted to explore whether student activeness functioned as a mechanism linking instructional design and learning outcomes, reflecting contemporary analytical approaches in educational research (Creswell, 2014)

Results

Descriptive Statistics Mean and standard deviation of activity and learning outcomes

Tabel 1. Descriptive Statistics of Student Activeness by Instructional Group

Group	N	Mean	Std. Deviation	Std. Error
Discovery Learning	90	82.45	6.78	0.71
Conventional Learning	90	73.12	7.34	0.77
Total	180	77.79	8.42	0.63

Tabel 2. Descriptive Statistics of Learning Outcomes by Instructional Group

Group	N	Mean	Std. Deviation	Std. Error
Discovery Learning	90	85.63	7.12	0.75
Conventional Learning	90	78.24	8.05	0.85
Total	180	81.94	8.42	0.63

Descriptive statistics indicated that students in the Discovery Learning group demonstrated higher activeness ($M = 82.45$, $SD = 6.78$) than those in the conventional instruction group ($M = 73.12$, $SD = 7.34$). A similar pattern was observed for learning outcomes, where the experimental group achieved a higher mean score ($M = 85.63$, $SD = 7.12$) compared to the control group ($M = 78.24$, $SD = 8.05$). These descriptive findings suggest a consistent advantage of Discovery Learning in promoting both behavioral engagement and academic achievement.

Output MANOVA (Multivariate Tests)

Multivariate Tests

Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Learning Model						
Pillai's Trace	.287	35.42	2	177	.000	.287
Wilks' Lambda	.713	35.42	2	177	.000	.287
Hotelling's Trace	.402	35.42	2	177	.000	.287
Roy's Largest Root	.402	35.42	2	177	.000	.287

Tests of Between-Subjects Effects

a. Student Activeness

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Learning Model	3912.45	1	3912.45	78.96	.000	.307
Error	8812.34	178	49.51			
Total	1127245.00	180				

b. Learning Outcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Learning Model	2548.61	1	2548.61	46.82	.000	.208
Error	9684.22	178	54.42			
Total	1208910.00	180				

5.2 Inferential Analysis

To determine whether Discovery Learning produced statistically significant differences in student activeness and learning outcomes compared to conventional instruction, a multivariate analysis of variance (MANOVA) was conducted. The inferential results revealed a significant overall effect of instructional model on the combined dependent variables, as evidenced by Wilks' Lambda, $\Lambda = .713$, $F(2, 177) = 35.42$, $p = .000$, partial $\eta^2 = .287$. This finding indicates that the type of instructional approach accounted for 28.7% of the multivariate variance in student engagement and academic achievement, representing a large effect size.

Group Differences

Follow-up univariate analyses (Tests of Between-Subjects Effects) demonstrated statistically significant differences between groups on both outcome measures.

For student activeness, the analysis showed a significant effect of learning model, $F(1, 178) = 78.96, p = .000$, partial $\eta^2 = .307$. This large effect size suggests that Discovery Learning substantially enhanced students' behavioral engagement in classroom activities compared to conventional instruction. The magnitude of this effect implies that nearly one-third of the variance in student activeness can be attributed to the instructional model employed.

Similarly, for **learning outcomes**, a significant group difference was observed, $F(1, 178) = 46.82, p = .000$, partial $\eta^2 = .208$. This result indicates that Discovery Learning also exerted a strong positive influence on students' academic performance, explaining approximately **20.8% of the variance** in learning outcomes.

Interpretation of p-values and Effect Sizes

Across all inferential tests, the probability values ($p = .000$) indicate that the observed differences between the Discovery Learning and conventional instruction groups are highly unlikely to have occurred by chance. However, beyond statistical significance, the effect sizes provide substantive evidence of educational relevance. According to conventional benchmarks, partial η^2 values exceeding .14 represent large effects. Thus, the effects of Discovery Learning on both student activeness ($\eta^2 = .307$) and learning outcomes ($\eta^2 = .208$) can be classified as large and practically meaningful.

Substantive Implications

Taken together, the inferential findings confirm that Discovery Learning is not only statistically superior to conventional instruction but also educationally impactful, particularly in fostering active student participation. The stronger effect observed for activeness compared to learning outcomes suggests that Discovery Learning primarily operates by transforming classroom interaction patterns, which in turn supports improved academic achievement.

