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Inclusive Teaching Practices in Secondary Science Education: A Qualitative Study on Strategies, Challenges, and Teacher Perspective

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Abstract

This study explored the inclusive teaching practices implemented by secondary science teachers to support diverse learners in inclusive classroom settings by examining the instructional strategies they use, the barriers they encounter, their reflections on the effectiveness of these practices, and a proposed output to strengthen inclusive science instruction. Using a qualitative phenomenological research design, the study gathered data from secondary science teachers teaching Grades 6–12 in the United States and the Philippines through surveys, semi-structured interviews, and focus group discussions, with the data analyzed using Virginia Braun and Victoria Clarke's Thematic Analysis Model. The findings revealed that teachers commonly employ differentiated instruction, scaffolding, collaborative learning, multimodal instruction, formative assessment, peer-assisted learning, and technology-assisted teaching to meet the diverse needs of learners while promoting equitable access, meaningful participation, learner engagement, and instructional accessibility. Teachers recognized learner diversity as a natural feature of science classrooms that requires continuous adaptation of teaching methods, instructional materials, and assessment practices. Although they faced challenges such as large class sizes, limited instructional resources, curriculum demands, insufficient professional development, inadequate preparation time, and limited institutional support, they consistently demonstrated commitment, adaptability, and creativity in fostering inclusive learning environments. The study further found that inclusive teaching practices positively enhance student participation, engagement, collaboration, confidence, and access to science learning. Based on these findings, the study proposed an Inclusive Science Teaching Guide to assist secondary science teachers in implementing flexible, learner-centered, and accessible instructional practices, concluding that successful inclusive science education depends on instructional flexibility, collaborative learning environments, ongoing professional development, and strong institutional support to effectively address learner diversity and provide equitable learning opportunities for all students.

Keywords: *inclusive education, inclusive teaching practices, secondary science education, diverse learners, differentiated instruction, qualitative research*

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CHAPTER 1
The Problem and its Background

Introduction

The increasing diversity in today's classrooms highlights the urgent need for inclusive teaching practices, particularly in science education. Teachers are expected to meet the needs of learners from a wide range of linguistic, cultural, socioeconomic, and ability backgrounds. Recent scholarship emphasizes that inclusive education is not only about physical presence in classrooms but also about ensuring meaningful participation and equitable opportunities for learning (Waitoller & Artiles, 2021). Despite this, many science teachers continue to face challenges in applying inclusive strategies due to limited professional development, inadequate access to culturally responsive materials, and systemic barriers within school systems.

In science education, inclusivity requires intentional instructional planning that integrates multiple pedagogical approaches, including differentiated instruction, culturally responsive teaching, and Universal Design for Learning (UDL). These frameworks provide teachers with flexible tools to address learner variability and promote equitable engagement, particularly for students with disabilities, multilingual learners, and those from historically marginalized groups (Meyer, Rose, & Gordon, 2022). Current research further highlights that equitable science instruction should ensure all students can actively engage in scientific inquiry and develop a deep understanding of disciplinary core concepts, regardless of their backgrounds (Lee, Miller, & Januszyk, 2021).

Improving teacher practice with inclusivity not only fosters academic achievement but also enhances students' sense of belonging and self-efficacy in science. This study seeks to explore how science educators currently implement inclusive strategies, identify the challenges they face, and recommend actionable steps to strengthen inclusive teaching practices in secondary science education.

Theoretical lens

This study focuses on how science teachers in the Philippines make their classrooms more inclusive for all kinds of students. These include students with disabilities, those learning English, and others who come from different cultures or backgrounds. To guide this study, three key ideas are used: social learning, universal design for learning (UDL), and critical, student-centered teaching.

The first idea is that students learn best through social interaction. This concept builds on Vygotsky's early work, and many researchers today still support it. Learning happens when students work with others, ask questions, and get support from their teachers (Edwards, 2021). When science teachers encourage teamwork and group discussions, students have more chances to understand complex topics, even if they struggle with language or need extra support.

Next is Universal Design for Learning (UDL), a teaching framework that helps teachers plan lessons that reach all kinds of learners. UDL promotes flexible ways to present lessons,

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engage students, and check for understanding. It helps teachers teach content in different ways and gives students more choices in how they learn and show what they know (CAST, 2022). For example, a science teacher might use hands-on experiments, videos, pictures, and class discussions instead of only using textbooks or tests. These options help students connect with the material in a way that works for them.

The third idea is about teaching that is fair and responsive to students' lives and identities. This includes reflecting on biases, respecting different cultures, and giving students a voice in the classroom. It helps create a space where every student feels safe, valued, and capable of succeeding (Gorski & Swalwell, 2021). In science classrooms, this could mean using examples that relate to students' communities or encouraging conversations about real-world problems like climate change or public health.

Together, these three ideas help guide this research. They show that inclusive teaching is not just about using new tools or methods. It's also about creating caring, flexible, and respectful learning environments where every student has the chance to learn and grow.

Central Question

As the Philippine education system continues to promote inclusive education, secondary science teachers are increasingly expected to meet the diverse needs of students with varying cultural, linguistic, and learning backgrounds. However, how these inclusive teaching practices are implemented in actual classroom settings remains insufficiently explored. This raises a central question: **How do secondary science teachers in the Philippines implement inclusive teaching practices to support diverse learners?**

Corollary Question

To address this overarching issue, the study also seeks to answer the following supporting questions:

1. What inclusive teaching strategies are most commonly implemented by secondary science teachers to ensure equitable participation and learning among students with diverse needs, languages, and cultural backgrounds?
2. What factors impede the effective implementation of inclusive science education among secondary school teachers?
3. What reflective insights do science teachers provide about the effectiveness of their inclusive teaching practices in enhancing student participation and achievement?
4. Based on the results of the study, what output may be proposed?

By answering these questions, the study aims to provide insights that can inform teacher training, curriculum design, and policy development to strengthen inclusive practices in science education.

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Scope and Delimitation of the Study

This study focuses on the inclusive teaching practices employed by secondary science teachers from the Philippines and the United States. It aims to document, analyze, and interpret the strategies, challenges, and perspectives of teachers who are actively implementing inclusive approaches in their classrooms. Specifically, the research seeks to identify the instructional methods used to support diverse learners, the barriers educators encounter in promoting inclusion, and the ways these practices influence student engagement and participation in science learning.

The study will involve secondary science teachers with at least one year of teaching experience who are currently applying inclusive strategies in their instruction. Data will be collected through in-depth interviews and focus group discussions to capture both individual experiences and shared insights. The research will include a purposive sample of schools representing various educational settings, ensuring diversity in teaching environments and learner populations.

This study is delimited to science education and does not extend to other subject areas such as mathematics, language, or social studies. While the views of administrators, parents, and students could contribute valuable perspectives, the primary participants are teachers, as they directly shape and implement inclusive classroom practices. The findings will be based on teachers' self-reported experiences and reflections, which may be influenced by personal interpretation. Therefore, the results are intended to provide context-based insights rather than broad generalizations about all secondary schools.

Significance of Study

This study is significant because it provides valuable insights into the implementation of inclusive teaching practices in secondary science education. By exploring the strategies used by teachers, the barriers they encounter, and their reflections on inclusive instruction, the research contributes to both theoretical understanding and classroom practice. The findings aim to inform future educational policies, enhance teacher preparation, and promote equity in science education.

Importantly, the study intends to help teachers based in the Philippines by offering insights drawn from both local and international perspectives. These findings can serve as a guide for improving inclusive instructional practices, particularly in addressing diverse learning needs within science classrooms. The research also has implications for various educational stakeholders:

Administrators

School leaders and administrators may use the findings as a basis for supporting and institutionalizing inclusive practices in their schools. The results can inform professional development programs, guide the allocation of resources, and strengthen policies that promote diversity, equity, and inclusion in science education.

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Teachers

Science teachers will directly benefit from the strategies and best practices identified in the study. The findings can enhance their instructional techniques, classroom management, and assessment practices when teaching students with varying abilities, languages, and cultural backgrounds. This may also increase their competence and confidence in implementing inclusive teaching.

Students with Diverse Learning Needs

Learners, especially those with disabilities, language barriers, or cultural differences, stand to benefit from the development of more inclusive and supportive science learning environments. The study promotes practices that foster participation, engagement, and equitable access to quality education.

Policy Makers

The study can serve as a reference for policymakers when designing or revising education programs and frameworks. The findings may support the creation of policies that strengthen inclusive teaching, teacher training, and resource distribution in science education both in the Philippines and internationally.

Future Researchers

The study will provide a foundation for further academic inquiry on inclusive education. It may inspire comparative research between countries, program evaluations, or the development of innovative frameworks for diversity, equity, and inclusion (DEI) in science teaching.

Definition of Terms

Accessibility

Accessibility refers to the degree to which educational environments, instructional materials, learning activities, and assessment practices are designed to be usable and available to all learners regardless of ability, disability, language proficiency, or learning differences.

Assistive Technology

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Assistive Technology refers to devices, software, applications, or equipment that enhance the learning, communication, participation, and independence of students with disabilities by providing support in accessing educational content and classroom activities.

Collaborative Teaching

Collaborative Teaching refers to an instructional approach in which two or more educators jointly plan, deliver, monitor, and assess instruction to meet the diverse academic, behavioral, and social needs of learners within inclusive classrooms.

Culturally Responsive Teaching

Culturally Responsive Teaching refers to an educational approach that incorporates students' cultural backgrounds, values, experiences, and perspectives into classroom instruction to promote meaningful engagement, inclusivity, and academic success.

Differentiated Instruction

Differentiated Instruction refers to a teaching approach in which educators modify instructional methods, learning activities, content, and assessments to address students' diverse readiness levels, interests, learning profiles, and educational needs.

English Language Learners (ELLs)

English Language Learners refer to students whose primary language is not English and who require additional linguistic support to effectively access academic content and participate meaningfully in classroom instruction.

Equitable Participation

Equitable Participation refers to providing all students with fair opportunities, appropriate accommodations, and necessary supports that enable meaningful engagement in learning activities regardless of their backgrounds or abilities.

Formative Assessment

Formative Assessment refers to the continuous process of gathering information about student learning during instruction to monitor progress, provide feedback, and inform instructional decision-making for improved outcomes.

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Inclusive Education

Inclusive Education refers to an educational philosophy and practice that ensures all learners have equitable access to quality education through supportive environments, differentiated instruction, and meaningful participation opportunities.

Inclusive Teaching Practices

Inclusive Teaching Practices refer to instructional approaches, classroom strategies, and educational interventions designed to accommodate learner diversity and promote accessibility, participation, engagement, and academic success for all students.

Instructional Adaptation

Instructional Adaptation refers to the process of modifying teaching methods, classroom activities, instructional materials, and assessments to address diverse learner needs and reduce barriers to learning.

Learner Diversity

Learner Diversity refers to the wide range of differences among students, including variations in abilities, language proficiency, cultural backgrounds, learning styles, interests, and educational experiences.

Learner-Centered Instruction

Learner-Centered Instruction refers to a teaching approach that prioritizes students' needs, interests, strengths, and learning preferences while actively engaging them in meaningful educational experiences.

Multimodal Instruction

Multimodal Instruction refers to the use of multiple forms of representation and communication, including visual, auditory, textual, kinesthetic, and digital methods, to support diverse learning needs.

Overcrowded Classrooms

Overcrowded Classrooms refer to educational settings where student enrollment exceeds recommended teacher-to-student ratios, limiting opportunities for individualized instruction and effective implementation of inclusive practices.

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Peer-Assisted Learning

Peer-Assisted Learning refers to instructional activities in which students collaborate, tutor, support, and learn from one another through structured interactions designed to enhance academic and social outcomes.

Phenomenological Research Design

Phenomenological Research Design refers to a qualitative research approach that explores and describes participants' lived experiences, perceptions, and interpretations regarding a particular educational phenomenon.

Policy Frameworks

Policy Frameworks refer to organized systems of laws, regulations, guidelines, and institutional directives that govern educational practices and support the implementation of inclusive education initiatives.

Professional Development

Professional Development refers to structured learning experiences, training programs, workshops, mentoring activities, and continuing education opportunities designed to improve educators' knowledge and instructional competencies.

Scaffolding

Scaffolding refers to the instructional support provided by teachers to assist learners in developing new knowledge and skills, with support gradually reduced as independence increases.

Secondary Science Education

Secondary Science Education refers to the teaching and learning of science subjects within Grades 6 through 12, focusing on scientific literacy, inquiry skills, critical thinking, and conceptual understanding.

Special Education (SPED)

Special Education refers to specialized educational services, accommodations, modifications, and instructional supports designed to address the unique learning needs of students with disabilities.

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Thematic Analysis

Thematic Analysis refers to a qualitative data analysis method used to identify, organize, interpret, and report recurring patterns, categories, and themes within qualitative data sets.

Universal Design for Learning (UDL)

Universal Design for Learning refers to an educational framework that promotes flexible learning environments through multiple means of engagement, representation, and expression to support learner variability.

CHAPTER 2
Review of Related Literature

The review of related literature provides the theoretical and empirical foundations for this study on inclusive teaching practices in secondary science education in the Philippines. It explores current perspectives, policies, and practices that shape the implementation of inclusive education, while highlighting the challenges teachers face in addressing diverse learner needs. By examining both global and local studies, this section situates the research within existing scholarship and identifies gaps that this study seeks to address. The review is organized around key themes such as inclusive education frameworks in the Philippine context, instructional strategies for inclusive science teaching, and the challenges that influence effective implementation.

