

Lived Experiences of Science Teachers in the Utilization of Differentiated Instruction in Ramsey County, Minnesota, USA

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ABSTRACT

This study explored the lived experiences of Filipino science teachers in implementing Differentiated Instruction (DI) in selected schools in Ramsey County, Minnesota, USA. It sought to understand the meanings teachers attributed to their experiences, identify the essential themes characterizing those experiences, and generate insights for a proposed framework for responsive differentiated science instruction. A qualitative phenomenological design was employed, with participants purposively selected based on their experience implementing DI in science classrooms. Data were generated through semi-structured interviews and analyzed using Colaizzi's phenomenological method. The findings revealed five interrelated themes that characterize differentiated science

instruction as a lived experience of responsive professional practice: encountering learner diversity as the starting point of differentiation; adapting science learning to individual needs; living with the tensions and demands of differentiated instruction; becoming flexible, reflective, and resourceful through experience; and finding fulfillment in learner engagement, understanding, and growth. Across these experiences, teachers described DI not as a fixed instructional technique or a set of isolated strategies, but as a continuous and context-responsive process of knowing learners, adapting instruction, negotiating classroom demands, and reflecting on learners' responses and development. The essence of the experience lies in teachers' sustained commitment to making science learning responsive to learner diversity while navigating the practical demands and constraints of classroom instruction. These findings provided the experiential basis for the development of a Responsive Differentiated Science Instruction (RDSI) Framework, which may serve as a guide for responsive, adaptive, and learner-centered science instruction.

Keywords: *differentiated instruction, science education, Filipino science teachers, lived experiences, phenomenological research, learner diversity, responsive science instruction*

INTRODUCTION

Science education has long been recognized as an essential foundation for preparing learners to succeed in a rapidly changing and technology-driven world. Across educational systems, schools are expected to equip students not only with scientific knowledge but also with critical thinking, problem-solving, collaboration, decision-making, and other competencies that can be applied beyond the classroom. These expectations reflect broader educational and development priorities that emphasize inclusive, equitable, and high-quality education capable of preparing learners to participate meaningfully in society and contribute to sustainable development. Achieving these goals requires instructional approaches that recognize learner diversity and provide meaningful opportunities for all students to engage in the learning process.

In the United States, classrooms encompass students with diverse academic readiness, interests, cultural backgrounds, linguistic experiences, prior knowledge, and learning preferences. These differences make it difficult for a single instructional approach to effectively address the needs of all learners. This challenge is particularly relevant in Public Schools Minnesota, USA, a large urban school system serving more than 316,000 students in school year 2025–2026, including substantial proportions of English learners, students with disabilities, and economically disadvantaged students. Such diversity underscores the need for responsive and learner-centered instructional practices that maintain academic rigor while providing equitable opportunities for students to participate and succeed.

One pedagogical approach that responds to learner diversity is Differentiated Instruction (DI). It involves intentionally adapting instructional content, learning processes, activities, and assessment according to students' readiness, interests, and learning profiles. Rather than providing identical learning experiences to all students, teachers create varied pathways through which learners can access content, engage in activities, and demonstrate understanding. In science education, this approach is particularly relevant because students enter classrooms with different levels of prior knowledge, conceptual understanding, abilities, and interests. Differentiated learning experiences may help students engage more meaningfully with scientific concepts while developing scientific reasoning, inquiry, problem-solving, collaboration, and other disciplinary competencies.

Recent scholarship suggests that although teachers recognize the value of differentiated approaches, implementation is influenced by the realities of classroom practice. Rubio (2024), in a qualitative study of teachers and paraprofessionals in an inclusion setting in the United States, found that teachers employed multiple pathways, learning stations, small-group arrangements, and other strategies to respond to learner differences, while their experiences also reflected the practical demands of implementation. Similarly, a 2024 qualitative study of differentiated instruction in teacher education reported that teachers often feel insufficiently prepared to implement differentiation and that teacher efficacy and school culture influence how differentiated practices are developed and sustained. These findings indicate that DI cannot be understood solely as a collection of instructional techniques; its utilization is also shaped by teachers' knowledge, confidence, professional experiences, and institutional context.

The relevance of DI is particularly evident in science education, where teachers must balance rigorous disciplinary learning with substantial variation in students' readiness and learning needs. Contemporary science instruction emphasizes inquiry, evidence-based reasoning, investigation, application of knowledge, and the use of science to understand real-world issues. These expectations require teachers to create learning experiences that are sufficiently challenging while remaining accessible to students with different backgrounds and abilities. DI offers one means of addressing this challenge by allowing teachers to adjust learning experiences while maintaining common instructional goals. Its emphasis on learner variability and equitable participation also aligns with *Sustainable Development Goal 4 (Quality Education)*, which calls for inclusive and equitable quality education and relevant learning outcomes. Its broader concern with inclusion and reducing barriers to participation is likewise consistent with the principles underlying *Sustainable Development Goal 10 (Reduced Inequalities)*.

These considerations are particularly significant for Filipino science teachers working in the United States. Teaching within a culturally diverse educational environment may require teachers to navigate differences in students' experiences, learning preferences, language backgrounds, curricular expectations, classroom structures, and professional practices. For Filipino science teachers, the utilization of DI may therefore involve not only applying pedagogical knowledge but also adapting to the expectations of a different educational system and responding to the specific characteristics of their students and schools. Their experiences may provide important insight into how differentiated practices are interpreted, adapted, and sustained within a multicultural U.S. educational environment.

Despite the growing literature on DI, important questions remain about how teachers experience its utilization in their everyday practice. Existing studies have examined strategies, teacher perceptions, implementation challenges, professional development, and potential effects on learning. Recent qualitative research has expanded understanding of teachers' practices and challenges, but studies differ substantially in terms of participant populations, grade levels, subject areas, and educational settings. Consequently, findings from inclusion settings, teacher education programs, or other subject areas may not fully capture the experiences of practicing science teachers working in culturally diverse U.S. public schools.

A more specific gap concerns the limited attention to the intersection of science teaching, differentiated instruction, cultural context, and Filipino teacher experiences. Existing literature provides useful information about how teachers differentiate instruction and the challenges associated with implementation, yet less is known about how Filipino science teachers themselves make sense of these experiences in their actual classrooms. Questions remain regarding how they recognize learner differences, make instructional decisions, adapt science lessons, negotiate classroom demands, and understand the professional meanings of utilizing DI. These dimensions are important because the implementation of DI is not necessarily uniform; it is shaped by teachers' beliefs, professional knowledge, student characteristics, institutional expectations, available resources, and the circumstances of particular classrooms.

This gap provides the rationale for a phenomenological inquiry into the lived experiences of Filipino science teachers in Ramsey County, Minnesota, USA. A phenomenological approach allows the study to move beyond asking which differentiated strategies are used or whether DI produces particular outcomes. Instead, it focuses on what teachers experience, how they interpret those experiences, and what meanings they attribute to utilizing DI in science teaching. Such an approach can reveal the opportunities, challenges, adjustments, and professional insights that may remain less visible in studies primarily focused on measurable outcomes or predetermined implementation indicators.

The study is also informed by the researcher's professional positionality and interest in science education and differentiated teaching. This professional proximity provides contextual sensitivity to the instructional challenges associated with learner diversity. However, because prior experiences may influence interpretation, reflexivity is necessary throughout the research process. The participants' descriptions and meanings will therefore remain central to the inquiry, while the researcher consciously examines and manages personal assumptions in interpreting the phenomenon.

Although the study is situated in the United States, its focus on Filipino science teachers also provides relevance to Philippine educational aspirations. Filipino educators working in international settings may develop professional experiences and pedagogical insights that contribute to broader discussions of teaching, learner diversity, and educational improvement. These insights may be considered in relation to *AmBisyon Natin 2040*, the Philippines' long-term vision, which expresses the aspirations of Filipinos for a stable, comfortable, and secure life and envisions a prosperous society in which Filipinos are smart and innovative. Quality education and the development of human capabilities are important foundations for advancing these aspirations.

The study is likewise relevant to the education reform directions identified by the *Second Congressional Commission on Education (EDCOM II)*. Its recent reports emphasize the urgency of addressing learning gaps and improving the foundations of Philippine education, while its work on teacher education has identified concerns regarding the alignment between teacher preparation and school-level needs. Examining the experiences of Filipino science teachers in utilizing DI may therefore provide contextual insights into teacher capacity, instructional responsiveness, and the professional conditions that influence learner-centered teaching.

Accordingly, the present study sought to explore the lived experiences of Filipino science teachers in the utilization of Differentiated Instruction in teaching science in selected schools in Minnesota, USA. It aimed to uncover the meanings teachers attribute to their experiences, identify the essential themes that characterize those experiences, and generate insights that may serve as a basis for a proposed framework,

learning guide, or model for differentiated science instruction. By focusing on teachers' lived experiences, the study sought to address a contextual and experiential gap in the literature and contribute to a deeper understanding of how DI is enacted within culturally diverse science classrooms.

Ultimately, the study positions Differentiated Instruction not merely as a collection of classroom techniques but as a pedagogical practice shaped by teachers, learners, and educational contexts. By examining the experiences of Filipino science teachers in selected schools in Minnesota, USA., the study may contribute to the broader discourse on inclusive science education, responsive teaching, and teacher professional practice. Its findings may also offer insights relevant to global commitments to quality and equitable education and to Philippine aspirations embodied in AmBisyon Natin 2040 and the continuing education reform agenda of EDCOM II.

Statement of the Problem

Central Question

How do science teachers perceive and describe their lived experiences in implementing Differentiated Instruction in science education?

Corollary Questions

Specifically, it seeks to answer the following questions:

1. What are the significant statements on the lived experiences of the teachers as to the utilization of differentiated instruction in teaching science?
2. What formulated meanings can be derived from the participants' significant statements?
3. Based on the formulated meanings, what emerging themes may be derived?
4. Based on the findings of the study, what framework, learning guide or model may be proposed?

Purpose of the Study

The purpose of this phenomenological study was to explore the lived experiences of Filipino science teachers in implementing Differentiated Instruction in teaching science in schools in Minnesota, USA. Using in-depth interviews, the study sought to understand how teachers perceived and navigated the process of designing and delivering science instruction that responded to the diverse readiness levels, interests, cultural backgrounds, and learning needs of their students. By examining the meanings teachers assigned to these experiences, the study aimed to reveal the essence of implementing Differentiated Instruction in science classrooms. The findings were intended to deepen the understanding of teachers' instructional experiences and offer practical insights for improving teacher education, professional development, and inclusive science teaching practices.

Literature Review

The Concept and Principles of Differentiated Instruction

Differentiated Instruction (DI) was widely recognized in recent scholarship as a learner-centered approach that addressed student diversity by adapting teaching strategies to learners' readiness levels, interests, and learning profiles. Rather than treating students as a homogeneous group, DI recognized learner variability and emphasized the need for teachers to provide responsive instructional experiences that addressed differences in students' abilities, prior experiences, interests, and learning needs. Recent literature further emphasized that DI extended beyond a collection of instructional techniques and functioned as a broader pedagogical framework for promoting equity, access, and meaningful participation in education (UNESCO, 2021; Gheysens et al., 2022; Smale-Jacobse et al., 2023).

A fundamental principle of DI was the systematic adaptation of instruction to accommodate learner variability. Teachers were expected to consider students' readiness, interests, and learning profiles when

planning and delivering instruction. In science education, this principle was particularly relevant because students entered science classrooms with varied levels of prior knowledge, conceptual understanding, learning preferences, and experiences. By aligning learning tasks with these differences, DI enabled learners to engage more meaningfully with complex scientific concepts and provided equitable opportunities for participation and learning.

The principle of responsiveness was also central to DI. Teachers adjusted instructional approaches according to the characteristics and needs of their learners rather than relying on a single method of instruction for all students. In this regard, DI was characterized as a dynamic and responsive pedagogical framework that enabled teachers to adapt instruction and classroom environments to differences in class composition and student diversity (Dulfer et al., 2025). Such responsiveness positioned the teacher as an intentional designer of learning experiences who considered learner differences in making decisions about instructional content, activities, assessment, and classroom organization.

Moreover, DI was increasingly associated with equity and inclusive education. Contemporary scholarship emphasized its role in providing learners with varied opportunities to access content, participate in learning activities, and demonstrate their understanding. This perspective positioned DI as an approach that sought not merely to accommodate differences but also to create more equitable learning opportunities within increasingly diverse educational environments (UNESCO, 2021; Gheysens et al., 2022).

Moreover, DI was characterized as a dynamic and responsive pedagogical framework because teachers adapted instructional processes and classroom environments according to class composition and student diversity (Dulfer et al., 2025).

These principles were particularly relevant to the present study because implementing DI required teachers to continuously interpret learner differences, make instructional decisions, and adjust their practices according to classroom conditions. In the context of science education, such adjustments could involve decisions regarding instructional content, learning activities, assessment, grouping, and classroom organization. Thus, understanding DI required not only an examination of the strategies teachers used but also an exploration of how teachers experienced and made meaning of the process of responding to diverse learners. This perspective provided an important foundation for examining the lived experiences of Filipino science teachers implementing DI in Ramsey County, Minnesota USA.

Dimensions of Differentiated Instruction

Differentiated Instruction was operationalized through deliberate modifications to four essential dimensions of instruction: *content, process, product, and learning environment*. These dimensions provided teachers with multiple ways of responding to differences in students' readiness, interests, and learning profiles while maintaining common instructional goals.

Content referred to what students were expected to learn, including the knowledge and scientific concepts they were expected to understand. Differentiating content involved systematically adjusting the complexity, resources, representations, and levels of support according to students' readiness, prior knowledge, and interests. In science instruction, teachers could provide tiered materials, multimedia resources, or contextualized and real-world examples to create multiple access points to essential scientific concepts without compromising curricular rigor. Such adaptations could make abstract concepts more comprehensible, reduce cognitive overload, and promote equitable access to science learning (Coubergs et al., 2023; Gheysens et al., 2022; Smale-Jacobse et al., 2023; Tomlinson, 2021; UNESCO, 2021).

The literature on content differentiation provided an important foundation for understanding the instructional decisions and adaptations involved in responding to learner diversity. Rather than focusing on the effectiveness of particular content adaptations, the present study considered how science teachers experienced the process of selecting, modifying, and presenting scientific content in response to their students' readiness, prior knowledge, interests, and learning needs. Examining these experiences provided

insight into how teachers navigated the demands of maintaining curricular expectations while making science content accessible to diverse learners within their classroom contexts.

Process referred to how students engaged with, explored, processed, and constructed meaning from scientific content. Process differentiation involved providing varied instructional activities and approaches that allowed learners to engage with concepts according to their cognitive abilities, prior knowledge, and experiences. In science classrooms, teachers could use inquiry-based learning, collaborative activities, laboratory experimentation, guided discovery, flexible grouping, and scaffolded instruction to provide different pathways for learning. These practices enabled students to engage with scientific concepts at appropriate levels of complexity and support (Melesse & Belay, 2022; Suprayogi et al., 2024). This study support the strategies/practices used in process differentiation.

Process differentiation also supported active and meaningful engagement with scientific concepts by aligning instructional experiences with learners' cognitive and experiential differences. Research indicated that varied learning processes could promote active participation, strengthen critical thinking, and deepen conceptual understanding (Deunk et al., 2022; Gheyssens et al., 2022; Tomlinson & Moon, 2022; Van Geel et al., 2021).

The literature on process differentiation provided an important foundation for understanding the instructional strategies and adaptations teachers employed to address learner diversity. Rather than focusing on the effectiveness of these strategies, the present study examined how science teachers experienced and navigated the process of selecting, adapting, and implementing varied learning activities, grouping arrangements, and levels of instructional support. Examining these experiences provided insight into how teachers made instructional decisions, responded to students' differing needs, and managed the demands of adapting learning processes within their science classrooms.

Product referred to how students demonstrated their learning and understanding of scientific concepts. Product differentiation provided learners with multiple avenues to communicate what they had learned while allowing teachers to assess common learning objectives using appropriate and consistent criteria. In science classrooms, students could demonstrate their understanding through written reports, experimental outputs, models, oral presentations, or digital artifacts. Providing varied forms of output recognized differences in learners' strengths and provided alternative ways for them to demonstrate their understanding (Gheyssens et al., 2022; Smale-Jacobse et al., 2023).

Product differentiation also reflected more flexible and inclusive assessment practices that encouraged students to exercise creativity, autonomy, and higher-order thinking. When learners were provided with appropriate choices for demonstrating their learning and were assessed using clear and consistent expectations, differentiated products could support motivation, engagement, and meaningful demonstrations of conceptual understanding (Hidayat et al., 2025; Tomlinson, 2021; UNESCO, 2021).

Implementing product differentiation therefore required teachers to make decisions about appropriate forms of assessment, develop or select suitable assessment tasks, and adapt evaluation practices while maintaining alignment with learning objectives. For the present study, these practices provided a basis for examining how science teachers experienced and navigated decisions related to assessing and evaluating diverse learners' demonstrations of scientific understanding.

Learning environment referred to the physical, social, and instructional conditions in which learning occurred. Differentiating the learning environment involved creating flexible, inclusive, and responsive classroom conditions that addressed students' diverse learning needs and encouraged participation, collaboration, and engagement. In science classrooms, this could include thoughtful classroom organization, varied learning resources, supportive classroom interactions, and the integration of digital technologies to provide learners with appropriate opportunities and pathways for learning. Creating a psychologically safe and supportive environment was also important in helping students feel respected, valued, and encouraged to participate actively in learning (Coubergs et al., 2023; Smale-Jacobse et al., 2023).

A well-structured and differentiated learning environment could promote student engagement, collaboration, and self-regulation while supporting inclusive practices in science education (Deunk et al., 2022; Hidayat et al., 2025; UNESCO, 2021).

Implementing this dimension required teachers to make decisions about classroom organization, learning resources, student interactions, and the use of instructional technologies in response to the needs and composition of their classes. For the present study, these practices provided a basis for examining how science teachers experienced and navigated the process of creating classroom environments that were responsive to learner diversity and conducive to meaningful participation in science learning.

Overall, the four dimensions of Differentiated Instruction—content, process, product, and learning environment—provided an integrated framework for responding to learner diversity in science classrooms. Content differentiation addressed what students learned, process differentiation focused on how they engaged with and made meaning from the content, product differentiation provided varied ways for students to demonstrate their learning, and learning environment differentiation addressed the physical, social, and instructional conditions that supported learning. These dimensions were interconnected and required teachers to make deliberate instructional decisions and adaptations based on students' readiness, interests, prior knowledge, abilities, and learning needs. Their implementation therefore involved more than applying individual instructional strategies; it required teachers to continuously assess classroom conditions, select appropriate resources and approaches, modify learning experiences, and maintain alignment with curricular expectations. For the present study, these dimensions provided an important framework for understanding how Filipino science teachers experienced, interpreted, and navigated the implementation of Differentiated Instruction in their science classrooms. Examining teachers' experiences across these dimensions offered a basis for understanding the challenges they encountered, the adaptations they made, the resources and support they utilized, and the meanings they attached to their practices.

Strategies for Implementing Differentiated Instruction

The implementation of DI involved the deliberate use of varied instructional strategies to respond to differences among learners. In science classrooms, teachers used varied learning activities, flexible grouping, scaffolded tasks, and personalized pacing to provide students with appropriate levels of challenge and support (Melesse & Belay, 2022; Suprayogi et al., 2024). These strategies enabled teachers to adjust instruction according to students' readiness levels and prior experiences while maintaining the intended learning goals.

Flexible grouping allowed teachers to organize students in different configurations according to instructional purposes, learning needs, or readiness levels. Similarly, scaffolding provided temporary support that helped students engage with scientific concepts or tasks that might otherwise have been difficult to accomplish independently. Varied learning activities provided multiple pathways through which students could engage with content, while differentiated products allowed learners to demonstrate their understanding through appropriate forms of performance.

In the immediate post-pandemic context, DI was identified as an effective approach for addressing learning gaps and supporting teachers in responding to diverse classroom needs (Scott et al., 2021). The increasing emphasis on differentiated approaches reflected broader changes in educational practice as schools responded to learner diversity and the need for more inclusive forms of instruction.

