HNUE JOURNAL OF SCIENCE
Journal of Educational Science 2026, Volume 71, Issue 6, pp. 129-142
ISSN: 2354-1075; Website: https://hnuejs.edu.vn/es
DOI: 10.18173/2354-1075.2026-0095

ANALYSIS OF THE APPLICATION OF DIFFERENTIATED INSTRUCTION IN CHEMISTRY LEARNING AT MA PEMBANGUNAN UIN JAKARTA

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Received: July 24, 2026. Revised: September 26, 2026. Accepted: September 29, 2026.

Abstract. Differentiated instruction (DI) is a core pedagogical expectation of Indonesia's Merdeka Curriculum, yet evidence on how it is enacted in secondary chemistry, particularly in *madrasah* (Islamic schools under the Ministry of Religious Affairs), remains limited and is often confined to a single component of DI. This qualitative case study analyzed how DI is understood and applied in chemistry learning at MA Pembangunan UIN Jakarta. It addressed four research questions concerning (1) the teacher's understanding of DI; (2) the identification of learners' readiness, interests, and learning profiles; (3) the differentiation of content, process, product, and learning environment; and (4) the planning, monitoring, and evaluation of DI and the challenges encountered. Data were obtained from the chemistry teacher as the key informant through semi-structured interviews, from classroom observations of 30 Grade X students, and from documents (teaching modules, assessment instruments, student products, and portfolios), and were analyzed using the Miles, Huberman, and Saldaña interactive model with source and technique triangulation. The teacher conceptualized DI as a strength-based approach grounded in the belief that every student has potential. Learner needs were mapped through non-cognitive and cognitive diagnostic assessments, matriculation, subject clubs, and a cultural background check. Differentiation was most developed in process and product, where students were grouped by learning style and produced podcasts, posters, and ecoprinting products, whereas content differentiation relied mainly on tiered materials. Progress was monitored through diagnostic, formative, and summative assessments and portfolios. The main challenges were managing the preparation workload, supervising several groups simultaneously, and dealing with insufficient time allocation. DI in chemistry therefore needs multi-meeting planning and institutional support for teachers.
Keywords: differentiated instruction; chemistry learning; Merdeka Curriculum; Madrasah; qualitative case study

1. Introduction

Students in every classroom differ in prior knowledge, learning pace, interests, learning preferences, and sociocultural backgrounds. Uniform instruction tends to treat these differences as obstacles and serves students at both ends of the ability range poorly (Widyawati & Rachmadyanti, 2023). Differentiated instruction (DI) responds by proactively adapting content, process, product, and the learning environment to students' readiness, interests, and learning profiles (Tomlinson, 2017; Goyibova et al., 2025). In Indonesia, DI is a formal expectation of the Merdeka Curriculum. The curriculum gives teachers flexibility to adjust learning, focuses on essential content, and strengthens the Pancasila student profile through project-based learning (Halimah et al., 2023; Nafi'ah et al., 2023). For madrasah, implementation is regulated by Decree of the Minister of Religious Affairs No. 347 of 2022 (Kementerian Agama Republik Indonesia, 2022). DI is therefore an expected part of chemistry teachers' practice in madrasah aliyah.

Chemistry is a demanding context for DI because students must connect macroscopic, submicroscopic, and symbolic representations (Luviani et al., 2021), and they differ in how easily

they move between these levels. DI has therefore been proposed to help more students understand chemistry (Ibnuzaman et al., 2024; Melyana et al., 2025). Process differentiation improved learning outcomes on the mole concept (Melyana et al., 2025). Learning-style-based product differentiation on acid–base topics let visual, auditory, and kinesthetic students express their understanding in different forms (Minarni et al., 2024). Using the CIPP model in three high schools in Jakarta and Bekasi, Muhab et al. (2024) found that learning-style-based modules and diagnostic pretests increased student engagement. In Malaysia, DI tailored to students' intelligences promoted active learning and confidence (Ibnuzaman et al., 2024).

