



PROCEEDINGS

International Conference on Education
Faculty of Tarbiyah | UIN Syekh Wasil Kediri
E-ISSN: 3025-6828

Volume 4, 2026

The Implementation of Differentiated Mathematics Instruction: Challenges of Instructional Uniformity at Madrasah Aliyah Kediri

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Abstract:

This study examines the diversity of students' abilities, learning styles, and learning readiness, which calls for a responsive approach to mathematics instruction tailored to individual needs. Differentiated instruction adjusts learning content, processes, and products to students' individual needs, in line with the National Education Process Standards, which emphasize student-centered, meaningful, and enjoyable learning. This study aims to describe the concrete implementation of differentiated mathematics instruction and assessment among students at Madrasah Aliyah Negeri (MAN) 1 Kediri, East Java. The study employed a descriptive qualitative approach. Research participants were selected purposively and comprised two mathematics teachers and two tenth-grade students with contrasting achievement levels (above and below the average), supported by information from the Vice Principal for Curriculum. Data were collected through interviews, classroom observations, and documentation, and were analyzed using the Miles and Huberman interactive model. The findings indicate that differentiated instruction began with mapping student diversity through cognitive and affective diagnostic assessments, followed by the development of teaching modules integrating content, process, and product differentiation. Instruction was implemented through a Project-Based Learning approach involving a clinometer project on trigonometry, flexible grouping, proactive scaffolding, and cross-group peer learning. Differentiated assessment encompassed diagnostic, observational formative, and digital summative assessment to ensure individual accountability. Time constraints were addressed through a combination of digital technology, standardized written instruments, and peer tutoring as a comprehensive monitoring mechanism.

Keywords: Differentiated Instruction, Project-Based Learning, Mathematics, Madrasah Aliyah

Introduction

Law No. 20 of 2003 on the National Education System stipulates that the purpose of national education is to develop individual capabilities and build the character of a dignified nation in order to educate the life of the nation (Nada & Trisoni, 2022). To achieve this goal, the Ministry of Education and Culture introduced the Merdeka Curriculum, which emphasizes skills development, character building, and learning that can be adapted to students' needs, while encouraging teachers to adjust their instructional approaches to become more responsive to student diversity (Tunas, Daniel, & Pangkey, 2024; Nisa, Ginting, & Ananda, 2025).

Mathematics plays an essential role in developing logical, critical, and systematic thinking skills (Kristanto, Taqiyuddin, Yulfiana, & Rukmana, 2022; Fuadi, 2015). Nevertheless, Indonesian students' mathematical literacy remains relatively low compared with international standards (Angriani et al., 2024), while differences in students' abilities to understand mathematical concepts call for an adaptive approach. The twenty-first century has been described as an era of superdiversity, which is clearly reflected in the diversity of students in classrooms (Dianto, Hasanah, Arbi, & Laksana, 2025). Consequently, a one-size-fits-all approach is no longer considered relevant to the needs of all students.

Differentiated instruction involves adapting learning content, processes, products, and environments to students' individual needs (Tomlinson & Imbeau, 2010; Wahyuningsari et al., 2022). This approach aims to accommodate the diverse learning needs of students (Fitriyah & Bisri, 2023) and has been shown to improve learning outcomes (Krishan, 2023; Mohammed et al., 2022). It is also relevant to the Merdeka Curriculum and aligns with Ki Hajar Dewantara's educational philosophy, which emphasizes respect for individual differences among learners (Ashari, Hasudungan, & Nababan, 2024; Karolina Milenia Parera et al., 2024).

Assessment is an integral element of differentiated instruction because it enables teachers to understand students' unique needs before designing learning activities (Sari et al., 2025; Mardiana, Haryati, & Wahyuni, 2021). Without comprehensive diagnostic assessment at the beginning of instruction, differentiation efforts tend to rely on assumptions and may fail to address students' actual needs.

Preliminary observations and initial interviews conducted by the researchers at MAN 1 Kediri in March 2025 revealed a gap between teachers' conceptual understanding of differentiated instruction and their ability to implement it consistently in the classroom. Teachers reported having attended Merdeka Curriculum training; however, time constraints, administrative workloads, limited post-training support, and the absence of planned diagnostic assessments had made differentiated practices difficult to sustain. At the same time, the preliminary observations identified another mathematics teacher at the same madrasah who had successfully implemented differentiated instruction in practice, from diagnostic-assessment-based planning to responsive formative assessment. The contrast between these practices within a single institution makes MAN 1 Kediri a valuable setting for documenting and analyzing established good practices in differentiated mathematics instruction.