Overall, the literatures on strategies for implementing Differentiated Instruction provided an important foundation for the present study by identifying the instructional practices through which teachers enacted differentiation in science classrooms. These strategies highlighted that implementing DI involved continuous instructional adjustments rather than the application of a single standardized approach. For the present study, these literatures provided a foundation for examining how Filipino science teachers experienced and navigated the implementation of these strategies, including the challenges, adaptations, resources, and support involved in their practice. Rather than evaluating the effectiveness of particular DI

strategies, the study sought to understand the meanings teachers attached to their experiences of implementing DI within their specific science classroom contexts.

Differentiated Instruction in Science Education

Recent literature from 2021 to 2025 underscored the increasing significance of DI in science education as an approach for addressing learner variability, enhancing engagement, and supporting academic learning. Within science classrooms, differentiated instruction enabled teachers to adjust learning experiences to accommodate differences in readiness, interests, prior experiences, and learning needs. Such adaptations were particularly relevant to science education because learners encountered complex concepts that could require different levels and forms of instructional support.

Contemporary research also highlighted the integration of DI into curriculum reforms and innovative teaching practices. The growing diversity of educational settings and increasing emphasis on inclusive education contributed to the integration of differentiated approaches into science curricula and learner-centered pedagogies (Gheysens et al., 2022; UNESCO, 2021). Recent bibliometric and systematic review research further indicated that DI had become increasingly prominent in science education research, particularly in relation to inclusive education, curriculum development, and innovative instructional practices (Hidayat et al., 2025).

Differentiated approaches were also associated with opportunities for students to develop higher-order competencies. By providing varied learning experiences and levels of support, differentiated science instruction could facilitate the development of critical thinking, problem-solving, conceptual understanding, and scientific inquiry. These competencies were considered essential to contemporary science education and were supported by instructional approaches that allowed learners to engage with scientific ideas at appropriate levels of complexity.

Outcomes and Benefits

The literature published between 2021 and 2025 reported several positive outcomes associated with the implementation of DI. Studies indicated that differentiated approaches could enhance student engagement, promote inclusive classroom environments, and support academic achievement across subject areas, including science education (UNESCO, 2021; Smale-Jacobse et al., 2023). More recent empirical and mixed-method investigations likewise reported positive associations between DI and students' academic achievement and conceptual understanding in science.

Students who experienced differentiated approaches were reported to demonstrate increased engagement, greater self-confidence, and deeper comprehension, which were attributed in part to personalized pacing and the use of varied instructional tasks (Eikeland & Ohna, 2022; Goyibova et al., 2025). DI was also reported to influence students' attitudes toward science by making learning experiences more interactive, relevant, and accessible to learners with varying abilities.

Overall, the literature from 2021 to 2025 positioned Differentiated Instruction as a responsive and learner-centered approach to science teaching. The literature emphasized its foundation in addressing learner variability, its operationalization through the differentiation of content, process, product, and learning environment, and its application through varied instructional strategies. Existing studies further associated DI with student engagement, conceptual understanding, academic achievement, inclusion, and equity. These findings established the relevance of DI within contemporary science education while also providing an important scholarly context for examining how science teachers experienced and interpreted its implementation in their own classrooms.

The literature on Differentiated Instruction in science education established the relevance of DI as a responsive approach to addressing learner diversity and supporting inclusive science teaching. The reported benefits, including engagement, conceptual understanding, and academic learning, provided a broader context for understanding why teachers implemented differentiated practices. However, these studies primarily focused on instructional applications and student outcomes rather than teachers' lived experiences. For the present study, this literature provided a foundation for examining how Filipino science

teachers experienced and interpreted the implementation of DI in their science classrooms, particularly how they responded to learner diversity and navigated the instructional demands of differentiated teaching.

Differentiated Instruction: Student Engagement and Motivation in Science Learning

Interest in Science

Interest in science serves as a fundamental driver of student motivation, as it directly influences learners' willingness to participate, explore, and invest effort in science-related tasks. Beyond initial curiosity, interest develops when students perceive science as meaningful and relevant to their daily lives. Recent studies emphasize that linking scientific concepts to real-world contexts such as environmental issues, health, or technology helps learners see the value of what they are studying, thereby strengthening both situational and sustained interest (Krapp & Prenzel, 2021; Potvin & Hasni, 2023). Moreover, inquiry-based and context-driven approaches allow students to ask questions, investigate phenomena, and construct their own understanding, thereby deepening their engagement with the subject. Over time, this repeated exposure to meaningful and enjoyable learning experiences contributes to the development of intrinsic motivation. In addition, differentiated and learner-centered strategies ensure that tasks are aligned with students' interests and readiness levels, making learning more accessible and personally relevant. Such approaches not only sustain curiosity but also encourage learners to pursue science beyond the classroom, supporting long-term interest and engagement (OECD, 2022; UNESCO, 2021).

Engagement in Learning Activities

Student engagement in science extends beyond mere participation; it encompasses behavioral involvement, cognitive investment, and emotional connection to learning tasks. Engaged learners are attentive, actively involved in discussions, and willing to think deeply about scientific ideas. Contemporary literature highlights that interactive and student-centered strategies such as collaborative group work, hands-on experiments, problem-based learning, and the integration of digital tools significantly enhance students' engagement. These approaches encourage learners to take an active role in constructing knowledge rather than passively receiving information (Fredricks et al., 2022; Hiver et al., 2021). Furthermore, engagement is strengthened when students feel their contributions are valued and experience a sense of belonging in the classroom. Differentiated instruction plays a critical role in this process by providing multiple learning pathways that accommodate diverse abilities, interests, and learning preferences. As a result, more students can participate meaningfully, leading to increased attention, improved understanding, and more positive learning experiences in science (Smale-Jacobse et al., 2023).

Persistence in Completing Science Tasks

Persistence reflects students' ability to maintain effort and remain focused on completing science tasks, even when they encounter difficulties. It is closely associated with students' motivation, goal orientation, and perception of task relevance. Research indicates that learners are more likely to persist when they view tasks as achievable yet challenging and understand the purpose and value of the activity. Instructional strategies such as scaffolding, step-by-step guidance, and timely formative feedback help students gradually build competence and confidence, thereby strengthening their perseverance. Additionally, learning environments that promote autonomy where students have some choice and control over their learning encourage them to take ownership of their tasks and remain committed to completing them (Ryan & Deci, 2021; Schunk & DiBenedetto, 2022). Differentiated instruction further enhances persistence by aligning task difficulty with individual readiness levels, reducing frustration and preventing disengagement. Through these supportive practices, students develop resilience and a stronger capacity to overcome academic challenges in science (Tomlinson, 2021).

Confidence in Learning Science

Confidence in learning science, often conceptualized as self-efficacy, is a crucial factor influencing students' motivation, engagement, and overall academic performance. Students who believe in their ability to succeed are more likely to participate actively, take intellectual risks, and persist in challenging tasks.

Confidence develops through repeated experiences of success, constructive and specific feedback, and supportive interactions with teachers and peers. When learners are provided with achievable tasks that gradually increase in complexity, they can build a sense of competence and mastery over time (Bandura, 2022; OECD, 2022). Furthermore, differentiated instruction builds confidence by ensuring that learning activities are appropriately matched to students' abilities, allowing them to experience success without feeling overwhelmed. Inclusive and learner-centered classroom environments also play a significant role by fostering a sense of belonging and reducing anxiety associated with science learning. As a result, students develop positive academic self-concepts, which are essential for sustaining motivation and achieving long-term success in science education (UNESCO, 2021).

Overall, the literature indicated that differentiated instruction could create learning experiences that supported students' interest, engagement, persistence, and confidence in science learning. These findings provided an important context for understanding the classroom experiences teachers encountered when implementing DI. For the present study, the literature provided a foundation for examining how Filipino science teachers perceived and responded to students' interest, engagement, persistence, and confidence while implementing differentiated instruction. Rather than measuring these outcomes, the study focused on how teachers experienced, interpreted, and navigated their instructional practices in responding to diverse learners.

Teachers' Experiences in Implementing Differentiated Instruction

Teachers' experiences with Differentiated Instruction have been examined in relation to their understanding, classroom practices, and perceptions of its implementation. Sertel Altun and Nayman (2022) found that teachers generally understood DI as an approach that addressed students' diverse needs and interests through adaptations in content, materials, activities, and learning processes. Teachers who implemented DI perceived positive effects on students' happiness and meaningful learning. However, many teachers reported difficulties in consistently implementing DI because of limited knowledge, examination pressures, inadequate instructional materials, and large class sizes. The study further indicated that implementation was more feasible when teachers possessed adequate knowledge and received school-level support. These findings suggested that teachers' experiences with DI were shaped not only by their instructional practices but also by classroom demands and institutional conditions.

The implementation of DI was also influenced by broader contextual and organizational factors. Daşcıoğlu and Bümen (2025), in a mixed-methods study of 470 Turkish teachers and interviews with 12 teachers, found that curriculum intensity, examination pressure, overcrowded classrooms, time constraints, inadequate resources, administrative challenges, and limited support presented barriers to DI implementation. Conversely, smaller classes, adequate infrastructure, professional development, diverse resources, supportive management, and parent collaboration facilitated implementation. Similarly, Geel et al. (2022) found that teachers' experience and available time contributed to the development of DI skills, while school-based communities of practice supported teachers' professional development. Gibbs (2023) likewise reported that limited resources, student behavior, insufficient planning time, inflexible curriculum, and large class sizes constrained DI implementation among Australian secondary teachers, while professional learning and collaboration helped address these challenges.

Science-specific studies further demonstrated that implementing DI required teachers to adapt their instructional practices to the diverse needs of science learners. Salleh, Rauf, and Saat (2022) examined the experiences of 16 Malaysian chemistry teachers through individual semi-structured interviews and thematic analysis. The study identified challenges related to addressing diverse learner needs, lesson planning and delivery, teachers' skills and support, and time constraints. These findings indicated that DI implementation in science classrooms involved not only the selection of instructional strategies but also teachers' ongoing adaptation of instruction while managing practical classroom demands.

Studies conducted in the Philippine context have likewise provided evidence of teachers' experiences with DI. Rubio (2024) examined the practices, experiences, and challenges of 17 teachers and paraprofessionals in an inclusive setting. The findings identified practices such as hands-on learning, project-based learning, learning stations, small-group instruction, and multiple learning pathways, while also highlighting challenges related to time, varied learner needs, classroom management, and preparation. Collaborative teaching, team support, and professional development were identified as mechanisms that helped teachers address implementation challenges. Similarly, Bunga (2025) examined the experiences and challenges of eight multigrade teachers through qualitative focus groups, with the findings informing the development of a tool for assessing DI proficiency in instructional planning, delivery, and classroom management.

Qualitative and phenomenological studies have also examined teachers' lived experiences of DI in specific educational contexts. Yuen, Luo, and Wan (2023) explored the lived experiences and perceptions of 40 primary and secondary teachers in Hong Kong regarding differentiation practices during the COVID-19 pandemic. Their findings addressed teaching arrangements, learning environments, teaching methods, support materials, and assessment. More recently, Yulidawati et al. (2026) used a phenomenological design to explore the lived experiences of four kindergarten teachers implementing DI in inclusive science learning. The study examined how teachers adapted science activities to differences in students' readiness, interests, communication modes, sensory needs, and ways of demonstrating understanding.

Overall, empirical studies have shown that teachers' experiences of implementing Differentiated Instruction were shaped by instructional decision-making, learner diversity, classroom demands, resources, time, professional development, and institutional support. Although existing research has examined DI across various countries, educational levels, and contexts, much of the literature has focused on implementation practices, barriers, competencies, and outcomes rather than the lived experiences and meanings teachers attached to its implementation. Limited attention has been given to the experiences of Filipino science teachers implementing DI in Public Schools in Minnesota, USA. This gap provided the basis for the present phenomenological study, which sought to understand how Filipino science teachers experienced and navigated DI, particularly their instructional decisions, adaptations, challenges, resources, support, and the meanings they associated with its implementation.

Theoretical Framework

This study was primarily anchored in Carol Ann Tomlinson's Theory of Differentiated Instruction, which provided the principal theoretical lens for understanding how Filipino science teachers experienced and navigated the implementation of Differentiated Instruction (DI). The study was further supported by Vygotsky's Constructivist Learning Theory, particularly the concept of the Zone of Proximal Development (ZPD). While Tomlinson's theory provided the primary framework for understanding the nature and dimensions of differentiation, Vygotsky's perspective offered a complementary explanation of how teachers provided appropriate support and adjusted instruction according to learners' capabilities and needs.

Tomlinson's Theory of Differentiated Instruction (DI) is a learner-centered framework that views student diversity as an essential consideration in planning and delivering instruction. The theory is grounded in the premise that learners differ in their readiness, interests, and learning profiles; therefore, effective instruction should respond to these differences rather than rely on a single approach for all learners (Tomlinson, 2014, 2017). Differentiated Instruction involves teachers making intentional and flexible adjustments to instruction while maintaining essential learning goals for all students. Recent research continues to operationalize Tomlinson's framework through these learner characteristics and the dimensions of differentiation, demonstrating its continuing relevance in contemporary educational research (Lang et al., 2024).

Building on these learner characteristics, Tomlinson identified four key elements through which teachers could differentiate instruction: content, process, product, and learning environment. Content refers

to what students learn and how they access knowledge; process concerns how students engage with and make meaning from the content; product refers to how students demonstrate their learning; and the learning environment encompasses the physical, social, and instructional conditions that support learning (Tomlinson, 2014, 2017). These elements are differentiated in response to students' readiness, interests, and learning profiles while maintaining appropriate learning expectations. Recent research similarly identifies these dimensions as core components of Tomlinson's framework and emphasizes teachers' role in adapting instruction to make learning more accessible to diverse learners (Lang et al., 2024).

Beyond these four dimensions, Tomlinson's framework emphasizes that differentiation is proactive, flexible, and responsive rather than a fixed set of teaching techniques. Teachers draw on their knowledge of learners and ongoing assessment to make instructional decisions, adjust learning experiences, and provide appropriate levels of challenge and support (Tomlinson, 2014, 2017). Thus, implementing DI involves an ongoing process of intentional decision-making in which teachers recognize learner differences and adapt classroom practices accordingly. This emphasis on responsive instructional support provides a connection to Vygotsky's view of learning as a socially mediated process.

Vygotsky's Constructivist Learning Theory, particularly the Zone of Proximal Development, further explained the importance of providing learners with appropriate guidance and support. Vygotsky (1978) proposed that learners could accomplish tasks beyond their independent capabilities when assisted by teachers or more capable peers. This perspective emphasized social interaction, scaffolding, and responsive support as important processes in learning. Recent research has continued to demonstrate the relevance of Vygotsky's constructivist perspective to differentiated learning, particularly through the use of scaffolding and instructional support responsive to individual learner capabilities (Wibowo, 2025). In the context of the present study, the ZPD provided a complementary lens for understanding how teachers adjusted levels of challenge, guidance, grouping, and scaffolding according to students' learning needs.

Taken together, the two theoretical perspectives provided a complementary foundation for examining the lived experiences of Filipino science teachers in implementing DI. Tomlinson's theory provided the primary framework for understanding how teachers responded to learner variability through the differentiation of content, process, product, and learning environment, whereas Vygotsky's theory provided a complementary lens for understanding how teachers adjusted support, scaffolding, interaction, and levels of challenge. In this way, Tomlinson's theory addressed the broader dimensions and purposes of differentiation, while Vygotsky's perspective helped explain the learning processes underlying teachers' responsive instructional decisions. Together, these theories guided the interpretation of participants' narratives concerning how they planned instruction, adapted their teaching practices, responded to learner differences, and navigated the challenges, resources, and institutional support associated with implementing DI. At the same time, the theories served as complementary interpretive lenses while preserving the phenomenological focus on the meanings participants attached to their lived experiences.

Conceptual Framework

The conceptual framework provided a visual representation of how the study explored the lived experiences of Filipino science teachers in implementing Differentiated Instruction. Anchored in Tomlinson's Theory of Differentiated Instruction and supported by Vygotsky's Constructivist Learning Theory, the framework focused on teachers' practices, adaptations, challenges, resources, support, and meanings associated with DI implementation. Colaizzi's descriptive phenomenological method guided the analysis of participants' narratives to derive the themes and essence of their lived experiences.

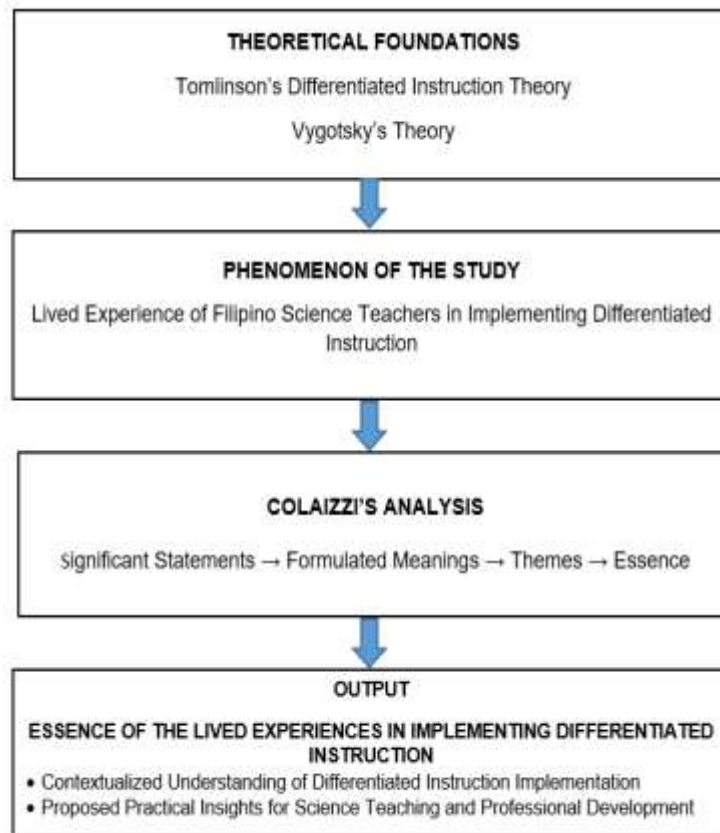


Figure 1. *The Conceptual Framework*

The framework centered on the lived experiences of Filipino science teachers in implementing Differentiated Instruction. These experiences encompassed their instructional practices and decision-making, adaptations to diverse learner needs, challenges encountered, and the resources and institutional support available to them. The participants' narratives served as the primary source of data for understanding how they experienced and interpreted the phenomenon.

Colaizzi's phenomenological method provided the analytical pathway for examining these narratives through the identification of significant statements, formulation of meanings, organization of themes, and development of the fundamental structure or essence of the phenomenon. Thus, the theoretical perspectives provided lenses for understanding the phenomenon, while Colaizzi's method guided the systematic analysis of the participants' lived experiences.

Research Gap and Justification of the Study

Although substantial research has documented the benefits of Differentiated Instruction (DI) in improving students' motivation, engagement, and academic achievement, much of the existing literature has employed quantitative and experimental research designs. These studies primarily focus on measuring DI effectiveness through student outcomes and standardized indicators, providing limited insight into how teachers personally experience, navigate, and make meaning of implementing differentiated instruction in their classrooms.

Existing qualitative studies have examined teachers' perceptions, instructional practices, challenges, and professional development needs related to DI; however, relatively few have employed a phenomenological approach to explore the lived experiences of science teachers. In particular, limited

attention has been given to how teachers experience planning differentiated lessons, responding to diverse learning needs, making instructional decisions, adapting strategies, and balancing curricular expectations. This gap is particularly relevant to science education, where teachers address abstract concepts, inquiry-based learning, laboratory activities, and varying levels of student readiness and conceptual understanding.

Furthermore, relatively few phenomenological studies have examined DI within the educational context of Minnesota, USA. Differences in curriculum expectations, classroom diversity, instructional resources, and institutional support may shape how teachers enact and understand differentiated instruction. Thus, findings from other contexts may not fully capture the experiences of science teachers in Ramsey County, Minnesota, USA.

The present study addresses these gaps by exploring the lived experiences of science teachers implementing DI in their classrooms. Using a phenomenological approach, the study seeks to understand the meanings teachers attribute to their experiences, including the challenges, adaptations, instructional decisions, resources, support, and professional learning that shape their practice. The findings may contribute to science education by providing contextualized insights that can inform teacher preparation, professional development, mentoring, and school-level support for responsive and inclusive science instruction.