Persistent weaknesses remain, however. Only about half of the teachers in some schools differentiated consistently, and curriculum density limited the time available (Muhab et al., 2024). Teachers struggle to identify students' profiles (Mastuti et al., 2022) and to adjust activities and assessment (Widiastuti et al., 2023). DI also brings heavy planning demands and stress (Pozas et al., 2023; Daşçıoğlu & Bümen, 2025). Whether teachers enact it depends on their beliefs, including a growth mindset and a student-oriented ethical compass (Gheyssens et al., 2022). Professional development improves teachers' attitudes and knowledge but has mixed effects on classroom practice (Langelaan et al., 2024). Most chemistry studies are quasi-experimental and examine a single component, and qualitative accounts of the whole DI cycle are scarce. Even a recent qualitative study was set in a public school and gave limited detail on its participants and instruments (Fakhriyana et al., 2026).

Three gaps follow. First, little is known about chemistry DI in madrasah, which combine the national science curriculum with religious education under a distinct regulatory framework. Second, studies rarely link teachers' understanding of DI to how learners' needs are identified and translated into differentiation of content, process, product, and environment. Third, planning, monitoring, evaluation, and the challenges teachers face are seldom documented as one coherent account. This study addresses these gaps at MA Pembangunan UIN Jakarta, which has applied DI in chemistry under the Merdeka Curriculum since 2023. It traces the full DI cycle rather than single outcomes. It triangulates interview, observation, and documentary data from an under-represented madrasah setting. It also documents overlooked practices, such as checking students' cultural backgrounds and linking products like podcasts and ecoprinting to everyday chemistry.

The analysis matters for three reasons. Chemistry teachers in madrasah need contextual examples of how to put DI into practice, not only general guidelines. Inconsistent implementation and heavy workload (Muhab et al., 2024; Pozas et al., 2023) risk reducing DI to a formality. Detailed accounts of practice can also inform professional development and school policies on time allocation and support (Langelaan et al., 2024). This study therefore analyzes DI in chemistry learning at MA Pembangunan UIN Jakarta, guided by four research questions: (RQ1) How does the chemistry teacher understand differentiated instruction? (RQ2) How does the teacher identify learners' readiness, interests, and learning profiles? (RQ3) How are content, process, product, and the learning environment differentiated in chemistry learning? (RQ4) How does the teacher plan, monitor, and evaluate DI, and what challenges are encountered?

2. Method

2.1. Research design and setting

This study used a qualitative approach with a single-case study design because it sought an in-depth understanding of how DI is enacted in a real classroom setting rather than to measure its effects. The case was chemistry learning at MA Pembangunan UIN Jakarta, which was selected purposively because it implements the Merdeka Curriculum and has applied DI in chemistry learning. Data were collected from January to July 2025. The school principal granted permission to conduct the study and to name the school in this manuscript. The teacher gave informed

consent, is identified only by initials, and no student identities are reported. Photographs were used with the school's permission and students' permission to show their faces.

2.2. Research subjects

The key informant was one chemistry teacher (initials FMS), selected purposively because the teacher designs and implements DI in chemistry at the school. The teacher has 18 years of teaching experience and has attended training on DI. The observation involved 30 Grade X students (15 males and 15 females) in one class during the topics of nano technology and ecoprinting, observed across four meetings. Students were observed as part of the learning setting and were not interviewed.

2.3. Instruments and data collection

Three instruments were used (Table 1). The first was a semi-structured interview guide consisting of 10 questions organized into five aspects that correspond to the research questions. The interview was conducted face to face, lasted approximately 45 minutes, and was audio-recorded with permission and transcribed verbatim. The second was an observation sheet used to record student grouping, learning activities, task and product variations, classroom arrangement, teacher–student interaction, and teacher supervision of groups. The third was a documentation checklist used to analyse teaching modules, assessment instruments, student products, portfolios, and photographs of learning activities.

