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Differentiated Instruction in Medical Laboratory Science Education in Eswatini: Challenges and Successes

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ABSTRACT

Differentiated Instruction (DI) is a learner-centred approach that adapts content, processes, assessments, and learning environments to address students' diverse needs. Although widely used in general education, its application in laboratory-based medical sciences remains limited, especially in resource-constrained tertiary contexts. This qualitative study examined the challenges and successes of DI in Medical Laboratory Sciences (MLS) classrooms across three higher education institutions in Eswatini. Guided by Cultural-Historical Activity Theory and a transformative paradigm, semi-structured interviews were conducted with 20 purposively selected lecturers. Thematic analysis of the interview data indicated that participants perceived differentiated instruction (DI) as an adaptive and inclusive strategy that supports student engagement, conceptual understanding, and practical competence. Participants described practices such as tiered tasks, case-based learning, peer support, flexible grouping, multimodal resources, and varied assessment methods as ways through which DI could be implemented in the classroom. However, large class sizes, limited laboratory resources, time constraints, inadequate training, and rigid institutional structures constrained implementation. Despite these barriers, DI improved weaker students' confidence, engagement, and laboratory accuracy while fostering collaboration. Participants advocated for institutional support, resource enhancement, and DI-focused professional development. The findings suggest that differentiated instruction may offer a practical pedagogical approach for supporting inclusive and competency-based learning in medical laboratory sciences programmes within resource-constrained tertiary institutions in Eswatini, while also contributing empirical insight into how DI is perceived and applied in specialised health science classrooms.

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INTRODUCTION

Differentiated Instruction (DI) is a pedagogical approach that tailors teaching content, instructional processes, and assessment to accommodate students' diverse abilities, learning styles, and learning profiles (Tomlinson, 2017). Rooted in the work of Tomlinson, DI emphasises adapting key elements of teaching—content, process, product, and the learning environment—to respond to learners' varying levels of readiness, interests, and learning needs (Tomlinson, 2001;

Tomlinson, 2014). Through such flexibility, DI seeks to individualise learning within the same classroom, thereby promoting experiential learning, meaningful engagement, academic achievement, and inclusivity while maintaining high academic standards (Gheyssens et al., 2023).

Although DI has been widely discussed within general education contexts, its application in health professions education (HPE) remains relatively limited. Recent scholarship suggests that DI may help address the growing diversity of adult learners in HPE programmes, who often differ in academic preparation, prior laboratory experience, and educational pathways (Colbert et al., 2023). However, empirical research examining DI within laboratory-based medical science disciplines such as haematology, microbiology, clinical biochemistry, and clinical chemistry remains scarce. These fields require students to integrate conceptual understanding, procedural competence, and strict safety-compliant practices, areas in which learners frequently display considerable variation. Exploring DI within medical laboratory sciences therefore offers an opportunity to examine how flexible instructional approaches may support learner heterogeneity in specialised, skills-intensive higher education environments.

The applicability of differentiated instruction (DI) in laboratory-based medical sciences can be informed by evidence from general science education, where flexible teaching strategies have been shown to address diverse learner needs in conceptually demanding and practice-oriented environments. Although the contexts are not identical, both require the integration of theoretical knowledge with laboratory skills, providing a reasonable basis for considering insights from science education. For instance, research in chemistry education shows that strategies such as adjusting task complexity, offering varied instructional supports, and allowing multiple ways for students to demonstrate understanding can enhance engagement and conceptual mastery among diverse learners (Ibnuzaman et al., 2024). Direct empirical studies in laboratory medicine remain limited; however, scholars in health-professions education suggest that DI may support practical competency development, deepen conceptual learning, and strengthen collaborative skills by enabling instruction to respond to learner variability (Colbert et al., 2023). Consequently, DI represents a theoretically grounded and pedagogically promising approach for medical laboratory sciences education that warrants further empirical investigation.

Globally, differentiated instruction (DI) is recognised as a pedagogical approach that can reduce achievement gaps, enhance engagement and motivation, and promote equity qualities particularly valuable in hands-on disciplines such as the medical sciences. Evidence from systematic reviews and meta-analyses in mainstream education indicates that when implemented with fidelity, DI can produce small to moderate gains in academic achievement while improving student engagement and perceived inclusivity (Meijer & Maulana, 2019; Ramaila, 2025). Despite its promise, translating DI into consistent classroom practice remains challenging: many educators treat it as a patchwork of strategies rather than a coherent teaching philosophy and cite insufficient professional development, time constraints, limited resources, large class sizes, and institutional barriers as obstacles to full implementation (Gheyssens et al., 2023). This gap between the theoretical benefits of DI and its uneven application highlights the need for systemic support, including targeted training, adequate resource allocation, and institutional commitment, to realise its potential in medical science education.