Relevance to the Present Study

The existing literature consistently recognizes Differentiated Instruction as a learner-centered approach that supports inclusive teaching by responding to students' diverse readiness levels, interests, learning profiles, and cultural backgrounds. Recent empirical studies have demonstrated that Differentiated Instruction contributes to improved student engagement, motivation, and academic achievement across various educational settings. These findings underscore the educational importance of implementing differentiated instructional practices, particularly in science classrooms where learners demonstrate diverse abilities and learning needs.

While these studies provide valuable evidence regarding the outcomes of Differentiated Instruction, they primarily emphasize student performance and instructional effectiveness. Comparatively less attention has been devoted to understanding the experiences of teachers who are responsible for designing, implementing, and sustaining differentiated practices in their daily instruction. The success of Differentiated Instruction ultimately depends on teachers' instructional decisions, professional expertise, classroom experiences, and ongoing reflections, making their perspectives essential for understanding how DI functions in practice.

The present study extends the existing literature by shifting the focus from measurable outcomes to the lived experiences of science teachers. Rather than asking whether Differentiated Instruction is effective, the study seeks to understand how teachers experience implementing it, how they interpret the challenges and opportunities it presents, and how these experiences shape their instructional practices and professional growth. Through a transcendental phenomenological approach, the study aims to reveal the shared meanings and essence of utilizing Differentiated Instruction within the context of science education.

By documenting teachers' authentic experiences, the study contributes to a more holistic understanding of Differentiated Instruction that complements existing quantitative research. The findings may serve as a valuable foundation for strengthening teacher education, guiding professional development, supporting school leadership, and informing educational policies that promote inclusive and responsive science instruction. In doing so, the study enriches the growing body of qualitative scholarship on Differentiated Instruction by highlighting the voices and experiences of teachers who bring this instructional approach to life in their classrooms.

METHODS

Research Design

This study adopted a *descriptive phenomenological approach*, guided by the philosophical foundations of Edmund Husserl's phenomenology and operationalized through Colaizzi's (1978) *phenomenological method* examined the teachers' firsthand experiences, reflections, and interpretations of implementing DI in their daily science instruction. Qualitative inquiry was deemed appropriate because the phenomenon under investigation involved complex social processes, contextual influences, and meaning-making experiences that could not be adequately understood through numerical measurement alone. The study sought to explore how science teachers understood, negotiated, and enacted their learner-support responsibilities in implementing Differentiated Instruction (DI) within their respective school contexts. Such experiences required an in-depth examination of participants' perspectives, interactions, and interpretations situated within real-world educational environments. Qualitative research provided the methodological foundation for capturing these realities through rich and contextually grounded narratives (Creswell & Poth, 2023).

The study was situated in middle school science classrooms New Century School district in Ramsey County, Minnesota, USA, and involved science teachers who had at least one year of experience implementing differentiated instruction (DI). The participants taught Grades 6–8 Science in schools using the Amplify Science curriculum. Within this context, teachers implemented DI to address diverse learners' academic, behavioral, and language needs while adapting available curriculum materials, resources, and instructional strategies to their classroom conditions. The study therefore focused specifically on how these middle school science teachers experienced, navigated, and adapted DI within their actual classroom settings.

Data were collected through semi-structured, in-depth interviews, which allowed the participants to describe their experiences and the meanings they attached to implementing DI in their science classrooms. The interview data were then analyzed using Colaizzi's (1978) seven-step phenomenological procedure. First, the researcher familiarized herself with the participants' accounts by repeatedly reading the interview transcripts. Second, significant statements directly relevant to the phenomenon were identified and extracted. Third, meanings were formulated from these significant statements while remaining grounded in the participants' descriptions. Fourth, the formulated meanings were organized into theme clusters and themes that represented common aspects of the participants' experiences. Fifth, an exhaustive description of the phenomenon was developed by integrating the themes into a comprehensive account of the teachers' experiences. Sixth, the exhaustive description was condensed into a fundamental structure that captured the essential meaning of the phenomenon. Finally, the findings were returned to the participants for member checking or validation, allowing them to confirm whether the description and interpretation adequately reflected their experiences (Creswell & Poth, 2023).

Through this approach, the study moved from individual descriptions to shared themes and ultimately to the essential structure of teachers' lived experiences in implementing differentiated instruction. Colaizzi's systematic procedure provided a clear analytical pathway for identifying the meanings and common experiential structures emerging from the participants' accounts.

The study was not primarily concerned with whether DI was effective; rather, it focused on what it was like for science teachers to experience and implement DI, how they made sense of those experiences, and what common meanings characterized their experiences.

Research Locale

The study was conducted in selected schools within the New Century School district in Ramsey County, Minnesota, USA, specifically Compass Academy in Bloomington and New Century School in St. Paul. Compass Academy served as the second campus within District 4240, while New Century School served as the district's other campus. The schools shared a common institutional affiliation and provided a

relevant context for exploring the lived experiences of science teachers who implemented Differentiated Instruction (DI) in their classrooms.

The schools served students with diverse educational backgrounds, abilities, interests, and learning needs, creating classroom contexts in which teachers needed to adapt instruction to address learner diversity. Such characteristics provided an appropriate setting for examining teachers' experiences in planning and implementing differentiated science instruction.

The study focused on science teachers who taught learners with varying levels of readiness, conceptual understanding, and learning needs. Teachers adapted instructional strategies, classroom activities, assessments, and learning experiences to support student engagement and meaningful learning. This setting provided a relevant context for understanding how science teachers experienced the implementation of DI, including the challenges they encountered, the adaptations they made, the resources and support they utilized, and the professional learning they gained. The participants' experiences provided contextualized insights into the enactment of DI in science classrooms and its implications for responsive and inclusive instruction.

Selection of Co-Participants

The participants in this study were certified science teachers employed in selected public-schools in Ramsey County, Minnesota, USA who had firsthand, direct, and sustained experience in implementing Differentiated Instruction (DI) in science classrooms. The participants were selected through purposive sampling, a sampling technique commonly used in phenomenological research to identify individuals who have personally experienced the phenomenon being explored.

Four (4) participants were selected from Compass Academy, while two (2) were selected from New Century School. The participants met the following criteria: (1) they were currently teaching Science at either Compass Academy or New Century School; (2) they had at least one year of experience implementing DI in their science classrooms; (3) they had personally designed and/or delivered differentiated science instruction; (4) they were willing to participate voluntarily and provided informed consent; and (5) they were able and willing to describe and reflect on their experiences during the semi-structured interviews. Teachers who did not meet these criteria or who did not provide informed consent were not included in the study.

The six (6) co-participants were considered appropriate for a transcendental phenomenological study because the study emphasized obtaining rich and in-depth descriptions of their lived experiences rather than achieving a large sample size. Their narratives provided meaningful descriptions from which the researcher identified common meanings and explored the essential nature of science teachers' lived experiences in implementing DI in science classrooms.

Research Instrument

The primary instrument used in this study was a researcher-developed reflective written response guide and a semi-structured interview guide consisting of seven (7) open-ended questions. These instruments were developed based on the Statement of the Problem and the theoretical perspectives underpinning the study to explore lived experiences of Science teachers in the utilization of differentiated instruction in the Ramsey County, Minnesota, USA

The questions were designed to elicit detailed narratives about participants' experiences, the challenges they encountered, the instructional decisions and adaptations they employed, and the meanings they attributed to the implementation of virtual laboratories. The reflective written response guide served as the primary data collection instrument. Participants first responded to the seven open-ended questions through written narratives submitted via email, allowing sufficient time for thoughtful reflection before the interviews. The same guide was then used during synchronous Zoom interviews to clarify, verify, and expand upon the written responses. When appropriate, follow-up and probing questions were asked to

encourage deeper reflection, clarify ambiguities, and obtain richer descriptions of participants' lived experiences. The semi-structured interview format ensured consistency across participants while providing the flexibility to explore emerging ideas during each interview. This approach enabled participants to describe their experiences in their own words, explain significant events, discuss instructional decisions, and reflect on the meanings they associated with the implementation of virtual laboratories in online science instruction. To establish the quality and appropriateness of the instruments, both the reflective written response guide and the semi-structured interview guide were submitted to three (3) experts in qualitative research, science education, and educational technology for content validation. The validators evaluated the instruments for clarity, relevance, alignment with the research questions, appropriateness of wording, and their capacity to elicit rich descriptions of the phenomenon. Their recommendations were incorporated to improve the wording, sequencing, and overall alignment of the questions with the study's purpose and theoretical perspectives. The validated instruments generated rich narrative accounts that supported an in-depth understanding of how certified online science teachers implemented differentiated instruction, navigated instructional challenges, adapted their teaching practices, and interpreted the meanings of these experiences within classroom based science instruction.

Selection of Co-Participants

The selection of participants was guided by the need to obtain information-rich, contextually grounded, and multi-perspective data capable of illuminating the phenomenon of in implementing Differentiated Instruction in science classrooms. Consistent with the qualitative phenomenological study design, participant selection prioritized depth, relevance, and experiential knowledge rather than statistical representativeness. Individuals included in the study have direct and sustained experience in applying Differentiated Instruction in their daily teaching practice, enabling them to provide rich, detailed, and meaningful accounts of the phenomenon under investigation. within their respective school contexts.

Sampling Strategy

The study employed criterion-based purposive sampling to identify participants who met predetermined characteristics aligned with the research objectives. Purposive sampling is widely recognized in qualitative research as an effective strategy for selecting participants who can provide detailed and relevant information regarding a phenomenon under investigation (Creswell & Poth, 2021). Rather than seeking representativeness of a larger population, the study sought participants capable of contributing rich descriptions and reflective accounts of utilizing Differentiated Instruction in their daily teaching practice in science classrooms.

Participant Composition

The final participant group consisted of six Filipino science teachers directly involved in teaching science classes using Differentiated Instruction. The participants were composed of four teachers from Compass Academy and two teachers from New Century Schools within County of Minnesota, USA. The final sample size was deemed sufficient because the data generated recurring patterns, thematic consistency, and information redundancy across participant narratives. These indicators suggested that adequate depth and breadth of understanding had been achieved for the purposes of the investigation.

Inclusion Criteria

To ensure alignment with the objectives of the study, participants met the following criteria:

1. Currently employed as within County of Minnesota, USA.
2. Possessed at least one year of experience in implementing Differentiated Instruction,
3. Voluntarily agreed to participate and provided informed consent.

These criteria ensured that participants possessed sufficient knowledge, experience, and involvement in the phenomenon under investigation.

Exclusion Criteria

The study excluded individuals who met any of the following conditions:

1. Teachers with no involvement in using Differentiated Instruction in teaching science.
2. Personnel with less than one year of experience in their designated learner-support role.
3. Individuals unwilling or unable to provide informed consent.
4. Individuals whose participation could potentially compromise ethical safeguards due to ongoing sensitive administrative or legal concerns.

The exclusion criteria helped ensure the relevance, quality, and ethical integrity of the data generated.

Recruitment Process

Participant recruitment followed a systematic and ethically grounded process. Prior to data collection, the researcher secured the necessary permissions from relevant educational authorities and school administrators to conduct the study within schools in Ramsey County, Minnesota, USA.

Following institutional approval, coordination was undertaken with school leaders to identify potential participants who satisfied the inclusion criteria. Eligible individuals were informed about the nature and purpose of the study and were invited to participate voluntarily.

Potential participants received information regarding the objectives of the research, expected participation requirements, confidentiality measures, and their rights as research participants. Individuals who agreed to participate were provided with informed consent forms detailing the ethical safeguards associated with the study, including voluntary participation, confidentiality, anonymity, and the right to withdraw at any stage without consequence.

Upon securing informed consent, interview schedules were arranged according to participant availability. Semi-structured interviews were conducted in settings that ensured privacy, comfort, and confidentiality. Throughout the recruitment and data collection process, the researcher adhered to the ethical principles of respect for persons, beneficence, confidentiality, and non-coercion.

To further protect participant identities, pseudonyms and participant codes were utilized during transcription, analysis, and reporting. All research data were securely stored and used exclusively for scholarly purposes associated with the study. Through these procedures, the study ensured that participant recruitment remained ethical, transparent, and aligned with accepted standards of qualitative research practice while generating rich and credible accounts of guidance advocacy within schools in Ramsey County, Minnesota, USA.

Data Generation

Data for this study were generated through in-depth, semi-structured interviews, which are considered one of the most appropriate methods for transcendental phenomenological research because they enable participants to describe their lived experiences in their own words. The interview method provided an opportunity for the co-participants to share their personal experiences, perceptions, reflections, and the meanings they attribute to the utilization of Differentiated Instruction in science classrooms. During the interviews, follow-up and probing questions will be asked, when necessary, to encourage participants to elaborate on their experiences and provide deeper insights into the phenomenon under investigation.

Upon securing approval from the university or school administrators, the researcher formally invited the selected co-participants to participate in the study. Before each interview, the researcher explained the purpose of the study, participants' rights, and the ethical considerations, after which written informed consent was obtained. Interviews were scheduled at a time and place convenient for the participants to ensure a comfortable, private, and distraction-free environment. With the participants' permission, all interviews were audio-recorded to ensure the accuracy and completeness of the data, while the researcher maintained field notes to document observations, non-verbal cues, and reflective insights throughout the

interview process. Each interview lasted approximately 10 to 15 minutes, allowing sufficient time for participants to describe their experiences comprehensively.

Following each interview, the audio recordings were transcribed verbatim to preserve the authenticity of the participants' narratives. The researcher carefully reviewed each transcript while listening to the recordings to verify their accuracy and completeness. To enhance the credibility of the data, member checking was conducted by providing the co-participants with copies of their interview transcripts, allowing them to review, clarify, or confirm the accuracy of their statements affixed with their signature. Data generation continued until data saturation was reached, at which point no new meanings, themes, or significant insights emerged from subsequent interviews. The completed interview transcripts, field notes, and the researcher's reflective journal served as the primary sources of data for the phenomenological analysis, which sought to uncover the essence of science teachers lived experiences in utilizing Differentiated Instruction in science education.

Ethical Considerations

The researcher adheres to established ethical principles throughout the conduct of this study to safeguard the rights, dignity, privacy, and well-being of all co-participants. Prior to data collection, permission to conduct the study was obtained from the administrators of Compass Academy and New Century School at Ramsey County, Minnesota, USA. Where applicable, approval was secured from the appropriate Institutional Review Board (IRB) or Ethics Review Committee of the University of Perpetual Help System-DALTA. Participation in the study was entirely voluntary, and prospective co-participants provided with complete information regarding the study's purpose, procedures, and expected duration before deciding whether to participate. They were informed of their rights, including the right to decline participation, refuse to answer any interview question, or withdraw from the study at any stage without penalty or adverse consequences. Written informed consent was obtained from all participants before the interviews commence.

The researcher maintained the confidentiality and anonymity of all co-participants by removing any identifying information from the interview transcripts and research report and using pseudonyms or participant codes in place of their names. All interview recordings, transcripts, consent forms, and related research documents were treated as strictly confidential, securely stored, and accessed only by the researcher for academic purposes. Throughout the interview process, participants were treated with respect and sensitivity, and every effort will be made to ensure that they feel comfortable sharing their experiences. Participants may decline to answer questions they find uncomfortable or discontinue the interview at any time. The researcher also upholds honesty, integrity, and objectivity by accurately presenting the participants' narratives without alteration, fabrication, or misrepresentation, ensuring that the findings authentically reflect their lived experiences while adhering to the ethical standards governing qualitative research.

Data Transcription and Management

The data generated from the in-depth, semi-structured interviews were carefully transcribed and managed to preserve the authenticity and accuracy of the co-participants' lived experiences. With the participants' permission, each interview was audio-recorded and transcribed verbatim, ensuring that their exact words, expressions, and meaningful pauses are accurately captured. The researcher carefully compared the audio recordings with the written transcripts to verify the completeness and accuracy. Whenever necessary, unclear responses were clarified through follow-up communication or during the member-checking process to ensure that the transcripts accurately reflect the participants' intended meanings. To further enhance the credibility of the data, each co-participant was provided with a copy of his or her transcript for review, allowing them to verify, clarify, or expand their responses before the data analysis begins.

To safeguard the privacy and confidentiality of the co-participants, each transcript was assigned with a pseudonym or participant code instead of using personal identifiers. All interview transcripts, audio recordings, field notes, and researcher reflections were securely organized and stored in password-protected electronic files, while any printed documents were kept in a locked storage area accessible only to the researcher. An audit trail documenting the research process, from data collection to analysis, was also maintained to strengthen the transparency and trustworthiness of the study. After transcript verification, the finalized data were prepared for analysis following Colaizzi's phenomenological approach. Upon the completion of the study and in accordance with institutional data retention policies, all research records will be securely destroyed to protect the confidentiality and privacy of the co-participants.

Data Analysis Method

The data gathered from the in-depth interviews were analyzed using Colaizzi's Phenomenological Analysis, a systematic approach that sought to uncover the essence of the co-participants' lived experiences. After each interview, the audio recordings were transcribed verbatim and carefully reviewed alongside the recordings to ensure the accuracy and completeness of the transcripts. Prior to analysis, the researcher practiced epoché or bracketing by consciously setting aside personal assumptions, beliefs, and prior experiences related to Differentiated Instruction to approach the participants' narratives with openness and objectivity. The analysis then proceeded through horizontalizations, where all significant statements were initially treated with equal importance before being organized into meaningful units and clustered into emerging themes that reflect shared patterns across the participants' experiences. Guided by these themes, the researcher developed textural descriptions that explain what the co-participants experienced and structural descriptions that describe how and under what circumstances these experiences occurred. These descriptions were integrated to produce a composite description that captures the essence of science teachers' lived experiences in utilizing Differentiated Instruction in science classrooms. To ensure the trustworthiness of the findings, member checking, reflective journaling, and an audit trail were employed throughout the analysis process, thereby strengthening the credibility, dependability, confirmability, and transparency of the study while providing a rich and authentic understanding of the phenomenon.

Trustworthiness and Rigor of the Study

To ensure the quality and rigor of this transcendental phenomenological study, the researcher will establish the trustworthiness of the findings by following the criteria of credibility, transferability, dependability, and confirmability originally proposed by Lincoln and Guba (1985) and reaffirmed by contemporary qualitative scholars such as Creswell and Poth (2024), Novak and Jen (2024), and Enworo (2023). These criteria remain widely recognized as the foundation for ensuring rigor in qualitative research and for demonstrating that the findings genuinely represent the participants' lived experiences. In this study, credibility was enhanced through in-depth, semi-structured interviews that encourage co-participants to openly share their experiences, together with member checking and the practice of epoché or bracketing, allowing the researcher to set aside personal assumptions and focus on the participants' perspectives. Transferability was supported by providing rich and detailed descriptions of the research setting, the co-participants, and the context in which Differentiated Instruction is implemented, enabling readers to determine whether the findings may be relevant to similar educational settings.

To further strengthen the rigor of the study, dependability was established by maintaining a comprehensive audit trail that documents every stage of the research process, from participant selection and data generation to transcription, coding, theme development, and phenomenological analysis. The researcher also kept detailed methodological notes and reflective records to ensure that the research process is transparent, consistent, and well documented. Confirmability was achieved by ensuring that the findings are grounded in the co-participants' narratives rather than the researcher's personal interpretations. This was supported using verbatim interview transcripts, field notes, reflective journaling, member checking, and the

audit trail, all of which provided evidence that the interpretations are derived directly from the participants lived experiences. By integrating these strategies throughout the study, the researcher aimed to produce findings that are credible, dependable, transferable, and confirmable, thereby offering an authentic and meaningful understanding of science teachers lived experiences in utilizing Differentiated Instruction in science classrooms.

RESULTS

Overview of Emergent Themes

Analysis of the interview transcripts generated a set of interrelated themes that illuminate how Filipino science teachers understand, utilized and enact their responsibilities in the implementation of differentiated instruction in their classrooms within Ramsey County, Minnesota schools in USA. The themes emerged through iterative examination of participant's narratives.

