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Implementing Differentiated Learning to Enhance Mathematical Reasoning Readiness for University Entrance Assessment: A Classroom Action Research in *Madrasah Aliyah*

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Abstract : This classroom action research aims to test the implementation of differentiated learning in improving the readiness of grade XII students to face the mathematical reasoning component in the Computer-Based Written Examination (UTBK), especially in madrasah schools. The study used a classroom action research design according to Arikunto et al. which was carried out through two cycles that included planning, implementation, observation, and reflection. The research subjects consisted of 34 grade XII science students at MA Sunan Prawoto Pati in the even semester of the 2025/2026 academic year. Differentiated learning was implemented through adjusting content, processes, and products based on students' readiness levels (high, medium, and low). Data were collected through learning outcome tests, observation sheets, and student perception questionnaires, then analyzed descriptively. The results showed a consistent increase in all indicators. The average student score increased from 58.4 at the initial condition to 69.2 in Cycle I and 81.5 in Cycle II, while learning completeness increased from 35.3% to 61.7% and finally reached 88.2%. Teachers' implementation of the learning model increased from 82% to 94%, while 85% of students reported that learning tailored to their level of readiness made them more comfortable and confident in solving mathematical reasoning problems. These findings suggest that differentiated learning improves academic achievement while strengthening learning engagement and reasoning skills by aligning learning strategies with students' learning needs. This study contributes by providing empirical evidence that differentiated learning within a classroom action research framework is an effective strategy for preparing students for reasoning-based mathematics assessments such as the Computer-Based Test (UTBK) and offers an adaptive learning model that can be applied to classes with heterogeneous student abilities.

Keywords : differentiated learning, mathematics reasoning; UTBK readiness, university entrance assessment, madrasah aliyah

Abstrak : *Penelitian tindakan kelas ini bertujuan mengkaji implementasi pembelajaran berdiferensiasi dalam meningkatkan kesiapan siswa kelas XII menghadapi komponen penalaran matematika pada Ujian Tulis Berbasis Komputer (UTBK). Penelitian menggunakan desain penelitian tindakan kelas yang dilaksanakan melalui dua siklus yang meliputi perencanaan, pelaksanaan, observasi, dan refleksi. Subjek penelitian terdiri atas 34 siswa kelas XII program IPA di Madrash Aliyah Sunan Prawoto Pati* *pada semester genap tahun ajaran 2025/2026. Pembelajaran berdiferensiasi diterapkan melalui penyesuaian konten, proses, dan produk berdasarkan tingkat kesiapan siswa. Data dikumpulkan melalui tes hasil belajar, lembar observasi, dan angket persepsi siswa, kemudian dianalisis secara deskriptif. Hasil penelitian menunjukkan peningkatan yang konsisten pada seluruh indikator. Nilai rata-rata siswa meningkat dari 58,4 pada kondisi awal menjadi 69,2 pada Siklus I dan 81,5 pada Siklus II, sedangkan ketuntasan belajar meningkat dari 35,3% menjadi 61,7% dan akhirnya mencapai 88,2%. Implementasi pembelajaran oleh guru meningkat dari 82% menjadi 94%, sementara 85% siswa melaporkan bahwa pembelajaran yang disesuaikan dengan tingkat kesiapan mereka meningkatkan kenyamanan dan kepercayaan diri dalam menyelesaikan soal penalaran matematika. Temuan ini menunjukkan bahwa pembelajaran berdiferensiasi mampu menciptakan pengalaman belajar yang lebih adaptif, mendorong keterlibatan aktif siswa madrasah dengan pendekayan Islam, serta memperkuat kemampuan penalaran melalui penyelarasan strategi pembelajaran dengan kebutuhan belajar yang beragam. Penelitian ini berkontribusi dengan menunjukkan bahwa implementasi pembelajaran berdiferensiasi dapat menjadi strategi pedagogis yang relevan bagi madrasah dalam mengakomodasi heterogenitas kemampuan siswa, meningkatkan kesiapan menghadapi asesmen berorientasi penalaran seperti UTBK, serta memperkuat transformasi pembelajaran matematika yang lebih inklusif, adaptif, dan berpusat pada peserta didik.*