Introduction to Inclusive Education: A Global Perspective

Inclusive education has become one of the most significant educational reforms of the twenty-first century, emphasizing the right of all learners to access quality education regardless of their abilities, disabilities, language backgrounds, cultural identities, socioeconomic status, gender, or other individual differences. The concept is grounded in the principle of educational equity, which recognizes that all students should be provided with meaningful opportunities to learn, participate, and succeed within general education settings. Inclusive education seeks to eliminate barriers to learning and participation by creating supportive environments that accommodate learner diversity and promote social belonging. Rather than viewing differences as deficits, inclusive education values diversity as a strength that enriches the educational experience for all learners (UNESCO, 2022).

Globally, inclusive education has gained increasing attention as a fundamental human right and an essential component of sustainable development. UNESCO (2022) emphasized that inclusive and equitable quality education is central to achieving Sustainable Development Goal 4 (SDG 4), which seeks to ensure lifelong learning opportunities for all individuals. The organization further highlights that inclusive education extends beyond the placement of students with disabilities in mainstream classrooms; it involves transforming educational systems, policies,

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curricula, teaching practices, and school cultures to ensure meaningful participation for every learner. As educational systems continue to diversify, the implementation of inclusive practices has become a critical priority for governments, educational institutions, and policymakers worldwide.

Recent studies have demonstrated that inclusive education contributes positively to both academic and social outcomes. According to Hehir et al. (2023), students educated in inclusive settings often experience improved academic achievement, stronger social relationships, increased self-esteem, and greater opportunities for participation in school activities. Inclusive classrooms also promote empathy, collaboration, and mutual respect among students by encouraging interactions among individuals with diverse backgrounds and abilities. Similarly, Sharma and Sokal (2022) noted that inclusive learning environments foster positive attitudes toward diversity and prepare students to participate effectively in increasingly multicultural and interconnected societies. These findings suggest that inclusive education benefits not only students with identified learning needs but also the broader school community.

Many countries have adopted policies and legislative frameworks that support inclusive education as a national priority. In the United States, the Individuals with Disabilities Education Act (IDEA) and related federal policies continue to promote the inclusion of students with disabilities within general education classrooms whenever appropriate. Likewise, countries such as Canada, Australia, Finland, and New Zealand have strengthened inclusive education initiatives by emphasizing equitable access, differentiated instruction, and collaborative support systems (Ainscow & Messiou, 2021). In the Philippines, inclusive education has been reinforced through policies such as Republic Act No. 11650, also known as the Inclusive Education Act, which seeks to establish comprehensive support services for learners with disabilities within mainstream educational settings. These efforts reflect a growing international commitment to ensuring educational opportunities for all learners.

Despite substantial progress, challenges remain in the implementation of inclusive education across many educational contexts. Research indicates that teachers frequently encounter barriers such as insufficient training, limited instructional resources, large class sizes, curriculum constraints, and inadequate institutional support (Florian & Black-Hawkins, 2021). These challenges may affect teachers' ability to effectively address the diverse needs of learners and implement inclusive instructional practices consistently. Furthermore, disparities in funding, access to specialized services, and teacher preparation continue to influence the quality of inclusive education in both developed and developing countries. As a result, ongoing professional development and systemic support remain essential components of successful inclusive education initiatives.

Another significant development in contemporary inclusive education is the increasing application of Universal Design for Learning (UDL). UDL promotes the creation of flexible learning environments through the provision of multiple means of engagement, representation, and expression, enabling educators to proactively address learner variability (CAST, 2021). Rather than adapting instruction after barriers arise, UDL encourages teachers to design learning experiences that accommodate diverse needs from the outset. Recent research suggests that UDL-

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based practices enhance accessibility, student engagement, and participation while reducing barriers to learning for students with varying abilities and backgrounds (Rao et al., 2023). Consequently, UDL has become an influential framework for advancing inclusive education globally.

As educational systems continue to evolve, the role of teachers remains central to the successful implementation of inclusive education. Teachers are expected to design accessible learning experiences, differentiate instruction, foster positive classroom climates, and collaborate with colleagues, families, and support personnel to meet the needs of diverse learners. According to DeMatthews and Knight (2022), teacher attitudes, beliefs, and instructional competencies significantly influence the effectiveness of inclusive practices. Therefore, strengthening teacher preparation programs and providing continuous professional development opportunities are essential strategies for sustaining inclusive educational reforms.

In summary, inclusive education represents a global commitment to educational equity, participation, and social justice. It seeks to ensure that all learners have meaningful opportunities to learn, participate, and thrive within general education settings. Although significant progress has been made in promoting inclusive education worldwide, challenges related to resources, teacher preparation, and systemic support continue to affect implementation. Nevertheless, ongoing policy reforms, evidence-based instructional frameworks such as UDL, and increased awareness of learner diversity continue to strengthen efforts toward creating more inclusive and equitable educational systems.

Legal and Policy Frameworks Supporting Inclusion

The implementation of inclusive education is strongly supported by international, national, and local legal frameworks that promote educational equity, accessibility, and participation for all learners. These policies recognize education as a fundamental human right and emphasize the responsibility of educational systems to accommodate learner diversity rather than requiring learners to adapt to rigid educational structures. Legal and policy frameworks serve as essential foundations for ensuring that schools, educators, and governments uphold inclusive practices that support students with disabilities, marginalized groups, and diverse learning needs.

At the international level, inclusive education is guided by several landmark agreements and declarations that have significantly influenced educational policies worldwide. One of the most influential frameworks is the United Nations Convention on the Rights of Persons with Disabilities (UNCRPD), which emphasizes the right of persons with disabilities to access inclusive and quality education without discrimination. Article 24 of the convention specifically calls on member states to establish inclusive education systems at all levels and ensure that learners with disabilities can participate fully in society through equitable educational opportunities (United Nations, 2022). The UNCRPD reinforces the principle that educational institutions must provide reasonable accommodations and remove barriers that prevent learners from accessing education.

Another important international framework is the Salamanca Statement, which continues to serve as a foundational document for inclusive education globally. Although originally adopted

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in 1994, its principles remain highly relevant in contemporary educational reforms. The Salamanca Statement advocates for schools to accommodate all children regardless of their physical, intellectual, social, emotional, linguistic, or other conditions. Recent UNESCO reports continue to reaffirm the statement's principles by emphasizing that inclusive schools are the most effective means of combating discrimination, promoting social cohesion, and improving educational outcomes for all learners (UNESCO, 2022). These international commitments have encouraged governments worldwide to adopt inclusive educational policies and practices.

Globally, educational systems have increasingly aligned their policies with Sustainable Development Goal 4 (SDG 4), which seeks to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. UNESCO (2022) emphasized that achieving SDG 4 requires educational systems to address barriers related to disability, poverty, language, gender, ethnicity, and other factors that contribute to educational exclusion. As a result, many countries have strengthened their legislative and policy frameworks to ensure that inclusive education becomes an integral part of educational planning, curriculum development, teacher preparation, and school improvement initiatives.

In the United States, inclusive education is supported through a comprehensive legal framework that protects the rights of students with disabilities. The Individuals with Disabilities Education Act (IDEA) remains one of the most significant federal laws supporting inclusion by guaranteeing eligible students a Free Appropriate Public Education (FAPE) in the Least Restrictive Environment (LRE). Under IDEA, schools are required to develop Individualized Education Programs (IEPs) that outline educational goals, accommodations, modifications, and specialized services designed to meet the unique needs of each student (U.S. Department of Education, 2023). The law promotes collaboration among general education teachers, special education teachers, related service providers, and families to ensure equitable access to educational opportunities.

Complementing IDEA is Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination based on disability in federally funded educational institutions. Section 504 ensures that students with disabilities receive necessary accommodations and support services that allow them to participate fully in academic and extracurricular activities. Recent guidance from the U.S. Department of Education (2023) emphasizes the importance of creating accessible learning environments and providing appropriate accommodations that support student success. Together, IDEA and Section 504 establish a strong legal foundation for inclusive education within American schools.

In the Philippines, inclusive education has become a major component of educational reform and development. Republic Act No. 10533, also known as the Enhanced Basic Education Act of 2013, promotes learner-centered, inclusive, and developmentally appropriate educational practices. The law recognizes the importance of addressing learner diversity and ensuring that educational programs are responsive to the varying needs, abilities, and interests of students. Through curriculum flexibility and contextualized instruction, the law supports the implementation of inclusive practices within Philippine schools (Department of Education [DepEd], 2022).

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Furthermore, DepEd Order No. 72, s. 2009 institutionalized inclusive education as a strategy for increasing participation and reducing exclusion among learners with special educational needs. The policy emphasizes the integration of diverse learners into regular classrooms whenever appropriate while ensuring access to support services and accommodations. More recently, the Basic Education Development Plan (BEDP) 2030 strengthened the government's commitment to inclusive education by aligning educational priorities with the Sustainable Development Goals and emphasizing equitable access, learner well-being, and educational quality (DepEd, 2022). These policy initiatives demonstrate the Philippines' commitment to creating a more inclusive and equitable educational system.

A significant legislative milestone was the enactment of Republic Act No. 11650, otherwise known as the Inclusive Education for Learners with Disabilities Act. This law institutionalizes inclusive education for learners with disabilities and mandates the provision of comprehensive support services, assistive technologies, teacher training programs, and accessible educational resources. The law further strengthens collaboration among educational institutions, local government units, and other stakeholders to ensure that learners with disabilities receive quality education within inclusive learning environments (Official Gazette of the Republic of the Philippines, 2022).

Across educational systems worldwide, these legal and policy frameworks reflect a common understanding that inclusive education extends beyond compliance with laws and regulations. Rather, inclusion represents a commitment to equity, social justice, human dignity, and educational excellence. Contemporary research suggests that effective implementation of inclusive education requires not only strong legislation but also supportive school cultures, adequate funding, continuous professional development, and collaborative partnerships among stakeholders (Ainscow & Messiou, 2021; Sharma & Sokal, 2022). Consequently, legal and policy frameworks play a critical role in guiding educational institutions toward the realization of truly inclusive and equitable learning environments.

Definitions and Goals of Inclusive Education

Inclusive education has emerged as a fundamental principle in contemporary educational systems, emphasizing the right of all learners to access quality education within shared learning environments. It is grounded in the belief that diversity is a natural characteristic of classrooms and that educational systems should be designed to accommodate learner differences rather than exclude individuals who may require additional support. Inclusive education promotes equity, participation, accessibility, and belonging by ensuring that all students, regardless of disability, language background, socioeconomic status, culture, gender, or learning ability, are provided meaningful opportunities to learn and succeed. As educational systems become increasingly diverse, inclusive education has become a central strategy for achieving educational justice and social inclusion.

The concept of inclusive education extends beyond the physical placement of students within general education classrooms. Rather, it involves a comprehensive process of transforming policies, curricula, instructional practices, learning environments, and school cultures to respond

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effectively to learner diversity. UNESCO (2022) defines inclusive education as the process of "addressing and responding to the diversity of needs of all learners through increasing participation in learning, cultures, and communities, and reducing exclusion within and from education." This definition highlights that inclusion is not merely about access to schooling but also about ensuring meaningful participation, engagement, and achievement for every learner. Consequently, inclusive education requires schools to identify and remove barriers that may limit students' opportunities to learn and participate fully.

Contemporary scholars describe inclusive education as a learner-centered approach that recognizes individual differences as valuable assets within the educational process. According to Sharma and Sokal (2022), inclusive education promotes equitable learning opportunities by encouraging educators to adopt flexible instructional approaches that accommodate varying learner needs, interests, and abilities. Inclusive practices support students through differentiated instruction, collaborative learning, accommodations, and individualized support while maintaining high expectations for academic achievement. This perspective shifts the focus from students adapting to the educational system toward educational systems adapting to meet the needs of all learners.

In many countries, inclusive education is closely associated with educational equity and social justice. Educational equity involves ensuring that learners receive the support, resources, and opportunities necessary to achieve success regardless of their personal circumstances or characteristics. According to UNESCO (2022), inclusive education contributes to reducing educational inequalities by addressing barriers associated with disability, poverty, language differences, ethnicity, gender, and geographic location. Through equitable educational practices, schools can foster environments where all students feel valued, respected, and capable of contributing to their learning communities. As a result, inclusive education has become a key strategy for promoting equal opportunities and reducing educational disparities worldwide.

Within the United States, inclusive education is strongly influenced by evidence-based instructional frameworks such as Universal Design for Learning (UDL), differentiated instruction, and equity-centered pedagogy. UDL emphasizes the importance of providing multiple means of engagement, representation, and expression to accommodate learner variability and improve accessibility (CAST, 2021). Rather than relying on a single method of instruction, teachers are encouraged to provide flexible learning options that support diverse learning preferences and abilities. Smith and Katz (2021) argue that inclusive classrooms become more effective when teachers intentionally design instruction that anticipates learner diversity and proactively addresses potential barriers to learning. These approaches allow students to access educational content in ways that align with their strengths and needs.

In Southeast Asia, inclusive education has increasingly been viewed as a mechanism for addressing educational inequalities and promoting social inclusion. SEAMEO INNOTECH (2021) describes inclusive education as a process that values cultural, linguistic, social, and educational diversity while ensuring equal educational access and participation for all learners. This perspective recognizes that learners come from diverse cultural and linguistic backgrounds and that educational systems must be responsive to these differences. Inclusive education in the region

therefore emphasizes culturally responsive teaching, community engagement, and learner-centered instructional practices that support diverse student populations.

A primary goal of inclusive education is to ensure equal access to quality education for all learners. This involves creating learning environments where students can participate meaningfully regardless of disability, language proficiency, socioeconomic background, or other characteristics. Equal access includes providing accommodations, instructional supports, assistive technologies, and flexible learning opportunities that enable students to engage successfully in educational activities. According to Hehir et al. (2023), inclusive educational settings often result in improved academic outcomes because students are provided opportunities to learn alongside their peers while receiving appropriate supports tailored to their needs.