The findings revealed that the lived experience of implementing differentiated instruction in science was characterized by a continuous process of knowing learners, adapting science teaching to their diverse needs, and negotiating the demands and constraints of the classroom. Participants experienced learner diversity through differences in ability, readiness, interests, language, behavior, confidence, and pace, which prompted them to continually modify their instruction, materials, activities, grouping, and learning resources. They described differentiation as demanding, particularly in terms of preparation time, classroom management, curriculum and standards alignment, limited laboratory facilities, and the need to address multiple learner needs simultaneously. These demands were accompanied by feelings of stress, frustration, and physical or mental exhaustion, but also by fulfillment when students participated, understood the lesson, gained confidence, or demonstrated progress. Through trial and error, reflection, collaboration, professional learning, and the creative use of available resources and technology, participants gradually became more flexible, patient, reflective, and resourceful in their teaching. Thus, the experience of differentiated instruction was understood as an ongoing learner-centered journey in which teachers continually adjusted their practice to make science learning meaningful and accessible while simultaneously developing themselves as responsive science educators.

Five major themes emerged from the data:

Theme 1. Encountering Learner Diversity as the Starting Point of Differentiation

This theme captures how participants experienced science classrooms as environments characterized by differences in ability, readiness, interests, language, behavior, confidence, and learning pace. These differences made a uniform approach insufficient and prompted teachers to know their learners more closely

Theme 2. Adapting Science Learning to Individual Needs

This theme reflects participants' experiences of differentiation as a continual process of modifying content, activities, instructional processes, assessments, and resources so that learners could access and make sense of science. Adaptation was often immediate and context-dependent.

Theme 3. Living with the Tensions and Demands of Differentiated Instruction.

Participants described the experience of implementing differentiated instruction as physically, mentally, and emotionally demanding, particularly as they responded to diverse learner needs and the demands of preparing and adapting instruction. Preparation, time limitations, multiple learner needs, behavior management, curriculum misalignment, large classes, and limited laboratory resources created tensions between what teachers wanted to provide and what classroom conditions allowed them to provide.

Theme 4. Becoming Flexible, Reflective, and Resourceful Through Experience

Participants emphasized how the difficulties they encountered shaped and transformed their instructional decision-making. Through trial and error, reflection, collaboration, self-directed learning,

professional development, and the use of technology, they developed greater flexibility, resourcefulness, and responsiveness in adapting their teaching to learners' needs.

Theme 5. Finding Fulfillment in Learner Engagement, Understanding, and Growth

Despite the demands of DI, participants experienced fulfillment when students participated, became confident, understood lessons, improved, and connected science with their experiences. Learner progress gave meaning to the effort required to differentiate instruction and contributed to teachers' own professional growth.

The themes collectively illustrate how participants navigated the complexities of meeting diverse learner needs while striving to make science learning accessible, meaningful, and engaging. The succeeding sections present each theme in detail, supported by participants' narratives and the descriptive phenomenological analysis guided by Colaizzi's method.

Theme 1. Encountering Learner Diversity as the Starting Point of Differentiation

Analysis of the participants' narratives revealed a shared understanding that differentiated instruction begins with knowing and recognizing the diversity of learners. Participants described their students as differing in ability, readiness, interests, language, behavior, confidence, and pace of learning. These differences shaped how teachers understood their learners and informed the instructional decisions they made in the classroom. Rather than viewing learners as a uniform group, participants recognized the need to understand individual strengths, difficulties, interests, and learning needs as a basis for determining appropriate ways to support their engagement and understanding of science. Thus, knowing learners emerged as a foundational aspect of differentiated instruction, guiding teachers in deciding what to modify, how to teach, and what forms of support to provide.

Four interconnected subthemes emerged from the analysis: (1) recognizing diversity in learners' abilities, readiness, and pace, (2) understanding learners' interests, experiences, and language needs, (3) observing learner responses and support needs; and (4) shifting toward a learner-centered understanding of teaching.

Subtheme 1.1 Recognizing Diversity in Learners' Abilities, Readiness, and Pace

Participants consistently described differentiated instruction as beginning with recognizing that learners differ in their abilities, readiness, confidence, interests, and pace of learning. The classroom was portrayed as a diverse learning environment in which some students readily grasped science concepts and were prepared for more challenging tasks, while others required additional time, guidance, explanation, or support. These differences required teachers to look beyond a single instructional approach and consider the varied needs of their learners when planning and delivering science instruction.

Table 1. *Recognizing Diversity in Learners' Abilities, Readiness, and Pace*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"My learners have diverse abilities, interests, and learning styles."</i>	Learners differ in abilities, interests, and ways of learning.
P3	<i>"It's really diverse, with students coming from different backgrounds. Their learning needs vary, so it can be challenging. However, it's actually rewarding once you get to know how to work with the students."</i>	Learners have different needs that require teachers to understand how to work with them.
P2	<i>"One of the first things I focused on, particularly during my second year, was learning more about my students and their learning styles."</i>	Knowing students and their learning preferences is important in responding to their needs.
P4	<i>"It's important because a lot of students have different learning styles. Some of them are visual learners, while others are auditory learners."</i>	Learners differ in how they engage with and process instruction.

P5	<i>"I have kids who are very slow, like we could say they are at a first-grade level, kindergarten level, or second-grade level."</i>	Learners may be functioning at different levels of readiness within the same classroom.
P6	<i>"I have kids who are very slow, like we could say they are at a first-grade level, kindergarten level, or second-grade level."</i>	Differentiation begins with recognizing differences in learners' needs, abilities, and interests.

The narratives revealed a shared perception of the participants that their classrooms were characterized by considerable diversity in learners' abilities, readiness, interests, learning styles, and learning needs. Some students were able to grasp science concepts quickly and were ready for more challenging tasks, whereas others required additional time, explanation, guidance, or intervention. Participants also observed differences in students' confidence and willingness to participate, particularly among those who experienced difficulty with science learning. These experiences led teachers to recognize that learners could not be expected to respond similarly to the same instructional approach. Understanding these differences became an important part of knowing their learners and served as a basis for determining the support and learning opportunities appropriate to each student.

Subtheme 1.2. Understanding Learners' Interests, Experiences, and Language Needs

Participants understand differentiated instruction as requiring knowledge of learners' individual characteristics, including their interests, backgrounds, readiness levels, abilities, learning styles, and language or reading needs, so that instruction can be appropriately adapted to their ways and levels of learning. At its core, this reflects the importance of understanding learners' individual characteristics and identifying the conditions and support they need for effective learning.

Table 2. *Understanding Learners' Interests, Experiences, and Language Needs*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"I aim to create a classroom where students feel supported in asking questions, exploring ideas, and making sense of scientific concepts."</i>	Creating supportive conditions for learners to participate, explore, question, and understand science.
P2	<i>"One of the first things I focused on, particularly during my second year, was learning more about my students and their learning styles."</i>	Learning about students and their learning styles to understand their individual needs.
P3	<i>"It's really diverse, with students coming from different backgrounds. Their learning needs vary, so it can be challenging."</i>	Recognizing that learners' diverse backgrounds contribute to differences in their learning needs.
P4	<i>"We have different types of children in the classroom, so we need to modify the lessons so that they would fit each and everyone's characteristics."</i>	Becoming familiar with individual learners to determine appropriate ways of working with them.
P5	<i>"It's not only about gearing instruction toward the interests of the kids, but more about determining what the best and most effective way is for them to grasp what is being taught."</i>	Using learners' interests and preferred ways of demonstrating learning to guide differentiation.

P5	<i>“If your students are at the very beginning level, how do you let them evaluate when they don’t even know how to grasp a concept at the surface-reading level?”</i>	Recognizing that limited reading proficiency may constrain learners’ understanding of science concepts.
P5	<i>“Basically, AI has helped me simplify the materials for those who are at a very low level.”</i>	Simplifying materials to accommodate learners with lower levels of readiness.
P6	<i>“For me differentiated instruction means adapting teaching methods, materials and activities to meet the diverse learning needs, abilities and the interest of students so that all learners can succeed.”</i>	Adapting instruction to learners’ diverse abilities, interests, and learning needs.

Participants do not view differentiation simply as changing activities; they first try to understand who their learners are and what they need in order to access science learning. Their narratives indicated that teachers considered what students already knew, how they learned, what interested them, and, in some cases, their reading or language proficiency when planning and adapting science instruction. This understanding enabled teachers to modify content, materials, activities, and learning processes to make science more accessible to learners with different levels of readiness. However, with “language needs”, it is not equally evident across all six participants. Participant 5 provides the strongest direct evidence, while the other participants more generally discuss learning needs, abilities, interests, and backgrounds.

Subtheme 1.3. Observing Learner Responses and Support Needs

The participants’ narratives revealed that differentiated instruction involves a continuous process of observing learners’ responses during classroom instruction and using these observations to determine the support they require. Rather than viewing learner needs as fixed characteristics that can be identified only before instruction, teachers described paying attention to learners’ participation, behavior, understanding, readiness, and engagement as instruction unfolds. These observations provide teachers with cues about whether learners are able to access the lesson, participate meaningfully, and demonstrate understanding, thereby informing subsequent instructional decisions. At its core, this reflects teachers’ continuous observation of learners’ responses and identification of the support they need to engage and progress in learning.

Table 3. *Observing Learner Responses and Support Needs*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>“I aim to create a classroom where students feel supported in asking questions, exploring ideas, and making sense of scientific concepts.”</i>	Attending to learners’ participation and understanding through their questions, exploration, and engagement.
P2	<i>“The first thing I had to focus on was classroom management, particularly student behavior.”</i>	Monitoring learner behavior to maintain conditions conducive to learning.
P5	<i>“If your students are at the very beginning level, how do you let them evaluate when they don’t even know how to grasp a concept at the surface-reading level?”</i>	Recognizing when learners’ level of understanding or reading proficiency limits their ability to perform more complex tasks.

P5	<i>““Basically, AI has helped me simplify the materials for those who are at a very low level.”</i>	Adapting instructional materials in response to learners’ limited readiness and comprehension needs.
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Taken together, these narratives suggest that observing learners is an integral part of differentiated instruction. Teachers attend to what learners say, do, understand, and demonstrate during classroom activities. Their observations of questioning, participation, behavior, comprehension, readiness, and engagement serve as practical indicators of whether the current instructional approach is appropriate for particular learners. When these observations reveal difficulty or limited access to the lesson, teachers respond by modifying materials, adjusting activities, providing additional support, or changing the way content is presented.

Thus, differentiated instruction is experienced not simply as the preparation of different activities for different learners, but as an ongoing process of noticing, interpreting, and responding to learner needs. The teachers’ experiences suggest that effective differentiation depends on their ability to remain attentive to learners throughout the learning process and to use the information gained from learners’ responses to make appropriate instructional adjustments.

Subtheme 1.4. Shifting Toward a Learner-Centered Understanding of Teaching

The participants’ narratives revealed a growing realization that effective teaching cannot rely on a single instructional approach or assume that all learners can adapt to the same method. Instead, teachers described a shift toward viewing instruction from the perspective of learners—their abilities, readiness, learning preferences, and individual needs. This shift reflects a movement from asking learners to adjust to a predetermined way of teaching toward recognizing the teacher’s responsibility to modify instruction so that learners can access and engage with science learning.

Table 4. *Shifting Toward a Learner-Centered Understanding of Teaching*

Participant	Direct Narrative Evidence	Formulated Meaning
P3	<i>“There’s no one-size-fits-all when it comes to instruction.”</i>	Recognizing that uniform instruction is insufficient for learners with diverse ways and needs of learning.
P3	<i>“As a teacher, it has always been your role to give them what they deserve and what they actually need—the ways that they can learn more and more efficiently.”</i>	Assuming responsibility for adapting instruction to provide learners with ways of learning that correspond to their individual needs.
P4	<i>“We have different types of children in the classroom, so we need to modify the lessons so that they would fit each and everyone’s characteristics.”</i>	Modifying lessons to fit learners’ individual characteristics rather than requiring learners to conform to a single instructional approach.
P5	<i>“It’s not only about gearing instruction toward the interests of the kids, but more about determining what the best and most effective way is for them to grasp what is being taught.”</i>	Determining and adapting instructional approaches according to how individual learners can most effectively understand the content.
P6	<i>“Differentiated instruction means adapting teaching methods, materials and activities to</i>	Viewing teaching methods, materials, and activities as

<i>meet the diverse learning needs, abilities and the interest of students so that all learners can succeed."</i>	adaptable elements that should respond to learners' diverse needs and abilities.
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Across the participants' narratives, a shared understanding emerged that teaching is a responsive and adaptive process. Rather than expecting learners to adjust to one instructional method, teachers described modifying lessons, materials, activities, and approaches based on learners' needs. Thus, learner diversity was viewed not as an obstacle but as a key consideration in planning instruction. This perspective also reflects a shift in teachers' professional roles—from delivering predetermined content to becoming adaptive facilitators who continually adjust instruction to provide meaningful access to learning.

The four subthemes reflect a progressive experiential movement: from encountering learner diversity, to understanding individual learner characteristics, observing learner responses and needs, recognizing the limitations of one-size-fits-all instruction, and ultimately adapting teaching to learners. This progression shows that differentiated instruction was not experienced simply as a collection of classroom techniques. Rather, it developed through the teachers' lived encounters with learners whose differences made a uniform approach difficult to sustain. As teachers became more familiar with their learners, they learned to recognize and interpret differences in background, interests, readiness, abilities, learning styles, behavior, and language or reading proficiency. These observations increasingly informed how they approached instruction.

Theme 2. Adapting Science Learning to Individual Needs

The participants' narratives revealed how teachers translated their understanding of learner diversity into responsive instructional practices. Their experiences showed that differentiation involved modifying the content, learning processes, materials, activities, and assessment to accommodate learners' varying abilities, readiness levels, interests, and ways of learning. Thus, teachers adapted science learning to provide learners with appropriate opportunities to access, engage with, and demonstrate their understanding of science.

Four interconnected subthemes emerged from the analysis: (1) modifying content and materials to match learner readiness, (2) varying instructional activities and learning pathways, (3) differentiating support and challenge across learner levels; and (4) using learner evidence to guide instructional adjustments.

Subtheme 2.1. Modifying Content and Materials to Match Learner Readiness

Participants described differentiated instruction as an ongoing process of modifying science content and learning materials in response to differences in students' readiness, abilities, and learning needs. Their experiences revealed that the materials provided by the curriculum or learning platform did not always correspond to the learners' actual levels of understanding. As a result, teachers adjusted the complexity of content, simplified explanations, developed supplemental materials, and selected additional resources to make science concepts more accessible to learners. These adaptations reflected the teachers' efforts to bridge the gap between the intended curriculum and what students were prepared to understand, allowing learners at different levels to engage with the same science concepts in more appropriate and manageable ways.

Table 5. *Modifying Content and Materials to Match Learner Readiness*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	"I also ensure that my instruction is aligned with state standards while adapting lessons to meet the diverse needs of my students."	Content and materials are modified to address learner needs and standards.

P5	<i>It's a lot of preparation—looking for the right materials, leveling them according to the students' abilities, and making sure they are appropriate for their level."</i>	Materials are adjusted to learners' readiness levels.
P6	<i>"I regularly adjust lessons from amplify science by simplifying instruction, providing visual, using additional materials I download online."</i>	Curriculum content is simplified and supplemented.
P6	<i>"some lessons are too advanced... So I need to adjust and simplify content."</i>	Teacher responds directly to mismatch between content and learner level.

Participants' significant experiences and formulated meanings reveal how teachers modified science content and learning materials according to learners' readiness and abilities. Teachers responded to differences in learner levels by simplifying content, adapting materials, modifying lessons, and developing supplemental resources to make science learning more accessible.

Subtheme 2.2. Varying Instructional Activities and Learning Pathways

This subtheme emerged from the participants' perceptions and narratives of how they varied instructional activities and learning pathways in response to the differences they observed among their learners. Across their accounts, the participants described that students did not always respond to science learning in the same way; consequently, they perceived a need to provide different activities, approaches, resources, and forms of support. Their narratives reflected efforts to create alternative ways for learners to participate in science lessons and engage with concepts according to their perceived readiness, needs, interests, and classroom circumstances.

Table 6. *Varying Instructional Activities and Learning Pathways*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"Some students learned best through visual and hands-on activities..."</i> <i>"learning stations, simulations, and real-life materials (realia) to make the lesson engaging and meaningful."</i>	Multiple learning pathways are provided to accommodate differences in learner needs.
P3	<i>"I could create stations in my classroom to capture their interest."</i> <i>The stations included technology, teacher support, independent learning, and manipulatives.</i>	Teachers organize differentiated learning environments in which students engage with science through different activities and levels of support.
P4	<i>"Some group members will be working in a controlled environment, while some group members will be working in a natural environment."</i> <i>"everyone gets that hands-on experience."</i>	Students are given varied experiential pathways to engage with science.
P6	<i>"visual hands on activities group work and modified worksheets and extra practice materials from online sources."</i>	Teachers employ varied instructional formats and supplementary materials to provide learners with alternative ways of engaging with science content.

From the participants' perspectives, instructional decisions were also shaped by the immediate realities of their classrooms. Their narratives showed that the choice of activity, grouping arrangement, resource, or level of support could change depending on students' learning needs, behavior, language abilities, available resources, and the particular science concept requiring flexibility and continuous adjustment rather than adherence to one uniform instructional pathway.

The participants experienced varying instructional activities and learning pathways as a responsive and flexible way of addressing learner differences. Their accounts portray teachers as continually observing learners, recognizing differences in how they participate in science learning, and adjusting instructional experiences accordingly. The subtheme therefore reflects the participants' perceived movement from recognizing learner differences toward creating varied opportunities through which learners could access, engage with, and make sense of science learning.

Subtheme 2.3. Differentiating Support and Challenge Across Learner Levels

Several participants described doing something different for struggling, average, and advanced learners. The participants' narratives revealed that differentiated instruction involved varying the level of support and challenge according to learners' readiness and perceived needs. They described recognizing that students did not begin learning with the same level of understanding, skills, or capacity to work independently.

Table 7. *Differentiating Support and Challenge Across Learner Levels*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"more challenging tasks for advanced students, allowing them to apply their understanding at a deeper level."</i>	Differentiation involves extending learning for advanced students rather than limiting instruction to the needs of the whole class.
P2	<i>"activities at different levels based on my students' learning needs and abilities." "For advanced learners, I design different activities that are appropriate for their abilities and provide additional challenges."</i>	Teachers vary task difficulty and provide additional challenge according to differences in learner ability.
P3	<i>"We have the average students... But I also have the advanced group, where I give them critical-thinking questions." "The struggling group received questions with pictures and scaffolding questions."</i>	Teachers differentiate the level of support and cognitive demand by providing scaffolding for struggling learners and more challenging tasks for advanced learners.
P5	<i>"There are students who finish early, and you have to make their work more challenging..." "For them, you also have to simplify the activities and make sure that you are assisting them."</i>	Teachers adjust the level of cognitive challenge and amount of support according to learners' readiness, enabling advanced learners to extend their understanding while helping struggling learners access the learning process.

Consequently, teachers adjusted activities, grouping, scaffolding, and expectations to provide greater assistance to learners who needed it while allowing more capable learners to engage with tasks that provided an appropriate level of challenge. In this sense, differentiation was perceived not as giving every

learner the same task, but as creating different pathways that enabled learners at varying levels to participate meaningfully in science learning.

The participants' experiences further suggested that such differentiation was responsive and flexible. Support was increased when learners experienced difficulty, while assistance was gradually reduced when learners demonstrated greater readiness or independence. Their narratives therefore reflected an understanding of differentiation as a *continuous process of matching instructional support and challenge with learners' changing needs*. This perception is consistent with the principle of differentiated instruction that teachers respond to differences in learner readiness by adjusting the complexity of learning experiences, scaffolds, and opportunities for independent engagement.

Subtheme 2.4 Using Learner Evidence to Guide Instructional Adjustments

The participants' narratives revealed that their instructional decisions were informed by ongoing evidence of learners' understanding, participation, behavior, and progress. Rather than relying solely on predetermined lesson plans, teachers described observing how students responded to activities and using these observations to determine whether additional explanation, scaffolding, practice, or alternative learning approaches were needed. Learners' performance therefore served as an important basis for making immediate instructional adjustments.