Previous studies on differentiated instruction have been conducted predominantly in general schools, while research at the Madrasah Aliyah level within the

framework of the Merdeka Curriculum remains limited. Therefore, this study aims to describe and analyze the implementation of differentiated mathematics instruction and assessment among students at MAN 1 Kediri. The study focuses on content, process, and product differentiation, as well as the implementation of diagnostic, formative, and summative assessment as an integrated learning cycle.

Methods

This study employed a qualitative approach with a descriptive design, which emphasizes an in-depth understanding of the meaning, processes, and context of a phenomenon in its natural setting (Sugiyono, 2013). Participants were selected purposively and consisted of two tenth-grade mathematics teachers and two tenth-grade students at MAN 1 Kediri. The teachers were selected because they had implemented differentiated instruction within the Merdeka Curriculum, while the students were selected based on diagnostic assessment results to represent contrasting ability levels: one student performing above the average and one performing below the average. In addition, information was obtained from the Vice Principal for Curriculum regarding the institutional policies underlying the implementation of differentiated instruction.

The study was conducted at MAN 1 Kediri, Kediri Regency, East Java. This location was selected because mathematics teachers at the madrasah had implemented differentiated instruction and assessment in a planned manner; the level of implementation maturity varied among teachers within the same institution; and empirical documentation of differentiated mathematics instruction at the Madrasah Aliyah level remains limited.

The research data comprised primary data from teachers, students, and the Vice Principal for Curriculum, as well as secondary data in the form of lesson plans/teaching modules, student worksheets, diagnostic and formative assessment instruments, and student assessment results. Data were collected using three complementary techniques: classroom observation, in-depth interviews, and documentation (Hasanah, 2016; Fadila & Khaddafi, 2025). Observations focused on the four indicators of differentiated instruction proposed by Tomlinson: content, process, product, and learning-environment differentiation, as well as the implementation of diagnostic, formative, and summative assessment. Interviews were conducted with three groups of informants (the Vice Principal, two mathematics teachers, and two students) to obtain managerial and pedagogical perspectives, as well as insights into students' learning experiences.

The data were analyzed qualitatively using the interactive model of Miles, Huberman, and Saldana (2014), which involves data reduction, data display, and conclusion drawing and verification, with the researcher serving as the primary instrument (Waruwu, 2024). Data trustworthiness was ensured through four forms of triangulation: method triangulation, data-source triangulation, member checking, and theory triangulation (Alfansyur & Mariyani, 2020).

RESULTS AND DISCUSSION

The study was conducted in a tenth-grade mathematics class, with Trigonometric Ratios and Their Applications serving as the main context for implementing differentiated instruction. The following results and discussion are organized around six interrelated dimensions of implementation: content, process, and product differentiation, as well as diagnostic, formative, and summative assessment.

1. Content Differentiation

Content differentiation was incorporated into the teaching module through a range of instructional media as an integral part of the module's structure rather than as supplementary materials. PowerPoint presentations were provided for students with visual learning preferences, while clinometers were used for students with kinesthetic learning preferences. In practice, both media were used alongside one another: the visual PowerPoint presentations contained diagrams and animations, while the student-made clinometers provided a qualitatively different yet equivalent kinesthetic learning pathway. An introductory question-and-answer activity on the Pythagorean Theorem was also used to assess students' readiness before determining the depth of prerequisite-concept explanations delivered through each medium.

These findings are consistent with Susanti (2026), who found that teachers with strong pedagogical competence apply differentiation adaptively from the planning stage. Similarly, Hery, Abduh, and Sutisna (2025) reported that a systematically developed differentiated learning module received a "Good" rating, with a validity score above 90%, and was effective in improving learning motivation. Rahma, Damayanti, Widyanto, and Febriansyah (2026) also found that supporting visual learners through diagrams and kinesthetic learners through hands-on practice increased motivation and participation. This is further supported by Afdilah and Bahri (2026), who reported that visual learners benefited most from multimedia, whereas kinesthetic learners experienced significant improvement through hands-on activities. The main constraint identified was the limited instructional time (2×45 minutes), which restricted teachers' ability to ensure every student's understanding. Consequently, teachers relied on the Wayground platform and individual observation sheets as additional monitoring mechanisms.