Kata kunci : *pembeljaran berdiefrensiasi, penalaran matematika; kesiapan UTBK, asesmen masuk perguruan tinggi, madrasah aliyah*

INTRODUCTION

The increasing emphasis on competency-based assessment in contemporary education has transformed the goals of mathematics learning from procedural mastery toward the development of higher-order thinking skills, particularly mathematical reasoning, problem-solving, and adaptive application of knowledge. Globally, mathematics education systems increasingly recognize that students must be able to interpret complex situations, construct logical arguments, and apply mathematical concepts flexibly in unfamiliar contexts rather than merely reproduce memorized formulas. Nevertheless, developing these competencies remains a persistent challenge in secondary education because students enter classrooms with diverse levels of prior knowledge, cognitive readiness, and mathematical experiences. These challenges become more complex in high-stakes assessments that evaluate reasoning ability under strict time limitations. In Indonesia, the Computer-Based Selection Test (UTBK) functions as a major pathway for secondary school graduates seeking admission to public universities. Among its Scholastic Potential Test components, the mathematics reasoning subtest represents a demanding area requiring conceptual understanding, logical reasoning, interpretation of non-routine problems, and flexible mathematical application (Putri et al., 2024). Therefore, instructional approaches that accommodate diverse readiness levels while strengthening mathematical reasoning are increasingly essential.

Differentiated instruction (DI) provides a pedagogical framework for addressing the challenge of diverse student readiness by adapting learning experiences according to students' readiness, interests, and learning preferences. Rather than providing identical instruction for heterogeneous learners, DI modifies learning content, instructional processes, learning products, and classroom environments to ensure that students receive appropriate academic challenges and meaningful learning opportunities (Tomlinson, 2014). In mathematics education, DI has gained increasing attention because mathematical reasoning development requires not only exposure to challenging tasks but also instructional flexibility that allows students to progress according to their cognitive readiness. Empirical evidence from international contexts demonstrates the potential of DI to improve mathematics learning outcomes. Konstantinou-Katzi et al. (2013), through an action research project in a first-year engineering calculus course, found that differentiated approaches enhanced students' engagement, motivation, and conceptual understanding compared with conventional lecture-based instruction. Furthermore, Marks et al. (2021) emphasized that effective differentiation requires continuous refinement through classroom practice rather than a fixed instructional procedure. Similarly, Van Geel et al. (2019) highlighted that DI is a complex, multidimensional practice whose success depends on teachers' consistency, reflective capacity, and instructional decision-making.

Within the Indonesian educational context, research evidence also demonstrates the relevance of differentiated instruction for improving mathematics learning, although its implementation continues to require careful pedagogical consideration. Syarifuddin and Nurmi (2022) reported that mathematics achievement among ninth-grade students improved through classroom action research cycles incorporating DI, confirming the applicability of differentiated approaches in Indonesian secondary education. However, teachers' experiences indicate that successful differentiation depends on sustained professional support, particularly in designing appropriate learning tasks and managing flexible grouping strategies, as DI implementation may become ineffective without structured guidance (Hidayati, 2020). At the instructional outcome level, differentiated problem-based learning has been shown to enhance students' conceptual understanding compared with conventional approaches (Ambarini et al., 2026), while students' mathematical dispositions influence the extent to which DI contributes to mathematical communication and reasoning development (Ndia et al., 2025). Furthermore, studies of Indonesian secondary classrooms reveal that differentiated learning resources, including comparison-oriented worksheets and interactive digital modules aligned with students' readiness and learning characteristics, provide stronger support for heterogeneous learners than uniform instructional materials (Meriza et al., 2024; Adawiah et al., 2026). These findings suggest that DI has considerable potential, yet its application in specific assessment-oriented contexts requires further investigation.