Another important goal of inclusive education is to promote positive social relationships and foster a sense of belonging among learners. Inclusive classrooms encourage collaboration, peer interaction, empathy, and mutual respect by bringing together students from diverse backgrounds and abilities. Research suggests that students educated in inclusive environments develop stronger social skills, greater acceptance of diversity, and improved interpersonal relationships (Ainscow & Messiou, 2021). These experiences contribute to the development of inclusive communities where differences are valued and respected rather than viewed as obstacles to learning.

Inclusive education also seeks to maximize learner participation and engagement. Participation extends beyond physical attendance and involves active involvement in classroom discussions, learning activities, assessments, and decision-making processes. Teachers play a critical role in promoting participation by implementing differentiated instruction, scaffolding, collaborative learning, and other inclusive teaching practices. According to Rao et al. (2023), educational environments that prioritize participation and accessibility are more likely to enhance student motivation, engagement, and academic achievement. Therefore, meaningful participation remains a central objective of inclusive education.

Ultimately, the overarching goal of inclusive education is to prepare all learners for successful participation in society. By promoting educational equity, social inclusion, collaboration, and respect for diversity, inclusive education contributes to the development of individuals who are capable of participating fully in social, economic, and civic life. As educational systems continue to evolve, the principles of inclusion remain essential for creating learning environments that recognize diversity, support individual growth, and ensure that every learner has the opportunity to succeed.

Inclusive Science Teaching Practices

Science education plays a vital role in preparing learners to understand the natural world, develop critical thinking skills, solve problems, and make informed decisions. As a discipline, science encourages inquiry, exploration, experimentation, and collaboration, making it an ideal context for implementing inclusive educational practices. However, science learning often involves abstract concepts, technical vocabulary, laboratory activities, mathematical reasoning,

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and scientific processes that may present challenges for diverse learners. Consequently, inclusive science teaching requires intentional instructional planning and the use of evidence-based strategies that ensure accessibility, participation, and meaningful learning experiences for all students.

Inclusive science teaching practices refer to instructional approaches designed to accommodate learner diversity while maintaining high academic expectations. These practices aim to remove barriers to learning by adapting instruction, providing multiple pathways for engagement, and creating supportive learning environments where all students can actively participate. According to UNESCO (2022), inclusive teaching involves responding to learner variability through flexible educational approaches that promote participation and achievement. Within science classrooms, this means ensuring that learners with different abilities, language backgrounds, cultural experiences, and learning preferences can successfully engage with scientific concepts and processes.

One of the most widely recognized inclusive teaching practices in science education is differentiated instruction. Differentiated instruction involves modifying content, instructional processes, learning activities, and assessment methods to address students' varying readiness levels, interests, and learning profiles. Research by Tomlinson and Moon (2021) emphasized that differentiation allows teachers to provide multiple entry points to learning while maintaining rigorous academic standards. In science education, differentiation may include providing varied reading materials, offering multiple options for demonstrating understanding, modifying laboratory activities, and adjusting instructional supports to accommodate diverse learner needs. Through differentiated instruction, teachers can increase accessibility while ensuring that all students remain engaged in scientific inquiry.

Scaffolding is another essential inclusive teaching practice frequently utilized in science classrooms. Scaffolding involves providing temporary instructional supports that assist learners in developing new knowledge and skills. These supports may include guided questioning, visual organizers, step-by-step instructions, modeling, vocabulary supports, and structured learning tasks. According to van de Pol et al. (2022), scaffolding is particularly effective in science education because it helps learners gradually develop conceptual understanding while building confidence and independence. As students become more proficient, teachers systematically reduce support, enabling learners to assume greater responsibility for their learning. Scaffolding is especially beneficial for students with learning difficulties, English language learners, and those encountering complex scientific concepts for the first time.

Collaborative learning also serves as a powerful strategy for promoting inclusion within science education. Collaborative learning encourages students to work together through group investigations, peer-assisted learning activities, cooperative problem-solving tasks, and scientific discussions. Research conducted by Gillies (2023) found that collaborative learning environments improve academic achievement, social interaction, communication skills, and student engagement. Inclusive science classrooms benefit from collaboration because students are able to learn from one another, share diverse perspectives, and develop interpersonal skills while participating in

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scientific inquiry. Furthermore, collaborative learning supports the development of positive classroom relationships and fosters a sense of belonging among diverse learners.

Multimodal instruction has gained increasing attention as an inclusive science teaching practice because it recognizes that students learn through different modes of representation and communication. Multimodal approaches integrate visual, auditory, kinesthetic, textual, and digital learning experiences to support understanding and engagement. Science teachers may utilize diagrams, videos, simulations, models, demonstrations, graphic organizers, interactive technologies, and hands-on experiments to present information in multiple ways. According to Rao et al. (2023), multimodal instruction enhances accessibility by reducing dependence on a single mode of learning and allowing students to access content through their preferred learning channels. This approach is particularly valuable for students with disabilities, English language learners, and those with diverse learning preferences.

The increasing integration of educational technology has further strengthened inclusive science teaching practices. Technology-assisted instruction provides opportunities for personalized learning, accessibility accommodations, and interactive engagement. Assistive technologies, virtual laboratories, simulation software, digital assessment tools, and learning management systems can help teachers address diverse learner needs while enhancing participation and comprehension. Research by Trust et al. (2023) indicated that technology-supported instruction improves accessibility, engagement, and learner autonomy when implemented effectively. In science education, technology can provide alternative ways for students to access information, conduct investigations, communicate findings, and demonstrate learning.

Universal Design for Learning (UDL) has become one of the most influential frameworks guiding inclusive science instruction. UDL encourages educators to proactively design learning experiences that accommodate learner variability through multiple means of engagement, representation, and expression (CAST, 2021). Rather than retrofitting accommodations after barriers emerge, UDL promotes the development of flexible instructional environments from the outset. In science education, UDL may involve offering varied instructional materials, multiple assessment options, and diverse opportunities for student participation. Recent research suggests that UDL-based science instruction enhances accessibility, student engagement, and academic performance while supporting the inclusion of learners with diverse needs (Rao et al., 2023).

Despite the benefits of inclusive science teaching practices, teachers frequently encounter challenges in implementation. Large class sizes, limited resources, curriculum demands, insufficient preparation time, and inadequate professional development often affect teachers' ability to provide individualized support and differentiated instruction. Florian and Black-Hawkins (2021) emphasized that effective inclusion requires not only teacher commitment but also supportive educational systems, adequate resources, and ongoing professional learning opportunities. Without sufficient institutional support, teachers may struggle to sustain inclusive practices despite their positive attitudes toward inclusion.

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Overall, inclusive science teaching practices play a critical role in ensuring equitable access to science education for all learners. Strategies such as differentiated instruction, scaffolding, collaborative learning, multimodal instruction, technology-assisted teaching, and Universal Design for Learning help create accessible and engaging learning environments that support diverse student populations. As science classrooms become increasingly diverse, the continued development and implementation of inclusive teaching practices remain essential for promoting participation, achievement, and scientific literacy among all learners.

Differentiated and Culturally Responsive Instruction

Differentiated instruction and culturally responsive teaching are widely recognized as essential components of inclusive education. Both approaches emphasize the importance of acknowledging learner diversity and adapting instruction to ensure equitable access to learning opportunities. In increasingly diverse classrooms, students differ in terms of academic readiness, cultural backgrounds, language proficiency, interests, prior experiences, and learning preferences. Consequently, educators are challenged to employ instructional approaches that are flexible, responsive, and learner-centered. Differentiated and culturally responsive instruction provide effective frameworks for addressing these diverse learner needs while promoting meaningful participation and academic success.

Differentiated instruction is an instructional approach that involves proactively modifying content, teaching methods, learning activities, and assessment practices to accommodate students' varying abilities, readiness levels, interests, and learning profiles. Rather than using a one-size-fits-all approach, differentiated instruction recognizes that students learn differently and therefore require varied instructional pathways to achieve educational goals. According to Tomlinson and Moon (2021), differentiation enables teachers to maximize learning opportunities by providing multiple avenues through which students can access content, process information, and demonstrate understanding. In inclusive classrooms, differentiation serves as a critical strategy for ensuring that all learners, regardless of ability or background, can participate meaningfully in instruction.

Within science education, differentiated instruction is particularly important because scientific concepts often involve abstract reasoning, technical vocabulary, inquiry processes, and laboratory experiences that may pose challenges for some learners. Science teachers frequently use differentiated instructional strategies such as flexible grouping, tiered assignments, graphic organizers, visual supports, modified laboratory activities, and varied assessment options to support learner diversity. Santos and Cruz (2022) found that differentiated instruction allows teachers to respond effectively to students' strengths and learning challenges through instructional methods such as visual representations, collaborative experiments, peer-assisted learning, and scaffolded activities. These instructional adaptations not only improve accessibility but also enhance student engagement and conceptual understanding.

Research consistently demonstrates the positive impact of differentiated instruction on student learning outcomes. A recent study by Suprayogi et al. (2022) revealed that differentiated teaching practices significantly improve student motivation, engagement, and academic performance by aligning instruction with learners' individual needs and preferences. The

researchers emphasized that effective differentiation requires teachers to continuously assess student progress and adjust instructional strategies accordingly. In inclusive science classrooms, ongoing assessment and instructional flexibility are essential for ensuring that all students have equitable opportunities to succeed.

Closely related to differentiation is culturally responsive teaching, which acknowledges the significant role that students' cultural backgrounds, experiences, values, and identities play in the learning process. Culturally responsive instruction seeks to make learning more meaningful by connecting academic content to students' lived experiences and cultural contexts. According to Gay (2021), culturally responsive teaching uses the cultural knowledge, prior experiences, and performance styles of diverse students as assets in the teaching and learning process. This approach promotes equity by recognizing and valuing student diversity rather than viewing differences as barriers to learning.

In science education, culturally responsive teaching is especially important because traditional science curricula have often reflected dominant cultural perspectives while overlooking the contributions and experiences of diverse populations. Integrating culturally relevant examples, local environmental issues, indigenous knowledge systems, and community-based experiences into science instruction can make learning more accessible and meaningful for students. Gay (2021) argued that culturally responsive pedagogy enhances student engagement because learners are more likely to connect with content that reflects their cultural identities and experiences. By contextualizing scientific concepts within familiar cultural settings, teachers can increase student interest, participation, and understanding.

In both the Philippines and the United States, educators are increasingly adopting culturally responsive practices to create more inclusive science classrooms. In the Philippines, teachers often incorporate localized examples, community practices, and indigenous knowledge systems to contextualize science instruction and make learning more relevant to students' daily lives. Similarly, educators in the United States are integrating culturally sustaining pedagogies that acknowledge students' linguistic and cultural diversity while promoting equity and social justice (Ladson-Billings, 2021). These practices not only improve academic engagement but also foster students' sense of belonging and cultural affirmation within the classroom.

Recent research suggests that combining differentiated instruction with culturally responsive teaching creates powerful opportunities for inclusive education. Sharma and Sokal (2022) noted that inclusive classrooms become more effective when teachers simultaneously address learner variability and cultural diversity. When instruction is both differentiated and culturally responsive, students are more likely to experience increased motivation, stronger academic achievement, and improved social-emotional outcomes. Furthermore, these approaches encourage positive classroom relationships and promote respect for diversity among students.

Despite their benefits, implementing differentiated and culturally responsive instruction presents several challenges. Teachers frequently report barriers such as limited instructional resources, insufficient professional development, curriculum constraints, large class sizes, and lack of preparation time (Florian & Black-Hawkins, 2021). Successfully implementing these

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approaches requires continuous professional learning, collaboration among educators, and supportive school leadership. Educational institutions must therefore provide teachers with adequate resources, training, and institutional support to effectively address the diverse needs of learners.

Overall, differentiated instruction and culturally responsive teaching represent essential components of inclusive science education. Both approaches promote accessibility, equity, participation, and meaningful learning by recognizing learner diversity as a strength rather than a challenge. Through flexible instructional practices and culturally meaningful learning experiences, educators can create inclusive science classrooms that support the success and participation of all learners.

Universal Design for Learning (UDL) in Science

Universal Design for Learning (UDL) has emerged as one of the most influential frameworks in contemporary inclusive education and has become a cornerstone of inclusive science instruction. Rooted in principles of accessibility, equity, and learner variability, UDL provides educators with a proactive framework for designing instructional environments that accommodate the diverse needs of all learners. Rather than adapting instruction only after barriers to learning are identified, UDL encourages teachers to anticipate learner diversity during the planning process and create flexible learning experiences that are accessible from the outset. As science classrooms become increasingly diverse, UDL offers a comprehensive approach for ensuring that all students can meaningfully participate in scientific inquiry and learning.

The UDL framework was developed by CAST and is founded on the recognition that learners differ in the ways they engage with information, process knowledge, and demonstrate understanding. According to CAST (2021), UDL is based on three core principles: providing multiple means of engagement, multiple means of representation, and multiple means of action and expression. These principles are intended to reduce barriers to learning and maximize opportunities for student participation and success. By offering learners various ways to access content, remain motivated, and demonstrate mastery, UDL promotes educational equity and inclusion within diverse classroom settings.

The first principle, multiple means of engagement, focuses on stimulating student interest, motivation, and persistence in learning. Science teachers implementing this principle provide learners with choices, relevant learning experiences, collaborative opportunities, and activities that promote curiosity and inquiry. Because students vary in their interests, motivations, and emotional responses to learning, providing different ways to engage with scientific content can significantly enhance participation and achievement. Recent research by Rao et al. (2023) indicated that student engagement increases when instructional experiences are designed to accommodate learner preferences, interests, and cultural backgrounds. In science education, engagement may be enhanced through inquiry-based learning, collaborative investigations, real-world applications, and technology-enhanced activities.