In developing regions, including Sub-Saharan Africa, the adoption of differentiated instruction (DI) often encounters systemic obstacles, such as limited teaching resources, insufficient instructor training, large class sizes, and broader institutional constraints (Mtweve et al., 2025; Maphumulo & Biccard, 2024). For example, a study of primary school mathematics teachers in South Africa highlighted time constraints, resource shortages, overcrowded classrooms, and inadequate parental or institutional support as major barriers to DI implementation (Maphumulo & Biccard, 2024). Although conducted in a primary education context, these structural challenges—particularly limited time, resources, and large class sizes—are also reported in higher education settings. Similar institutional and logistical constraints may affect the implementation of DI in tertiary medical laboratory sciences programmes, where laboratory facilities, instructional time, and staff capacity influence how effectively teaching can

be tailored to diverse learner needs. In under-resourced or disadvantaged contexts, these challenges are further compounded by infrastructural deficits, including inadequate learning materials, poor technological access, and limited laboratory spaces, as well as broader socio-economic inequalities that hinder effective instruction (Mtweve et al., 2025; Tibane et al., 2023).

Additionally, insights from inclusive-education research involving learners with special needs (e.g., visual impairment) demonstrate how differentiated instruction (DI) can employ alternative media such as Braille, auditory materials, assistive technologies, and varied assessment formats to enhance access, participation, and learner agency (Awini, 2025). Although these strategies are primarily documented in primary and secondary inclusive education contexts, their underlying principles are also relevant to tertiary science education. In medical laboratory sciences programmes, where students engage with complex theoretical concepts and practical laboratory competencies, differentiated instructional approaches such as multimodal learning materials, adaptive laboratory demonstrations, and varied assessment strategies may support diverse learning needs and improve comprehension. However, similar to findings in inclusive-education settings, DI implementation in resource-constrained institutions remains under-researched, and many lecturers lack formal pedagogical training in inclusive and differentiated teaching practices (Awini, 2025). This gap highlights the need to examine how DI can be effectively implemented within medical laboratory sciences classrooms in tertiary institutions.

Given these empirical patterns and gaps, implementing differentiated instruction (DI) in medical laboratory sciences, especially in developing regions or resource-limited contexts such as higher-education institutions in Sub-Saharan Africa, holds promise but also demands careful adaptation. Differentiated strategies allow instructors to tailor content, processes, and assessments to accommodate diverse learner needs, including prior knowledge, learning preferences, and skill levels (Gheyssens et al., 2023; Manuel & Mempin, 2025). Evidence from mainstream education shows that DI can improve student engagement, academic performance, and social inclusion, while enhancing well-being and self-concept (Pozas et al., 2021). However, effective implementation is constrained by systemic challenges, including limited teaching resources, large class sizes, insufficient faculty training, and institutional barriers (Turner et al., 2025; Coubergs et al., 2023). Furthermore, laboratory-based instruction in science disciplines requires careful pedagogical design; studies indicate that poorly structured labs even in well-resourced institutions may fail to enhance learning outcomes and can exacerbate inequities, such as gender-based participation differences (Holmes et al., 2017; Quinn et al., 2020).

The present study therefore examines the integration of differentiated instruction (DI) strategies in laboratory practicals, with particular attention to inclusive, flexible, and adaptive teaching approaches that respond to diverse learner needs. It explores the use of practices such as multimedia-supported polymerase chain reaction (PCR) demonstrations, scaffolded enzyme assays, reflective journals, and peer teaching as examples of differentiated instructional approaches within medical laboratory sciences education. In addition, the study considers contextual challenges associated with implementing DI in resource-constrained settings, including limited laboratory materials, insufficient staff training, and institutional constraints (Botha & Hall, 2024; Coubergs et al., 2023).