Despite the growing evidence supporting differentiated instruction, existing research in mathematics education has predominantly focused on general classroom settings or university-level learning environments, with limited attention to how DI can be systematically designed and refined for preparing secondary students to face high-stakes, reasoning-oriented examinations. In particular, few studies have examined the role of classroom action research in developing adaptive differentiation strategies for UTBK mathematics reasoning preparation. Previous studies on UTBK have primarily identified students' difficulties in solving mathematics reasoning problems without investigating instructional interventions that address these challenges (Putri et al., 2024). This concern is strengthened by evidence indicating that Indonesian secondary students' mathematical reasoning abilities remain at a moderate level even in non-UTBK learning contexts (Rohmah et al., 2020). Moreover, although the Kurikulum Merdeka formally encourages differentiated learning, its classroom implementation remains inconsistent across educational settings (Balkist et al., 2022). This research gap is particularly significant for madrasah institutions, where teachers must address heterogeneous student abilities while preparing learners for competitive university admission processes. Therefore, differentiated strategies specifically oriented toward reasoning development and assessment readiness require further empirical exploration.

To address this gap, the present study investigates the implementation of differentiated instruction through a two-cycle classroom action research design in preparing heterogeneous twelfth-grade students at MA Sunan Prawoto Pati for the UTBK mathematics reasoning subtest. The study focuses on how differentiated content, instructional processes, and learning products can be systematically designed, implemented, and refined through reflective classroom cycles using compound probability and statistics as mathematical learning contexts. The novelty of this research lies in integrating differentiated instruction with UTBK-oriented reasoning preparation within an Islamic madrasah setting, where adaptive pedagogy must respond simultaneously to curriculum demands and diverse learner characteristics. Through classroom-based reflection, this study seeks to demonstrate how differentiation can overcome common implementation challenges, including inappropriate grouping patterns and unequal task distribution, while promoting students' mathematical readiness. The findings are expected to contribute empirical insights into adaptive mathematics pedagogy in madrasah education and provide practical implications for teachers seeking to develop more inclusive, responsive, and reasoning-focused learning environments. Accordingly, this research aims to examine the design, implementation, and outcomes of differentiated instruction in enhancing students' mathematical achievement and readiness for the UTBK mathematics reasoning subtest.

RESEARCH METHODS

Research Design

This investigation adopted a classroom action research (CAR) design following the cyclical model proposed by Arikunto et al. (2021), comprising sequential phases of planning, action, observation, and reflection. The study unfolded across two cycles, with each cycle's outcomes and reflections informing subsequent cycle design. This design was selected because it enables collaborative identification of instructional problems by teachers and researchers, implementation of targeted interventions, and systematic evaluation and refinement of those interventions based on evidence gathered throughout each cycle (Arikunto et al., 2021; Kemmis et al., 2014). Unlike experimental designs that prioritize variable control, CAR is particularly well-suited for improving teaching practices in authentic classroom settings and generating context specific knowledge that can be directly applied to address real pedagogical challenges (Creswell & Poth, 2018; Burns, 2010).

Research Subjects and Setting

The research participants comprised 34 twelfth grade science students (18 female, 16 male) from Class XII SAINTEK 1 at MA Sunan Prawoto Pati, Central Java, Indonesia, during the 2025/2026 even semester. This class was purposively selected as the research site based on three primary considerations.

First, the school and specific class were chosen due to observed heterogeneity in students' initial mathematical readiness for the UTBK mathematics reasoning subtest. Based on preliminary tryout results and pre-intervention classroom observations, students fell into three distinct readiness categories: high-readiness (8 students), who quickly grasped concepts but became disengaged when instruction slowed; moderate-readiness (18 students), who understood fundamentals but were frequently confused by complex reasoning items; and low-readiness (8 students), who struggled with prerequisite algebraic skills and demonstrated low confidence in attempting non-routine problems. This substantial readiness disparity, which uniform whole-class instruction had failed to accommodate, rendered the class appropriate for investigating whether DI could address such heterogeneity (Tomlinson, 2014; Van Geel et al., 2019).