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The second principle, multiple means of representation, emphasizes presenting information in various formats to accommodate differences in perception, language, and comprehension. Science concepts are often abstract and complex, involving technical terminology, diagrams, mathematical representations, and laboratory procedures that may be difficult for some students to understand. UDL encourages teachers to present scientific information using diverse instructional resources such as visual aids, multimedia presentations, simulations, models, demonstrations, graphic organizers, and interactive technologies (CAST, 2021). According to Tan (2023), the use of multimedia tools, visual representations, and hands-on materials significantly improves comprehension among students with disabilities and English language learners. Providing multiple forms of representation allows learners to access scientific concepts through pathways that align with their individual strengths and needs.

The third principle, multiple means of action and expression, recognizes that learners differ in how they demonstrate knowledge and skills. Traditional assessment methods may not accurately capture the abilities of all students, particularly those with disabilities, communication challenges, or language differences. UDL therefore encourages educators to provide varied opportunities for students to express understanding and demonstrate learning. Examples include oral presentations, projects, demonstrations, portfolios, laboratory investigations, multimedia productions, and written assignments. Research suggests that offering flexible assessment options improves learner confidence, participation, and academic performance because students can demonstrate understanding using methods that align with their abilities and preferences (Meyer et al., 2022).

Within science education, UDL has proven particularly valuable because science instruction often relies on inquiry, experimentation, and active participation. Science classrooms frequently include learners with diverse abilities, linguistic backgrounds, and learning preferences, making accessibility a critical concern. UDL-based science instruction may involve using digital simulations to supplement laboratory activities, providing visual and tactile models to explain scientific phenomena, incorporating captioned videos for language support, and allowing students to communicate scientific understanding through various formats. Such practices enable all learners to actively participate in scientific investigations while reducing barriers associated with traditional instructional approaches.

Numerous studies have demonstrated the positive impact of UDL on student outcomes in science education. Rao et al. (2023) found that UDL implementation significantly improves accessibility, learner engagement, academic achievement, and participation among students with diverse educational needs. Similarly, Basham et al. (2022) reported that UDL-based instructional practices enhance student motivation, self-regulation, and independence while promoting equitable access to curriculum content. These findings suggest that UDL not only benefits students with identified disabilities but also supports the learning of all students by creating flexible and responsive educational environments.

The use of educational technology has further strengthened the implementation of UDL in science classrooms. Digital tools such as virtual laboratories, interactive simulations, adaptive learning platforms, multimedia presentations, and assistive technologies provide multiple opportunities for representation, engagement, and expression. Technology also enables teachers to

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personalize instruction and provide accommodations that support diverse learner needs. Trust et al. (2023) emphasized that technology-enhanced instruction can improve accessibility and participation when integrated intentionally within inclusive educational frameworks. Consequently, technology serves as an important mechanism for operationalizing UDL principles in science education.

Despite its demonstrated benefits, implementing UDL in science classrooms may present challenges. Teachers frequently report barriers related to insufficient training, limited access to instructional resources, time constraints, and inadequate institutional support (Florian & Black-Hawkins, 2021). Effective implementation of UDL requires professional development opportunities that equip teachers with the knowledge and skills necessary to design flexible learning experiences. Furthermore, school leaders and policymakers play essential roles in providing resources and support systems that facilitate successful UDL implementation.

Overall, Universal Design for Learning represents a powerful framework for advancing inclusive science education. By emphasizing multiple means of engagement, representation, and expression, UDL enables educators to address learner variability proactively and create accessible, equitable, and meaningful learning experiences for all students. As science classrooms continue to diversify, the application of UDL principles remains essential for promoting participation, scientific literacy, and academic success among diverse learners.

Support for English Language Learners (ELLs)

The increasing linguistic diversity within contemporary classrooms has highlighted the importance of providing effective support for English Language Learners (ELLs). ELLs are students whose primary language is not the language of instruction and who are in the process of developing proficiency in academic English. As globalization and migration continue to reshape educational systems worldwide, schools are serving growing numbers of multilingual learners with diverse linguistic and cultural backgrounds. Consequently, educators are challenged to implement instructional practices that promote both language development and academic achievement. Within inclusive education, supporting ELLs is essential to ensuring equitable access, participation, and success for all learners.

Science education presents unique challenges for English Language Learners because scientific concepts often involve specialized vocabulary, abstract ideas, complex sentence structures, and discipline-specific language. Scientific discourse frequently requires students to interpret texts, analyze data, explain phenomena, construct arguments, and communicate findings using precise academic language. These linguistic demands may create barriers to learning for ELLs who are simultaneously acquiring content knowledge and developing proficiency in the language of instruction. According to Lee et al. (2022), language barriers often hinder ELLs' ability to participate fully in scientific inquiry, engage in classroom discussions, and demonstrate conceptual understanding. Therefore, science educators must intentionally integrate language supports within instruction to promote meaningful participation and learning.

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One of the most widely recommended instructional approaches for supporting ELLs is scaffolding. Scaffolding refers to the temporary instructional support provided by teachers to help students successfully complete tasks and develop new knowledge and skills. In science classrooms, scaffolding strategies may include guided questioning, sentence frames, graphic organizers, modeling, structured discussions, and step-by-step instructions. Baldovino (2021) emphasized that scaffolding enables ELLs to gradually build both scientific understanding and academic language proficiency by reducing cognitive and linguistic demands during instruction. As students become more proficient, instructional supports are systematically reduced, fostering learner independence and confidence.

Visual supports also play a critical role in facilitating science learning among English Language Learners. Because science concepts are often abstract and highly conceptual, visual representations can significantly enhance comprehension and retention. Teachers frequently utilize diagrams, charts, illustrations, videos, simulations, graphic organizers, real objects, and demonstrations to support understanding. Research by Lee et al. (2022) found that visual supports improve ELLs' ability to comprehend scientific texts, understand complex processes, and engage actively in classroom discussions. Visual representations provide alternative pathways for accessing information, allowing students to connect new scientific concepts with prior knowledge and experiences.

Explicit vocabulary instruction is another essential strategy for supporting ELLs in science education. Scientific terminology often differs considerably from everyday language, making it difficult for multilingual learners to understand and apply academic concepts. Effective vocabulary instruction involves directly teaching scientific terms, providing multiple exposures to key vocabulary, using contextual examples, and encouraging meaningful language use across instructional activities. According to García and Kleifgen (2022), explicit vocabulary instruction helps ELLs develop academic language proficiency while strengthening conceptual understanding. Teachers who intentionally integrate language objectives alongside content objectives are better able to support students in mastering both scientific knowledge and disciplinary language.

Contemporary research increasingly emphasizes the importance of integrating language and content instruction rather than treating them as separate educational goals. Integrated language and content instruction recognizes that language learning occurs most effectively when students engage in authentic academic tasks and meaningful communication. ELLs benefit when science instruction simultaneously develops conceptual understanding and academic language skills. Lee and Buxton (2021) argued that science classrooms provide rich opportunities for language development because students engage in inquiry, collaboration, explanation, argumentation, and problem-solving activities. Through these experiences, learners acquire both scientific concepts and the language needed to communicate scientific understanding effectively.

Collaborative learning strategies have also proven highly effective in supporting English Language Learners within science classrooms. Cooperative learning activities, peer discussions, group investigations, and peer-assisted learning provide ELLs with opportunities to practice academic language in meaningful social contexts. Through interaction with peers, students can negotiate meaning, clarify misunderstandings, and develop confidence in using scientific language.

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Research by de Jong et al. (2023) demonstrated that collaborative learning environments enhance both language acquisition and science achievement among multilingual learners by promoting active participation and authentic communication.

Culturally responsive teaching further strengthens support for ELLs by recognizing and valuing students' linguistic and cultural resources. Rather than viewing language differences as deficits, culturally responsive educators acknowledge multilingualism as an asset that enriches classroom learning. Teachers may incorporate students' home languages, cultural experiences, and community knowledge into science instruction to make learning more meaningful and accessible. According to Gay (2021), culturally responsive pedagogy fosters greater engagement, motivation, and academic success among linguistically diverse learners by affirming their identities and promoting a sense of belonging within the classroom.

The integration of technology has also expanded opportunities for supporting ELLs in science education. Digital translation tools, multimedia resources, interactive simulations, captioned videos, and language-learning applications provide additional instructional supports that facilitate comprehension and participation. Technology-assisted instruction allows teachers to present information through multiple modalities, thereby reducing language barriers and increasing accessibility. Trust et al. (2023) noted that educational technologies can significantly enhance learning opportunities for ELLs when intentionally integrated within inclusive instructional frameworks.

Despite the availability of effective instructional strategies, teachers frequently encounter challenges in supporting ELLs. Limited professional development, insufficient instructional resources, curriculum pressures, and large class sizes may hinder teachers' ability to provide individualized language support. Consequently, sustained professional learning opportunities focused on culturally and linguistically responsive instruction are essential for strengthening teachers' capacity to support multilingual learners effectively (Sharma & Sokal, 2022).

Overall, supporting English Language Learners is a critical component of inclusive science education. Effective instructional practices such as scaffolding, visual supports, explicit vocabulary instruction, collaborative learning, culturally responsive teaching, and integrated language-content instruction help ELLs access scientific knowledge while developing academic language proficiency. As classrooms become increasingly linguistically diverse, educators must continue to implement inclusive practices that ensure equitable participation and meaningful learning opportunities for all students.

Collaboration and Co-Teaching

Collaboration and co-teaching have become essential components of inclusive education because they enable educators to collectively address the diverse academic, social, emotional, and behavioral needs of learners. Inclusive classrooms are increasingly composed of students with varying abilities, learning preferences, cultural backgrounds, and support needs. Consequently, no single teacher is expected to possess all the knowledge and expertise necessary to effectively address every learner's needs. Collaborative practices allow educators, specialists, families, and

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other stakeholders to work together in creating supportive and equitable learning environments that promote student success. Within science education, collaboration is particularly important because science instruction often involves inquiry-based activities, laboratory investigations, differentiated instruction, and individualized supports.

Teacher collaboration refers to the process in which educators work collectively to plan instruction, share expertise, analyze student progress, solve instructional challenges, and improve educational outcomes. Research suggests that collaborative educational environments contribute to enhanced instructional quality, improved student achievement, and stronger professional relationships among teachers (Ainscow & Messiou, 2021). Collaboration encourages educators to share resources, discuss effective teaching strategies, and collectively address barriers that may hinder student participation and learning. Within inclusive classrooms, collaborative partnerships foster shared responsibility for ensuring that all students receive appropriate support and equitable access to educational opportunities.

One of the most widely implemented collaborative models in inclusive education is co-teaching. Co-teaching is an instructional arrangement in which two or more educators, typically a general education teacher and a special education teacher, jointly plan, deliver, and assess instruction within the same classroom. According to Friend et al. (2021), co-teaching allows educators to combine their expertise in content instruction, differentiation, assessment, and individualized support to better meet the needs of diverse learners. Rather than separating students based on ability or disability, co-teaching promotes inclusion by providing specialized support within the general education environment.

Several co-teaching models have been identified in the literature, including one teach-one assist, station teaching, parallel teaching, alternative teaching, team teaching, and one teach-one observe. Each model offers varying levels of teacher collaboration and instructional flexibility depending on classroom needs and instructional objectives. Team teaching, for example, involves both teachers sharing instructional responsibilities equally, whereas station teaching allows students to rotate among learning stations facilitated by different teachers (Friend et al., 2021). These models provide opportunities for differentiated instruction, small-group support, and individualized interventions while maintaining inclusive learning environments.

Research consistently demonstrates the positive impact of co-teaching on student outcomes. Friend and Cook (2021) found that co-teaching improves academic achievement, student engagement, classroom participation, and social inclusion by combining expertise in content instruction and individualized support. Similarly, Murawski and Bernhardt (2022) reported that co-taught classrooms often demonstrate increased student achievement, improved classroom management, and enhanced opportunities for differentiated instruction. The collaborative nature of co-teaching enables educators to provide immediate feedback, targeted interventions, and flexible instructional supports that benefit all learners.

Co-teaching also contributes to the development of positive classroom communities. Because students receive support within general education settings, inclusive classrooms promote peer interaction, collaboration, and social participation among students with and without

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disabilities. Research indicates that inclusive learning environments reduce social stigma, increase acceptance of diversity, and foster stronger peer relationships (Sharma & Sokal, 2022). Through collaborative instructional practices, students develop empathy, cooperation, and mutual respect while participating in shared learning experiences. Consequently, co-teaching supports not only academic development but also social-emotional growth and inclusive school culture.

Despite its many benefits, effective co-teaching requires adequate planning time, shared instructional responsibilities, administrative support, and ongoing professional development. Teachers often report challenges related to limited planning opportunities, unclear role expectations, insufficient training, and communication difficulties (Florian & Black-Hawkins, 2021). Successful co-teaching partnerships therefore depend on strong professional relationships, mutual respect, open communication, and institutional support. Educational leaders play an essential role in creating organizational structures that facilitate collaboration and sustain effective co-teaching practices.

Technology Integration

Technology integration has become increasingly important in inclusive science education because it provides innovative opportunities for improving accessibility, participation, and engagement among diverse learners. Advances in educational technology have transformed instructional practices by enabling teachers to personalize learning experiences, deliver content through multiple formats, and provide accommodations that support individual learner needs. Within inclusive classrooms, technology serves as a powerful tool for reducing barriers to learning and promoting equitable access to educational opportunities. Consequently, technology integration is now considered an essential component of effective inclusive teaching practices.