Table 8. *Using Learner Evidence to Guide Instructional Adjustments*

Participant	Direct Narrative Evidence	Formulated Meaning
P2	<i>"If students receive low scores on an assessment, I know that I need to revise my instruction or use a different strategy."</i>	Teachers revise instruction when assessment evidence indicates that students have not adequately understood the lesson.
P3	<i>"Based on their understanding from the previous lesson, 80% or 70% of them were able to get it, while the remaining 30% were struggling..." "For those who were struggling, I needed to give a different lesson..."</i>	Teachers interpret evidence of students' understanding and use it to reorganize instruction, providing additional support to learners who have not yet mastered the prerequisite understanding.
P3	<i>"how they actually do during the instruction time... how they do on the exit tickets, or how they feel about it during the lesson."</i>	Teachers continuously monitor learner responses and use immediate and subsequent evidence to determine whether a different instructional approach is needed.
P4	<i>"Basically, it's based on how your relationship works with your students because each teacher already knows the character of each student in the classroom."</i>	Teachers draw on their knowledge of individual learners to determine grouping and instructional arrangements.
P5	<i>"At the beginning of the school year, I already conducted a diagnostic... it will guide you in determining what the plans are and what approaches you're going to implement throughout the year."</i>	Teachers use initial diagnostic evidence to establish a basis for planning differentiated approaches throughout the school year.

The participants also perceived learner evidence as dynamic and responsive, recognizing that students' needs could become more apparent as instruction unfolded. When learners demonstrated difficulty or limited engagement, teachers modified activities, provided additional support, or introduced alternative

resources. Conversely, when learners showed greater understanding or readiness, teachers allowed them to proceed with more independent or challenging tasks. Thus, the participants experienced differentiated instruction as a continuous process of observing learners, interpreting evidence of their needs, and adjusting instruction accordingly. This reflects the phenomenological essence of their experience: differentiation was not simply a planned instructional technique but an ongoing response to what teachers encountered and learned about their students during the teaching-learning process.

The four interconnected subthemes reveal how participants experienced adapting science learning in response to the diverse needs they encountered in their classrooms. Their narratives describe an ongoing process of modifying content and materials, varying instructional activities and learning pathways, adjusting the level of support and challenge, and using information about learners to guide subsequent instructional decisions. These experiences suggest that differentiation was not experienced as a fixed set of instructional techniques but as a continuing process of responding to learners as teaching and learning unfolded.

Theme 3. Living with the Tensions and Demands of Differentiated Instruction.

The participants' narratives provided rich descriptions of the demands and tensions they encountered while implementing differentiated instruction in their science classrooms. Their accounts reflected experiences related to extensive preparation and time requirements, managing multiple learner and classroom demands, working within curriculum and resource constraints, and coping with the practical and emotional strain of differentiation. The significant experiences and formulated meanings derived from these narratives are presented below and organized according to the four sub-themes that emerged from the descriptive phenomenological analysis.

Four sub-themes emerged from the participants' narratives: (1) experiencing extensive preparation and time demands; (2) managing competing learner and classroom demands; (3) negotiating curriculum, resource, and facility constraints; and (4) experiencing the emotional and practical strain of differentiation.

Subtheme 3.1. Experiencing Extensive Preparation and Time Demands

Participants' lived experiences revealed that implementing differentiated instruction involved considerable time and preparation as they developed and modified lessons and materials to respond to diverse learner needs.

Table 9. *Experiencing Extensive Preparation and Time Demands*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"I often create my own presentations, modify lessons, and design supplemental activities..."</i>	Differentiation required teachers to invest additional time in developing and modifying instructional resources.
P1	<i>"This requires me to prepare different lessons, instructional materials, and differentiated teaching strategies for each grade level..."</i>	Managing multiple grade levels and learner differences increased the amount of preparation required.
P5	<i>"It's a lot of preparation—looking for the right materials, leveling them according to the students' abilities, and making sure they are appropriate for their level."</i>	Differentiation involved extensive preparation to ensure materials matched varying learner levels.
P6	<i>"I also face difficulties in preparing differentiated test takes time..."</i>	Developing differentiated assessments required additional time and effort.

These experiences often made differentiation difficult and time-consuming, particularly when teachers had to respond to several learner needs at the same time and make instructional decisions during

the lesson. Despite these demands, participants also described moments of fulfillment when their efforts enabled students to participate, understand the lesson, and demonstrate learning. Thus, this theme captures the tension inherent in participants' lived experiences of differentiated instruction—between the substantial demands of adapting instruction and the sense of meaning and reward that emerged when those adaptations supported student learning.

Subtheme 3.2. Managing Competing Learner and Classroom Demands

This subtheme emerged from the participants' experiences of navigating multiple and competing learner and classroom demands while implementing differentiated instruction.

Table 10. *Managing Competing Learner and Classroom Demands*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"I teach approximately 25 students per class across three grade levels... without a teaching assistant."</i>	Teachers had to manage multiple learner and instructional demands without additional classroom assistance.
P1	<i>"Managing multiple preparations, varied student behaviors, and diverse instructional demands makes differentiated instruction both complex and time-consuming."</i>	Differentiation was experienced as complex because teachers had to manage several competing demands simultaneously.
P2	<i>"The most challenging part is managing student behavior."</i>	Classroom behavior added another demand to differentiated instruction.
P5	<i>"One student might need to ask you a question while, at the same time, you are assisting another group."</i>	Teachers had to divide their attention among learners requiring different forms of assistance.
P4	<i>"You also need to manage their behavior. You can't have kids running around the whole classroom..."</i>	Differentiated and hands-on activities required simultaneous instructional and behavioral management.

Their narratives revealed the challenge of simultaneously responding to diverse learning needs, behavioral concerns, language differences, and instructional expectations within the same classroom. These experiences illustrate how participants continually balanced competing demands and adjusted their instructional responses to sustain meaningful learning opportunities for all learners.

Subtheme 3.3. Negotiating Curriculum, Resource, and Facility Constraints

This sub-theme concerns the tension between what teachers intended or were expected to provide and the curriculum, materials, facilities, or resources actually available. Participants experienced the challenge of bridging the gap between prescribed curriculum and available resources by finding alternative ways to support science learning.

Table 11. *Negotiating Curriculum, Resource, and Facility Constraints*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"Our school is a STEM school, we do not have a science laboratory."</i>	Teachers experienced a mismatch between the intended nature of science instruction and the available laboratory facilities.
P4	<i>"The problem with our curriculum is that it's not aligned with the Minnesota standards. So, you always need to cut and then add..."</i>	Teachers had to modify prescribed curriculum because it did not fully correspond to required standards.

P4	<i>"Especially when you don't have a laboratory where you can do hands-on learning, you need to find other ways."</i>	Lack of laboratory facilities required teachers to seek alternative ways of delivering experiential science learning.
P1	<i>"I rely on simulations, videos, demonstrations, and improvised instructional materials instead of conducting laboratory experiments."</i>	Resource limitations required teachers to substitute alternative instructional resources for conventional laboratory experiences.

Participants described experiencing a gap between the prescribed science curriculum and the resources and facilities available in their classrooms, particularly when lessons required laboratory or hands-on experiences. To address this gap, they relied on alternative resources such as videos, websites, simulations, and improvised materials to support science learning.

Subtheme 3.4. Experiencing the Emotional and Practical Strain of Differentiation

This sub-theme captures the participants' experience of differentiation as difficult, demanding, and taxing, even when it was meaningful or rewarding.

Table 12. *Experiencing the Emotional and Practical Strain of Differentiation*

Participant	Direct Narrative Evidence	Formulated Meaning
P3	<i>"It's a lot. It's a lot of work, but it's rewarding when you see everyone get the exit ticket at the end of the day."</i>	Differentiation was experienced as demanding while simultaneously providing a sense of reward when learners succeeded.
P5	<i>"So, preparation is really difficult, and implementation is difficult, too."</i>	Both planning and actual implementation were experienced as difficult and demanding
P5	<i>"It was difficult. It was difficult, but as long as you understand how to navigate the complexity of differentiated instruction..."</i>	Teachers experienced DI as complex and difficult to manage, requiring them to learn how to navigate its demands.
P1	<i>"Managing multiple preparations, varied student behaviors, and diverse instructional demands makes differentiated instruction both complex and time-consuming."</i>	The cumulative demands of differentiation contributed to the perceived burden and complexity of teaching.

Participants experienced differentiated instruction as both difficult and demanding, particularly because it required extensive preparation, continuous attention to varied learner needs, and adjustments during instruction. Despite these demands, they also found the experience meaningful and rewarding when their efforts resulted in students becoming engaged, understanding the lesson, and successfully demonstrating their learning. Thus, the experience reflected a tension between the effort required to differentiate instruction and the fulfillment derived from seeing learners respond positively and make progress.

The four interconnected subthemes reveal the participants' lived experiences of navigating the demands and tensions involved in implementing differentiated instruction in their science classrooms. Their narratives describe differentiation as requiring substantial preparation, time, attention, and emotional investment while they simultaneously responded to diverse learner needs and worked within curriculum, resource, and facility limitations. These experiences suggest that differentiation was not experienced as a simple instructional adjustment but as an ongoing process that placed multiple demands on participants as they sought to respond to individual learners.

Theme 4. Becoming Flexible, Reflective, and Resourceful Through Experience

Participants' lived experiences revealed a gradual transformation in how they understood, approached, and enacted differentiated instruction. As they encountered diverse learners, instructional challenges, and changing classroom conditions, they learned to reconsider their existing practices, reflect on their instructional decisions, and develop new ways of responding to learners' needs. Through continued classroom experience, professional learning, collaboration, and engagement with available technologies and resources, participants became more flexible, reflective, and resourceful in their teaching. Thus, becoming an adaptive teacher emerged as an evolving lived experience shaped by the continuous process of encountering, reflecting on, and responding to the realities of differentiated science instruction.

Four sub-themes emerged from the participants' narratives: (1) developing flexibility through classroom experience; (2) learning and refining practice through reflection and experience; (3) learning through collaboration and professional development; and (4) becoming resourceful through technology and alternative resources.

Subtheme 4.1 Developing Flexibility Through Classroom Experience

Participants' lived experiences revealed that flexibility developed as an essential way of responding to the diverse and changing needs encountered while implementing differentiated instruction. Through continued teaching experience, they learned to adjust their approaches, develop their own techniques, and respond more readily to varying learner needs and classroom conditions.

Table 13. *Developing Flexibility Through Classroom Experience*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>"These experiences helped me realize the importance of flexibility and adaptability in teaching science."</i>	Encountering diverse learners and contextual limitations led teachers to develop greater flexibility and adaptability in their science teaching.
P4	<i>"Ever since we started teaching, from our first year of teaching until now, after a couple of years, you kind of find your own way and develop your own techniques when it comes to differentiated instruction inside your classroom."</i>	Teachers developed individualized ways of implementing DI through accumulated classroom experience.

As teachers experienced differences in learners' readiness, abilities, and responses to instruction, they gradually learned to adjust their teaching approaches, develop their own techniques, and modify instruction according to the demands of particular classroom situations. Thus, flexibility emerged through the lived process of continually adapting science teaching to learners and their changing instructional needs.

Subtheme 4.2 Learning and Refining Professional Development

This sub-theme captures the participants' evolving understanding of differentiated instruction as they reflected on their lived classroom experiences and reconsidered how they approached teaching.

Table 14. *Learning and Refining Professional Development*

Participant	Direct Narrative Evidence	Formulated Meaning
P3	<i>"For a long time, I've been doing these things without really knowing the term for them." "Now that I understand the concept, I realize that the practices I've been using are, in fact, examples of differentiated instruction."</i>	Teachers reflected on their previous practices and developed a new understanding of those practices through increased awareness of differentiated instruction.

P5	<i>"I believe that your experience would actually help you develop a deeper understanding of what differentiated instruction is all about."</i>	Continued classroom experience deepened teachers' understanding of differentiated instruction and informed how they enacted it.
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Participants' lived experiences revealed that their understanding and practice of differentiated instruction developed through continuous reflection on their classroom experiences. As participants encountered diverse learner needs and instructional challenges, they reconsidered their existing practices, gained new insights, and refined how they approached differentiated science teaching. Through this ongoing process, experience became a source of learning that shaped their understanding and strengthened their instructional practice.

Subtheme 4.3 Learning Through Collaboration and Professional Development

This subtheme captures the participants' lived experiences of learning and developing their approach to differentiated instruction through day-to-day classroom teaching, interactions with colleagues, professional development, and academic study. Their narratives reveal how they came to understand, adapt, and make sense of differentiated instruction through these encounters within their teaching contexts.

Table 15. *Learning Through Collaboration and Professional Development*

Participant	Direct Narrative Evidence	Formulated Meaning
P5	<i>"I have observed my colleagues here in the school and how they carry it through. I also joined staff development or professional development activities, such as seminars and training, and engaged in professional readings."</i>	Teachers developed their differentiated instructional practices through observing colleagues, participating in professional development, and engaging with professional literature.
P2	<i>"I first learned about differentiated instruction while pursuing my master's degree in the Philippines. I further developed my understanding during my doctoral studies and through classroom observations while taking special education courses..."</i>	Formal academic study and classroom observation contributed to the teachers' developing understanding of differentiated instruction.
P6	<i>"I learned about differentiated instruction through trainings, classroom experiences and dealing with students with diverse learning needs."</i>	Professional training combined with direct classroom experience strengthened teachers' capacity to implement differentiated instruction.

Further, participants' lived experiences revealed that their development in differentiated instruction was shaped not only by classroom experience but also by interactions with colleagues and participation in professional learning opportunities. Through observing colleagues, attending seminars and training, engaging in professional readings, and pursuing further academic study, participants expanded their understanding and refined their approaches to differentiated science instruction.

Subtheme 4.4 Becoming Resourceful Through Technology and Alternative Resources

This subtheme captures the participants' lived experiences of navigating limitations in their teaching contexts and finding ways to continue differentiating instruction. Their narratives reveal how they experienced, responded to, and made meaning of the challenges they encountered while sustaining differentiated instruction in their science classrooms.

Table 16. *Becoming Resourceful Through Technology and Alternative Resources*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>“simulations, videos, demonstrations, and improvised activities”</i> <i>“flexible and creative in planning and delivering science instruction.”</i>	Teachers became resourceful by drawing on alternative instructional resources when conventional science facilities were unavailable.
P5	<i>“AI has helped me simplify the materials for those who are at a very low level.”</i>	Teachers used emerging technology to modify instructional materials and improve access to learning for students requiring greater support.
P6	<i>“additional materials I download online.”</i>	Teachers expanded beyond prescribed curriculum resources by sourcing supplementary materials online to address learner needs.

Participants’ lived experiences revealed that resourcefulness developed as they encountered limitations in available instructional resources and responded to the diverse needs of their learners. P1 relied on simulations, videos, demonstrations, and improvised materials when laboratory experiences were unavailable, while P5 used AI to simplify materials for learners with lower levels of readiness. P6 also supplemented Amplify Science with materials downloaded from online sources. Through these experiences, participants learned to creatively draw on available technologies and alternative resources to modify, enrich, and sustain science learning.

The four interconnected subthemes reveal how participants experienced the development and refinement of their approach to differentiated instruction through their ongoing encounters in the classroom and beyond. Their narratives describe a gradual process of becoming more flexible, reflective, collaborative, and resourceful as they responded to the demands of diverse learners. Rather than describing differentiated instruction as a practice that was fully established from the outset, participants experienced it as something that developed through continued engagement with classroom situations, reflection on what worked and what did not, learning from others, and finding alternative ways to address instructional needs.

Theme 5. Finding Fulfillment in Learner Engagement, Understanding, and Growth

This theme emerged from the participants’ narratives of finding meaning and fulfillment in moments when learners became more engaged, demonstrated understanding, and showed progress in their learning. Their experiences revealed that observing learners respond positively to differentiated instructional approaches provided a sense of purpose and satisfaction in their teaching. The participants described how learners’ increased participation, improved understanding, and gradual growth served as meaningful indicators that their efforts to respond to individual needs were making a difference in the classroom. These experiences suggest that, amid the demands and challenges of differentiated instruction, witnessing learners engage, understand, and develop provided the participants with a sense of accomplishment and affirmation in their teaching practice.

Analysis of the data generated four interrelated subthemes: (1) experiencing fulfillment through learner engagement and participation, (2) finding meaning in learner understanding of science, (3) experiencing reward through learners’ demonstrated learning, and (4) experiencing meaning in making science accessible to diverse learners.

Sub-theme 5.1. Experiencing Fulfillment Through Learner Engagement and Participation

This captures the participants’ lived experiences of finding meaning as they witnessed learners becoming involved and actively participating in science learning.

Table 17. *Experiencing Fulfillment Through Learner Engagement and Participation*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>Through differentiated activities, “students were more engaged.”</i>	Teachers experienced fulfillment when instructional adaptations enabled students to become actively engaged in science learning.
P5	<i>The importance of DI was “to get the kids involved and engaged into what they are learning.”</i>	Teachers found meaning in seeing learners become involved in and interested in science.
P6	<i>Students rotated through stations so that “everyone gets the chance to do what they’re supposed to do.”</i>	Teachers experienced inclusive participation as an important indication that differentiated activities were reaching learners.

Participants narratives suggest that learners’ willingness to participate, respond to questions, collaborate with peers, and take part in learning tasks provided the teachers with a sense of accomplishment. Such moments were perceived as meaningful because they indicated that learners were becoming more involved in the learning process rather than remaining passive recipients of instruction. The participants’ experiences show that learner engagement and participation became personally rewarding aspects of implementing differentiated instruction, particularly when teachers observed learners responding positively to instructional adjustments made to address their differing needs.

Subtheme 5.2. Finding Meaning in Learner Understanding of Science

The participants’ lived experiences revealed a sense of fulfillment when they were able to reach learners who might otherwise struggle with science, particularly as they witnessed these learners gradually make sense of and develop an understanding of the concepts being taught.

Table 18. *Finding Meaning in Learner Understanding of Science*

Participant	Direct Narrative Evidence	Formulated Meaning
P2	<i>DI “helps our learners understand the topics better” and gives teachers a sense of fulfillment when learners understand the lessons well.</i>	Teachers experienced learner understanding as evidence that their differentiated teaching was meaningful and effective.
P1	<i>Students were able to “understand the lesson in ways that matched their individual learning needs” after differentiated activities.</i>	Teachers experienced meaning when adaptations enabled learners to understand science in ways appropriate to their needs.
P5	<i>DI helped lower-level students “understand and grasp what is going on around them.”</i>	Teachers experienced satisfaction when differentiation helped learners gain access to and make sense of science.
P6	<i>The purpose of DI was to meet diverse needs “so that all learners can succeed.”</i>	Teachers understood successful learning as creating access to science for diverse learners.

Participants narratives suggest that moments when learners were able to explain ideas, make connections, or demonstrate what they had learned were experienced as meaningful indicators of learning. The participants viewed these moments as affirming their efforts to adjust instruction in response to learners’ different needs and levels of understanding. Thus, witnessing learners move from difficulty or

uncertainty toward greater understanding became a significant and rewarding aspect of their experience in implementing differentiated instruction.

Subtheme 5.3 Experiencing Reward Through Learners' Demonstrated Learning

The participants' lived experiences revealed a tangible sense of fulfillment as they witnessed learners demonstrate their learning through active participation, responses, completed activities, and classroom performance. These moments were meaningful to the participants as they experienced learners' demonstrated learning as an affirmation of their efforts to respond to diverse learner needs.

Table 19. *Experiencing Reward Through Learners' Demonstrated Learning*

Participant	Direct Narrative Evidence	Formulated Meaning
P3	<i>"It's a lot of work, but it's rewarding when you see everyone get the exit ticket at the end of the day."</i>	Teachers experienced the results of learners' successful demonstration of understanding as rewarding and meaningful.
P1	<i>Students "were more engaged and were able to understand the lesson" following differentiated activities.</i>	Visible learner responses provided teachers with a sense that their differentiated efforts had achieved their intended purpose.
P2	<i>When learners understand lessons, teachers can feel "fulfilled."</i>	Evidence of learner understanding became a source of professional fulfillment.

Participants narratives suggest that seeing learners apply concepts, accomplish learning tasks, or show improvement provided teachers with a tangible sense of reward for their instructional efforts. These experiences were particularly meaningful when learners who initially struggled were able to demonstrate their developing knowledge or skills. The participants' accounts indicate that learners' demonstrated learning served as a meaningful affirmation of their efforts to adapt instruction to diverse learner needs.