Figure 1. Construction of a Clinometer as a Kinesthetic Learning Pathway

2. Process Differentiation

Process differentiation was designed through individualized scaffolding and the allocation of roles based on students' strengths. Students were grouped according to their conceptual, manual-kinesthetic, and creative strengths across three consecutive sessions: visual conceptual understanding, hands-on exploration in the field, and group project presentations. The teacher actively moved around the classroom, asked questions, provided immediate corrections, and recommended peer tutoring when direct assistance was not effective.

Grouping based on learning readiness should not be understood as permanent labeling, but rather as a flexible and adaptive diagnostic mechanism (Karmilawati & Yani, 2024; Febrianti & Zulpiani, 2025). Hafiz et al. (2025) emphasize that effective process differentiation requires teachers to identify individual needs and design flexible strategies. Meanwhile, Risnawati, Iswandhiari, and Nahwiyah (2023) demonstrated that scaffolding accompanied by continuous monitoring can significantly increase student engagement. When one approach proves ineffective, peer tutoring serves as a second layer of intervention, consistent with the findings of Pratiwi, Sari, and Langgi (2025), who reported that this method can substantially improve learning outcomes.

The most persistent challenge was limited instructional time, which constrained the depth of individual observation of all 24 students simultaneously. A similar challenge was identified by Defianty and Wilson (2024) among teachers in Indonesia, although it can be addressed through instructional modifications and technology integration. In response, the teachers in this study combined three mechanisms: the Wayground platform to make summative grading more efficient, individual observation sheets to detect social loafing, and peer tutoring to distribute the mentoring workload. This strategy is consistent with Umayrah and Wahyudin (2024), who found that combining independent student instruments is essential to sustaining differentiated instruction when teacher capacity is limited.



Figure 2. Implementation of Project-Based Differentiated Instruction in the Classroom

3. Product Differentiation

Product differentiation gives students the freedom to select measurement objects and project-report formats, either as posters created using Canva or videos produced using CapCut. These choices remain aligned with the same learning objectives and assessment rubric, meaning that only the mode of expression differs. Implementation is evaluated based on the depth of understanding demonstrated by students during group presentations.

These findings support Misnawati et al. (2023), who demonstrated that product differentiation as an alternative form of assessment significantly improves students' understanding compared with conventional methods. They are also consistent with Agung (2024), who found that combining product differentiation with Project-Based Learning substantially improves students' cognitive achievement while also enhancing affective and psychomotor domains. The freedom to choose a report format in this study represents a practical application of this principle: students are given diverse ways to express their learning while remaining subject to consistent and accountable assessment standards. The main challenge remains the limited time available to ensure that every group receives an equal level of guidance.

4. Diagnostic Assessment

Diagnostic assessment was conducted through two complementary approaches. The cognitive component involved oral question-and-answer activities on prerequisite concepts (right-angled triangles and the Pythagorean Theorem), while the non-cognitive component consisted of an 18-item learning-interest questionnaire and an affective ice-breaker activity. The results were used directly to determine the depth of prerequisite-concept discussions and the composition of learning groups. Thus, the assessment served as a foundation for instruction rather than as a means of assigning permanent labels to students.

Differentiated instruction cannot be planned without a comprehensive understanding of students' initial readiness (Samsudin, 2020; Puspita, 2026). Affective dimensions and student interests also provide an important foundation for meaningful planning (Herwina, 2021). Riyanto (2026) demonstrated that the integrated

consideration of cognitive, affective, and psychomotor domains can substantially improve overall mastery. Preliminary classroom activities used as initial assessment instruments have also been shown to significantly influence students' learning readiness (Eka, Siregar, & Meldi, 2025; Pangestu Al-Muwattho, 2018). Instrument efficiency is another critical practical consideration given the time-management challenges faced by teachers (Wahyuni & Ardiansyah, 2024; Kholid, Rahman, & Irawan, 2024). Nevertheless, Ertando and Zulkarnaen (2026) caution that an ideal diagnostic instrument must balance ease of administration with psychometric accuracy. In this study, the oral question-and-answer activity was qualitative and had not been psychometrically standardized; therefore, its interpretation remained dependent on the teacher's judgment. This limitation should be acknowledged and may serve as a direction for future instrument development.