Against this backdrop, the study seeks to explore lecturers' perspectives and experiences of using differentiated instruction to support diverse learners and foster inclusive laboratory-based education. It further aims to identify systemic, institutional, and resource-related barriers that may impede the equitable implementation of DI in medical laboratory sciences classrooms. Finally, the study examines the perceived successes and impacts of DI in enhancing student engagement, practical skill development, and inclusivity, with the goal of generating contextually relevant recommendations for promoting equity and social justice in laboratory-based medical sciences education. By situating the investigation within the realities of tertiary laboratory learning environments where learner diversity is high and resources may be limited, the study

contributes to ongoing discussions on inclusive pedagogical practices in science and health professions education.

Research Objectives

1. To explore lecturers' perspectives and experiences on using differentiated instruction to support diverse learners and foster inclusive laboratory-based education.
2. To identify systemic, institutional, and resource-related barriers that impede the equitable implementation of DI in medical laboratory sciences classrooms.
3. To examine lecturers' perceptions of the impacts of DI on student engagement, practical skill development, and inclusivity in laboratory learning, and to generate context-specific recommendations for improving the implementation of differentiated instructional practices.

Statement of the Problem

Despite growing recognition of learner diversity in STEM classrooms, teaching in many medical and laboratory science programmes continues to rely on uniform instructional approaches that may not adequately address varied learning needs. While Differentiated Instruction (DI) has been widely associated with improved learner engagement and academic outcomes in general education contexts (Smale-Jacobse et al., 2019; Liou et al., 2023), its application within medical laboratory sciences education remains underexplored. There is limited empirical evidence on how DI strategies are implemented within laboratory-based learning environments, where instruction must integrate theoretical understanding with practical skill development. This gap is especially pronounced in resource-constrained tertiary institutions, where limited laboratory materials, large class sizes, and insufficient staff training may influence the feasibility of adopting differentiated approaches (Whitcomb & Singh, 2020; Van Dusen et al., 2024). Consequently, there remains insufficient understanding of how lecturers experience and implement DI in laboratory-based medical sciences education and what contextual factors shape its perceived effectiveness. Addressing this gap is necessary to inform contextually appropriate strategies for supporting diverse learners in laboratory-intensive STEM programmes.

Theoretical Framework

This study adopted Cultural-Historical Activity Theory (CHAT) as its theoretical framework to examine the implementation of Differentiated Instruction (DI) in medical laboratory sciences classrooms in Eswatini. CHAT, grounded in the socio-cultural work of Lev Vygotsky (1978) and later expanded by Yrjö Engeström (2001), conceptualizes learning as a socially mediated activity shaped by interactions among participants, tools, rules, community structures, and the division of labor within a broader activity system. Rather than focusing solely on individual learning processes, CHAT provides a holistic lens for examining how teaching and learning practices are embedded within institutional, social, and material contexts.

CHAT was selected for this study because the implementation of DI in laboratory-based education involves complex interactions between multiple elements of the teaching–learning environment. Laboratory instruction requires the coordinated use of specialized tools and equipment, collaboration among students, guidance from lecturers, and adherence to institutional rules and curriculum structures. In resource-constrained tertiary settings, these interactions are further shaped by contextual constraints such as limited laboratory materials, large class sizes, and uneven access to instructional resources. CHAT is particularly well suited to analyzing these dynamics because it enables researchers to examine how such structural and contextual factors influence pedagogical practices and learner engagement within an integrated activity system.

Integrating CHAT with DI also allows the study to examine how differentiated approaches such as adapting content, instructional processes, and assessments to learners' readiness levels, prior knowledge, and learning preferences (Tomlinson, 2017; Colbert et al., 2023) operate within

the broader socio-cultural and institutional environment of laboratory education. Previous studies in STEM and health-professions education have demonstrated the usefulness of CHAT for analyzing collaborative learning, tool-mediated instruction, and adaptive pedagogical practices (Engeström, 2001; Roth & Lee, 2007; Pata, 2018). In this study, CHAT therefore provides an analytical framework for understanding how differentiated instructional strategies interact with institutional structures, available resources, and social relationships in the classroom. By applying this lens, the research examines how these interconnected elements shape the opportunities and challenges of implementing DI and influence the inclusivity and effectiveness of laboratory-based learning.