Table 1. Research instruments, aspects examined, and related research questions

Instrument	Aspects examined	RQ
Semi-structured interview guide (chemistry teacher)	(a) Meaning and importance of DI; (b) identification of readiness (initial ability, learning style, special needs), interests, and learning profiles (learning pace, preferences, cultural background); (c) strategies for content, process, and product differentiation; (d) physical and psychological learning environment; (e) planning of modules and assessment, progress monitoring, evaluation of effectiveness, challenges, and follow-up.	RQ1–RQ4
Observation sheet (classroom)	(a) Basis and composition of student grouping; (b) learning methods and activities of each group; (c) variation of tasks and products; (d) classroom layout and use of learning resources; (e) teacher–student interaction and classroom climate; (f) teacher's supervision of and feedback to groups.	RQ3–RQ4
Documentation checklist	(a) Teaching module (learning objectives, diagnostic results, differentiated activities); (b) assessment instruments and rubrics (formative, summative, peer assessment); (c) student products and portfolios; (d) photographs of learning activities and online documentation of products.	RQ2–RQ4

2.4. Data analysis and trustworthiness

Data were analyzed using the interactive model of Miles et al. (2020), consisting of data condensation, data display, and conclusion drawing and verification. In the condensation stage, the transcripts, observation notes, and documents were coded using a priori codes derived from Tomlinson's (2017) framework (readiness, interest, learning profile, content, process, product, learning environment, planning, monitoring, and evaluation), while new codes such as "challenges" and "follow-up" were allowed to emerge. The coded data were then displayed in matrices (e.g., Table 2) and compared across sources before conclusions were drawn. Credibility was established

through source triangulation (interview, observation, and documents) and technique triangulation, and through member checking with the teacher-author to confirm the interpretations.

3. Results and Discussion

The results are presented according to the research questions: Section 3.1 answers RQ1, Section 3.2 answers RQ2, Sections 3.3 and 3.4 answer RQ3, and Section 3.5 answers RQ4.

3.1. Chemistry teacher's understanding of differentiated instruction (RQ1)

The teacher understands DI as a strength-based approach: every student is believed to have potential, and the diversity of student characteristics and learning styles is regarded as an asset rather than a problem. "Differentiated learning is … seeing the strengths … that exist within students. So, there are no stupid students or incapable students, but they each have their own strengths …" [INT-FMS]

The teacher also considers DI important because knowing students' abilities enables the teacher to direct their development. The teacher stated: "Because each student has their own abilities and competencies. So, when we study these students, we already know what their learning abilities are, and we can develop them in a better direction…" [INT-FMS] Table 2 summarizes the teacher's understanding across six aspects.

Table 2. The chemistry teacher's understanding of differentiated instruction by aspect

Aspect	Interview evidence [INT-FMS]	Researchers' interpretation
Meaning of DI	"…seeing the strengths …that exist within students."	Strength-based conception; DI is seen as a way of viewing students, not only as a technique.
View of students' ability	"… there are no stupid students or incapable students, but they each have their own strengths…"	Reflects a growth-mindset orientation.
Purpose of DI	"…when we study these students, we already know what their learning abilities are, and we can develop them in a better direction…"	DI starts from knowing students (diagnosis) before acting.
Basis of differentiation	"… non-diagnostic assessments, where we test them in terms of auditory, visual, or kinesthetic intelligence…"; "…cognitive diagnostic tests…"	Readiness and learning profile are recognized; learning profile is mainly equated with VAK learning styles.
Elements differentiated	"…content differentiation should be divided into high, middle, and low learning abilities…"; products are chosen according to learning style	The teacher recognises content, process, and product as elements of DI.
Conditions for success	"…2 hours of lessons is not enough, nor is 1 meeting, but if possible, it should be around 3–4 times…"	Awareness that DI requires extended time and planning.

The teacher holds a coherent and positive conception of DI that covers why to differentiate (students' diverse strengths), on what basis (readiness and learning profile), and what to differentiate (content, process, and product). The belief that "there are no stupid students" is consistent with a growth-mindset orientation, which is an important precondition for differentiating in practice. However, the teacher's notion of learning profile is largely limited to visual–auditory–kinesthetic (VAK) learning styles and multiple intelligences, while interest receives less emphasis in the teacher's definition.