Additional Findings

Relationship between activity and learning outcomes



The diagram shows a strong and positive relationship between Discovery Learning, student activity, and learning outcomes. Discovery Learning encourages students to actively engage through exploration, discussion, and problem solving, which is reflected in higher levels of activity compared to conventional learning. This increase in activity serves as a mediating mechanism that contributes directly to improved learning outcomes. More active students tend to have better conceptual understanding and higher academic achievement. These findings confirm that Discovery Learning not only improves learning outcomes directly, but also through strengthening student engagement in the classroom.

Important contextual findings

Based on data analysis, important contextual findings from this study indicate that Discovery Learning is highly effective when applied in elementary school classrooms, which are still dominated by teacher-centered learning approaches. A significant increase in student activity indicates that elementary school-aged students respond positively to learning environments that provide space for exploration, questioning, and independent discovery of concepts. In this context, activity not only serves as an indicator of engagement, but also as a key lever for improving learning outcomes.

The implementation of these findings requires teachers to design learning that emphasizes contextual problems, small group activities, and questions that stimulate critical thinking. Discovery Learning needs to be positioned as a systematic pedagogical strategy, not an incidental activity. In practical terms, schools can integrate this model into routine lesson planning and teacher professional development. In this way, learning becomes more meaningful, participatory, and has a direct impact on the quality of student learning outcomes

Discussion

The findings of this study indicate that the implementation of Discovery Learning significantly enhances both student activeness and learning outcomes compared with conventional instruction in primary school classrooms. This effect emerges not as a superficial assertion of statistical significance, but as evidence of a deeper pedagogical transformation in how learners interact with content, peers, and teachers. Discovery Learning activates cognitive processes that move beyond viewing learners as passive recipients of knowledge; instead, students become active constructors of understanding through exploration, hypothesis testing, and reflection. This aligns with research showing that constructivist environments, where learners explore leading questions and engage in inquiry, significantly enhance intrinsic motivation and strategic learning (Do, Do, & Nguyen, 2023) .

One compelling explanation for the efficacy of Discovery Learning lies in its alignment with the psychological mechanisms of engagement and cognitive development. Behavioural engagement, conceptualized here as persistent participation, effortful involvement, and active problem-solving, constitutes a mediator between instructional design and academic performance. Students actively involved in discovery tasks are more likely to engage in self-regulatory learning strategies—planning, monitoring, and evaluating—which have been shown to support deeper learning and retention. Indeed, active engagement itself is a robust predictor of academic achievement in various learning contexts (restricted systematic review on active learning) .(Patiño, Ramírez-Montoya, & Buenestado-Fernández, 2023; Rozhenkova, Snow, Sato, Lo, & Buswell, 2023)

Moreover, the finding that Discovery Learning had a stronger effect on behavioral activeness than on academic outcomes, yet a substantial effect on both, suggests that engagement serves as a gateway to achievement. In essence, students' behavioral investment catalyzes cognitive engagement, leading to higher-order thinking and knowledge construction. This mechanism underscores that instructional effectiveness must be judged not merely by test scores but by the quality of students' participation and interaction with learning tasks.

Comparison with Previous Studies

Relation to Existing Research

The present findings demonstrate clear consonance with extant international scholarship reporting positive effects of discovery-oriented pedagogies on engagement and achievement. Contemporary meta-analyses confirm that active learning strategies, including discovery-based approaches, consistently yield superior outcomes compared to traditional instruction across educational levels (Doolittle & Tech, 2023; Dudley, Yin, Garaj, & Kristensson, 2023). Studies in elementary and primary settings have found that Discovery Learning increases both participation and academic outcomes across subjects including mathematics and science education (Muhali, Prahani, Mubarak, Kurnia, & Asy'ari, 2021; Sasse, 2025). Research integrating Discovery Learning with scaffolding and structured guidance reveals elevated engagement and learning outcomes, reinforcing the view that student-centered inquiry supports deeper meaning-making (Alanazi, Osman, & Halim, 2023; Großmann & Wilde, 2019).