Second, the location was selected for its relevance to the UTBK preparation context. Class XII SAINTEK 1 was in its final secondary school year, during which students intensively prepare for university entrance examinations. The UTBK mathematics reasoning subtest is widely recognized as one of the most demanding selection test components, requiring conceptual mastery alongside logical reasoning, non-routine problem-solving, and flexible formula application under time pressure (Putri et al., 2024). This context provided a natural and urgent setting for examining whether DI could be designed and refined specifically to prepare heterogeneous students for high-stakes, reasoning-based assessments, rather than for general mathematics instruction alone (Marks et al., 2021; Syarifuddin & Nurmi, 2022).

Third, MA Sunan Prawoto Pati was selected based on accessibility and the availability of collaboration between the researcher and the school. CAR necessitates sustained collaboration between researchers and classroom teachers across multiple cycles of planning, implementation, observation, and reflection (Arikunto et al., 2021). The school administration and mathematics teacher expressed willingness to participate and collaborate in designing, implementing, and refining DI strategies. This collaborative readiness was essential for ensuring sufficient implementation fidelity and translating classroom reflections into meaningful instructional improvements across cycles (Burns, 2010; Hidayati, 2020). Additionally, the researcher had established access to the school, facilitating regular classroom visits, data collection, and ongoing communication throughout the research period.

Based on initial tryout results, students were grouped into three readiness levels to inform the design of differentiated content, processes, and products in each cycle. Grouping was dynamic, permitting student movement between groups as readiness evolved across cycles, consistent with Tomlinson's (2014) recommendation that differentiation should be responsive and flexible rather than fixed. Table 1 summarizes the characteristics of each readiness group at the study's outset.

Table 1. Distribution of Students by Readiness Level at Baseline

Readiness Level	Number of Students	Characteristics
High	8	Rapid concept grasp; disengagement during slow-paced instruction; ready for independent, challenging work
Moderate	18	Fundamental understanding; confusion with complex reasoning items; require structured support
Low	8	Difficulty with prerequisite algebra; low confidence; need intensive scaffolding

Procedure

Cycle I addressed compound-event probability across two meetings (4 × 45 minutes). During planning, a differentiated lesson plan was developed incorporating content differentiation a reading module for the moderate group, animated videos for visual learners, and illustrated formula cards for the low group and process differentiation, with intensive scaffolding for the low group while the high group independently completed project-based worksheets using prior UTBK problems. Implementation followed the planned design, while observation documented teacher fidelity and student activity. The design of differentiated materials drew on evidence that content differentiation is most effective when material formats whether printed modules, formula cards, or videos are deliberately matched to students' readiness and learning style characteristics rather than kept uniform across groups (Ramdhani et al., 2025; Adawiah et al., 2026). Reflection analyzed Cycle I test results and observations to identify strengths and weaknesses for Cycle II.

Cycle II addressed statistics and data analysis relevant to the UTBK, similarly implemented across two meetings (4 × 45 minutes). Based on Cycle I reflection, readiness group composition was made more flexible, tiered worksheets with graded difficulty were introduced, and product differentiation was added by allowing students to choose their group work presentation format either as an infographic for design-oriented students or as oral/whiteboard explanations for analytically oriented students.

Data Collection Instruments

Three instruments were employed for data collection. First, an achievement test comprising five UTBK-style mathematics reasoning items (complex multiple-choice and matching formats) measured conceptual understanding, logical reasoning, and formula application, administered at each cycle's conclusion. Second, a teacher-and-student observation sheet using a four-point Likert scale (1-4) assessed classroom management, motivation provision, student involvement, and group work effectiveness. Third, a student response questionnaire consisting of five Guttman-scale statements (yes/no or strongly agree/disagree) captured students' comfort and motivation with the differentiated approach, administered after Cycle II.