This understanding is consistent with Ibnuzaman et al. (2024), whose chemistry teachers also described DI as addressing students' interests, readiness, and learning styles, and with Muhab et al. (2024), who found that teachers built modules around VAK styles. It also supports Gheyssens et al. (2022), who showed that teachers who combine a growth mindset with a student-oriented

ethical compass differentiate more frequently. The teacher's belief that DI improves learning is in line with evidence of improved chemistry achievement and learning outcomes (Özüdoğru, 2022). By contrast, the strong reliance on learning styles should be treated with caution, because empirical support for matching instruction to learning styles is weak (Brown, 2023); in Tomlinson's (2017) framework, learning profile is broader and also includes intelligence preferences, culture, and learning environment preferences.

3.2. Identification of learners' characteristics

3.2.1. Learners' readiness to learn

The teacher identifies readiness through three layers of assessment: (a) a non-cognitive assessment of VAK learning styles, (b) a "mock test" of multiple intelligences at the beginning of the school year, and (c) a cognitive diagnostic test of learning ability. Students with special needs are accommodated using information from homeroom teachers, guidance counselors, and parents, supported by school facilities.

Readiness identification is institutionalized rather than ad hoc: assessments are scheduled at the beginning of the school year and combine non-cognitive and cognitive information. This gives the teacher an initial map of students before differentiation begins. Accommodation for students with special needs relies on collaboration with other school staff, indicating that DI is supported at the school level rather than being the responsibility of the chemistry teacher alone. The data do not show, however, whether topic-specific diagnostic tests of chemistry prerequisites are used before each unit.

While Mastuti et al. (2022) reported that teachers found it difficult to identify students' profiles at the beginning of learning, the school-level assessment routine in this case appears to reduce that difficulty. The use of non-cognitive assessment is supported by Hadriana et al. (2023), who showed that a non-cognitive diagnostic e-assessment reveals students' learning styles and motivation and helps teachers adapt their methods. The use of diagnostic pretests is similar to the practice reported by Muhab et al. (2024). The accommodation of students with special needs is consistent with Azizah et al. (2025), who emphasized that appropriate accommodations allow students with special needs to participate on an equal footing.

3.2.2. Learners' interest in learning

The teacher identifies students' interests through matriculation activities at the beginning of learning and through open classes for subject clubs. The teacher explained: "…If identifying interests means that initially it is like our usual matriculation … we also usually hold open classes for subject clubs… if, for example, the student seems to enjoy it, we usually offer open recruitment for subject clubs…" [INT-FMS].

To raise motivation, the teacher presents interesting journal articles about everyday chemistry and uses new learning methods and games "…because chemistry is related to everyday life and can also be relevant to them" [INT-FMS].

Compared with readiness, interest is identified less systematically; it relies mainly on the teacher's observation during matriculation and club activities rather than on a structured instrument. Moreover, the teacher uses information about interest mainly to motivate students (e.g., contextual articles and games) rather than to offer students choices of content or tasks based on their interests. Interest therefore functions more as a motivational strategy than as a basis for differentiation.

Solari et al. (2022) recommended periodic interest mapping involving reflection by both students and teachers while the approach in this case is less systematic and is carried out mainly at the beginning of the year. The use of everyday-life contexts is supported by Harahap (2024), whose contextual chemistry module had a positive effect on students' motivation and achievement, and the use of games is consistent with Byusa et al. (2022), who found that game-based learning improves both motivation and conceptual understanding of chemistry.

3.2.3. Learners' learning profiles

The teacher identifies students' learning pace through formative assessment and provides remedial teaching, by the teacher or by peers, for students who have not achieved the learning objectives. The teacher explained, "…we have formative assessments …we examine the learning objectives to see how many people have achieved them and how many have not. Well, for those who have not achieved them or are in the slow category, we usually have remedial teaching…remedial teaching can be done by the teacher themselves or by the students." [INT-FMS] and further stated "…we usually have peer teaching from teachers and other students…" [INT-FMS].