RESEARCH METHOD

Research Paradigm

This study adopted a transformative research paradigm, which emphasizes addressing social inequities and promoting more inclusive practices in education (Mertens, 2020). This paradigm was particularly appropriate because the study investigates how differentiated instruction (DI) can support diverse learners in medical laboratory sciences classrooms, especially within resource-constrained settings where systemic barriers may limit engagement and learning outcomes. It guided the qualitative research design, informed the purposive selection of lecturers actively involved in laboratory teaching, and shaped interview questions to explore experiences with learner diversity, resource accessibility, institutional support, and adaptation of instructional strategies. During analysis, the paradigm directed attention to how structural, institutional, and contextual factors influence pedagogical practices, enabling interpretation of findings in terms of both challenges and opportunities for promoting equitable, inclusive, and effective laboratory-based learning. By foregrounding equity and inclusion, the transformative paradigm ensured that the study not only described practices but also generated contextually relevant insights for fostering more just educational environments.

Research Approach

A qualitative research approach was employed to generate rich, contextually grounded insights into lecturers' experiences with Differentiated Instruction (DI) in medical laboratory sciences classrooms (Creswell & Poth, 2018). This approach was particularly appropriate because DI implementation involves complex, context-dependent interactions between lecturers, students, instructional tools, and institutional structures, especially in resource-constrained settings. Qualitative inquiry allowed for in-depth exploration of how lecturers adapt content, instructional processes, and assessments to meet diverse learner needs, while also capturing challenges posed by limited laboratory materials, large class sizes, and institutional policies. By focusing on subjective experiences and contextual influences, this approach provided nuanced understanding of both practical strategies and systemic factors shaping DI implementation insights that could not be fully captured through quantitative methods (Patton, 2015).

Participant Selection

Participants were purposively selected to provide in-depth insights into the implementation of differentiated instruction (DI) in medical laboratory sciences classrooms. The sample comprised 20 lecturers drawn from three tertiary health institutions in Eswatini, including two church-owned institutions and one government-owned institution. Eligible participants were required to have at least five years of teaching experience and to be directly involved in laboratory-based instruction in medical laboratory sciences courses. This ensured that participants possessed sufficient expertise to reflect on both pedagogical strategies and contextual challenges. Participants held a variety of institutional roles, including course coordinators, laboratory supervisors, and lecturers responsible for practical sessions across core medical laboratory subjects such as clinical chemistry, hematology, microbiology, and molecular diagnostics. The selected institutions varied in size, resource availability, and infrastructure, allowing the study to

capture a range of contextual experiences. The sample size was deemed sufficient to achieve data saturation while remaining manageable for in-depth qualitative analysis (Guest et al., 2020).

Data Generation

Semi-structured interviews were used to explore lecturers' experiences and perspectives on implementing differentiated instruction (DI) in medical laboratory sciences classrooms. This method was particularly appropriate because it allowed participants to provide rich, detailed accounts of how they adapt content, instructional processes, and assessments to meet diverse learner needs, while also reflecting on contextual challenges such as limited laboratory resources, large class sizes, and institutional constraints. Interviews were audio-recorded with consent and transcribed verbatim, enabling in-depth analysis and identification of emergent patterns aligned with the study objectives. While classroom observations and document analysis were considered, they were not feasible across multiple institutions. Semi-structured interviews thus provided a flexible yet focused approach for capturing nuanced insights into lecturers' practices, perceptions, and the contextual factors shaping DI implementation (Kallio et al., 2016).

Data Analysis

Data were analysed using a reflexive thematic analysis approach, following Braun and Clarke's (2006) six-phase framework. A hybrid inductive–deductive strategy was employed, with initial codes generated inductively from participants' accounts of implementing Differentiated Instruction (DI) and refined deductively using the Cultural-Historical Activity Theory (CHAT) framework and study objectives. Analysis involved familiarisation with transcripts, coding, theme development, and iterative review, capturing both commonalities and divergences across lecturers' experiences. Reflexive memoing was used to enhance transparency and rigour (Nowell et al., 2017). This approach enabled the study to explore how lecturers' instructional strategies, institutional constraints, and socio-cultural factors interacted within the broader activity system, linking empirical insights directly to the theoretical and transformative frameworks guiding the study.

Ethical Considerations

Ethical approval for the study was obtained from the Eswatini Medical Christian University Ethics Committee. All participants provided informed consent prior to data collection and were fully informed about the study's purpose, procedures, their right to withdraw at any time without consequence, and how their data would be handled. Confidentiality and anonymity were maintained by assigning codes to participants and removing identifying information from transcripts. Audio recordings and transcripts were securely stored on password-protected devices accessible only to the research team. The study adhered to national and institutional guidelines for human-subject research, including data protection and ethical reporting practices (Eswatini Ministry of Health, 2021).