Data Analysis

Quantitative achievement test and observation data were analyzed using descriptive statistics, specifically class mean scores and mastery percentages (Kriteria Ketuntasan Tujuan Pembelajaran, KKTP score ≥ 75). Qualitative data from observation notes and questionnaires were analyzed descriptively to complement and explain quantitative findings. The action was deemed successful if the class mastery percentage reached at least 85% by Cycle II's conclusion.

RESULTS AND DISCUSSION

Result

Baseline Condition

Prior to intervention, students' mathematics tryout scores averaged 58.4 (0-100 scale), ranging from 35 (lowest) to 80 (highest), with only 35.3% (12 of 34 students) achieving mastery. Pre-intervention observations revealed that students at the rear of the room tended toward passivity and off-task conversation during whole-class explanations, and a substantial comprehension gap was evident: high-readiness students found the pace too slow, while low-readiness students abandoned problems they perceived as overly abstract. This baseline confirmed the inadequacy of uniform instruction for the class's heterogeneous readiness levels and provided empirical justification for the differentiated intervention.

Cycle I: Compound-Event Probability

Following Cycle I's content and process differentiation, the class mean rose to 69.2, with 61.7% (21 of 34) reaching mastery. Observation indicated teacher implementation fidelity of 82% (good category) and increased overall student activity compared to baseline. However, reflection identified two implementation issues: readiness group composition was overly rigid, causing some students to feel constrained within fixed levels, and time allocation for independent worksheet work was disproportionate across groups, leaving low-readiness members confused when working without constant supervision. These findings align with Marks et al. (2021), who observed that DI is rarely optimal upon first implementation and requires iterative refinement grounded in classroom evidence.

Table 2. summarize the progression of learning outcomes across the pre-cycle condition and the two action research cycles.

Assessment Indicator	Baseline Condition	Cycle I Result	Description / Change
Class Mean Score	[Insert baseline, e.g., 58.4]	69.2	Significant increase
Learning Mastery (%)	[Insert baseline, e.g., 35%]	61.7% (21 of 34 students)	Has not reached classical mastery target (e.g., ≥75%)
Teacher Implementation Fidelity	[Insert baseline if available]	82%	Categorized as good, but requires time management adjustments
Student Activity	Low / Passive	Increased	Active participation more visible, especially in high and medium readiness groups

Cycle II: Statistics and Data Analysis

Responding to Cycle I reflection, Cycle II introduced more flexible grouping, tiered worksheets, a help desk mechanism for the low-readiness group, and product differentiation allowing students to choose their preferred group work presentation mode. These adjustments yielded further improvement: the class mean rose to 81.5, mastery reached 88.2% (30 of 34 students), exceeding the 85% success indicator. Teacher implementation fidelity increased to 94%, and observations recorded optimal engagement across all readiness groups. The student questionnaire further indicated that 85% felt more comfortable with mathematics learning because materials matched their ability levels, and UTBK-style reasoning problems seemed more manageable to break down into steps.