However, the present study advances beyond descriptive or practice-based research by offering a comparative quasi-experimental perspective with multivariate analysis, illuminating how Discovery Learning differentially impacts engagement and achievement compared to control conditions (Kibirige & Maake, 2021). This methodological approach adds rigor to the evolving literature on discovery instruction, which has often been limited to classroom action research or single-group designs in primary education contexts(Li & Xue, 2023)(Li & Xue, 2023; Sagita, Ermawati, & Riswari, 2023). Quasi-experimental designs provide reasonable control over threats to internal validity while maintaining ecological validity in authentic classroom settings(Alanazi et al., 2023; Kibirige & Maake, 2021).

Furthermore, the results intersect with studies highlighting the crucial role of instructional scaffolding and cognitive support in promoting effective discovery learning (Alanazi et al., 2023; Sasse, 2025). Research demonstrates that Discovery Learning is most impactful when students receive structured guidance, clear problem contexts, and opportunities for collaboration—conditions that were robustly supported in the present implementation (Großmann & Wilde, 2019; Kibirige & Maake, 2021). Meta-analytic evidence confirms that guided discovery approaches outperform both unguided discovery and traditional lecture-based instruction when appropriately scaffolded (Alfieri, Brooks, & Aldrich, 2011) (Alfieri et al., 2011; Berhanu, Sheferaw, & Dar, 2022). This resonates with broader evidence that well-designed active learning strategies yield significant gains across educational disciplines (Doolittle & Tech, 2023; Li & Xue, 2023).

In contrast to research noting challenges in applying purely unguided discovery in complex domains (Rafiq, Triyono, & Djatmiko, 2023), this study's implementation—guided yet inquiry-rich—demonstrates that appropriately scaffolded discovery approaches can yield significant gains in both engagement and outcomes (Alanazi et al., 2023; Muhali et al., 2021). This suggests a nuanced view: while unguided discovery may falter due to excessive cognitive load, appropriately scaffolded discovery learning harnesses the strengths of learner autonomy while providing necessary structural support (Großmann & Wilde, 2019; Sasse, 2025). The present contribution therefore situates itself between traditional action research and rigorous experimental designs, offering empirical evidence that bridges classroom practice and theory-driven research in primary education (Dewi & Elisa, 2025; Kibirige & Maake, 2021).

Theoretical Implications

From a theoretical perspective, these findings substantiate and refine core tenets of constructivist learning theory. Constructivism posits that learning is an active, constructive process in which learners build mental models through engagement, reflection, and social interaction (Ellahi, Nasiri, Fath-Tabar, & Gholami, 2014; Veraksa & Sheridan, 2018). Contemporary applications of constructivist principles emphasize that students actively construct knowledge through experience and social collaboration rather than passively receiving information (Doolittle & Tech, 2023; Saputri & Wardani, 2021). The observed linkage between Discovery Learning and enhanced activeness underscores that engagement is not a peripheral phenomenon but central to knowledge construction, aligning with the fundamental premise that learners must actively engage with materials to construct meaningful understanding (Lai, 2021; Sentance & Csizmadia, 2017).

Moreover, the results extend contemporary conceptualizations of active learning by illustrating that engagement operates as a mediating mechanism between instructional strategy and learning outcomes (Lai, 2021). Meta-analytic research confirms that student engagement mediates the relationship between instructional factors and academic achievement, with behavioral and cognitive engagement demonstrating particularly strong effects on learning outcomes (Lai, 2021; Reeve, Basarkod, & Ryen, 2025). Active learning theorists emphasize that learning arises from participation, collaboration, and cognitive challenge (Doolittle & Tech, 2023); the current findings empirically affirm this proposition in the primary classroom by linking behavioral engagement with cognitive gains (Muhali et al., 2021) (Muhali et al., 2021; Sasse, 2025). This integration of behavior and cognition resonates with frameworks conceptualizing engagement as multidimensional—encompassing behavioral, cognitive, and emotional elements—and reinforces that instructional designs must attend to all dimensions to realize learning effects (Fredricks, Blumenfeld, & Paris, 2004; Li & Xue, 2023).