RESULTS AND DISCUSSION

Result

The analysis of lecturers' perspectives on Differentiated Instruction (DI) in Medical Laboratory Sciences (MLS) programmes in Eswatini generated several interrelated themes. These themes reflect how DI is conceptualised, implemented, and experienced in practice, capturing both the strategies lecturers employ and the challenges they encounter. Key findings include participants' understanding of DI as a flexible, learner-centred approach; the motivations and structural constraints influencing its use; the instructional, practical, and assessment strategies applied to accommodate diverse learners; the influence of student characteristics on differentiation; perceived positive impacts on learning and engagement; institutional limitations affecting adoption; and recommendations for strengthening DI implementation. Each theme is illustrated with representative participant quotations to provide an empirical grounding for the findings.

Table 1. Thematic analysis

Theme	Subtheme / Focus	Representative Quotation	Participant Code
Converging Approaches to DI in MLS	Flexible, learner-centred instruction	*"Tailoring teaching methods, content, and assessments to students' varying abilities, backgrounds, and learning styles while ensuring all achieve core laboratory competencies."*	P01
	Inclusive and equitable learning	*"An adaptive pedagogical approach that recognizes the diverse learning need, customising content, processes, products, and the learning environment."*	P03
Motivation and Structural Challenges in DI Implementation	Lecturer motivation	*"I'm motivated by improved student engagement, achievement, and practical skills."*	P04
	Structural barriers	*"Large class sizes, limited resources, and heavy workload discourage use of DI."*	P02
	Time constraints & curriculum pressure	*"Significant time constraints… and pressure to cover prescribed content compromise differentiation."*	P06
	Student readiness/motivation	*"Lack of students' positive commitment makes DI challenging."*	P06
Instructional Practical, and Assessment Strategies	Tiered tasks & case-based learning	*"Students are exposed to different levels of practical activity, from step-by-step guidance for beginners to higher-level tasks."*	P05
	Peer learning & flexible grouping	*Use of visual aids, discussions, class quizzes, supplementary reading materials, and oral questioning."*	P08
	Mixed assessment formats	*"I use case-based learning, tiered lab tasks, group projects, peer teaching, varied assessments, and simulation-based practicals."*	P10
Learner Characteristics Shape Differentiation	Academic preparation, language, and practical skills	*"I've observed differences in academic preparation, learning speed, language proficiency, learning styles, motivation, and practical laboratory skills."*	P03
	Targeted instructional adjustments	*"Visual vs. kinesthetic learners require varied DI approaches."*	P05
Perceived Impacts of DI on Student Learning and Engagement	Confidence & competence	*"Tiered case studies boosted weaker students' confidence… leading to higher test scores and more accurate bench performance."*	P04

Theme	Subtheme / Focus	Representative Quotation	Participant Code
	Engagement & collaborative learning	*"Group work and presentations allow students to engage more and learn from peers."*	P02
6. Institutional Limitations Restrict DI Adoption	Resource scarcity	*Limited resources, large class sizes, rigid timetables, and minimal institutional incentives restrict meaningful DI."*	P02
	Simulation/digital tools	*"Limited access to simulation tools or digital resources."*	P06
	Policy & administrative support	*"Absence of explicit institutional policies incorporating DI principles hinders sustained implementation."*	P10
Recommendations for Strengthening DI	Class size & lab group management	*"Smaller lab groups would allow for more personalised instruction and engagement."*	P09
	Professional development	*"Provide DI-focused training to equip educators with pedagogical and technical skills."*	P04
	Resource and policy support	*"Increased investment in laboratory facilities, simulation tools, and digital platforms… institutional policies that enhance DI use."*	P12

Theme 1: Converging Approaches to Differentiated Instruction in MLS

Participants consistently described Differentiated Instruction (DI) as a flexible approach that tailors teaching, content, processes, and assessments to meet the varied needs of students in competency-based Medical Laboratory Sciences (MLS) programs. They highlighted the importance of adjusting both theoretical and practical instruction to account for differences in prior knowledge, learning styles, and competencies. One participant (P01) explained, "*Tailoring teaching methods, content, and assessments to students' varying abilities, backgrounds, and learning styles while ensuring all achieve core laboratory competencies,*" while another (P07) noted, "*Adapting teaching methods to meet diverse learner needs… adjusting content, pace, and assessments in theory and practical sessions.*" These accounts demonstrate how lecturers perceive DI as both responsive and structured, allowing alignment of learning experiences with student readiness and curriculum requirements.