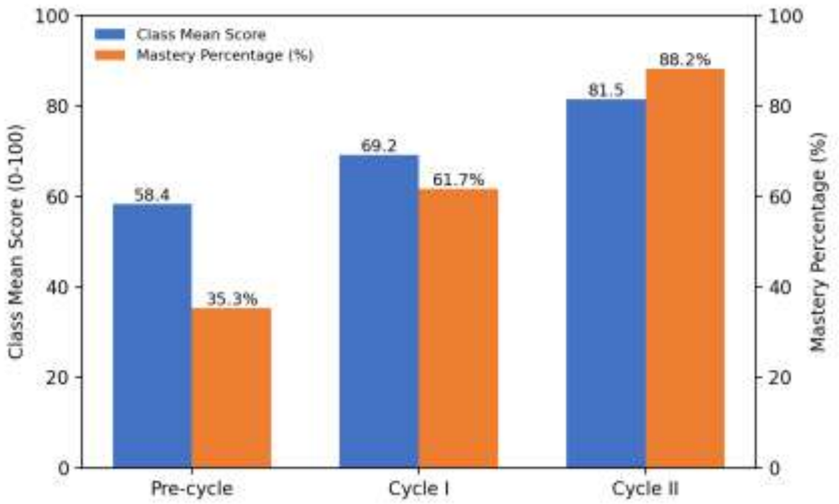
Table 3 and Figure 1 summarize the progression of learning outcomes across the pre-cycle condition and the two action research cycles.

Table 3. Class Mean Score and Mastery Percentage Across Pre-cycle, Cycle I, and Cycle II

Stage/Cycle	Class Mean Score	Students Reaching Mastery	Mastery Percentage
Pre-cycle (baseline)	58.4	12 of 34	35.3%
Cycle I	69.2	21 of 34	61.7%
Cycle II	81.5	30 of 34	88.2%

Building on the reflection from Cycle I, Cycle II introduced more responsive instructional adjustments by strengthening flexible grouping, providing differentiated worksheets, establishing a support mechanism for students who required additional assistance, and allowing greater choice in the format of group presentations. These adaptations created a more inclusive learning environment in which students could engage with mathematical reasoning tasks according to their individual readiness levels. The implementation of differentiated instruction resulted in meaningful improvement in students' learning outcomes, as most learners demonstrated greater confidence, active participation, and independence in solving UTBK-style reasoning problems. Teacher implementation also became more consistent, indicating stronger alignment between instructional planning and classroom practice. Observational data revealed that students across different readiness levels were able to participate more effectively, while questionnaire responses suggested that learners experienced greater comfort and motivation because the learning materials were perceived as more relevant to their abilities. Furthermore, students reported that complex mathematical reasoning tasks became easier to understand when they were presented through structured and manageable problem-solving steps.

Figure 1. Class Mean Score and Mastery Percentage Across Cycles



The consistent upward trend from 35.3% baseline mastery to 88.2% after Cycle II, alongside the corresponding rise in teacher fidelity from 82% to 94%, indicates that achievement improvement was closely associated with more consistent and better-targeted DI implementation, not merely repeated exposure to test-style items. This finding corroborates Van Geel et al. (2019), who emphasized that DI's effectiveness depends substantially on implementation consistency and quality rather than design alone. It also aligns with Konstantinou-Katzi et al. (2013), whose tertiary calculus action research similarly found improved engagement and understanding through DI, and with Syarifuddin and Nurmi (2022), who reported comparable mathematics outcome gains among Indonesian secondary students through DI across action research cycles. The magnitude of observed gain parallels that reported in a recent quasi-experimental study of a differentiated, learning-style-based e-module for junior secondary mathematics, which found statistically significant numeracy advantages for the differentiated group over conventionally taught controls (Triyono et al., 2026), suggesting that DI benefits observed through CAR converge with those obtained under more controlled experimental designs.

Discussion

The findings demonstrate that DI implementation across two CAR cycles successfully enhanced twelfth-grade students' mathematical reasoning readiness for the UTBK. The most notable finding was increased participation and confidence among moderate- and low-readiness groups following Cycle II's product differentiation (Clark &

Nillas, 2025). This suggests that DI is not merely generally effective but exerts disproportionately greater impact on student subgroups often marginalized in conventional mathematics instruction (Whittington-Jones, 2013).