Figure 3. Implementation of Diagnostic Assessment at the Beginning of the Lesson

5. Formative Assessment

Formative assessment was implemented using a group-project rubric comprising six indicators: project planning, clinometer construction, measurement and calculation, presentation media, teamwork, and presentation skills. The maximum score was 24 and was converted to a 100-point scale. The rubric was supplemented by individual observation sheets to assess collaboration, creativity, and critical reasoning. Assessment took place throughout the learning process as the teacher circulated to monitor clinometer construction and observe group dynamics during presentations, rather than being conducted only midway through the learning cycle.

This layered formative assessment system can capture learning-process dynamics more comprehensively than a single written test, particularly because it can identify social loafing (Hajar Dewanti et al., 2024; Utami et al., 2025). Separating assessments of individual contributions from group achievement is important because mechanisms that fail to distinguish between the two may conceal actual disparities in participation (Tosuntaş, 2020). By contrast, systems that make individual contributions separately visible and measurable have been shown to reduce the tendency toward social loafing (Fitriana & Saloom, 2018; Melati et al., 2024). The main challenge remained limited time, as it was difficult to observe all 24 students individually while simultaneously monitoring

group dynamics (Damanik et al., 2025). Therefore, teachers relied on individual observation sheets to detect social loafing and peer tutoring to distribute the mentoring workload.



Figure 4. Learning Process and Observation during Group Formative Assessment

6. Summative Assessment

Summative assessment was conducted through an individual quiz on the Wayground platform, consisting of five questions covering a broad range of cognitive levels, from calculating the tangent ratio to identifying errors in measurement procedures. The platform provided real-time scores and a graphical dashboard showing the score distribution for the entire class, which teachers could review immediately. Students responded positively to this feature because of its transparency.

The use of different cognitive levels based on Bloom's Taxonomy in the summative assessment ensured that all students had a fair opportunity to demonstrate their mastery. An incomplete distribution of cognitive levels may restrict opportunities for high-achieving students (Jannah, Mahanal, & Mashfufah, 2023), while an assessment dominated by higher-order thinking skills (HOTS) questions may prevent lower-achieving students from engaging successfully from the outset (Prakarsa Arzfi, Ananda, & Fitria, 2022). The instant-feedback feature of digital platforms enables students to evaluate their own understanding, increase their motivation (Jong & Tacoh, 2024), and identify and correct specific mathematical errors (Nainggolan & Listiani, 2024). To address structural constraints arising from limited instructional time, teachers combined Wayground for efficient grading, individual observation sheets to detect social loafing, and peer tutoring to distribute the mentoring workload. This approach is consistent with Rabiatal Adawiyah (2023), who found that peer assessment provides substantially more time for assessment than relying solely on teacher assessment, and Yuliana (2022), who confirmed the effectiveness of peer tutoring in improving student learning outcomes.

Conclusion

The implementation of differentiated mathematics instruction among students at MAN 1 Kediri demonstrates that mapping student diversity through cognitive and affective diagnostic assessment is an essential prerequisite for ensuring the relevance of subsequent instructional decisions. Teaching modules that explicitly and integratively incorporate content, process, and product differentiation transform differentiation from an instructional intention into a verifiable teaching practice. This is realized through a clinometer-based Project-Based Learning approach involving flexible grouping based on students' strengths, proactive scaffolding, and freedom of expression within consistent assessment standards. Assessment is not a standalone component of this instruction but an integral part of the entire learning cycle: diagnostic assessment provides the foundation for planning; formative assessment monitors the learning process and helps detect and prevent social loafing by distinguishing individual and group performance; and summative assessment, with proportionate cognitive-level coverage and immediate digital feedback, provides a measurable and transparent indication of final achievement. Structural challenges, particularly limited instructional time and large class sizes, can be addressed pragmatically through a strategic combination of digital technology, standardized written instruments, and the distribution of monitoring responsibilities through peer tutoring. These findings provide empirical insight into the implementation of differentiated mathematics instruction in the Madrasah Aliyah context, an area that has been relatively underdocumented, and offer practical guidance for mathematics teachers in other madrasahs. Future research is recommended to employ comparative or quasi-experimental designs to measure the impact of differentiated instruction on learning outcomes, and to develop and validate contextualized mathematics diagnostic assessment instruments for the Madrasah Aliyah level.

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