Participants also emphasized DI's role in fostering inclusive and equitable learning environments. One lecturer (P03) described it as "an *adaptive pedagogical approach that recognizes the diverse learning needs… customizing content, processes, products, and the learning environment,*" while another (P12) framed it as "a *precision education model, where education is individualized based on student profiles, learning styles, [and] prior experience.*" These perspectives show how DI operationalizes inclusivity by addressing heterogeneity in learner backgrounds and competencies. This aligns with literature highlighting differentiated strategies as essential for promoting equitable outcomes in higher education, particularly in health sciences where competency acquisition is critical (Sousa & Tomlinson, 2018; Tomlinson, 2017).

Theme 2: Motivation and Structural Challenges in DI Implementation

Participants were motivated to implement differentiated instruction (DI) because it enhances engagement, supports both weaker and stronger learners, and improves practical and conceptual understanding in medical laboratory sciences (MLS) programmes. One lecturer (P04) explained, *"I'm motivated by improved student engagement, achievement, and practical skills,"* while another (P09) observed, *"It enhances knowledge delivery… supports weak learners without slowing down fast learners."* These reflections align with research showing that DI promotes inclusivity and accommodates diverse learning needs (Tomlinson, 2017; Subban, 2006).

Despite this motivation, participants consistently reported that institutional, structural, and logistical barriers constrained the effective implementation of DI. Large class sizes were frequently mentioned as a significant challenge, limiting opportunities for individualised attention and tailored instruction. One participant (P02) noted, *"Large class sizes, limited resources, and heavy workload discourage use of DI,"* while P06 observed, *"Significant time constraints… and pressure to cover prescribed content compromise differentiation."* Similarly, P08 reflected, *"Large class sizes make implementing DI challenging, as some students do not get the attention they need."*

Resource limitations, including insufficient laboratory equipment, consumables, and digital or simulation tools, further impeded the application of DI strategies. As P05 stated, *"Insufficient consumables and equipment"* constrained practical, hands-on learning experiences. Participants also highlighted curriculum density and time pressures, with P07 explaining, *"Dense curriculum with pressure to complete required content… limits flexibility."* Staffing shortages and limited professional development were additional barriers, with P10 noting, *"Inadequate professional development in DI."* Student-related factors, such as low motivation or readiness, were also reported to influence the effectiveness of DI, as P11 observed, *"Lack of students' positive commitment makes DI challenging."*

These findings are consistent with literature showing that high student–teacher ratios, resource scarcity, dense curricula, and insufficient institutional support remain significant barriers to DI implementation in higher education (Tomlinson, 2014; Tomlinson & Moon, 2013; Hall, 2002; Sharma et al., 2016; Subban, 2006). Collectively, the data suggest that while lecturers are motivated to adopt DI to support diverse learners, meaningful and sustained implementation requires structural support, adequate resources, policy alignment, and professional development opportunities.

Theme 3: Implementation of DI Through Multiple Instructional, Practical, and Assessment Strategies

Participants highlighted the use of diverse instructional strategies as central to implementing differentiated instruction (DI) in medical laboratory sciences (MLS) education. Several lecturers described employing tiered practical tasks and case-based scenarios to accommodate varied levels of student competence. One participant (P05) explained, *"Students are exposed to different levels of practical activity, from step-by-step guidance for beginners to higher-level tasks,"* while another (P11) noted, *"Case studies and practical simulations allow us to challenge advanced learners while supporting those who need more guidance."* These accounts illustrate how lecturers adjust tasks and learning activities to meet the differing readiness and skill levels of students within laboratory sessions.