DI's success in the UTBK preparation context can be interpreted through Vygotsky's Zone of Proximal Development (ZPD) framework (Geletu & Mihiretie, 2024). In differentiated classrooms, teachers intentionally design tasks within each student's ZPD sufficiently challenging to stimulate cognitive growth yet not so difficult as to induce frustration (Liang et al., 2024). In Cycle I, content and process differentiation enabled access to materials at respective readiness levels. However, Cycle II's product differentiation yielded greater benefits for low- and moderate-readiness groups, suggesting that offering demonstration choices can lower psychological barriers preventing these students from engaging with complex reasoning tasks (Krysiak, 2020).

The observed DI effectiveness can be explained through complementary theoretical frameworks. Cognitive load theory explains that variations in prior knowledge reflect differences in cognitive load experienced during problem-solving (Aini & Retnowati, 2023). These researchers demonstrated that DI can reduce students' cognitive load during learning, although its effectiveness in improving problem-solving ability was comparable to non-differentiated instruction. In the UTBK context requiring higher-order reasoning, reducing extraneous cognitive load through readiness-aligned content presentation enables students to allocate working memory for deeper processing (Lempp & Tyler, 2024).

Constructivist theory emphasizes that knowledge is actively constructed through interaction with the learning environment (Prasad et al., n.d.). DI facilitates this construction by providing multiple entry points and pathways toward common learning objectives. Product differentiation's significant benefits support the view that students require autonomy in choosing how to construct and demonstrate understanding (Tomlinson, 2014, as cited in Chestnutt, 2025). Tomlinson (2014) asserts that differentiating learning products gives students varied demonstration avenues aligned with their strengths, which in high-stakes test preparation contexts translates into broader willingness to attempt reasoning-based problems.

Gardner's multiple intelligences theory provides justification for DI's multisensory approach (Chestnutt, 2025). Indonesian research indicates that expert teachers apply content differentiation based on multisensory learning styles and differentiate processes through multidimensional strategies connecting readiness, learning styles, and interests (Universitas Negeri Surabaya, n.d.). In UTBK preparation, this approach enables students with different learning profiles—visual, auditory, or kinesthetic to access reasoning materials through their most effective modalities (Lempp & Tyler, 2024).

These findings reinforce and extend prior DI research in mathematics education. Konstantinou-Katzi et al. (2013) found DI effective in improving achievement in heterogeneous classrooms; the present study confirms these findings while adding a specific contextual variation preparation for Indonesia's highly competitive university entrance examination (Refleksi tentang pembelajaran berdiferensiasi, 2026).

Marks et al. (2021) developed a DI practice framework for Australian secondary mathematics teachers emphasizing pedagogical content knowledge, teacher efficacy, and formative assessment. The present study enriches these findings by demonstrating that effective DI implementation in examination-preparation contexts requires not only content and process modification but also particular attention to product differentiation as a confidence- and engagement-building strategy (Geletu & Mihiretie, 2024).

Syarifuddin and Nurmi (2022) and Triyono et al. (2026) have documented DI effectiveness in Indonesian mathematics contexts. This study contributes new evidence that DI is specifically effective for preparing students for UTBK's increasing reasoning demands (Universitas Negeri Surabaya, n.d.). This finding aligns with Geletu and Mihiretie (2024), who showed that teacher professional development in DI can improve differentiated practices and student engagement, though they also identified challenges in aligning DI practices with diverse learning outcomes.

This study's novelty lies in integrating DI with Indonesia's high-stakes examination preparation context. Most prior research focused on DI in regular instruction or for special needs students (Whittington-Jones, 2013). This study demonstrates DI's relevance not only to inclusive education but also as an effective strategy for maximizing all students' potential in high-reasoning assessments like UTBK. This finding extends DI literature by showing that product differentiation often overlooked relative to content and process differentiation plays a critical role in building confidence and engagement among low and moderate readiness students (Clark & Nillas, 2025; Krysiak, 2020).