Inclusive science education often involves learners with diverse abilities, language backgrounds, communication needs, and learning preferences. Traditional instructional approaches may not adequately address these differences, making technology-assisted instruction particularly valuable. According to Trust et al. (2023), educational technologies create flexible learning environments that accommodate learner variability while enhancing engagement and accessibility. Digital tools allow educators to provide multiple pathways for learning, consistent with the principles of Universal Design for Learning (UDL). As a result, technology can support inclusive science instruction by ensuring that all students can access, participate in, and benefit from educational experiences.

Assistive technology represents one of the most significant technological innovations supporting inclusive education. Assistive technologies include devices, software applications, and digital tools specifically designed to support learners with disabilities and other learning needs. Examples include screen readers, speech-to-text software, text-to-speech applications, communication devices, captioning systems, and adaptive input technologies. Ramos and Flores (2022) highlighted that assistive technologies significantly improve accessibility for students with disabilities and English Language Learners by enabling them to access scientific information, communicate effectively, and participate more independently in classroom activities. These

technologies help reduce learning barriers while promoting student autonomy and academic success.

Virtual simulations and interactive technologies have also transformed science instruction by providing alternative methods for exploring scientific concepts and conducting investigations. Science classrooms increasingly utilize virtual laboratories, interactive simulations, augmented reality applications, and digital modeling tools to enhance conceptual understanding. According to Cheng and Tsai (2022), virtual simulations improve student engagement, scientific reasoning, and conceptual understanding by allowing learners to explore scientific phenomena in safe, flexible, and interactive environments. For students with physical disabilities, limited laboratory access, or language barriers, virtual simulations provide equitable opportunities to participate in scientific inquiry.

Digital learning platforms further contribute to inclusive science education by supporting personalized learning and differentiated instruction. Learning management systems, adaptive learning software, online assessments, and educational applications enable teachers to tailor instruction according to individual learner needs and progress. These technologies provide opportunities for self-paced learning, immediate feedback, and continuous progress monitoring. Research conducted by Bond et al. (2023) found that digital learning environments enhance learner engagement and academic achievement by allowing students to access instructional content at their own pace and according to their preferred learning styles.

Technology integration is particularly beneficial for English Language Learners and students with communication challenges. Multimedia resources, interactive visualizations, captioned videos, translation applications, and digital graphic organizers provide multiple means of representation that facilitate comprehension of complex scientific concepts. Ramos and Flores (2022) noted that digital tools such as screen readers, interactive visualizations, and speech-to-text applications significantly improve access to science content among multilingual learners and students with disabilities. These technologies enable learners to access information through varied modalities while simultaneously developing academic language proficiency.

In addition to supporting accessibility, technology promotes continuous assessment and feedback within inclusive classrooms. Digital assessment platforms allow teachers to monitor student progress in real time, provide immediate feedback, and adjust instruction based on learner performance. Continuous feedback supports student self-regulation, motivation, and academic growth while enabling teachers to make data-informed instructional decisions (Bond et al., 2023). Consequently, technology-enhanced assessment practices contribute to more responsive and individualized science instruction.

Despite its many advantages, effective technology integration requires adequate infrastructure, teacher training, technical support, and equitable access to digital resources. Teachers often report challenges related to limited access to technology, insufficient professional development, unreliable internet connectivity, and inadequate institutional support (Trust et al., 2023). Therefore, educational institutions must invest in technological infrastructure and

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professional learning opportunities to maximize the benefits of technology within inclusive science classrooms.

Overall, collaboration, co-teaching, and technology integration are essential elements of inclusive science education. Collaborative instructional practices foster shared responsibility and collective expertise, while technology enhances accessibility, participation, and personalized learning. Together, these approaches strengthen teachers' capacity to address learner diversity and create equitable, engaging, and supportive science learning environments for all students.

Challenges in Implementing Inclusive Education

Despite significant global progress in promoting inclusive education, numerous challenges continue to hinder its effective implementation across educational systems. While policies and legislative frameworks increasingly advocate for equitable access and participation, the practical realization of inclusive education remains complex. Teachers frequently encounter barriers related to professional preparation, instructional resources, classroom conditions, time constraints, cultural diversity, and institutional support. These challenges are particularly evident in science classrooms, where instruction often involves complex concepts, laboratory activities, specialized equipment, and diverse learner needs. Consequently, understanding these barriers is essential for improving inclusive educational practices and developing effective support systems for teachers and learners.

Lack of Teacher Training and Professional Development

Teacher preparedness is widely recognized as one of the most critical factors influencing the successful implementation of inclusive education. Effective inclusive instruction requires teachers to possess knowledge and skills related to differentiation, classroom management, assessment accommodations, Universal Design for Learning (UDL), culturally responsive pedagogy, and strategies for supporting diverse learners. However, many educators report feeling inadequately prepared to address the varying needs of students within inclusive classrooms.

Research indicates that many teachers receive limited pre-service and in-service training related to inclusive education. Seiler et al. (2020) found that science teachers frequently report insufficient preparation in implementing UDL principles, differentiated instruction, and inclusive assessment practices. Without adequate training, teachers may experience uncertainty regarding how to adapt instruction, modify assessments, and provide appropriate accommodations for learners with disabilities and English Language Learners (ELLs).

Similarly, Santos and Cruz (2022) observed that limited professional development opportunities leave many teachers uncertain about how to effectively support students with disabilities, multilingual learners, and students with diverse learning needs. Teachers often express concerns regarding their ability to implement inclusive instructional strategies while simultaneously addressing curriculum expectations and maintaining academic rigor.

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Recent studies further suggest that inadequate professional preparation negatively affects teacher self-efficacy and attitudes toward inclusion. Sharma and Sokal (2022) reported that teachers who receive specialized training in inclusive education demonstrate greater confidence, stronger commitment to inclusion, and more positive attitudes toward learner diversity. Conversely, teachers with limited training often experience increased stress and decreased confidence when working within inclusive settings.

Continuous professional development is therefore essential for strengthening teachers' competencies in inclusive education. Ongoing workshops, mentoring programs, collaborative professional learning communities, and classroom-based coaching can provide educators with practical knowledge and evidence-based strategies for supporting diverse learners (Florian & Black-Hawkins, 2021).

Ultimately, sustained and practice-oriented professional development is necessary to ensure that teachers possess the skills, confidence, and instructional expertise required to successfully implement inclusive science education.

Limited Resources and Infrastructure

Limited resources and inadequate infrastructure remain persistent barriers to inclusive education worldwide. Effective inclusion requires accessible instructional materials, assistive technologies, specialized equipment, adaptive learning resources, and support personnel. However, many schools continue to experience shortages in these essential resources.

UNESCO (2022) reported that funding inequities in both developed and developing countries significantly affect schools' capacity to implement inclusive educational programs. Schools with limited financial resources often struggle to provide assistive devices, accessible classroom materials, and specialized services necessary for supporting diverse learners.

In science education, resource limitations are particularly problematic because effective science instruction frequently depends on laboratory equipment, technological resources, visual aids, and hands-on materials. Students with disabilities and multilingual learners may require additional accommodations such as adapted laboratory equipment, assistive technologies, enlarged print materials, or captioned instructional videos.

Teachers frequently compensate for these shortages by creating their own instructional materials or modifying existing resources to accommodate learner needs. Although these efforts demonstrate teacher commitment and creativity, they substantially increase teacher workload and contribute to professional stress (Ramos & Flores, 2022).

The lack of specialized support personnel, including special education teachers, speech-language pathologists, interpreters, and instructional aides, further limits schools'

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ability to provide individualized support. Without adequate human resources, classroom teachers may struggle to address diverse learner needs effectively.

Addressing resource and infrastructure limitations requires increased educational investment, equitable funding allocation, and sustained institutional commitment to inclusive education.

Overcrowded Classrooms and Diverse Student Needs

Overcrowded classrooms represent another significant challenge affecting inclusive education. Large class sizes reduce opportunities for individualized instruction, ongoing assessment, and meaningful teacher-student interactions, all of which are essential components of effective inclusive practice.

Tan (2023) found that overcrowded classrooms, particularly within public educational systems, reduce teachers' ability to implement differentiated instruction and individualized support. When teachers are responsible for large numbers of students, providing accommodations, monitoring progress, and responding to diverse learner needs becomes increasingly difficult.

Inclusive classrooms often include students with varying academic abilities, disabilities, language backgrounds, cultural experiences, and behavioral needs. Managing such diversity within overcrowded settings may overwhelm teachers, especially when adequate support systems are unavailable.

Large class sizes also limit teachers' ability to implement collaborative learning, laboratory activities, and inquiry-based instruction effectively. Science teachers frequently encounter challenges related to supervising experiments, ensuring student safety, and providing individualized feedback during practical activities.

Research by Ainscow and Messiou (2021) suggests that manageable class sizes contribute significantly to effective inclusion because they enable teachers to develop stronger relationships with students and provide more personalized instructional support.

Consequently, reducing class size and strengthening classroom support systems remain important strategies for improving inclusive educational practices.

Time Constraints and Workload Pressures

Time constraints and increasing workload demands significantly affect teachers' ability to implement inclusive instructional practices. Inclusive education requires extensive planning, instructional adaptation, assessment modification, collaboration, and continuous progress monitoring. These responsibilities often extend beyond teachers' regular instructional duties.

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Smith and Katz (2021) noted that teachers frequently struggle to balance curriculum requirements with the need to provide individualized instruction for diverse learners. Inclusive science instruction often requires teachers to develop differentiated lesson plans, modify laboratory activities, create alternative assessments, and prepare instructional accommodations.

Science teachers face additional responsibilities related to laboratory preparation, equipment management, safety procedures, and practical assessments. These responsibilities may leave limited time for instructional adaptation and individualized support.

Furthermore, teachers often engage in administrative duties, documentation requirements, meetings, and communication with families and specialists. Collectively, these responsibilities contribute to increased workload and reduced instructional planning time.

Recent studies indicate that excessive workload may negatively influence teacher well-being, instructional quality, and attitudes toward inclusion (Florian & Black-Hawkins, 2021). Teachers experiencing significant workload pressures may find it difficult to sustain inclusive practices consistently.

Providing collaborative planning time, reducing administrative burdens, and strengthening institutional support systems are therefore essential for promoting sustainable inclusive education.

Cultural and Language Barriers

Cultural and linguistic diversity enriches classroom learning experiences; however, it also presents instructional challenges for educators. Increasingly diverse classrooms require teachers to address differences in language proficiency, communication styles, cultural norms, and prior educational experiences.

Magno and Lim (2021) emphasized that culturally and linguistically diverse learners often encounter barriers when instructional practices fail to reflect their backgrounds and experiences. Science instruction may become particularly challenging when learners are unfamiliar with the language of instruction or the cultural contexts embedded within educational materials.

Scientific vocabulary is often highly technical and abstract, posing difficulties for multilingual learners and students from diverse linguistic backgrounds. Without appropriate supports, language barriers may limit students' participation, comprehension, and academic performance.

Teachers therefore need to develop cultural competence and implement multilingual instructional strategies such as visual supports, scaffolding, translanguaging,

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and culturally responsive pedagogy. These approaches help ensure that diverse learners can access scientific concepts meaningfully.

However, many educators report receiving limited preparation related to culturally responsive teaching and multilingual instruction. Insufficient training may contribute to misunderstandings, miscommunication, and unintended exclusion within inclusive classrooms (Gay, 2021).

Strengthening teacher preparation in culturally responsive and linguistically inclusive instructional practices remains essential for promoting equitable science education.

Resistance to Change and Limited Administrative Support

Resistance to educational change and inadequate administrative support continue to hinder the implementation of inclusive education. Although many teachers value inclusion conceptually, institutional practices and school cultures may not consistently support inclusive initiatives.

Ramos and Flores (2022) found that teachers are more likely to implement inclusive practices when they receive strong leadership support, clear policies, adequate resources, and opportunities for collaboration. Conversely, the absence of administrative support often results in inconsistent implementation and reduced teacher motivation.

School leaders play a critical role in fostering inclusive cultures by establishing shared visions, allocating resources, promoting collaboration, and supporting professional development. Effective leadership also involves monitoring inclusive practices and ensuring that policies translate into classroom implementation.

Resistance to change may arise from concerns regarding increased workload, limited confidence, insufficient resources, or uncertainty about inclusive practices. Some educators may continue to favor traditional instructional approaches due to familiarity or perceived efficiency.

Research by DeMatthews and Knight (2022) suggests that supportive school leadership significantly influences teacher attitudes and commitment toward inclusion. Administrators who actively promote inclusive values contribute to stronger implementation and more positive educational outcomes.

Ultimately, sustainable inclusive education requires collaborative leadership, shared responsibility, supportive school cultures, and ongoing institutional commitment to educational equity.

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Synthesis

The reviewed literature consistently emphasizes that inclusive education has become a global educational priority grounded in the principles of equity, social justice, and human rights. International organizations such as UNESCO and the United Nations advocate for educational systems that ensure meaningful participation and quality learning opportunities for all students regardless of disability, language, culture, socioeconomic status, or other individual differences. The literature demonstrates that inclusive education extends beyond physical placement in general education classrooms and instead requires systemic transformation of policies, instructional practices, curricula, and school cultures to address learner diversity effectively.

The literature further reveals that legal and policy frameworks serve as essential foundations for the implementation of inclusive education. International agreements such as the United Nations Convention on the Rights of Persons with Disabilities and the Salamanca Statement have significantly influenced national educational policies worldwide. In both the United States and the Philippines, educational laws and policies emphasize equitable access, learner-centered instruction, and inclusive participation. These frameworks establish inclusive education not only as a legal obligation but also as a moral commitment to ensuring dignity, equality, and educational opportunities for all learners.