Participants also highlighted the use of peer learning, flexible grouping, and mixed instructional media as strategies for implementing DI in MLS classrooms. These approaches were described as ways to respond to students' varied preferences and ways of engaging with content. One participant (P08) stated, *"Use of visual aids, discussions, class quizzes, supplementary reading materials, and oral questioning,"* while another (P14) observed, *"Case-based learning and presentations that allow students to learn from each other."* Lecturers described these strategies as ways to accommodate what they perceived as diverse student preferences, including visual, auditory, and kinesthetic modes of engagement, rather than as a formalized explanatory framework. They reported using case-based and collaborative learning to engage students and apply theory to

practice. Mixed assessment formats including oral questioning, practical demonstrations, and written tests were perceived to support fairer assessment opportunities and provide a broader picture of student learning. One participant (P10) summarized this integration of strategies: *"I use case-based learning, tiered lab tasks, group projects, peer teaching, varied assessments, and simulation-based practicals."*

Theme 4: Learner Characteristics Shape Differentiated Instruction

Participants highlighted the extensive diversity among students, noting differences in academic preparation, language proficiency, learning preferences, practical skills, motivation, and confidence. Such variation was reported to necessitate deliberate differentiation strategies to ensure all students achieve the competency standards required in MLS programs. One participant (P03) observed, *"I've observed differences in academic preparation, learning speed, language proficiency, learning styles, motivation, and practical laboratory skills,"* while another (P09) emphasized, *"Students enter with varying levels of foundational science knowledge and differing abilities to acquire hands-on skills."* Unlike general classroom settings, MLS education requires students to integrate theoretical knowledge with highly specific practical laboratory techniques, meaning that variability in prior scientific knowledge, psychomotor skills, and procedural understanding can directly affect not only learning outcomes but also safety and professional competence.

In practice, these differences manifested in varied English proficiency, learning preferences (visual, kinesthetic, verbal), and practical competencies, which lecturers addressed through flexible and scaffolded teaching approaches. P05 noted, *"Visual vs. kinesthetic learners require varied DI approaches,"* while P08 observed, *"Different academic backgrounds… and wide range of practical competencies,"* highlighting the need for targeted instructional adjustments that go beyond conventional differentiation. In MLS programs, learner diversity is particularly consequential because students must acquire precise laboratory skills, interpret complex data, and adhere to strict procedural standards—challenges that amplify the impact of differences in preparation and practical aptitude. These findings illustrate that accommodating learner variability in MLS is not only about promoting engagement or equitable assessment but is also integral to ensuring competence, safety, and professional readiness in laboratory practice (Goyibova et al., 2025; Heacox, 2017; Tomlinson, 2017; Sousa & Tomlinson, 2018).

Theme 5: Positive Impacts of DI on Student Learning and Engagement

Participants consistently highlighted that the implementation of Differentiated Instruction (DI) in Medical Laboratory Sciences (MLS) was perceived to support student learning, confidence, and practical competence. Lecturers described using tiered tasks, targeted support, and flexible grouping to create opportunities for learners at different proficiency levels to progress meaningfully. One participant (P04) reflected, *"Tiered case studies boosted weaker students' confidence… leading to higher test scores and more accurate bench performance."* Several participants noted that DI appeared to enhance conceptual understanding, engagement in laboratory activities, and analytical reasoning, though these outcomes were based on their classroom observations rather than direct measurement of student performance. Participants also emphasized the benefits for struggling students, who reportedly gained confidence and demonstrated improvement when provided with targeted scaffolding, consistent with literature suggesting that differentiated approaches help low-performing students close learning gaps (Goyibova et al., 2025; Hall, Vue, Strangman, & Meyer, 2017).

Interactive strategies such as group work, peer learning, and case-based activities were reported to promote deeper engagement and collaborative knowledge construction, consistent with constructivist perspectives emphasizing socially mediated learning (Vygotsky, 1978). Participants also observed improvements in practical accuracy, suggesting that DI supported the transfer of theoretical understanding to laboratory performance, a critical component of competence-based health sciences education (Harden, 2018). For example, one lecturer (P04)

noted, *"Tiered case studies boosted weaker students' confidence… leading to higher test scores and more accurate bench performance,"* while another (P07) reflected, *"Group work and presentations allow students to engage more and learn from peers."* These accounts indicate that, when implemented intentionally and with adequate resources, DI enables students to build both conceptual understanding and practical competence, fosters self-directed learning, and enhances analytical skills, highlighting its potential as an effective pedagogical approach in MLS programmes.