These findings carry significant implications for Indonesian teachers, schools, and policymakers. For senior high school mathematics teachers, this research highlights the importance of systematically adopting DI in UTBK preparation, not merely through varied practice questions but by designing instruction that holistically considers students' readiness, interests, and learning profiles (Liang et al., 2024). Teachers need to develop capacity for identifying readiness levels through ongoing formative assessment and using that data to design appropriate learning experiences (Marks et al., 2021).

For schools, this study indicates the need for systemic DI support, including adequate planning time, diverse learning resources, and sustained professional development. Liang, To, and Lo (2024) demonstrate that teacher empowerment in DI requires a three-stage journey mediated by internal and external factors, with implications for sustainable professional development models. Schools should cultivate collaborative cultures where teachers share best practices and learn from each other about effective DI strategies (Geletu & Mihiretie, 2024; Al-Arif et.al, 2026).

For policymakers, these findings provide evidence that DI is a contextual and relevant strategy for improving Indonesian secondary education quality. Policies supporting curriculum flexibility, reduction of teachers' administrative burdens, and investment in DI-based professional development can contribute to improved UTBK readiness (Refleksi tentang pembelajaran berdiferensiasi, 2026). Policymakers should recognize that effective DI implementation requires a paradigm shift from teacher-centered to student-centered learning (Lempp & Tyler, 2024).

Theoretically, this study extends understanding of DI application in classrooms with highly heterogeneous academic abilities and high examination pressure. The finding that product differentiation had greater impact on low- and moderate-readiness groups suggests that DI theory should more explicitly consider the affective dimension of learning self-confidence, motivation, and engagement as a critical mechanism linking DI practices to learning outcomes (Clark & Nillas, 2025).

This study also enriches Vygotsky's theory by demonstrating that ZPD concerns not only task difficulty but also how students can demonstrate understanding. By providing choice in learning products, teachers effectively expand students' ZPD through varied scaffolding via different demonstration formats (Geletu & Mihiretie, 2024). This aligns with the view that learning is a complex social and cognitive process in which affective and contextual factors significantly determine success (Prasad et al., n.d.).

Furthermore, this study contributes to DI literature in Indonesia by showing that although DI remains relatively new for Indonesian teachers, careful implementation through classroom reflection cycles can produce significant improvements in student readiness (Universitas Negeri Surabaya, n.d.). This finding supports the importance of CAR as a method for developing and refining DI practices in specific local contexts (Refleksi tentang pembelajaran berdiferensiasi, 2026).

CONCLUSION

This classroom action research demonstrates that iterative implementation of differentiated instruction (DI) through two reflective cycles effectively enhanced twelfth-grade students’ readiness for the UTBK mathematics reasoning subtest at MA Sunan Prawoto Pati. Students’ mean scores increased from 58.4 at baseline to 69.2 in Cycle I and 81.5 in Cycle II, while mastery achievement improved from 35.3% to 88.2%. These improvements indicate that DI, when systematically aligned with students’ readiness levels, reasoning-based assessment characteristics, and continuous classroom reflection, can create more adaptive mathematics learning experiences for heterogeneous learners. The findings contribute empirical evidence that differentiated instruction is not merely an approach for addressing learning diversity but also a strategic pedagogical framework for preparing madrasah students to engage with high-stakes mathematical reasoning assessments. This study highlights the importance of flexible grouping, adaptive task design, and reflective instructional adjustment in strengthening students’ mathematical confidence and readiness.

However, the findings should be interpreted within the study’s contextual limitations. The research involved a limited number of students from a single madrasah and was implemented within a relatively short intervention period, which restricts broader generalization and long-term evaluation of learning outcomes. In addition, the researcher’s dual role as implementer and interpreter may have introduced potential bias, a common challenge in classroom action research. Future studies should investigate DI implementation across diverse educational settings using larger samples, longer intervention periods, and comparative research designs to examine its sustained impact on mathematical reasoning development. Further exploration is also needed to identify scalable differentiation models supported by teacher professional development and technology-enhanced learning environments, particularly for madrasah and other resource-constrained educational contexts.

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