A common theme emerging from the literature is that effective inclusive education requires flexible and learner-centered instructional practices. Studies highlight differentiated instruction, culturally responsive teaching, Universal Design for Learning (UDL), collaborative learning, scaffolding, and technology integration as essential strategies for supporting diverse learners. These instructional approaches recognize learner variability and provide multiple pathways for engagement, representation, and expression, thereby promoting accessibility and meaningful participation within inclusive classrooms.

The literature also underscores the importance of culturally responsive and linguistically inclusive instructional practices, particularly in increasingly diverse educational settings. Researchers emphasize that integrating students' cultural experiences, linguistic backgrounds, and community knowledge into classroom instruction enhances engagement, relevance, and academic achievement. Similarly, instructional supports such as visual representations, scaffolding, explicit vocabulary instruction, and multilingual strategies are identified as effective practices for supporting English Language Learners and promoting equitable participation in science education.

Another significant finding in the literature is the critical role of collaboration in inclusive education. Collaborative teaching models, particularly co-teaching, allow general education and special education teachers to combine their expertise in delivering instruction and supporting diverse learners. Research indicates that collaborative instructional practices improve academic achievement, increase student engagement, strengthen classroom communities, and reduce social stigma among learners with disabilities. Furthermore, collaboration among teachers, families, school leaders, and support personnel is consistently identified as essential for sustaining inclusive educational practices.

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The literature likewise highlights the growing importance of educational technology in promoting inclusive science education. Assistive technologies, virtual simulations, multimedia resources, digital learning platforms, and adaptive instructional tools provide diverse learners with multiple opportunities to access content, participate in classroom activities, and demonstrate understanding. Technology integration is particularly beneficial for students with disabilities and English Language Learners because it supports accessibility, personalized instruction, and continuous feedback. However, effective technology integration requires adequate infrastructure, teacher preparation, and institutional support.

Despite the recognized benefits of inclusive education, the literature consistently identifies numerous barriers that hinder effective implementation. Common challenges include inadequate teacher preparation, insufficient professional development opportunities, limited instructional resources, overcrowded classrooms, heavy workloads, cultural and linguistic barriers, and limited administrative support. These barriers often affect teachers' confidence, instructional effectiveness, and ability to provide individualized support for diverse learners. Consequently, the literature emphasizes the need for sustained professional development, adequate funding, collaborative leadership, and supportive school environments.

Overall, the reviewed literature demonstrates broad consensus that inclusive education is most effective when supported by strong policies, flexible instructional practices, collaborative partnerships, and institutional support systems. While substantial progress has been made globally, persistent challenges continue to affect implementation. These findings provide a strong foundation for the present study by highlighting the importance of exploring how secondary science teachers implement inclusive teaching practices, the barriers they encounter, and the strategies they employ to support diverse learners within inclusive educational settings.

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CHAPTER 3
Methodology

This study aimed to explore the experiences of secondary science teachers in implementing inclusive teaching practices, with particular emphasis on identifying the strategies they employed, the barriers they encountered, and their reflections on the effectiveness of inclusive instruction. A qualitative research design was utilized to obtain an in-depth understanding of teachers' lived experiences, perspectives, and instructional approaches in promoting inclusion within science classrooms. Data were gathered through surveys, semi-structured interviews, and focus group discussions to generate rich and descriptive accounts of the realities of inclusive science teaching. The participants consisted of secondary science teachers from diverse educational settings in order to capture a wide range of experiences and contextual perspectives. Through this qualitative inquiry, the study generated meaningful findings that may inform educational policies, teacher preparation programs, and instructional practices aimed at strengthening inclusive science education.

Research Design

The study employed a qualitative research design, specifically utilizing a phenomenological approach. A qualitative design was deemed appropriate because the study sought to explore meanings, experiences, and perspectives rather than measure or quantify variables. By focusing on the lived experiences of secondary science teachers, this approach facilitated a comprehensive understanding of how inclusive teaching practices were implemented, the instructional strategies teachers employed, and the challenges they encountered within diverse classroom settings. The qualitative approach aligned with the purpose of the study, which was to capture authentic insights and experiences that could not be adequately represented through numerical data.

The phenomenological approach was selected because it emphasized the description and interpretation of the essence of participants' lived experiences. Through surveys, semi-structured interviews, and focus group discussions, the study gathered rich and detailed narratives from secondary science teachers regarding their experiences and perspectives on inclusive education. These methods enabled participants to articulate their instructional practices, identify barriers to implementation, and reflect on their roles in promoting inclusivity within science classrooms. Consequently, the use of phenomenology ensured that the findings presented a holistic and meaningful understanding of inclusive teaching practices in secondary science education.

Data Collection Methods

Three methods were employed to generate data: surveys, semi-structured interviews, and focus group discussions (FGDs). The survey served as the initial phase of data collection and was used to gather information regarding the strategies teachers employed to support diverse learners within science classrooms. The semi-structured interviews provided participants with opportunities to share detailed accounts of the challenges they experienced, while allowing the researcher to probe further into emerging themes and significant responses. Finally, the focus

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group discussions created a collaborative environment in which teachers exchanged perspectives, compared instructional practices, and reflected on the effectiveness of inclusive strategies in promoting student engagement and learning.

Purpose of the Multi-Method Approach

The use of multiple data collection methods ensured that both individual and collective perspectives were captured. Surveys provided breadth by collecting information from a wider group of participants, whereas interviews offered depth through detailed personal narratives. Focus group discussions, on the other hand, facilitated collaborative reflection and generated insights that may not have emerged through individual interviews alone. This triangulated approach enhanced the credibility, richness, and validity of the findings by ensuring that the study reflected a comprehensive understanding of inclusive science teaching practices.

Selection of Co-Participants

Sampling Technique

The study employed purposive sampling to identify participants who could provide rich and meaningful insights relevant to the research objectives. Purposive sampling was considered appropriate because it involved selecting individuals who possessed direct experience and substantial knowledge regarding inclusive teaching practices within secondary science classrooms.

Inclusion Criteria

The co-participants consisted of secondary science teachers who actively implemented inclusive teaching practices or possessed considerable experience in handling diverse learners in science classrooms. Teachers from both public and private educational institutions were included to capture a broad range of experiences and contextual variations. The inclusion of participants from different school settings enabled the study to reflect not only the realities of under-resourced public schools but also the perspectives of teachers working in private institutions where educational conditions may differ.

Participant Groups

The study involved three groups of participants. Initially, a larger group of secondary science teachers completed the survey to document their inclusive teaching strategies and classroom practices. From this group, a smaller number of participants were purposively selected for in-depth interviews based on the significance of their survey responses and their willingness to share detailed experiences. Subsequently, a mixed group of teachers was invited to participate in the focus group discussions, combining perspectives from both the survey and interview phases. This selection process ensured that participants represented diverse professional experiences, educational contexts, and school types.

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Thematic Reflection

Familiarization

The data analysis process began with familiarization, during which the researcher immersed themselves in the raw data. Survey responses, interview transcripts, and focus group discussion transcripts were read repeatedly to develop initial impressions and gain a thorough understanding of the participants' experiences. This stage ensured comprehensive engagement with the data before proceeding to systematic coding.

Initial Coding

During the initial coding stage, significant statements, phrases, and insights were identified, highlighted, and assigned descriptive codes. These codes reflected recurring ideas related to instructional strategies, barriers to implementation, perceptions of inclusivity, and professional support needs. This process reduced large volumes of qualitative data into manageable segments while preserving the meanings expressed by participants.

Theme Development

The initial codes were subsequently grouped into broader categories and organized into themes that captured essential aspects of teachers' experiences. For example, codes describing instructional modifications and adaptations were clustered under themes related to inclusive teaching strategies, whereas codes referring to insufficient resources, limited training, and institutional barriers were categorized under implementation challenges. Additional themes emerged concerning teachers' perceptions of effectiveness, learner engagement, and support needs. These themes served as the foundation for interpreting participants' perspectives in relation to the research questions.

Reflection and Interpretation

The final stage involved reflecting upon and interpreting the themes to uncover deeper meanings and relationships among participants' experiences. This interpretive process extended beyond simple description and sought to understand how instructional practices, challenges, and perceptions interacted to shape inclusive science teaching. Thematic reflection ultimately generated a holistic narrative that highlighted both common experiences and unique insights shared by the participants.

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Ethical Considerations

Informed Consent

Prior to data collection, all participants were provided with clear and detailed information regarding the study's purpose, objectives, procedures, and expected participation requirements. Consent forms were distributed to participants, emphasizing their rights and confirming their voluntary agreement to participate in the study.

Voluntary Participation

Participation in the study was entirely voluntary. Participants were informed that they had the right to withdraw from the study at any stage without experiencing any negative consequences or penalties. This principle ensured that all participants engaged willingly and without coercion.

Confidentiality and Anonymity

To protect participants' privacy, all personal identifiers, including names of individuals, schools, and specific locations, were excluded from research reports and transcripts. Codes and pseudonyms were assigned to participants to maintain anonymity. Furthermore, all collected data were stored securely in password-protected files accessible only to the researcher.

Minimization of Harm

Participants were informed that they could decline to answer any question they considered sensitive or uncomfortable. During focus group discussions, conversations were carefully moderated to maintain a respectful and supportive environment. Sensitive issues, particularly those related to professional challenges and systemic barriers, were approached with caution to minimize discomfort or emotional distress.

Ethical Approval

This procedure ensured that the study complied with established academic and ethical standards and safeguarded the rights, welfare, and well-being of all participants based on the panel's recommendations.

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CHAPTER 4
Presentation of Findings

This chapter presents, analyzes, and interprets the findings of the study on inclusive teaching practices in secondary science education. Guided by a qualitative phenomenological approach, data from surveys, interviews, and focus group discussions were analyzed using Braun and Clarke's (2021) Reflexive Thematic Analysis. Five major themes emerged: (1) Diverse Learner Needs and Classroom Realities, (2) Inclusion as Access and Participation, (3) Instructional Adaptation as Inclusive Practice, (4) Challenges in Implementing Inclusion, and (5) Need for Support and System Alignment.

Demographic Profile of the Participants

The study involved a total of eight secondary science teachers who participated in the surveys, semi-structured interviews, and focus group discussions. The demographic profile of the participants reflected diversity in terms of gender, geographical location, and years of teaching experience, thereby providing a broad range of perspectives regarding inclusive teaching practices in secondary science education.

With respect to gender, the participants consisted of four female teachers and four male teachers, indicating an equal representation of both genders in the study. This balanced distribution allowed the study to capture experiences and perspectives from both male and female science teachers, thereby enriching the understanding of inclusive teaching practices across different teaching contexts.

In terms of geographical location, five participants were teaching in the Philippines, while three participants were teaching in the Americas. The inclusion of teachers from different regions provided opportunities to examine inclusive teaching practices across varied educational contexts and systems. Although educational policies, available resources, and institutional support may differ across countries, participants from both regions reported similar commitments to promoting equitable access and meaningful participation among diverse learners. The cross-regional representation further strengthened the credibility of the findings by demonstrating that many of the experiences related to inclusive science teaching transcend geographical boundaries.

Regarding professional experience, all participants had substantial teaching experience, ranging from five to fifteen years in secondary science education. This range suggests that the participants possessed sufficient professional knowledge and classroom experience to provide rich and meaningful insights into inclusive instructional practices. Teachers with several years of experience are often better positioned to reflect on the effectiveness of various teaching strategies, identify barriers to implementation, and recommend improvements for inclusive practice. The participants' extensive teaching experience therefore contributed to the depth and trustworthiness of the data collected.

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Overall, the demographic profile of the participants indicates that the study drew upon the experiences of experienced secondary science teachers from diverse backgrounds and educational settings. The diversity in gender, geographical location, and years of teaching experience enhanced the richness of the findings and provided a comprehensive understanding of how inclusive teaching practices are implemented within secondary science classrooms.

Table 1. Demographic Profile of the Participants

Participant Characteristic	Category	Frequency (n = 8)	Percentage (%)
Gender	Male	4	50.0
	Female	4	50.0
Geographical Location	Philippines	5	62.5
	United States	3	37.5
Teaching Experience	5–9 years	4	50.0
	10–15 years	4	50.0
Professional Role	Secondary Science Teachers	8	100.0

Narrative Description. The study involved eight secondary science teachers. In terms of gender, the participants consisted of four male teachers (50.0%) and four female teachers (50.0%), indicating equal representation of both genders. Regarding geographical location, five participants (62.5%) were teaching in the Philippines, while three participants (37.5%) were teaching in the Americas. In terms of teaching experience, participants had between five and fifteen years of experience in secondary science education, reflecting substantial professional expertise relevant to inclusive teaching practices.

Data Collection Methods

Data for this study were collected using three qualitative methods: surveys, semi-structured interviews, and focus group discussions (FGDs). The survey gathered preliminary information regarding the inclusive teaching practices employed by secondary science teachers. Semi-structured interviews provided in-depth insights into participants' experiences, perceptions, and challenges related to inclusive science teaching. Meanwhile, the FGDs enabled participants to share experiences, exchange ideas, and collectively reflect on their inclusive teaching practices.

Data Analysis Method

The collected data were analyzed using Braun and Clarke's (2021) Reflexive Thematic Analysis. The analysis involved several stages, including familiarization with the data, initial coding, theme development, theme review, and interpretation. This systematic approach enabled the researcher to identify recurring patterns and meaningful insights from participants' experiences.