Differences in learning preferences are accommodated through peer teaching. Students' cultural backgrounds (place of birth, ethnicity, nationality, and length of residence in Jakarta) are considered. "…I check their culture, for example, the local customs in our area, which is Jakarta. So, I usually have a kind of test about where you were born, for example, your nationality, your ethnicity, and then how many years you have lived in Jakarta…" [INT-FMS].

The formative–remedial cycle is the most systematic element of learning-profile identification, because decisions are based on students' achievement of learning objectives. Peer teaching serves a double function which accommodates different learning preferences and provides additional remedial support. The cultural background check is a distinctive practice that is rarely reported in chemistry DI studies; however, the data do not yet show how this cultural information is used to adapt chemistry content or examples.

This practice is consistent with Ndlovu (2025), who emphasized that formative assessment must be well designed to address students' learning difficulties, and with Hassan (2023), who found that continuous remedial support benefits low-performing students in a higher education setting. The use of peer teaching is supported by Hidayat and Saad (2025), who reported that peer teaching improves academic performance and social–emotional engagement among high school students. The cultural check reflects the principle of culturally responsive personalized learning (Ober et al., 2023), although Ober et al. stress that cultural information should be used actively to shape learning opportunities, a step that is not yet evident in this case.

3.3. Differentiation of content, process, and product

3.3.1. Content differentiation

Content is differentiated mainly through tiered materials for high, middle, and low ability levels. She witnessed that "…content differentiation should be divided into high, middle, and low learning abilities…" [INT-FMS]. The teacher updates chemistry content using recent journal articles and viral content and considers the links between chemistry and other subjects to be natural, so no special modification is made for this purpose, "…I prefer to use the latest journals that are easy for me to read or, for example, viral content …It is definitely related to other material. For example, when we teach thermochemistry, it is related to physics, energy calculations…" [INT-FMS].

Content differentiation is based on readiness (ability level) and is less developed than process and product differentiation. Interdisciplinary connections are acknowledged but not deliberately designed. It is also not clear from the data whether students' membership in ability tiers is reviewed as they progress.

While Green (2022) also grouped students into low, medium, and high levels based on pretests, but allowed students to move between groups weekly according to their performance, such flexibility was not evident in this case. Kotsalidis et al.(2024) showed that deliberately designed cross-disciplinary activities improved students' understanding of molecular structure; in contrast, the teacher here relies on the natural links between topics. The relative weakness of content differentiation is consistent with Fakhriyana et al.(2026), who reported that differentiating content was the most difficult aspect for chemistry teachers.

3.3.2. Process differentiation

The teacher uses a variety of learning models, namely problem-based learning (PBL), project-based learning (PjBL), cooperative learning, jigsaw, Two Stay Two Stray, and talking stick. She, however, considers PjBL the most effective " because it really provides a thorough analysis… assessment isn't just about cognitive aspects but also psychomotor and affective aspects. Then there's how they communicate with others, how they work with a team…" [INT-FMS].

During projects, students are grouped according to their multiple intelligences or learning styles into auditory, visual, and kinesthetic groups. "…if, for example, the material is related to the process, I usually base it on multiple intelligences. If, for example, the project is about learning styles…" [INT-FMS]

Observation confirmed that students worked in separate auditory, visual, and kinesthetic groups with different activities [OBS] (Figures 1–3).

Process differentiation is the most developed element of DI in this case. The teacher values PjBL primarily because it allows cognitive, affective, and psychomotor competencies to be assessed simultaneously, which shows that the teacher views process differentiation through an assessment lens. Grouping by learning style makes differentiation visible and manageable, but grouping that remains fixed may label students and limit their exposure to other modes of learning.



Figure 1. Auditory group learning process



Figure 2. Visual group learning process



Figure 3. Kinesthetic group learning process

The preference for PjBL is supported by Rofiana and Sukadari (2023), who found that DI combined with PjBL made learning more enjoyable and meaningful, and the benefits of process differentiation are consistent with Melyana et al. (2025). Grouping according to multiple intelligences is consistent with Murtafiah et al. (2024). However, Pozas et al. (2023) reported that homogeneous grouping is perceived by teachers as demanding, and Brown (2023) found little evidence that matching instruction to learning styles improves learning; varying and rotating the grouping criteria may therefore be more beneficial than grouping by learning style alone.