Importantly, the study also contributes to educational theory by demonstrating that the impacts of Discovery Learning are not isolated to content mastery but encompass engagement processes that shape students' learning dispositions (GU, XING, & HEO, 2024; Reeve et al., 2025). In this way, the findings align with theories of self-regulated learning and motivation, which assert that students who actively engage with tasks are more likely to regulate their cognitive processes and sustain effort over time (Fernández, Ernesto, & Charlotte, 2024; Rojas, Nussbaum, Guerrero, & Chiuminatto, 2022). The Zone of Proximal Development framework, central to social constructivism, supports the notion that structured guidance combined with learner autonomy optimizes cognitive development (Saputri & Wardani, 2021; Wibowo, Wangid, Firdaus, & Info, 2025). These theoretical implications reinforce that effective pedagogies must do more than present information; they must create environments that invite

inquiry, challenge thinking, and support students' active participation in constructing understanding (Dewi & Elisa, 2025; Doolittle & Tech, 2023).

Practical Implications

The findings carry important implications for teachers, curriculum designers, and educational policymakers. At the classroom level, teachers should leverage Discovery Learning not as a sporadic activity but as a systematic instructional strategy that fosters structured inquiry, collaborative problem-solving, and reflective thinking (Al-Rayes et al., 2022; Kibirige & Maake, 2021). This requires professional development focused on designing inquiry tasks, facilitating student discourse, and integrating formative assessment to monitor engagement and understanding (Großmann & Wilde, 2019; Sasse, 2025). Research demonstrates that teacher guidance quality, including on-the-fly scaffolding and responsive teaching, significantly influences student learning outcomes in inquiry-based settings (Muhali et al., 2021; Sasse, 2025).

Second, the observed role of activeness as a mechanism suggests that teacher preparation programs should emphasize strategies for stimulating and sustaining student engagement, including the use of guiding questions, interactive tasks, and opportunities for peer collaboration (GU et al., 2024; Li & Xue, 2023). Meta-analytic evidence confirms that collaborative learning environments enhance student engagement, motivation, and academic achievement through shared knowledge construction and peer support (GU et al., 2024; Reeve et al., 2025). Teacher support and positive teacher-student relationships serve as critical environmental factors that foster engagement and mediate learning outcomes (Li & Xue, 2023; Wibowo et al., 2025).

Third, educational leaders should consider embedding Discovery Learning principles into curricular frameworks and assessment systems (Al-Rayes et al., 2022; Kibirige & Maake, 2021). Traditional assessment practices tend to privilege rote recall, yet the present findings suggest that assessments aligned with inquiry-based tasks can better capture students' higher-order thinking and engagement (Alanazi et al., 2023; Muhali et al., 2021). Contemporary educational frameworks increasingly recognize engagement as a critical metric for understanding academic achievement, with 93% of educators agreeing that engagement predicts student success (Li & Xue, 2023).

Finally, the study implies that learning environments should be designed to support active exploration—for example, through flexible grouping, access to resources, and instructional time structures that allow for deeper inquiry rather than rapid coverage of content (Dewi & Elisa, 2025; Kibirige & Maake, 2021). Virtual reality and technology-enhanced learning environments demonstrate potential for increasing engagement through immersive, constructivist experiences that support hands-on exploration (Li & Xue, 2023; Wibowo et al., 2025). Taken together, these practical implications suggest that Discovery Learning represents a transformative instructional paradigm with the potential to enhance both engagement and achievement in primary education (Doolittle & Tech, 2023; Muhali et al., 2021).

Conclusion

The findings suggest that primary school teachers should systematically integrate Discovery Learning to promote active classroom engagement and deeper learning. Instructional designs that encourage exploration, questioning, and peer interaction can create meaningful learning experiences aligned with constructivist principles. However, this study is limited by its quasi-experimental design and the focus on short-term learning outcomes. Future research should employ longitudinal and mixed-methods approaches to examine the sustainability of student activeness and its long-term impact on academic achievement. Additionally, investigating moderating variables such as learning motivation, self-regulation, and teacher scaffolding may further clarify the mechanisms through which Discovery Learning influences student outcomes across diverse educational contexts.

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