Subtheme 5.4. Experiencing Meaning in Making Science Accessible to Diverse Learners

This subtheme captures the deeper meaning participants attached to reaching learners who might otherwise struggle, reflecting their sense of purpose and fulfillment in making science learning more accessible to learners with varied needs, abilities, and levels of readiness. Teachers experienced differentiated instruction as meaningful when it enabled learners with varying levels and needs to participate in and access science learning.

Table 20. *Experiencing Meaning in Making Science Accessible to Diverse Learners*

Participant	Direct Narrative Evidence	Formulated Meaning
P1	<i>Differentiated activities enabled learners with different needs and abilities to understand the lesson.</i>	Teachers experienced meaning in making science accessible through approaches responsive to individual differences.
P3	<i>"There's no one-size-fits-all" and teachers need to give learners "what they deserve and what they actually need."</i>	Teachers experienced their role as providing appropriate access to learning for individual learners.
P5	<i>DI helped students, "especially those at the lower level," understand and grasp what was happening around them.</i>	Teachers found meaning in helping learners who struggled with grade-level demands gain access to science understanding.

Their narratives suggest that adapting explanations, materials, activities, and learning supports enabled teachers to provide learners with opportunities to participate and engage with science in ways that were more responsive to their individual circumstances. The participants found meaning in seeing learners who might otherwise experience difficulty gain access to and participate in science learning. These experiences suggest that making science accessible was perceived not only as an instructional responsibility but also as a meaningful and rewarding aspect of their teaching experience.

The four interconnected subthemes reveal how participants experienced meaning and fulfillment in moments when they witnessed learners engage with, understand, and demonstrate learning in science. Their narratives describe these moments as personally significant because they provided participants with a sense that their efforts to respond to diverse learner needs had meaning within the classroom. Rather than experiencing differentiated instruction only through its demands and challenges, participants also encountered moments of satisfaction and affirmation when they saw learners participate, make sense of science, demonstrate what they had learned, and gain access to learning opportunities.

DISCUSSION

This chapter presents the analysis and interpretation of the findings generated from the qualitative descriptive phenomenological study examining the utilization of Differentiate Instruction (DI) in science by Filipino teachers in selected schools within Ramsey County, Minnesota, USA. Whereas Chapter 4 focused on presenting participants' experiences, perspectives, and narratives through thematic findings, the present chapter moves beyond description to examine the deeper meanings, implications, and significance of those findings within broader theoretical, professional, and educational contexts. Through this interpretive process, the study sought to explain not only what participants experienced but also why these experiences occur and what they reveal about the evolving practices of differentiated instructions within the research context.

The analysis is guided by the conceptual and theoretical foundations of the study and is informed by relevant scholarly literature related to differentiated instruction, learner diversity, instructional adaptation, responsive teaching, teacher decision-making, and inclusive science education. Particular attention is given to the ways in which participants' experiences converge with, diverge from, extend, or contextualize existing knowledge concerning the implementation of differentiated instruction in science classrooms. The discussion further explores how teachers' understanding of learner differences, instructional strategies, assessment practices, available resources, professional learning, and school-based support collectively shape their experiences in adapting science instruction to learners' varying readiness levels, interests, abilities, learning needs, and pace of learning. In doing so, the findings are interpreted not only in terms of the instructional practices teachers employ, but also in relation to the classroom and institutional conditions that facilitate or constrain the enactment of differentiated instruction.

The interpretation is organized according to the five themes presented in Chapter 4. Each thematic section examines the meaning and essence of the participants' lived experiences of differentiated instruction, as derived through Colaizzi's (1978) phenomenological method. The discussion connects the participants' significant statements, formulated meanings, and emergent themes with the conceptual and theoretical foundations of differentiated instruction and relevant empirical literature. Particular attention is given to how the participants experienced learner diversity, adapted science instruction to individual needs, navigated challenges in implementing differentiated instruction, and drew upon available resources and support within their teaching contexts.

Consistent with the descriptive phenomenological approach, the interpretation seeks to remain grounded in the participants' descriptions of their experiences while identifying the common meanings and essential structures underlying those experiences. The discussion therefore examines areas of convergence and variation across participants and considers how their experiences illuminate the ways differentiated instruction is understood, enacted, adapted, and experienced in science classrooms.

The chapter further examines the relationships among the five themes to clarify how the participants' experiences collectively describe the phenomenon of differentiated instruction. Rather than treating the themes as isolated categories, the discussion considers their interconnectedness in revealing a progressive experiential process—from encountering learner diversity, understanding individual learning needs, adapting instruction and learning activities, responding to implementation challenges, and drawing on resources and support to sustain differentiated practices.

Through this analytical lens, the findings are situated within the broader discourse on differentiated instruction, learner diversity, responsive science teaching, inclusive classroom practices, and teacher decision-making. The discussion also considers the implications of the participants' lived experiences for science teaching practice, professional development, instructional support, and the development of learning environments that respond meaningfully to differences in learners' readiness, interests, experiences, abilities, language needs, and pace of learning.

Theme 1. Knowing Learners and Recognizing Diversity.

Four interconnected subthemes emerged from the analysis: (1) recognizing diversity in learners' abilities, readiness, and pace, (2) understanding learners' interests, experiences, and language needs, (3) observing learner responses and support needs; and (4) shifting toward a learner-centered understanding of teaching.

The descriptive phenomenological analysis revealed that knowing learners and recognizing their diversity constituted the starting point of participants' experiences with differentiated instruction in science. Across the narratives, participants consistently described their classrooms as environments characterized by differences in learners' abilities, readiness, interests, learning styles, backgrounds, and learning needs. Rather than experiencing the classroom as a homogeneous group of learners, participants encountered students who responded to science instruction in different ways and who required varying forms and levels of support. P1 explicitly described the learners as having “*diverse abilities, interests, and learning styles*,” while P3 emphasized that students came from “*different backgrounds*” and that their “*learning needs vary*.” These accounts indicate that learner diversity was not perceived as an incidental characteristic of the classroom but as an everyday condition that shaped how participants experienced and understood their teaching.

Participants' experiences further revealed that recognizing learner diversity involved becoming familiar with individual students and their ways of learning. P2 described how one of her initial priorities was “*learning more about my students and their learning styles*.” This narrative is significant because it illustrates a movement from simply encountering learner differences toward intentionally knowing the learners behind those differences. For the participants, knowing learners involved paying attention to how students learned, what they could understand, and what kinds of support enabled them to participate in science learning. This understanding provided teachers with information that could guide subsequent instructional decisions.

The participants also experienced learner diversity in terms of readiness and level of understanding. P5 described having students functioning at different levels, including students who were at a “*first-grade level, kindergarten level, or second-grade level*.” This experience made visible the gap that could exist between students' grade placement and their actual readiness for learning tasks. Similarly, P1 emphasized that students did not learn “*in the same way or at the same pace*,” and that differentiation allowed her to support struggling learners while continuing to challenge advanced students. These experiences suggest that participants understood learner diversity not only as differences in preferences or interests but also as differences in the level at which students could access and process science content.

Differences in learning preferences were another important dimension of participants' experiences. P4 described students as having different learning styles, specifically noting that some were “*visual learners*” while others were “*auditory learners*.” For her, recognizing these differences created an

experiential need to reconsider how lessons were presented. The narrative illustrates that participants did not experience differentiation simply as the addition of different activities; rather, they encountered situations in which students' different ways of accessing information required teachers to consider whether the instructional approach was appropriate for particular learners.

The narratives also demonstrate that participants came to understand learner diversity as a challenge to a uniform approach to science teaching. P3 expressed this understanding most explicitly by stating that learners *"all have different ways of learning and understanding things"* and that *"there's no one-size-fits-all when it comes to instruction."* Her account captures a central experiential realization shared across the narratives: teaching the same content to all learners through exactly the same approach does not necessarily provide equivalent opportunities for learning. Instead, teachers experienced the need to understand individual differences before determining how science could be made accessible to particular learners.

This recognition was closely connected to participants' understanding of what differentiated instruction meant. P1 defined differentiated instruction in terms of adjusting teaching strategies, learning activities, and assessments according to students' *"individual needs, readiness levels, and learning styles."* P2 similarly described differentiation as adapting lessons to different ability levels and learning styles, while P6 referred to adapting teaching methods, materials, and activities to students' *"diverse learning needs, abilities and the interest of students."* These descriptions demonstrate that participants' understanding of differentiated instruction was grounded in their lived encounters with learner differences. Their conceptualization of DI was therefore not detached from classroom experience; it was connected to what they observed and experienced in working with diverse learners.

Across participants, therefore, recognizing learner diversity emerged as more than an awareness that students were different. It involved a developing understanding that these differences had consequences for how science teaching was experienced and enacted. Participants learned to attend to learners' abilities, readiness, interests, learning styles, backgrounds, and needs as meaningful aspects of the teaching situation. P3's observation that teaching requires giving students *"what they deserve and what they actually need"* illustrates this shift toward a more responsive understanding of the teacher's role.

From a descriptive phenomenological perspective, the participants' accounts reveal a movement from encountering learner diversity to understanding its instructional significance. Initially, diversity was experienced through observable differences among students—their abilities, backgrounds, learning styles, readiness, and needs. Through continued classroom experience, participants developed a more intentional orientation toward knowing their learners. This knowing became the basis from which they could determine how to respond to individual differences. Thus, learner diversity was not merely part of the context in which differentiated instruction occurred; it was experienced as the condition that made differentiation necessary.

The essence of this theme, therefore, lies in the participants' realization that *differentiated instruction begins with knowing the learner before determining the instruction*. Their experiences challenged the assumption that a common instructional approach could adequately serve all students. Instead, participants came to understand that meaningful science teaching required attention to who their learners were, how they learned, what they were ready to understand, and what support they needed. In this sense, knowing learners was experienced as the foundation upon which subsequent instructional adaptation was built.

Consequently, Theme 1 provides the experiential foundation for Theme 2, Adapting Science Learning to Individual Needs. Once participants recognized differences among learners, they were compelled to consider how content, activities, materials, instructional processes, and assessments could be adjusted in response. The movement from knowing learners to adapting instruction therefore represents an important experiential progression in the implementation of differentiated instruction. The participants' narratives suggest that differentiation was not initially experienced as a fixed set of techniques; rather, it emerged from teachers' encounters with individual learners and their continuing efforts to understand and respond to those learners.

The finding that differentiated instruction begins with knowing learners and recognizing their diversity is supported by recent literature conceptualizing differentiated instruction as a response to learner variability. Gheysens et al. (2022) examined teachers' philosophy and practice of differentiated instruction and specifically framed differentiation around students' interests, readiness, and learning profiles. Their findings reinforce the view that student differences are central considerations in differentiated teaching. This closely corresponds with the participants' descriptions of learners as differing in abilities, interests, learning preferences, backgrounds, and learning needs. Thus, the present finding suggests that participants experienced learner diversity not simply as a classroom characteristic but as an important basis for understanding how instruction needed to be approached.

The importance of recognizing learner differences is further demonstrated in research on teachers' actual implementation of differentiated instruction. Bi et al. (2026), in a qualitative study involving 14 primary and 14 secondary Chinese teachers, found that teachers were aware of multiple forms and dimensions of student diversity and used various approaches to adapt instruction accordingly. The study is particularly relevant to the present phenomenological finding because it connects teachers' awareness of student diversity with their subsequent instructional responses. The researchers reported that teachers generally favored student-centered approaches and demonstrated awareness of different forms of learner diversity. This supports the present interpretation that recognizing learners as different is an important experiential step before instructional adaptation occurs.

Recent qualitative research also demonstrates that teachers' understanding of learner diversity is associated with how they interpret differentiated instruction. Adam and Porta (2025), in a qualitative collective case study of four primary teachers in the Maldives, found that teachers understood differentiated instruction in terms of meeting students' educational demands by considering individual ability levels. At the same time, the study identified a limitation in which teachers tended to categorize students into fixed ability groups rather than conceptualizing readiness flexibly. This finding is useful when interpreting the present participants' descriptions of students who were at different levels. It suggests that teachers' recognition of learner differences is important, but how those differences are conceptualized also matters. In the present study, participants' narratives indicate a more dynamic understanding of learner variation, particularly in terms of changing support, pace, and instructional access.

Kara and Tekindur (2025) provide additional science-education evidence. Their mixed-methods study examined differentiated instruction among third-grade students in science and considered student differences in the design of instruction. The study demonstrates how differentiated instruction can be operationalized in science classrooms by using student-centered approaches responsive to learners' needs. This provides contextual support for the present finding that science teachers cannot assume uniformity in how students access and understand scientific concepts.

Overall, the recent literature from 2022 to 2026 converges on the view that learner diversity is a fundamental starting point of differentiated instruction. Across qualitative, quantitative, mixed-methods, and systematic-review research, students are described as varying in readiness, ability, interests, learning profiles, language-related needs, and ways of engaging with learning. The present participants' narratives are consistent with this body of evidence. P1 described learners as having "*diverse abilities, interests, and learning styles*"; P2 emphasized the importance of "*learning more about my students and their learning styles*"; P3 recognized that students came from "*different backgrounds*" and that their learning needs varied; and P5 experienced classrooms in which students were functioning at markedly different academic levels.

The convergence between the literature and the participants' narratives suggests that knowing learners is not merely a preliminary classroom activity but part of the lived experience of implementing differentiated instruction. Participants first encountered diversity through observable differences among students and then developed an increasingly intentional understanding of those differences. Their experiences indicate that the teacher's recognition of who learners are, what they are ready to learn, what

interests them, and what support they require provides the basis for subsequent instructional decision-making. In this respect, the present findings are consistent with recent science-education evidence emphasizing the importance of teachers' "noticing" and knowledge of individual students in the development of differentiated practice.

Thus, Theme 1 may be interpreted as the experiential foundation of differentiated instruction: teachers experienced diversity first, came to know their learners more closely, and recognized that such differences carried instructional significance. This finding provides the phenomenological bridge to Theme 2 "*Adapting Science Learning to Individual Needs*", where participants' recognition of learner differences became translated into modifications of content, processes, activities, materials, grouping, and assessment.

Theme 2. Adapting Science Learning to Individual Needs

Four interconnected subthemes emerged from the analysis: (1) modifying content and materials to match learner readiness, (2) varying instructional activities and learning pathways, (3) differentiating support and challenge across learner levels; and (4) using learner evidence to guide instructional adjustments.

The participants' narratives revealed that adapting science learning to individual needs was experienced as a *continuous process of adjusting instruction in response to learners' readiness, abilities, understanding, and participation*. Rather than applying one uniform approach, participants described modifying what they taught, how they presented it, the level of support they provided, and the resources they used. P1 captured this experience by stating that she "constantly adjust[ed]" instruction to meet students' varying needs.

A prominent experience was *modifying content and materials according to learner readiness*. P5 described "looking for the right materials, leveling them according to the students' abilities, and making sure they are appropriate for their level." P6 similarly reported adjusting Amplify Science by "simplifying instruction" and adding materials from online sources. P1 also created presentations, modified lessons, and developed supplemental activities. These experiences show that teachers modified prescribed content when its level or form did not correspond with what learners could readily access. P5 expressed this mismatch directly: "You cannot expect kids from a second-grade level to understand everything that you feed them at a fifth-grade level."

Participants also described *varying activities and learning pathways*. P1 used "learning stations, simulations, and real-life materials (realia)" when teaching physical and chemical changes. P3 created technology, teacher-support, independent-learning, and manipulative stations during a cell biology lesson. P4 used different plant-growth environments and rotated students so that "everyone gets that hands-on experience." The participants therefore provided different ways for students to encounter and participate in science learning rather than relying on a single instructional pathway.

A third experience involved *adjusting support and challenge according to learner level*. P5 described making tasks "more challenging" for students who finished early while simplifying activities and guiding struggling learners through the process. P3 provided pictures and scaffolding questions for struggling learners and critical-thinking questions for advanced learners. P1 likewise provided more challenging tasks for advanced students. These accounts demonstrate that teachers adjusted the amount of guidance and cognitive demand rather than expecting all learners to work at the same level.

A fourth experience was using learner evidence to determine subsequent instructional decisions. P1 relied on observations, student performance, assessment results, and class scores. P2 revised instruction when assessment results were low. P3 described using the results of one lesson to determine what would happen in the next. After observing that some students were still struggling, she stated, "For those who were struggling, I needed to give a different lesson." She also considered tests, classroom responses, exit tickets, and student interest when deciding whether another instructional approach was needed. P6 acknowledged that making such adjustments quickly during instruction could be difficult.

Taken together, these experiences indicate that participants did not experience differentiation as a fixed procedure completed before teaching. Instead, they experienced it as instructional decision-making that developed in relation to learners' actual responses. Content could be simplified, activities changed, support increased, or challenge extended as teachers encountered particular learner needs.

The narratives also show a clear progression from knowing learners to acting on that knowledge. Theme 1 described participants' recognition of differences in readiness, ability, interests, and ways of learning. In Theme 2, those observations became concrete instructional decisions. P3's account of knowing "what this group of kids understood better and what this group of kids could do independently" before creating learning stations illustrates this connection.

At the same time, the participants' responsiveness created additional demands. P5 described needing to be "very present and attentive" because one learner might need assistance while another group required support simultaneously. This connects Theme 2 with Theme 3, where participants described the time, preparation, and attentional demands of differentiated instruction.

Overall, the lived experience captured in this theme was one of continually adjusting science teaching to correspond with learners' emerging needs and responses. Participants modified content and materials, provided varied learning pathways, calibrated support and challenge, and used learner evidence to guide what they did next. Differentiation was therefore experienced as a responsive and evolving way of enacting science instruction rather than as a single strategy applied uniformly across learners.

The present finding is consistent with Jager et al. (2025), who found that teachers' differentiated instructional practices involved simultaneous adaptations of multiple instructional elements in response to diverse learner characteristics and educational purposes. This supports the participants' narratives in the present study, which demonstrated that adaptation extended beyond a single teaching strategy. Participants described modifying materials, varying activities, adjusting support and challenge, and responding to evidence of learner progress. Thus, their experiences suggest that differentiated instruction was perceived as a multifaceted process of instructional decision-making rather than as the implementation of an isolated classroom technique.

The participants' experiences of using learner evidence to guide subsequent instructional adjustments are supported by Slim et al. (2026), whose study of differentiated instruction in science education highlighted the importance of teachers' ability to notice learner responses and consequences of instructional decisions. Their findings suggest that teachers' developing awareness of learners can serve as an important catalyst for changes in differentiated practice. This complements the present participants' narratives, in which learner performance, participation, and observed needs became sources of information for modifying subsequent science instruction.

In the Philippine context, Fille (2025) found that Science and Non-Science teachers demonstrated competency across differentiated-instruction dimensions involving learner readiness, interest, learning profile, content, process, and product. This provides contextual support for the present participants' narratives, particularly their experiences of modifying materials, varying instructional activities, and responding to differences in learner readiness and needs. The convergence suggests that attention to learner characteristics and corresponding instructional adjustments is also evident in Philippine teachers' differentiated instructional practices.

Theme 3. Living with the Tensions and Demands of Differentiated Instruction

Four sub-themes emerged from the participants' narratives: (1) experiencing extensive preparation and time demands; (2) managing competing learner and classroom demands; (3) negotiating curriculum, resource, and facility constraints; and (4) experiencing the emotional and practical strain of differentiation.

The participants' narratives revealed that living with differentiated instruction involved more than adapting content, activities, and support to address learner differences. Their experiences also reflected the demands associated with making these adaptations possible within the realities of their classrooms.

Participants described the additional preparation and time required to differentiate instruction, the challenge of simultaneously responding to competing learner and classroom demands, the need to work around curriculum, resource, and facility limitations, and the practical and emotional strain associated with sustaining responsive instruction. These experiences suggest that differentiation was lived as a continuing process of negotiation in which participants attempted to respond to individual learner needs while managing the demands and constraints of their teaching contexts.