3.3.3. Product differentiation

Assignments are varied according to learning styles: auditory students produce podcasts or songs, visual students produce posters or physical flowcharts, and kinesthetic students produce hands-on products such as cosmetics (makeup), ecoprinted tote bags, and pickles. Within each learning style, students may choose the form of the product.

"…for example, we can't ask them to make physical products …So they have to open a podcast …I ask them to choose a podcast, song, or whatever…" [INT-FMS]

"… visual can be posters or, for example, making a framework from something, or for example, making something like a flowchart but in physical form…" [INT-FMS]

"…those with a kinesthetic learning style usually involve a lot of movement. At that time, I made makeup, made tote bags, and there were also those who made pickles, and so on…" [INT-FMS]

The observation and documentation confirmed a live podcast presentation, a poster presentation, and ecoprinting products [OBS; DOC] (Figures 4–6).

Product differentiation is the most visible form of DI and connects chemistry with everyday life (cosmetics, natural dyes, and food preservation), which may also increase students' motivation. Offering a choice of product within each learning style gives students some autonomy. At the same time, because the products differ greatly in form, a common rubric anchored in the same chemistry learning objectives is needed so that the chemical concepts are assessed equivalently across groups.



Figure 4. Live podcast presentation by the auditory group



Figure 5. Poster presentation by the visual group

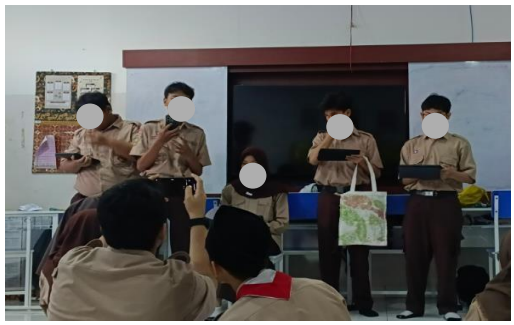


Figure 6. Presentation of ecoprinting products by the kinesthetic group

This practice is similar to that of Minarni et al. (2024), in which visual students produced concept maps, auditory students produced video podcasts and songs, and kinesthetic students conducted acid–base experiments. The difference is that in this case the kinesthetic products are everyday chemical products rather than laboratory experiments. The prominence of product differentiation is also consistent with Fakhriyana et al. (2026), who found that product differentiation was the strongest component of DI in high school chemistry.

3.4. Learning environment

3.4.1. Physical environment

The classroom is arranged flexibly according to the learning activity (e.g., a U-shape for discussions and group clusters for podcast-style activities), and learning resources, including a learning management system (LMS), are complete and easily accessible.

"Actually, our classroom is very mobile, so the chairs can be arranged in a U-shape or according to the needs of the material…the children gather in their respective groups to discuss. Then the presenter stands." [INT-FMS].

"Complete, all access is easy…LMS is available, facilities and infrastructure are available." [INT-FMS].

The observation showed students sitting on mats and in group clusters during group work [OBS] (Figures 1–3).

A flexible physical environment and adequate resources enable conditions that make simultaneous group activities possible. These conditions may not be typical of all *madrasahs*, which suggests that the practices described here are partly supported by the school's resources. Cole et al. (2021) found that flexible seating increases student engagement, and Shafa (2024) showed that an LMS helps teachers manage learning and adjust it to individual needs. The role of resources is consistent with Daşçıoğlu and Bümen (2025), who found that teachers in schools with adequate infrastructure and diverse resources implemented DI more frequently.

3.4.2. Psychological environment

The teacher builds a comfortable and supportive classroom by getting to know each student individually and by using ice-breakers, educational games (e.g., Kahoot and Quizizz), and question-and-answer sessions.