Theme 6: Institutional Limitations Restrict DI Adoption

Institutional barriers emerged as a major constraint to effective Differentiated Instruction (DI) implementation in Medical Laboratory Sciences (MLS) programmes across Eswatini's tertiary institutions. Participants consistently highlighted chronic resource shortages, including limited budgets, inadequate equipment, and insufficient teaching materials, which undermine lecturers' capacity to adapt content, processes, and learning environments to diverse student needs. One participant (P02) noted, *"Limited resources, large class sizes, rigid timetables, and minimal institutional incentives restrict meaningful DI,"* reflecting structural inefficiencies that impede instructional flexibility. The absence of adequate simulation tools or digital technologies was also emphasised, with another participant (P06) stating, *"Limited access to simulation tools or digital resources."* Large class sizes were particularly problematic, as overcrowded cohorts reduce opportunities for individualised feedback, with P08 explaining, *"Large class sizes make implementing DI challenging, as some students do not get the attention they need."* Participants further reported limited administrative support and the lack of explicit institutional policies incorporating DI principles (P10), highlighting systemic gaps that hinder sustained implementation. These findings align with literature indicating that resource constraints, high student–teacher ratios, and inflexible institutional policies remain significant barriers to DI in higher education (Almguyhiri & Bagazi, 2026). Collectively, the data suggests that without structural changes such as increased resource allocation, policy alignment, and workload adjustments DI implementation will remain constrained, despite lecturers' willingness to employ more inclusive and responsive teaching practices.

Theme 7: Clear Recommendations for Strengthening DI in MLS

Participants offered concrete, actionable strategies for enhancing the implementation of Differentiated Instruction (DI) within Medical Laboratory Sciences (MLS) programmes across Eswatini's tertiary institutions. A recurring recommendation was the need to reduce class sizes, often highlighted as essential for enabling personalised instruction and effective laboratory engagement. As one participant stated, institutions should *"provide DI-focused training, reduce class sizes, [and] improve lab and digital resources", while another added that class sizes could be managed by using "smaller lab groups"*. Participants also emphasised the importance of increasing DI-specific training and ongoing professional development, arguing that educators require both pedagogical and technical support to design responsive instructional approaches. Strengthening laboratory resources, simulation tools, and digital technologies was described as necessary, with one respondent calling for *"increased investment in laboratory facilities, simulation tools, and digital platforms"*. Institutional structures were also seen as pivotal, with participants recommending the development and adherence to supportive DI policies, as reflected in the excerpt noting the need for *"institutional policies that enhance DI use"*. Finally, participants advocated for broader adoption of blended learning and competency-based models, ensuring that *"all students should be given equal chances to demonstrate competency according to their ability"*. These recommendations align with literature emphasising resource adequacy, educator capacity-building, and institution-wide policy support as key drivers of effective DI implementation (Coubergs et al., 2017; Santangelo & Tomlinson, 2012).

CONCLUSION

This study indicates that Differentiated Instruction (DI) can enhance engagement, competency mastery, and practical skill development in Medical Laboratory Sciences (MLS) programmes by allowing lecturers to tailor content, instructional strategies, and assessments to diverse student needs. Participants reported that DI supports both weaker and stronger students, improves conceptual understanding, and builds confidence in laboratory practice. However, large class sizes, limited laboratory resources, heavy workloads, and restricted access to professional development were identified as constraints that limit its consistent implementation. Variability in students' academic preparation, language proficiency, and practical skills further underscores the need for adaptable teaching strategies. These findings are based solely on lecturers' perspectives, were drawn from a small number of institutions in Eswatini, and do not include classroom observations or student outcomes, which limits generalisability. Nevertheless, the study offers insights into strategies and contextual factors relevant to implementing DI in resource-constrained MLS settings.

Recommendations

Based on these findings, several recommendations can be considered to strengthen the implementation of Differentiated Instruction (DI) in MLS programmes. Institutions could prioritise reducing class sizes and establishing smaller laboratory groups to facilitate more personalised instruction and active engagement. Investment in laboratory infrastructure, simulation tools, and digital platforms may support the use of diverse instructional methods. Continuous professional development focused on DI strategies can help equip educators with the pedagogical and technical skills needed for effective implementation. Additionally, institutional policies that explicitly support DI and align with competency-based curricula and blended learning approaches could further enable its application. Lecturers may adopt multimodal teaching, tiered practical tasks, and flexible assessments to address the varied needs of learners. Collectively, these measures have the potential to create a supportive environment that enhances the effectiveness and inclusivity of MLS education in Eswatini.

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