Experiencing Extensive Preparation and Time Demands. This subtheme emerged from the participants' narratives describing the additional preparation and time they experienced as necessary when implementing differentiated instruction. P1 described having to create presentations and modify lessons and materials to respond to the differences among learners. This experience suggests that differentiation required the participant to move beyond the preparation of a single, uniform lesson and instead consider how instructional materials could be adjusted for learners with different needs. The preparation itself became part of the lived experience of differentiation because the participant had to anticipate learner differences before instruction took place. Similarly, P5 described the experience as involving "a lot of preparation," particularly in looking for appropriate materials and leveling them according to learners' needs. The participant's narrative conveys that preparation involved not only gathering resources but also evaluating and modifying them so that they would be accessible to learners at different levels. The experience therefore reflects an additional layer of teacher work: materials had to be considered in relation to the learner rather than simply in relation to the lesson objective.

P6 likewise described differentiated assessment preparation as something that "takes time." This account further illustrates that the time demand extended beyond instructional activities to assessment-related practices.

Taken together, the narratives of Participants 1, 5, and 6 reveal a shared experience in which differentiation required sustained preparation, modification, and reconsideration. The participants experienced time not merely as a scheduling issue but as a necessary condition for responding adequately to learner differences. The formulated meaning emerging from these narratives is that differentiation was experienced as an expanded preparation process in which teachers had to invest additional time and effort to make instruction and assessment responsive to varied learner needs. Their experiences demonstrate that the work of differentiation began before the lesson itself and extended into the preparation and modification of materials and instructional resources.

Managing Competing Learner and Classroom Demands. This subtheme emerged from participants' experiences of having to attend to multiple learner needs while simultaneously managing the classroom as a whole. P1, who described teaching approximately 25 students across three grade levels without an assistant, experienced the demands of multiple preparations, varied student behaviors, and diverse instructional needs. The narrative reflects the complexity of responding to learner differences when several instructional and classroom responsibilities occur simultaneously. For P2, the experience was particularly evident in the statement that "the most challenging part is managing student behavior." The participant's narrative suggests that classroom management could become an immediate concern that competed with the intention to provide differentiated instruction. Rather than being able to focus exclusively on adapting instruction to individual needs, the participant had to respond to behavioral demands that affected the flow of classroom teaching. P4 also described managing learner behavior as part of the realities of classroom instruction. Meanwhile, P5 described situations in which one student would ask questions while the participant was assisting another group. This narrative captures the simultaneous nature of classroom demands: attending to one learner did not eliminate the needs of others. The participant had to continually shift attention among learners and groups while maintaining the progress of the lesson.

These narratives reveal that the participants experienced differentiated instruction within a classroom characterized by simultaneous and competing demands. Individualized responsiveness had to occur alongside behavior management, monitoring, questioning, group assistance, and whole-class

responsibilities. The formulated meaning is therefore that differentiation was experienced as a continual balancing of individual learner needs with the collective demands of classroom management and instruction. Participants were not simply deciding how to differentiate; they were continually deciding where their limited attention and time were most needed.

Negotiating Curriculum, Resource, and Facility Constraints. This subtheme emerged from participants' narratives describing how contextual conditions influenced their ability to implement differentiated science instruction. P1 expressed the contradiction of being in a STEM school while stating, "Our school is a STEM school, we do not have a science laboratory." The narrative conveys a gap between the expectations associated with science-oriented instruction and the physical facilities available to support such instruction. For the participant, the absence of a laboratory meant that science learning had to be approached through alternatives rather than through the full range of experiences that might ordinarily be available in a laboratory setting. P4 similarly described the absence of a laboratory and the need to improvise classroom experiments. The participant's experience suggests that providing differentiated science experiences sometimes required additional planning, adaptation, and attention to safety because the available setting did not readily support laboratory-based activities. Curriculum-related constraints were also evident in the narratives of P4 and P6. P4 described a curriculum that was not fully aligned with Minnesota standards, while P6 experienced Amplify Science lessons as too advanced or misaligned for some learners and therefore requiring adjustment and simplification. These accounts reveal that participants were negotiating not only physical resource limitations but also the relationship between prescribed curriculum materials, standards, and the learners in front of them. The experience of P5 further illustrates the interaction between learner needs and available resources. The participant described difficulties related to the lack of science equipment, including microscopes and measuring tools, as well as limitations in the classroom environment. These circumstances meant that participants sometimes had to find alternative ways of presenting science concepts and providing learning experiences.

Taken together, these narratives reveal that the participants experienced differentiation as a process of negotiating between instructional intentions and contextual possibilities. They wanted to provide learning experiences responsive to their students, yet the curriculum, facilities, equipment, and available materials did not always provide the conditions they needed. The formulated meaning is that differentiated instruction was experienced as requiring resourcefulness and adaptation when curriculum expectations, learner needs, and available instructional conditions did not fully coincide.

Experiencing the Emotional and Practical Strain of Differentiation. This subtheme emerged from the participants' narratives in which the demands of differentiation were experienced not simply as additional instructional tasks but as an ongoing personal and practical challenge. P2 described the difficulty of implementing differentiated instruction during the first year, particularly when classroom management and student behavior required immediate attention. The narrative suggests that the participant experienced a tension between the intention to differentiate and the practical need to establish and maintain classroom order. P5 explicitly conveyed the difficulty of the experience through the statement "it's hard," while also describing limited science background and a need to develop strategies for teaching science within a setting that lacked appropriate equipment and was not always conducive to science instruction. This narrative is significant phenomenologically because it conveys the participant's experience of differentiation as a demanding responsibility situated within several simultaneous challenges. The difficulty was not attributable to one factor alone but emerged from the interaction of instructional expectations, learner needs, available resources, and the participant's perceived preparedness.

The experiences of P1, P4, P5, and P6 likewise reveal that the practical strain of differentiation was connected to the continual need to modify materials, navigate curriculum concerns, compensate for resource limitations, and respond to learner differences. Their narratives suggest that the effort involved in differentiation was sustained rather than confined to isolated instructional moments. Participants continually had to make adjustments and find workable responses to circumstances that were not always

within their control. At the same time, their continued efforts to adapt instruction reveal a sense of responsibility toward their learners. Thus, the emotional dimension of the experience should not be interpreted simply as stress or burden. Rather, participants appeared to experience a tension between wanting to provide appropriate learning opportunities for diverse learners and confronting the practical limits within which they had to teach. The formulated meaning emerging from these narratives is that differentiation was experienced as a demanding responsibility that required sustained patience, flexibility, resourcefulness, and personal effort while teachers negotiated the limits of their classroom conditions and instructional capacity.

Across the four subthemes, the participants' narratives reveal that living with differentiated instruction meant continually negotiating between responsiveness to learner differences and the realities of classroom teaching. Participants 1, 5, and 6 experienced the additional preparation and time required to modify materials, lessons, and assessments. Participants 1, 2, 4, and 5 experienced the challenge of simultaneously attending to learner needs, behavior, group assistance, and whole-class responsibilities. Participants 1, 4, 5, and 6 described contextual constraints involving laboratories, equipment, curriculum alignment, and instructional materials. These experiences, particularly those described by Participants 2 and 5, also conveyed the practical and emotional difficulty of sustaining differentiation under challenging classroom conditions.

The participants' experiences in this theme further illuminate the adaptations described in Theme 2. While Theme 2 showed how participants adjusted instruction to address learner differences, their narratives in this theme revealed the challenges of sustaining these adaptations while managing the classroom. Participants described attending to different learners while also managing behavior, assisting groups, responding to questions, and keeping the lesson moving. This finding is consistent with Jager et al. (2025), who found that teachers had to adapt to multiple learner needs while managing competing instructional demands. Thus, the participants experienced differentiation not only as adapting instruction to learner needs but also as balancing these adaptations with the demands of classroom teaching.

The participants' experiences of curriculum, resource, and facility constraints can likewise be understood in relation to research emphasizing the contextual conditions necessary to support differentiated instruction. Herliana et al. (2024), in a systematic review of differentiated instruction through adaptive learning platforms in science education, identified accessibility, technological infrastructure, feedback systems, and teacher preparation as important considerations in implementing personalized learning approaches. The authors emphasized the need for institutions to assess their technological infrastructure and provide appropriate teacher training. These findings provide contextual support for the participants' narratives concerning limited laboratory facilities, equipment, instructional materials, and other resources. In the present study, such limitations were not experienced merely as shortages; they became conditions that required participants to improvise, seek alternatives, and modify their instructional plans in order to continue responding to learners' needs.

From the participants' lived experiences, their narratives were interconnected rather than separate challenges. Preparing differentiated materials required additional time, while competing learner needs made it difficult to allocate attention effectively. Curriculum, facility, and resource limitations further required participants to adapt and modify their plans. Together, these demands created practical and emotional strain, making differentiated instruction an ongoing process of adjustment, balancing, and negotiation.

Participants described differentiated instruction as an ongoing effort to respond to individual learners' needs while balancing limited time, competing classroom demands, contextual constraints, and the personal effort required to maintain this responsiveness. Their narratives reveal that differentiation was not experienced as a straightforward instructional procedure but as an ongoing lived responsibility shaped by the realities of the classroom in which it was enacted.

Theme 4. Becoming Flexible, Reflective, and Resourceful Through Experience

Four sub-themes emerged from the participants' narratives: (1) developing flexibility through classroom experience; (2) learning and refining practice through reflection and experience; (3) learning through collaboration and professional development; and (4) becoming resourceful through technology and alternative resources.

The participants' narratives revealed that their experiences with differentiated instruction were accompanied by changes in how they approached their teaching. As they encountered diverse learner needs, classroom challenges, and limitations in resources and instructional conditions, participants described becoming more flexible in their instructional decisions, more reflective about their practices, more willing to learn from others, and more resourceful in finding ways to support learners. These experiences suggest that differentiated instruction was not experienced only as a set of practices to be implemented but also as a process through which participants gradually learned how to respond to the realities of their classrooms. Their narratives reflected a movement from relying on established ways of teaching toward becoming more responsive, reflective, collaborative, and resourceful in their practice.

Developing Flexibility Through Classroom Experience. Participants' lived experiences revealed that flexibility developed through repeated encounters with diverse learners and changing classroom conditions. P1 described how working with a more diverse group of students and teaching in a setting with limited laboratory resources helped her "realize the importance of flexibility and adaptability in teaching science." For P4, flexibility developed gradually through years of teaching, as teachers "find your own way and develop your own techniques" in implementing differentiated instruction. These experiences suggest that flexibility was formed through encounters that challenged teachers to move beyond familiar ways of teaching. P1's experience in a more diverse and resource-limited setting prompted a recognition that existing approaches could not always be relied upon, while P4's experience shows that repeated classroom encounters gradually enabled teachers to develop approaches suited to their own learners and circumstances. In both accounts, flexibility emerged through the teachers' direct engagement with situations that required reconsideration and adjustment.

Phenomenologically, becoming flexible can therefore be understood as a *gradual change in how participants experienced and responded to the classroom*. Instead of approaching differentiated instruction as something that could be implemented through predetermined techniques, participants came to experience teaching as requiring openness to change, responsiveness to circumstances, and willingness to develop alternative ways of working. The phrase "find your own way" captures this experiential shift from following established approaches toward exercising greater personal judgment in deciding how differentiation could work in a particular classroom. Thus, flexibility represented more than the ability to modify a lesson. It reflected a *developing way of being as a differentiated science teacher*—one shaped by experience, informed by encounters with learners, and expressed through the willingness to reconsider instructional approaches when classroom realities called for something different. Through this experience, participants gradually became more responsive to the particular learners and situations before them.

Learning and Refining Professional Development. This subtheme emerged from the participants' experiences of developing a deeper understanding of differentiated instruction through continued classroom practice and reflection. Their experiences enabled them to recognize existing practices, gain new insights, and refine how they responded to learner differences. P3 described a significant experience of recognizing that practices already used in the classroom were forms of differentiated instruction: "*For a long time, I've been doing these things without really knowing the term for them.*" With increased conceptual understanding, the participant was able to reinterpret previous teaching practices as examples of differentiated instruction. This experience reflects a shift from *intuitive practice to conscious understanding*. Similarly, P5 emphasized that continued classroom experience contributed to a deeper understanding of differentiated instruction: "*I believe that your experience would actually help you develop a deeper understanding of what differentiated instruction is all about.*" The experience suggests that

understanding developed progressively as the participant engaged with actual classroom situations and reflected on instructional practices.

The narratives indicate that *professional learning developed through the interaction of experience, reflection, and growing awareness*. Classroom experience became a source of learning that enabled participants to recognize what they were already doing, deepen their understanding, and continually refine their practice of differentiated instruction.

Learning Through Collaboration and Professional Development. This subtheme captures the participants' lived experiences of developing their understanding of differentiated instruction through collaboration, professional development, and academic study. Their narratives revealed that professional learning was experienced as an ongoing process of gaining new perspectives, connecting knowledge with practice, and refining their responses to learner diversity. P5 described learning by observing colleagues and engaging in professional development: *"I have observed my colleagues here in the school and how they carry it through. I also joined staff development or professional development activities, such as seminars and training, and engaged in professional readings."* This experience shows that learning was not confined to formal training; it also occurred through observing how differentiated instruction was enacted by others. These shared professional experiences provided practical insights that helped the participant make sense of and refine personal teaching practices. P2 described a gradual development of understanding through academic study and classroom observation: *"I first learned about differentiated instruction while pursuing my master's degree in the Philippines. I further developed my understanding during my doctoral studies and through classroom observations while taking special education courses..."* This narrative reflects an experience of deepening understanding over time, as academic knowledge was extended through observation and exposure to actual instructional practices. P6 similarly emphasized learning through training, classroom experiences, and interactions with diverse learners: *"I learned about differentiated instruction through trainings, classroom experiences and dealing with students with diverse learning needs."* This experience suggests that professional learning became meaningful through direct engagement with learners, allowing the participant to connect what was learned in training with the realities of classroom practice.

Taken together, the participants' experiences reveal that learning differentiated instruction was a continuous, socially situated, and practice-based process. Collaboration, academic study, professional development, and classroom encounters provided different opportunities for participants to expand their understanding and reconsider their instructional practices. The essence of the experience was therefore not simply acquiring knowledge, but making sense of differentiated instruction through interaction, observation, learning, and lived classroom experience.

Becoming Resourceful Through Technology and Alternative Resources. This subtheme captures the participants' lived experiences of working within resource limitations while striving to meet diverse learner needs. Their narratives reveal how encounters with limited facilities, materials, and learner readiness shaped their ways of thinking and responding to differentiated science instruction. Rather than experiencing limitations as preventing differentiation, participants experienced them as situations that called for flexibility, creativity, and resourcefulness. P1 described using *"simulations, videos, demonstrations, and improvised activities"* and becoming *"flexible and creative in planning and delivering science instruction."* This experience reflects how the absence of conventional science resources shaped the participant's instructional experience. The participant responded by finding alternative ways to provide meaningful learning experiences, suggesting that resourcefulness emerged through actively responding to the realities of the classroom. P5 shared, *"AI has helped me simplify the materials for those who are at a very low level."* This narrative reflects an experience of recognizing that existing materials did not always match learners' levels of readiness. Technology provided a way to respond to this reality by modifying materials and making learning more accessible. The experience therefore illustrates how participants made meaning of technology as a tool for responding to individual learner needs. P6 similarly described using *"additional*

materials I download online.” This experience demonstrates how the participant responded to limitations in available instructional resources by seeking materials beyond the prescribed curriculum. The act of searching for and incorporating additional resources became part of the participant’s lived experience of adapting instruction to learners’ needs.

Viewed phenomenologically, these narratives show that resourcefulness was not simply a teaching skill but an experience that developed through encountering and responding to limitations. Participants experienced the realities of their classrooms, recognized what was needed, and adapted their practices using whatever resources were available. Through these experiences, limitations became opportunities to exercise flexibility, creativity, and responsiveness.

Overall, the essence of the experience was becoming resourceful through the lived realities of teaching. Participants learned to sustain differentiated instruction not by relying solely on ideal or prescribed resources, but by creatively adapting technology, online materials, and available alternatives to respond to the needs of their learners.

Viewed through the participants’ lived experiences, their experiences with differentiated instruction were accompanied by a gradual development of flexibility, reflection, collaboration, and resourcefulness. Participants became more willing to modify their instructional approaches, learned from the outcomes of their classroom experiences, drew on colleagues and professional development, and sought alternative resources when existing options were insufficient. These four dimensions were interconnected. Classroom experience prompted flexibility; flexibility created opportunities for reflection; reflection supported the refinement of practice; collaboration and professional development expanded participants’ knowledge and perspectives; and the need to respond to learner and contextual demands encouraged resourcefulness. Thus, the participants’ development did not appear to occur through a single event but through repeated encounters with learners, instructional challenges, colleagues, and available resources.

The finding that participants learned and refined their practice through reflection and experience is supported by Slim et al. (2026), whose study of preservice teachers’ professional development in science education showed that reflection on differentiated instruction and attention to students’ responses contributed to changes in teachers’ practice. The researchers identified teachers’ ability to notice consequences of instruction as an important catalyst for professional change. Similarly, the participants in the present study described learning through experience, including trying different approaches, observing learner responses, and refining subsequent instructional decisions. These experiences suggest that professional learning occurred through an ongoing process of action, reflection, and adjustment.

The participants’ experiences of learning through collaboration and professional development are also supported by Liang et al. (2024), who examined teachers’ development of professional capacity for differentiated instruction through a longitudinal case study. Their findings highlight the importance of collaborative activities, including lesson co-planning, in supporting teachers’ development in responding to learner diversity. Similarly, the participants in the present study described learning from colleagues and professional development activities as sources of new ideas and strategies for addressing classroom needs. This suggests that their growth in differentiated instruction was not developed solely through individual classroom experience but was also shaped by opportunities to learn with and from others.

The participants’ growing resourcefulness in using technology and alternative resources is supported by Herliana et al. (2024), whose systematic review identified learning management systems, artificial intelligence, and other adaptive technologies as resources that can support differentiated instruction in science education. Their findings further emphasized the importance of accessibility and teacher preparation in using such technologies effectively. Similarly, the participants in the present study described turning to technology, online materials, and alternative resources when conventional resources were limited or when instructional materials needed to be adjusted to learners’ levels. These experiences indicate that resourcefulness involved identifying available tools and adapting them to address specific learner and classroom needs.

Theme 5. Finding Fulfillment in Learner Engagement, Understanding, and Growth

Analysis of the data generated four interrelated subthemes: (1) experiencing fulfillment through learner engagement and participation, (2) finding meaning in learner understanding of science, (3) experiencing reward through learners' demonstrated learning, and (4) experiencing meaning in making science accessible to diverse learners.

Experiencing Fulfillment Through Learner Engagement and Participation. This subtheme captures the participants' lived experiences of finding meaning and fulfillment when they witnessed learners becoming actively involved in science learning. Their narratives revealed that learner engagement was not simply an instructional outcome but a meaningful experience that affirmed the value of their efforts to differentiate instruction. P1 described that through differentiated activities, *"students were more engaged."* This experience reflects the participant's awareness that adapting activities to learners' needs could encourage greater involvement in learning. Seeing students become more engaged provided a sense of fulfillment because it signaled that the instructional adjustments were creating opportunities for learners to participate more actively in science. P5 emphasized that the purpose of differentiated instruction was *"to get the kids involved and engaged into what they are learning."* This experience shows that learner involvement was central to how the participant understood the value of differentiation. Engagement became meaningful because it indicated that learners were not merely receiving instruction but were becoming personally involved in the learning process. P6 described using learning stations so that *"everyone gets the chance to do what they're supposed to do."* This experience highlights the importance of inclusive participation. The participant found meaning in creating opportunities for all learners to take part in the activity, suggesting that fulfillment came from seeing differentiated instruction provide learners with an active place in the learning process.

Viewed through the participants' lived experiences, learner engagement and participation became visible signs that their instructional efforts were reaching learners. Moments when students participated, interacted, and became involved in science learning were experienced as rewarding because they gave teachers a sense that their adaptations were meaningful. The participants therefore experienced fulfillment not simply from delivering differentiated instruction, but from witnessing its significance in learners' active participation. The essence of this experience was finding meaning in seeing learners become involved in learning. Differentiated instruction became personally rewarding when participants observed that their efforts created opportunities for learners to participate, interact, and engage more actively in science. In this sense, learner engagement served as a meaningful affirmation of the teachers' experiences and efforts in implementing differentiated instruction.