The teacher stated: "…to feel comfortable, first I have to get to know the students, so they have to know each student's name …" [INT-FMS]. "…At the beginning, there's usually an ice-breaker to build relationships between teachers and students …Games…Like Kahoot, Quizizz, and others …Standard question-and-answer sessions like in a regular class …" [INT-FMS]. The teacher treats the teacher–student relationship as the foundation of DI: knowing each student by name is both a relational strategy and a prerequisite for recognizing individual needs. This finding is consistent with Tomlinson's (2017) view that a respectful and supportive learning environment is the foundation of differentiation, and it is consistent with Fitria (2023), who found that ice-breaking creates a comfortable and positive classroom atmosphere.

3.5. Planning, monitoring, evaluation, and challenges

3.5.1. Planning

Differentiated teaching modules are developed by considering material availability, students' readiness, and available facilities. Not all topics in a semester are differentiated; usually only one or two learning objectives are selected. Assessment planning follows the Merdeka Curriculum, using developmental criteria and formative, summative, cognitive, and non-cognitive assessments, with a star-rating format for peer assessment.

The teacher explained: "…in one semester, not all of them are differentiated. Because usually there is only one material or one learning objective or two …Because of the readiness of the material, the readiness of the students, the facilities and infrastructure, and so on. And also so that the learning process does not become boring…" [INT-FMS].

"…The way we assess it is actually the same as the independent curriculum; we just look at whether they are developing, have developed, are developing well, or are highly developed …Formative, summative, cognitive assessment, non-cognitive assessment … But when it comes to peer teaching and peer assessment, it's the same star system." [INT-FMS].

The teacher applies DI selectively rather than continuously. This is a pragmatic strategy for managing workload and avoiding monotony, but it also means that DI is an occasional event rather than the default mode of chemistry learning in this case.

The practice of starting module development from students' needs is consistent with Marlina et al. (2025), and the teacher's intention that no student is left behind is in line with Hassan and

Ajma'in (2022). The combination of formative and summative assessment reflects their complementary roles (Chand & Pillay, 2024). Whereas Muhab et al. (2024) interpreted partial implementation as inconsistency, the present case suggests that partial implementation may also be a deliberate planning choice made in response to time and resource constraints.

3.5.2. Progress monitoring and follow-up

Students' progress is monitored through a sequence of cognitive diagnostic, non-cognitive, formative, and summative assessments. Products are documented in portfolios, exhibitions, the teacher's Instagram account, and a website (PJJ Chemistry), as noted by the teacher:

"… cognitive assessment tests at the beginning … Non-cognitive assessment … followed by formative assessment, then summative assessment …" [INT-FMS].

"The portfolio is complete. Then we also have an exhibition, where everything is collected in a portfolio, because it's a project … I have documentation on Instagram and I also have my own website to upload learning outcomes or products. The website is PJJ Chemistry …" [INT-FMS].

The portfolios and online documentation were examined as documentary evidence [DOC].

Monitoring is assessment-rich and products are made public through exhibitions and online media, which can increase students' accountability and sense of achievement. However, the data do not show how monitoring results are used to regroup students or to adjust subsequent instruction. Ndlovu (2025) emphasized that formative assessment is effective only when its results are used to respond to students' difficulties, and Green (2022) regrouped students weekly on the basis of performance. Compared with these studies, the feedback loop from monitoring to regrouping is less evident in this case.

3.5.3. Evaluation of effectiveness and challenges

The teacher judges the success of DI by students' achievement of the predetermined learning objectives. "… So in the learning objectives, it is already written, for example, being able to identify … when he presents the content, or for example, in a test when he can answer the questions … he is considered to have completed them." [INT-FMS].

Three challenges were identified: (a) preparation is time-consuming because grouping, content, delivery, feedback, and assessment must all be considered; (b) supervising several groups at once is difficult, especially when the kinesthetic group works outside the classroom; and (c) two lesson hours or one meeting is not enough, so the teacher suggests 3–4 meetings per topic. As a follow-up, the teacher plans to reorganize the learning modules.