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Presentation of the Emergent Themes

The thematic analysis generated five major themes that addressed the research questions of the study. These themes were: (1) Diverse Learner Needs and Classroom Realities, (2) Inclusion as Access and Participation, (3) Instructional Adaptation as Inclusive Practice, (4) Challenges in Implementing Inclusion, and (5) Need for Support and System Alignment. The themes served as the framework for presenting and discussing the findings of the study.

Table 2: Coding and thematic analysis

Sample Excerpt (Participant Response)	Code	Category	Theme
"Very mixed talaga… may fast learners… struggling readers…"	Learner Diversity	Student Differences	Diverse Learner Needs and Classroom Realities
"Hindi pwede isang explanation lang… kailangan ulit-ulitin"	Need for Repetition	Instructional Needs	Diverse Learner Needs and Classroom Realities
"Even if naiintindihan nila concept, hindi nila ma-express"	Language Barrier	Communication Challenges	Diverse Learner Needs and Classroom Realities
"Hindi lang presence… naiintindihan nila"	Learning Access	Inclusion Concept	Inclusion as Access and Participation
"Hindi students ang mag-aadjust sayo"	Teacher Adaptation	Inclusive Mindset	Inclusion as Access and Participation
"When students help each other"	Peer Support	Student Interaction	Inclusion as Access and Participation
"I allow alternative outputs… drawing or oral explanation"	Differentiation	Instructional Strategy	Instructional Adaptation as Inclusive Practice
"Start with simple terms, then visuals, then application"	Scaffolding	Instructional Strategy	Instructional Adaptation as Inclusive Practice
"Students explain in their own language"	Peer Learning	Collaborative Strategy	Instructional Adaptation as Inclusive Practice
"I check understanding lagi"	Formative Checking	Assessment Strategy	Instructional Adaptation as Inclusive Practice

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Sample Excerpt (Participant Response)	Code	Category	Theme
"Preparing differentiated lessons takes more time"	Time Constraint	Structural Challenge	Challenges in Implementing Inclusion
"40 plus students"	Large Class Size	Structural Challenge	Challenges in Implementing Inclusion
"Hindi theory lang"	Need for Practical Training	Professional Development	Challenges in Implementing Inclusion
"You improvise… but it's exhausting"	Resource Limitation	Instructional Constraint	Challenges in Implementing Inclusion
"Slow down for inclusion… but curriculum says move fast"	Curriculum Pressure	System Constraint	Challenges in Implementing Inclusion
"Sharing strategies, materials"	Peer Collaboration	Support System	Need for Support and System Alignment
"Inclusive teaching takes more effort"	Need for Admin Support	Institutional Support	Need for Support and System Alignment
"Sample lesson plans… differentiation strategies"	Need for Tools	Instructional Support	Need for Support and System Alignment

How do secondary science teachers implement inclusive teaching practices to support diverse learners?

The findings of the study revealed that secondary science teachers implemented inclusive teaching practices through continuous instructional adaptation, learner-centered pedagogical approaches, and responsive classroom practices designed to address learner diversity. Teachers recognized that science classrooms are composed of students with varying academic abilities, linguistic backgrounds, behavioral characteristics, and socioemotional needs, requiring flexible instructional approaches to ensure meaningful participation and learning. The analysis further demonstrated that inclusive teaching was viewed not as a single instructional strategy but as a dynamic and ongoing process that involves modifying instruction, providing differentiated support, and creating equitable learning opportunities for all students. Two major themes emerged from the analysis that collectively addressed the central research question: **(1) Diverse Learner Needs and Classroom Realities** and **(2) Inclusion as Access and Participation**.

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Theme 1: Diverse Learner Needs and Classroom Realities

The findings revealed that secondary science teachers perceived learner diversity as a natural and expected characteristic of contemporary science classrooms. Participants consistently described their classrooms as highly diverse environments consisting of learners with varying academic readiness, language proficiencies, learning preferences, behavioral characteristics, and support needs. Teachers acknowledged that diversity had become an inherent feature of science education and recognized the need to adjust their instructional approaches to accommodate these differences.

Participants described diverse learners as including fast learners, struggling learners, students with disabilities, multilingual learners, and students who required additional instructional support. Several participants reported that students entered science classrooms with different levels of prior knowledge, varying degrees of motivation, and distinct learning preferences. Teachers explained that while some students demonstrated high levels of independence and conceptual understanding, others required repeated explanations, individualized assistance, and scaffolded instruction to grasp scientific concepts. These findings suggest that secondary science teachers viewed diversity as a normal classroom reality rather than an exception.

Academic diversity emerged as a significant aspect of learner variability. Participants emphasized that students possessed varying levels of science achievement and readiness, requiring teachers to provide differentiated instruction and flexible learning opportunities. Teachers frequently modified lesson content, adjusted instructional pacing, and provided alternative learning activities to address these differences. Such findings indicate that teachers recognized academic diversity as a major factor influencing instructional planning and classroom decision-making. Similar findings were reported by Smale-Jacobse et al. (2022), who found that differentiated instructional practices are essential for addressing learner variability and promoting equitable participation in inclusive classrooms.

Linguistic diversity also emerged as an important consideration in inclusive science teaching. Participants explained that some students experienced difficulties understanding scientific vocabulary and communicating scientific concepts due to language barriers. Teachers reported using simplified language, visual representations, repeated explanations, and contextual examples to support students' understanding of scientific concepts. The findings suggest that language proficiency significantly influences students' ability to access and participate in science learning. These findings are consistent with Lee et al. (2023), who argued that multilingual learners often encounter challenges related to scientific discourse and academic language, requiring teachers to integrate language support within content instruction.

Behavioral and socioemotional diversity likewise influenced instructional practices. Participants reported that students' emotional readiness, behavior, motivation, and social interactions often affected classroom participation and learning outcomes. Teachers noted that some learners required additional emotional support, positive reinforcement, and individualized behavioral interventions to remain engaged in science learning activities. These findings indicate that inclusive science teaching extends beyond academic support and encompasses responsiveness

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to students' social and emotional needs. Brackett et al. (2022) similarly emphasized that supportive classroom environments positively influence student engagement, academic achievement, and overall well-being.

Overall, the findings from Theme 1 indicate that secondary science teachers recognized learner diversity as an inherent characteristic of inclusive classrooms. Teachers demonstrated awareness of the academic, linguistic, behavioral, and socioemotional differences among learners and acknowledged the need for flexible instructional practices to address these diverse needs. These findings support UNESCO's (2022) assertion that inclusive education requires educational systems and instructional practices to respond to learner variability rather than expecting students to adapt to existing structures.

The findings are also consistent with the principles of inclusive education, which emphasize equity, accessibility, participation, and responsiveness to learner diversity. Inclusive education recognizes that all students possess unique strengths, needs, and learning preferences and therefore require flexible and supportive learning environments (Florian & Black-Hawkins, 2021). The participants' recognition of learner diversity demonstrates alignment with these inclusive principles and highlights their commitment to creating equitable science learning experiences.

Theme 2: Inclusion as Access and Participation

The second major theme revealed that participants conceptualized inclusion primarily as ensuring equitable access and meaningful participation for all learners. Teachers consistently emphasized that inclusion extends beyond simply placing students within regular classrooms. Instead, participants described inclusion as creating learning environments where all students can actively engage, participate, and succeed regardless of their individual differences.

Participants explained that inclusion involved ensuring that every learner understood lesson content, participated in classroom activities, and experienced success in science learning. Several teachers stressed that the responsibility for successful inclusion lies with teachers rather than students. Participants expressed the belief that teachers should adapt instructional practices to meet learner needs rather than expecting students to conform to rigid instructional approaches. Such perspectives reflect learner-centered educational philosophies and align with contemporary understandings of inclusive education.

The findings further revealed that teachers viewed meaningful participation as a central indicator of successful inclusion. Participants described implementing various instructional adaptations, collaborative activities, and flexible learning experiences to encourage active student participation. Teachers emphasized that students should not merely be physically present in science classrooms but should also be actively engaged in discussions, investigations, experiments, and collaborative learning activities. This finding supports UNESCO's (2022) conceptualization of inclusion as promoting access, participation, and achievement for all learners.

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Equitable access to learning opportunities was another important aspect of teachers' understanding of inclusion. Participants reported modifying instructional materials, providing visual supports, offering alternative assessment methods, and using multiple instructional modalities to ensure accessibility. These practices reflect the principles of Universal Design for Learning, which advocate providing multiple means of engagement, representation, and expression to accommodate learner variability (CAST, 2021). By providing flexible pathways for learning, teachers reduced barriers that might otherwise limit student participation and achievement.

Student engagement also emerged as a significant component of inclusive practice. Participants observed that learners became more motivated and actively involved in science learning when instructional activities were adapted to their needs and interests. Teachers reported increased participation, improved confidence, and greater enthusiasm among students when inclusive instructional strategies were implemented. Similar findings were reported by Gillies (2023), who found that inclusive and collaborative instructional practices positively influence student engagement and academic outcomes.

Peer interaction likewise played a crucial role in promoting inclusion. Participants described collaborative learning, peer tutoring, and group activities as effective strategies for supporting both academic and social inclusion. Teachers noted that peer interaction facilitated communication, encouraged participation, and promoted a sense of belonging among students. These findings are consistent with Vygotsky's (1978) Social Constructivist Theory, which posits that learning occurs through social interaction and collaborative meaning-making. Through peer interaction, students are provided with opportunities to construct knowledge collectively while simultaneously developing social relationships.

Overall, the findings from Theme 2 indicate that secondary science teachers viewed inclusion as a process of ensuring equitable access, meaningful participation, and active engagement for all learners. Teachers emphasized the importance of adapting instruction, removing barriers to participation, and creating supportive classroom environments that promote learning and belonging. These findings align with contemporary literature emphasizing that inclusive education involves much more than physical integration and instead requires meaningful participation and equitable educational experiences (Florian & Black-Hawkins, 2021; UNESCO, 2022).

Synthesis

Collectively, Themes 1 and 2 demonstrate that secondary science teachers implemented inclusive teaching practices by recognizing learner diversity and ensuring equitable access and meaningful participation in science learning. Teachers continuously adapted their instructional practices in response to students' academic, linguistic, behavioral, and socioemotional needs while creating learning environments that promoted engagement, collaboration, and success for all learners. These findings suggest that inclusive science teaching is a dynamic and learner-centered process requiring flexibility, responsiveness, and intentional instructional planning.

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The findings also support the study's theoretical framework. Consistent with Vygotsky's Social Constructivist Theory, teachers emphasized the importance of social interaction, collaboration, scaffolding, and guided support in facilitating student learning. Similarly, the findings align with Universal Design for Learning principles, which advocate flexible instructional approaches that accommodate learner variability through multiple means of engagement, representation, and expression (CAST, 2021). Overall, the findings suggest that effective inclusive science teaching requires both responsive instructional practices and a commitment to equity, participation, and accessibility.

Corollary Question 1: What inclusive teaching strategies do secondary science teachers implement to support diverse learners?

The findings of the study revealed that secondary science teachers employed a variety of instructional strategies to address the diverse needs of learners within inclusive science classrooms. Participants recognized that students possess different academic abilities, learning preferences, language backgrounds, and support needs, requiring teachers to adopt flexible and responsive instructional practices. The analysis demonstrated that teachers continuously adapted their instruction to ensure that all learners had meaningful opportunities to access, participate in, and succeed in science learning. The findings generated the theme **Instructional Adaptation as Inclusive Practice**, which encompasses differentiated instruction, scaffolding strategies, collaborative learning, multimodal instruction, formative assessment, and technology integration. Collectively, these instructional approaches illustrate how teachers operationalized inclusive education within their classroom practices.

Theme 3: Instructional Adaptation as Inclusive Practice

The findings indicated that instructional adaptation served as the primary mechanism through which secondary science teachers implemented inclusive education. Participants consistently emphasized the importance of modifying instructional approaches, learning activities, assessments, and classroom interactions to accommodate learner diversity. Teachers recognized that effective science instruction requires flexibility and responsiveness to students' individual needs, abilities, and interests.

Differentiated Instruction

Differentiated instruction emerged as one of the most frequently reported inclusive teaching strategies among participants. Teachers described modifying content, instructional processes, learning activities, and assessment tasks to accommodate varying learner needs and readiness levels. Participants reported providing alternative learning activities, adjusting instructional pacing, simplifying scientific concepts, and offering multiple options for students to demonstrate understanding.

One participant explained, *"I allow students to demonstrate learning through oral presentations, drawings, projects, or written outputs depending on their strengths."* Another participant stated, *"Some students need more guidance, while others*

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can work independently, so I adjust activities based on their needs." These responses demonstrate that teachers intentionally differentiated instruction to provide equitable learning opportunities for diverse learners.

The findings suggest that differentiated instruction enabled teachers to respond effectively to learner variability while promoting accessibility and participation. By providing multiple pathways for learning and assessment, teachers reduced barriers that could potentially limit student engagement and achievement. Similar findings were reported by Smale-Jacobse et al. (2022), who found that differentiated instruction positively influences student engagement, motivation, and academic performance in inclusive classrooms. Tomlinson (2022) likewise argued that differentiated instruction is essential in addressing learner diversity because it allows teachers to tailor instruction according to students' readiness, interests, and learning profiles.

Scaffolding Strategies

Scaffolding strategies also emerged as a significant instructional practice implemented by participants. Teachers reported providing guided support to assist students in understanding complex scientific concepts and gradually increasing the level of difficulty as learners developed competence. Participants frequently used step-by-step explanations, guided questioning, structured activities, and teacher modeling to facilitate student learning.