Finding Meaning in Learner Understanding of Science. This subtheme captures the participants' lived experiences of finding fulfillment when they witnessed learners gradually make sense of science concepts despite differences in their learning needs and readiness. Their narratives revealed that seeing learners overcome difficulty and engage successfully with science gave significance to the teachers' efforts to adapt instruction. P2 described how differentiated instruction *"helps our learners understand the topics better."* The participant experienced learners' progress as a meaningful indication that instructional adaptations were helping them move beyond difficulty and engage more successfully with the lesson. P1 observed that students were able to *"understand the lesson in ways that matched their individual learning needs"* after differentiated activities. This experience highlights the participant's recognition that learners can reach learning goals through different pathways. Fulfillment came from seeing instructional adaptations provide learners with approaches suited to their needs. P5 shared that DI helped lower-level students *"understand and grasp what is going on around them."* This experience reflects the value the participant placed on making science accessible to learners who might otherwise struggle. Seeing these learners gain access to the lesson became a rewarding aspect of the teaching experience. P6 described the purpose of DI as meeting diverse needs *"so that all learners can succeed."* This reflects an inclusive view of teaching in

which differentiated instruction creates opportunities for learners with varying needs to participate and progress in science.

Across the participants' lived experiences, the participants experienced learners' progress as an affirmation of their teaching efforts. Their encounters with learner difficulties prompted them to adapt instruction, while observing learners respond positively to those adaptations provided a sense of fulfillment. The significance of differentiation was therefore experienced through visible moments of learner progress, participation, and achievement. The essence of the experience was finding fulfillment in seeing learners move beyond difficulty and make progress in science. For the participants, the value of differentiated instruction became most evident when learners who might otherwise struggle were able to engage with concepts, demonstrate learning, and experience success.

Experiencing Reward Through Learners' Demonstrated Learning. This subtheme captures the participants' lived experiences of finding reward when learners visibly demonstrated what they had learned through their responses, completed tasks, and classroom performance. These moments provided concrete evidence of learners' progress and gave significance to the effort involved in differentiated instruction. P3 described differentiation as "*a lot of work,*" but found it "*rewarding when you see everyone get the exit ticket at the end of the day.*" The participant's experience reveals how the demands of differentiation became worthwhile when learners were able to complete the expected task. Seeing "*everyone*" succeed provided a tangible sense of accomplishment after the effort invested in adapting instruction. P1 observed that students "*were more engaged and were able to understand the lesson*" following differentiated activities. The participant experienced these observable changes as indications that the instructional adaptations were producing positive responses. Learners' performance thus provided a concrete point of reference for the teacher's reflection on the value of the instructional approach. P2 expressed that when learners understood the lessons, teachers could feel "*fulfilled.*" This account highlights the personal significance attached to learners' progress. Their accomplishments became a source of professional satisfaction and reinforced the teacher's sense of purpose in responding to diverse learning needs.

From a phenomenological perspective, the participants experienced visible learner achievement as a rewarding moment within the demands of teaching. The significance lay not simply in learners completing tasks, but in what those accomplishments represented to the teachers—their efforts had translated into observable progress. The essence of the experience was finding professional reward in witnessing the results of instructional effort through learners' demonstrated progress. Learner accomplishments transformed the demands of differentiation into moments of satisfaction and affirmed the teachers' sense of purpose in their practice.

Experiencing Meaning in Making Science Accessible to Diverse Learners. This subtheme captures the participants' lived experiences of finding purpose in making science learning accessible to learners with different needs, abilities, and levels of readiness. Their narratives revealed that differentiation became particularly meaningful when teachers were able to respond to learners who might otherwise struggle to participate in science learning. P1 described how differentiated activities enabled learners with different needs and abilities to understand the lesson. This experience reflects the participant's recognition that learners responded differently to instruction and therefore required varied ways of accessing the lesson. Seeing learners participate and engage when activities were adapted to their needs gave the participant a sense that science learning could become more attainable for a wider range of learners. P3 emphasized that "*there's no one-size-fits-all*" and that teachers need to give learners "*what they deserve and what they actually need.*" This statement reflects a significant shift in the participant's experience of teaching—from providing the same instructional approach to recognizing learners as individuals with different circumstances and needs. The participant's sense of purpose was connected to being responsive to these differences and ensuring that learners were provided with appropriate opportunities to access learning. P5 focused particularly on students "*especially those at the lower level,*" describing how DI helped them grasp what was happening around them. This experience highlights the participant's concern for learners who

might have difficulty keeping pace with grade-level expectations. Supporting these learners to participate in science gave the teacher a sense of purpose because differentiation created an opportunity for them to engage rather than remain on the margins of the learning experience. Across these accounts, the participants' experiences reveal that making science accessible involved more than modifying activities or materials. It required noticing learner differences, recognizing barriers to participation, and responding intentionally to what individual learners needed. The teachers experienced fulfillment when these responses opened opportunities for learners who might otherwise have difficulty accessing science.

Viewed phenomenologically, accessibility was experienced as a personal and professional responsibility embedded in everyday teaching. The participants encountered learner diversity as a reality that challenged uniform approaches to instruction. Their responses to this reality allowed them to experience teaching as creating possibilities for learners rather than simply delivering the same lesson to everyone. The essence of the experience was finding purpose in creating opportunities for diverse learners to access and participate in science. The participants experienced differentiated instruction as meaningful when it enabled learners with different needs and readiness levels to have a place in science learning. In these experiences, making science accessible became more than an instructional adjustment; it became a source of purpose and fulfillment in their work as teachers.

The participants' lived experiences revealed that the meaning of differentiated instruction was most evident when they witnessed learners becoming engaged, making progress, demonstrating learning, and gaining access to science despite differences in their needs and readiness. These experiences are consistent with previous research. Moallemi (2024) found that responding to individual learner differences was associated with greater learner engagement, while Zhao et al. (2026) reported positive differences in both engagement and academic achievement among students experiencing differentiated instruction in science. These findings provide support for the participants' experiences of finding fulfillment when learners actively participated and demonstrated their learning.

The participants' emphasis on making science accessible also reflects the findings of Lindner and Schwab (2020), who identified differentiation and individualization as approaches for responding to learner diversity and moving beyond one-size-fits-all instruction. Similarly, Sedanza and Abatayo (2026) reported positive overall effects of differentiated instruction on learner outcomes, while recognizing variation across contexts. Thus, the literature echoes the participants' lived experiences that the value of differentiated instruction was experienced not simply in the act of adapting instruction, but in witnessing learners become more engaged, make progress, demonstrate what they had learned, and gain meaningful access to science learning.

Summary of the Study

The basis for this study arises from the need to understand differentiated instruction not merely as a set of instructional strategies, but as a lived pedagogical experience shaped by learner diversity, classroom demands, teacher decision-making, and educational context. Although existing research has examined differentiated instructional strategies, teacher perceptions, implementation challenges, professional development, and learning outcomes, less is known about how practicing science teachers experience and make sense of utilizing differentiated instruction in culturally diverse public school classrooms in Minnesota, USA. In particular, limited attention has been given to the experiences of Filipino science teachers and to how they recognize learner differences, make instructional decisions, adapt science lessons, manage competing classroom demands, and derive meaning from their practice.

This gap is significant because differentiated instruction is enacted within the realities of particular classrooms rather than applied uniformly. Teachers must continually respond to differences in learners' readiness, interests, prior knowledge, language backgrounds, and abilities while maintaining common science learning goals. For Filipino science teachers working in U.S. public schools, these experiences may also involve navigating cultural, curricular, linguistic, and professional differences within a multicultural

educational environment. Thus, examining what teachers actually experience and how they interpret those experiences can provide insights that may not be fully captured through studies focused primarily on instructional strategies or measurable outcomes.

The study involved six (6) science teacher co-participants from Compass Academy and New Century School, both located in Minnesota, USA. Participants were selected through purposive sampling based on established inclusion and exclusion criteria. Data were collected through semi-structured interviews using a researcher-developed interview guide. The interview approach provided sufficient structure to address the research objectives while allowing participants to freely describe their experiences in their own words and enabling the researcher to ask follow-up questions for clarification and deeper exploration. The study was geographically and institutionally bounded to the two participating schools in Minnesota and to the experiences of the selected Filipino science teacher as participants during the specified study period.

A phenomenological inquiry is warranted to explore how teachers experience, interpret, and make meaning of utilizing differentiated instruction in science teaching. By centering on participants' lived experiences and narratives, the study seeks to illuminate the opportunities, challenges, adaptations, professional learning, and fulfillment that characterize their experience of the phenomenon. The findings may contribute to a deeper understanding of the lived experience of differentiated science instruction and provide contextual insights for teacher professional development and inclusive education.

As a qualitative phenomenological inquiry involving a small, purposively selected group of participants, the study seeks to describe and understand the essence of the phenomenon as experienced by the participants within the specific context of the participating schools. The findings are therefore intended to provide a rich and contextualized understanding of the phenomenon rather than statistically generalizable conclusions applicable to all science teachers or schools in Minnesota or the United States. Any practical recommendations or instructional implications are limited to meanings and insights grounded in the participants' lived experiences and the context in which the phenomenon was experienced.

1. Major Themes Emerging from the Participants' Lived Experiences

Five major themes emerged from the participants' lived experiences of implementing differentiated instruction in science classrooms. These themes collectively illustrate how participants navigated the complexities of meeting diverse learner needs while striving to make science learning accessible, meaningful, and engaging.

Theme 1: Encountering Learner Diversity as the Starting Point of Differentiation

This theme describes participants' experiences of encountering diverse learners with varying abilities, readiness, interests, language needs, behaviors, confidence, and learning pace. These differences led participants to recognize the limitations of a uniform instructional approach and the importance of understanding learners before determining how instruction should be provided.

Theme 2: Adapting Science Learning to Individual Needs

This theme captures participants' experiences of continually adapting science instruction in response to learners' differences and emerging needs. Participants described modifying content, activities, processes, assessments, and resources to make science learning more accessible and meaningful, often making adjustments as classroom situations unfolded.

Theme 3: Living with the Tensions and Demands of Differentiated Instruction

This theme reflects the challenges participants experienced while sustaining differentiated instruction amid the realities of classroom practice. Time and preparation demands, competing learner needs, behavior management, curriculum constraints, large classes, and limited resources created tensions between the instruction participants wanted to provide and what classroom conditions permitted.

Theme 4: Becoming Flexible, Reflective, and Resourceful Through Experience

This theme illustrates how participants' experiences with the challenges of differentiation contributed to changes in their instructional practices. Through reflection, trial and error, collaboration,

professional learning, self-directed learning, and technology use, participants developed greater flexibility and resourcefulness in responding to learners' needs.

Theme 5: Finding Fulfillment in Learner Engagement, Understanding, and Growth

This theme captures the meaning and fulfillment participants experienced when they witnessed learners engage in science, develop understanding, demonstrate learning, and make progress. These experiences gave significance to the effort involved in differentiation and affirmed the value of creating learning opportunities responsive to diverse learners.

Collectively, the five themes portray differentiated instruction as an ongoing lived experience of recognizing learner differences, responding through instructional adaptation, navigating the demands of practice, developing greater responsiveness through experience, and finding meaning in learners' engagement and growth.

2. Essential Meanings Embedded Within the Five Themes

Through the synthesis of the participants' significant experiences and formulated meanings, the essential meanings embedded within each theme were identified. The resulting essences represent the core of what was experienced by the participants as they lived through the implementation of differentiated instruction. Rather than merely summarizing the findings, these essences illuminate the meaning and significance that participants attributed to their experiences across the five themes.

Theme 1: Encountering Learner Diversity as the Starting Point of Differentiation

The essence of this theme lies in the participants' lived realization that differentiated instruction begins with knowing and understanding the learner before determining how instruction should be designed. Through their experiences, participants came to recognize that learners differ in their interests, experiences, readiness, abilities, language needs, and ways of responding to instruction, making a uniform approach insufficient for addressing their diverse needs. Knowing the learner was therefore experienced not simply as a preliminary step in planning instruction but as the foundation of responsive science teaching. This realization shaped how participants interpreted learner needs and informed the instructional adaptations they subsequently made.

Theme 2: Adapting Science Learning to Individual Needs

The essence of this theme lies in the continual adjustment of science teaching in response to learners' emerging needs and responses. Differentiated instruction was experienced as an evolving and learner-responsive process rather than a fixed instructional procedure. This reflects the participants' ongoing commitment to modifying their instructional approaches to provide meaningful learning opportunities suited to individual learners.

Theme 3: Living with the Tensions and Demands of Differentiated Instruction

The essence of this theme lies in the experience of living with the tension between the responsibility to respond to individual learners and the practical demands of sustaining differentiated instruction in everyday classroom teaching. Participants experienced differentiation as a continuous negotiation between their instructional intentions and the realities of time, resources, classroom management, and curriculum expectations.

Theme 4: Becoming Flexible, Reflective, and Resourceful Through Experience

The essence of this theme is reflected in how participants, through living with the realities of differentiated instruction, gradually developed greater flexibility in responding to learners, reflectiveness in examining their practices, openness to learning from others, and resourcefulness in finding ways to support diverse learners within their classroom contexts. These experiences contributed to their continuing development as responsive and adaptive science teachers.

Theme 5: Finding Fulfillment in Learner Engagement, Understanding, and Growth

The essence of this theme lies in the participants' experience of fulfillment in witnessing learners engage, understand, demonstrate learning, and gain access to science learning despite their differences. These experiences gave meaning to the participants' efforts to differentiate instruction, as they saw their

adaptations create opportunities for learners to participate, progress, and experience success. Differentiated instruction was therefore lived not only as a demanding responsibility but also as a meaningful and rewarding experience when participants witnessed the impact of their responsiveness on learners' engagement and growth.

3. Integrated Synthesis of the Five Essences

Taken together, the five theme essences reveal differentiated instruction as a dynamic and evolving lived experience of recognizing learner diversity, adapting instruction to individual needs, and navigating the demands and constraints of classroom practice.

Through these experiences, participants became more flexible, reflective, and resourceful in responding to learners. Despite the challenges involved, they found meaning and fulfillment when learners engaged in science, developed understanding, demonstrated learning, and experienced growth.

Thus, differentiated instruction was lived as an ongoing commitment to understanding learners, responding to their differences, and creating meaningful opportunities for their participation and growth.

4. Fundamental Structure of the Lived Experiences

The five themes and their interconnected subthemes were integrated to formulate the fundamental structure of the participants' lived experiences of implementing differentiated instruction in science classrooms.

The participants' narratives revealed that differentiated instruction was experienced as a continuous and responsive process that began with recognizing and understanding learner differences and extended to adapting content, materials, activities, learning pathways, and levels of support according to individual needs. As teachers responded to these differences, they simultaneously navigated the demands of preparation, time, classroom management, curriculum, resources, facilities, and the emotional and physical effort associated with differentiation. These realities required them to make ongoing instructional decisions, adjust their approaches, and find workable ways to sustain differentiation within the conditions of their teaching contexts.

Through repeated encounters with diverse learners, participants gradually developed greater flexibility, reflection, and resourcefulness. Their understanding and application of differentiated instruction evolved through classroom experience, reflection, collaboration, professional development, and the use of available technologies and alternative resources. Although the process was demanding, participants also experienced moments of meaning and fulfillment when they witnessed learners becoming engaged, developing understanding, demonstrating what they had learned, and gaining greater access to science learning. These moments provided a sense of purpose and affirmed the significance they attached to responding to learners' individual needs.

Thus, the fundamental structure of the lived experience was characterized by a continual movement between recognizing learner differences, responding through purposeful instructional adaptation, navigating the realities and constraints of teaching, and developing as a more flexible and resourceful teacher. Differentiated instruction was therefore experienced not simply as the application of varied instructional strategies but as a learner-responsive way of teaching in which teachers continually observed, adjusted, reflected, and grew in relation to the learners and circumstances before them.

5. Essence of the Phenomenon

The essence of the phenomenon lies in the lived experience of continually recognizing learner differences, responding through purposeful instructional adaptation, and navigating the realities of science teaching while finding meaning in reaching diverse learners.

At its core, differentiated instruction was experienced as a continual process of seeing, responding, adapting, and growing, one that required teachers to consistently recognize learner needs, modify instructional approaches, manage competing demands, and draw upon available resources and support.

Fulfillment emerged when teachers witnessed learners engage, develop understanding, and participate meaningfully in science learning. These experiences reinforced the significance of their instructional efforts and their commitment to addressing learner diversity.

Thus, differentiated instruction was experienced as a dynamic interplay between challenge and fulfillment, in which the demands of responding to learner diversity were given meaning through the opportunities created for learner engagement, growth, and participation.

Summary of Major Findings

The study explored the experiences, perceptions, and realities of Filipino science teachers in implementing Differentiated Instruction in science education? Analysis of the data generated five major findings that collectively explain the implementation of differentiated instruction in science education within Ramsey County, Minnesota, USA.

1. The lived experiences of middle school science teachers revealed that differentiated instruction is not experienced as a fixed instructional technique or a series of isolated strategies, but as a continuous, learner-responsive process of knowing, adapting, negotiating, and reflecting within the realities of the science classroom. Teachers began with an awareness of learner diversity, recognizing differences in readiness, interests, experiences, language, abilities, and support needs. This awareness became the basis for adapting science content, activities, learning pathways, grouping, and levels of support to make instruction more responsive to individual learners. The participants experienced differentiation as a demanding and sometimes tension-filled responsibility. They had to balance diverse learner needs with limited time, competing classroom demands, curriculum expectations, resource limitations, behavioral concerns, and the personal effort required to sustain differentiated practices. Despite these challenges, teachers continued to make instructional adjustments by drawing on observations, learner responses, assessment evidence, available resources, and their own professional judgment. Their experiences therefore demonstrated that differentiation involves continual decision-making rather than the mechanical application of predetermined strategies.
2. The participants found meaning and fulfillment when their differentiated efforts resulted in greater learner engagement, participation, understanding, and demonstrated learning. These experiences gave personal and professional significance to the work of differentiation and reinforced teachers' commitment to responding to learners as individuals.
3. The five themes reveal the essence of differentiated science instruction as a lived experience of responsive professional practice: teachers first encounter and understand learner diversity, respond by adapting instruction, negotiate the tensions and demands of implementation, and derive meaning from learners' engagement, understanding, and growth. Thus, differentiated instruction is best understood as an ongoing cycle of responsiveness in which teachers continuously interpret learner needs, make contextual instructional decisions, monitor learner responses, and adjust their practice while sustaining their commitment to learner growth.
4. The RDSI Framework was grounded in the five themes that emerged from the participants' lived experiences of differentiated science instruction. These themes served as the basis for deriving the framework's components, which collectively represent the process of knowing learners, adapting instruction, managing classroom demands, responding to learner development, and sustaining responsive practice. Thus, the framework translates teachers' lived experiences into an experience-based guide for responsive and learner-centered science instruction.

Recommendations

Based on the findings, interpretations, and conclusions of the study, the following recommendations are proposed to strengthen responsive differentiated science instruction in middle school science classrooms:

1. **Strengthen teachers' understanding of learner diversity.** Science teachers may systematically identify learners' readiness, interests, experiences, language needs, abilities, and support requirements as a foundation for responsive differentiated instruction.
2. **Enhance teachers' capacity to adapt instruction.** Professional development may provide teachers with practical strategies for adapting science content, activities, grouping, learning pathways, assessment, and levels of support based on learners' needs and responses.
3. **Provide administrative support for navigating the demands of differentiation.** School administrators and science departments may provide adequate planning time, resources, collaboration opportunities, and instructional support to help teachers manage the time, curriculum, behavioral, and workload demands associated with differentiated instruction.
4. **Establish a supportive school environment for differentiated instruction.** School administrators may develop and sustain school policies, programs, and leadership practices that recognize the demands of differentiated instruction and encourage teacher collaboration, sharing of effective practices, and continuous professional growth in responsive science teaching.
5. **Sustain and further develop responsive differentiated science instruction.** The Responsive Differentiated Science Instruction (RDSI) Framework may be used as an experience-based guide for integrating the themes of learner awareness, instructional adaptation, negotiation of implementation demands, and reflection on learner growth. Future research may further examine the framework across diverse grade levels, science contexts, and educational settings.

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