The teacher stated: "The challenge is that preparing for it is usually difficult; it requires careful consideration. For example, how to group students, what kind of content to use, how to deliver it, what kind of feedback to give students, and how to assess them. Thinking about all of that takes time …" [INT-FMS].

"… The second challenge is monitoring each group. So, for example, if the kinesthetic group has to be in the field, then it is difficult for us to monitor the visual and audio groups …" [INT-FMS].

"… 2 hours of lessons is not enough, nor is 1 meeting, but if possible, it should be around 3–4 times … Perhaps we want to reorganize learning to be more effective, improving students' abilities, especially in terms of maximizing learning." [INT-FMS]

The challenges are structural (time allocation and the ratio of one teacher to several simultaneous groups) rather than a lack of understanding or commitment on the teacher's part. This also explains why DI is applied selectively (Section 3.5.1). Evaluation focuses on the achievement of learning objectives; a systematic evaluation of the DI strategy itself, for example by comparing the progress of different groups, is not yet evident.

Time constraints were likewise the main obstacle for Malaysian chemistry teachers (Ibnuzaman et al., 2024) and Indonesian senior high school ones (Muhab et al., 2024), and workload was reported as the main challenge by Fakhriyana et al. (2026). Pozas et al. (2023)

found that insufficient planning time and support increase teachers' stress, and Daşçıoğlu and Bümen (2025) identified time constraints and intensive curricula as major barriers. Langelaan et al. (2024) showed that collaboration among teachers and supportive school leadership help to sustain DI; collaborative planning, for example with other science teachers, could therefore reduce the preparation burden identified in this case.

3.6. Limitations

This study has several limitations. It involved a single key informant in one school, so the findings are not intended to be generalized statistically. Much of the evidence comes from the teacher's self-report, although it was triangulated with observations and documents, and students' perspectives and learning outcomes were not measured. Future studies should involve several teachers and schools, include student interviews or questionnaires, and examine learning outcomes over a longer period.

4. Conclusion

This study shows that DI in chemistry learning at MA Pembangunan UIN Jakarta rests on the teacher's strength-based view of students: every learner is believed to have potential, and diversity is treated as an asset rather than a problem. This belief is translated into practice through a deliberate effort to know students before teaching them. Readiness is mapped systematically through non-cognitive and cognitive diagnostic assessments at the beginning of the school year, learning pace is followed through a formative–remedial cycle supported by peer teaching, and students' cultural backgrounds are also considered. Interest, however, is explored less systematically and serves mainly to raise motivation, while the notion of learning profile remains largely confined to learning styles.

Building on this knowledge of students, differentiation is most evident in the learning process and in students' products. Varied learning models, with project-based learning regarded as the most effective, and grouping by learning style allow students to learn in different ways, and they demonstrate their understanding through podcasts, posters, and ecoprinting products that connect chemistry with everyday life. Content differentiation, in contrast, is still limited to tiered materials. These practices are made possible by a flexible classroom, adequate learning resources, and a warm teacher–student relationship. Differentiation is planned selectively for one or two learning objectives each semester and monitored through diagnostic, formative, and summative assessments and portfolios, but it is constrained by the demands of preparation, the difficulty of supervising several groups at once, and limited lesson time.

Taken together, the findings suggest that sustaining DI in chemistry depends less on teachers' understanding, which is already strong in this case, than on the conditions surrounding their work. Allocating several meetings to a differentiated topic, planning collaboratively with other teachers, using flexible rather than fixed grouping, and assessing varied products with common rubrics could make differentiation a more regular part of chemistry learning. Future studies involving more teachers and schools, and examining the effects on students' learning outcomes, would strengthen these conclusions.

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***Conflict of Interest**: The authors declare that there is no conflict of interest associated with this research, its authorship, or the publication of this manuscript. The research was conducted objectively and*

independently, and no financial, personal, professional, or institutional interests have influenced the design, conduct, analysis, interpretation, or reporting of the study.

***Acknowledgments**: The authors would like to express their sincere gratitude to the school that participated as the research site and to the teacher and students who contributed to this study.*

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