Teachers also described using visual aids, simplified language, graphic organizers, demonstrations, and concrete examples to make abstract scientific concepts more accessible. One participant shared, *"I break lessons into smaller steps and use visuals because science concepts can be difficult for some students."* Another participant explained, *"I simplify instructions and provide examples before asking students to work independently."*

These findings indicate that scaffolding enabled teachers to support students within their individual zones of proximal development by providing temporary assistance that gradually decreased as students gained independence. Such findings strongly support Vygotsky's (1978) Social Constructivist Theory, which emphasizes guided learning and social interaction in knowledge construction. Recent research by van de Pol et al. (2023) similarly found that scaffolding significantly enhances learner participation, conceptual understanding, and academic achievement in diverse classrooms.

Collaborative Learning

Collaborative learning emerged as another important inclusive instructional strategy. Participants frequently described using group activities, peer tutoring, cooperative learning tasks, and peer-assisted instruction to support student learning. Teachers

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emphasized that collaborative learning not only facilitated academic understanding but also promoted social interaction and inclusion.

One participant stated, *"Students learn from each other during group work because some students explain concepts better to their classmates."* Another participant remarked, *"Peer tutoring helps struggling students become more comfortable asking questions."* These responses suggest that collaborative learning created opportunities for students to support one another while actively participating in science learning activities.

The findings indicate that collaborative learning promotes both academic and social inclusion by encouraging interaction, communication, and shared responsibility for learning. Through collaboration, students develop scientific understanding while simultaneously strengthening social relationships and communication skills. These findings are consistent with Gillies (2023), who reported that cooperative learning enhances academic achievement, student engagement, and social inclusion. Similarly, Vygotsky (1978) emphasized that learning occurs through social interaction and collaborative meaning-making, highlighting the importance of peer interaction in cognitive development.

Multimodal Instruction

The findings further revealed that participants regularly employed multimodal instructional approaches to accommodate diverse learning preferences. Teachers described using visual representations, demonstrations, hands-on activities, experiments, videos, diagrams, and interactive activities to facilitate understanding of scientific concepts.

One participant explained, *"I use videos, pictures, and demonstrations because students understand concepts better when they see them."* Another participant stated, *"Hands-on activities are important because not all students learn effectively through lectures."* These responses demonstrate teachers' recognition that learners process information differently and therefore benefit from varied instructional modalities.

The findings suggest that multimodal instruction increased accessibility by presenting information through multiple formats, thereby accommodating diverse learner preferences and abilities. This approach aligns with Universal Design for Learning (CAST, 2021), which advocates providing multiple means of representation to support learner variability. Similar findings were reported by Rao et al. (2023), who found that multimodal instructional practices enhance student engagement, accessibility, and learning outcomes in inclusive educational settings.

Formative Assessment

Formative assessment also emerged as a critical inclusive teaching practice. Participants reported continuously monitoring student understanding through questioning, classroom observations, quizzes, discussions, and informal assessments. Teachers

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emphasized that ongoing assessment enabled them to identify student misconceptions, adjust instruction, and provide timely support.

One participant shared, *"I regularly check for understanding because students learn at different paces."* Another participant explained, *"Assessment helps me know who needs additional support and who is ready to move on."* These responses indicate that formative assessment served as an essential tool for responsive and individualized instruction.

The findings suggest that formative assessment promotes inclusive practice by enabling teachers to make data-informed instructional decisions and provide appropriate support based on students' learning needs. Black and Wiliam (2021) emphasized that formative assessment plays a crucial role in inclusive education because it supports responsive teaching and enhances student learning outcomes. Continuous assessment also enables teachers to monitor progress and ensure that all learners remain actively engaged in the learning process.

Technology Integration

Technology integration emerged as another significant instructional strategy implemented by participants. Teachers described using digital presentations, educational videos, simulations, online learning platforms, and interactive applications to enhance accessibility and student engagement. Participants noted that technology provided additional opportunities for students to access scientific concepts and participate in classroom activities.

One participant remarked, *"Technology helps students visualize concepts that are difficult to explain through lectures alone."* Another participant stated, *"Digital resources allow students to learn at their own pace and review concepts when necessary."* However, participants also acknowledged limitations related to internet connectivity, limited technological resources, and unequal access to digital devices.

The findings indicate that technology integration enhanced inclusive science teaching by providing multiple means of engagement, representation, and expression. Technology facilitated differentiated instruction, increased learner engagement, and supported accessibility for students with diverse needs. These findings are consistent with CAST (2021), which identifies technology as a key component of Universal Design for Learning. Trust et al. (2023) likewise reported that technology integration promotes equitable learning opportunities by providing flexible and accessible instructional experiences.

Synthesis

Collectively, the findings demonstrate that secondary science teachers implemented inclusive teaching through a wide range of instructional adaptations designed to address learner

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diversity. Teachers employed differentiated instruction, scaffolding strategies, collaborative learning, multimodal instruction, formative assessment, and technology integration to ensure equitable access and meaningful participation in science learning. These instructional strategies reflect teachers' commitment to creating responsive and learner-centered classroom environments that accommodate varying learner needs and preferences.

The findings suggest that instructional adaptation serves as the foundation of inclusive science teaching. By continuously modifying instructional approaches, learning activities, and assessment practices, teachers reduced barriers to participation and increased accessibility for diverse learners. The findings further support the principles of Universal Design for Learning and Social Constructivist Theory, both of which emphasize instructional flexibility, learner variability, social interaction, and equitable access to learning opportunities. Overall, the study demonstrates that effective inclusive science teaching requires intentional, flexible, and responsive instructional practices that support the participation and success of all learners.

Corollary Question 2: What barriers do secondary science teachers encounter in implementing inclusive teaching practices?

The findings of the study revealed that although secondary science teachers demonstrated strong commitment to inclusive education, they encountered numerous barriers that affected the effective implementation of inclusive teaching practices. Participants consistently emphasized that inclusive teaching requires significant planning, instructional flexibility, and continuous adaptation. However, several structural and systemic constraints limited their ability to fully implement inclusive practices. The analysis generated the theme **Challenges in Implementing Inclusion**, which encompassed time constraints, large class sizes, limited instructional resources, insufficient professional development, curriculum pressures, and institutional support limitations.

Theme 4: Challenges in Implementing Inclusion

Time Constraints

Time constraints emerged as one of the most frequently reported barriers among participants. Teachers explained that implementing inclusive practices requires extensive preparation, including differentiating lessons, modifying instructional materials, preparing accommodations, and monitoring student progress. Several participants expressed that the demands associated with inclusive instruction often exceeded the available planning time.

One participant stated, *"Differentiating lessons takes a lot of time, especially when students have different learning needs."* Another participant remarked, *"Sometimes, there is not enough time to prepare materials for all learners."*These responses indicate that teachers experience significant workload pressures when attempting to implement inclusive practices.

The findings suggest that insufficient planning time may limit teachers' ability to provide individualized support and differentiated instruction consistently. Similar findings

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were reported by Tan (2023), who found that time constraints significantly affect teachers' capacity to implement inclusive instructional strategies effectively. Likewise, Florian and Black-Hawkins (2021) argued that inclusive pedagogy requires adequate planning time to ensure that instructional adaptations address learner diversity appropriately.

Large Class Sizes

Large class sizes also emerged as a major barrier to inclusive science teaching. Participants reported that overcrowded classrooms limited their ability to provide individualized attention and monitor student learning effectively. Teachers explained that managing large numbers of students while simultaneously addressing diverse learning needs posed considerable challenges.

One participant explained, *"It is difficult to give individualized attention when there are more than forty students in one class."* Another teacher shared, *"Large classes make it hard to monitor all students, especially those who need additional support."*

The findings indicate that overcrowded classrooms reduce opportunities for individualized instruction, formative assessment, and meaningful teacher-student interaction. These findings are consistent with UNESCO (2022), which identified large class sizes as a persistent challenge in inclusive education worldwide. Similarly, Sharma and Sokal (2022) found that overcrowded classrooms often limit teachers' capacity to implement differentiated instruction and individualized support.

Limited Instructional Resources

Limited instructional resources emerged as another significant barrier. Participants reported shortages of instructional materials, assistive technologies, laboratory equipment, and visual resources needed to support diverse learners effectively. Teachers frequently relied on personal initiative and creativity to compensate for these shortages.

One participant remarked, *"We often improvise because we do not always have enough materials."* Another participant explained, *"There are times when teachers have to create their own resources to support students."*

The findings suggest that resource limitations place additional burdens on teachers and may affect the sustainability of inclusive practices. UNESCO (2022) similarly reported that inadequate resources continue to hinder inclusive education implementation globally. Ramos and Flores (2022) further emphasized that insufficient instructional resources often compel teachers to rely on personal effort and improvisation, thereby increasing workload and stress.

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Insufficient Professional Development

Participants consistently highlighted the lack of practical professional development opportunities as a barrier to inclusive teaching. Teachers explained that existing training programs frequently focus on theoretical concepts and provide limited classroom-based strategies for supporting diverse learners.

One participant stated, *"Most trainings are theoretical, but teachers need practical examples that can be applied immediately in the classroom."* Another participant commented, *"More professional development focused on inclusive strategies is needed."*

These findings indicate that teachers require sustained and practice-oriented professional development to strengthen their competence and confidence in inclusive education. Similar findings were reported by Sharma and Sokal (2022), who found that ongoing professional development positively influences teacher efficacy and attitudes toward inclusion. Florian and Black-Hawkins (2021) likewise emphasized that practical professional learning experiences are essential for strengthening inclusive teaching practices.

Curriculum Pressure

Curriculum pressure also emerged as a challenge in implementing inclusive practices. Participants explained that balancing curriculum requirements with differentiated instruction often created tensions in classroom practice. Teachers reported feeling pressured to complete curriculum content while simultaneously addressing diverse learner needs.

One participant stated, *"There is pressure to cover all competencies, even when students need more time."* Another teacher explained, *"Sometimes pacing guides do not allow enough flexibility for differentiation."*

The findings suggest that curriculum expectations may constrain teachers' ability to provide individualized support and flexible instruction. Similar concerns were reported by OECD (2021), which noted that rigid curriculum structures often limit teachers' capacity to implement inclusive pedagogies effectively.

Institutional Support Limitations

Participants also identified limited institutional and administrative support as a significant barrier. Teachers expressed the need for stronger leadership, collaborative planning opportunities, and additional support systems to sustain inclusive practices.

One participant shared, *"Teachers need support from school administrators to successfully implement inclusion."*Another participant stated, *"Inclusion should not depend solely on teacher initiative."*

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The findings suggest that inclusive education requires shared responsibility among teachers, school leaders, and policymakers. DeMatthews and Knight (2022) emphasized that supportive leadership and institutional commitment are critical for sustaining inclusive educational practices. Without adequate support systems, inclusive practices may remain inconsistent and dependent on individual teacher commitment.

Synthesis

Collectively, the findings demonstrate that secondary science teachers encounter multiple barriers in implementing inclusive teaching practices, including time constraints, large class sizes, limited instructional resources, insufficient professional development, curriculum pressures, and inadequate institutional support. These barriers affect teachers' ability to provide individualized instruction, differentiate learning experiences, and sustain inclusive practices over time. The findings suggest that while teachers remain committed to inclusive education, effective implementation requires stronger systemic support, adequate resources, practical professional development, and supportive educational policies.

Corollary Question 3: What are teachers' reflective insights regarding the effectiveness of inclusive teaching practices?

The findings revealed that teachers generally perceived inclusive teaching practices as effective in promoting student engagement, participation, confidence, and collaboration. Participants reflected positively on the outcomes of inclusive instructional strategies and emphasized that inclusive practices contribute to more meaningful and accessible learning experiences. The analysis generated the theme **Need for Support and System Alignment**, highlighting both the positive outcomes of inclusive teaching and the support required to sustain these practices.

Theme 5: Need for Support and System Alignment

Student Engagement

Participants consistently reported that inclusive teaching strategies increased student participation and engagement in science learning. Teachers observed that students became more actively involved when instructional activities were adapted to their needs and interests.

One participant explained, *"Students participate more when activities are varied and accessible."* Another participant remarked, *"When students feel included, they become more engaged in learning."*

These findings suggest that inclusive instructional practices positively influence student motivation and participation. Gillies (2023) similarly found that inclusive and collaborative learning environments promote greater student engagement and academic involvement.

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Improved Student Confidence

Teachers also reflected that inclusive strategies enhanced students' confidence and willingness to participate. Participants observed that students became more comfortable expressing ideas and engaging in classroom activities when instructional supports were provided.

One teacher shared, *"Students who were previously hesitant became more confident in participating."* Another participant stated, *"Flexible assessments help students demonstrate what they know without fear."*

The findings indicate that inclusive practices contribute to positive learner self-efficacy and confidence. Hehir et al. (2023) similarly reported that inclusive educational environments positively influence students' academic confidence and self-esteem.

Positive Classroom Relationships

Participants emphasized that inclusive practices strengthened peer relationships and promoted social inclusion. Teachers reported that collaborative learning activities encouraged students to support one another and fostered a sense of belonging.

One participant remarked, *"Group activities help students work together and appreciate each other's strengths."*Another teacher noted, *"Students become more accepting of differences."*

These findings support Vygotsky's (1978) Social Constructivist Theory, which emphasizes the importance of social interaction in learning and development.

Teacher Reflection on Effectiveness

Participants generally viewed inclusive instructional strategies as beneficial and effective. Teachers acknowledged that differentiated instruction, scaffolding, collaborative learning, and flexible assessments positively influenced student learning outcomes.

However, participants also recognized limitations related to time, resources, and institutional support. Teachers explained that the effectiveness of inclusive practices may be constrained when support systems are inadequate.

These findings suggest that although inclusive practices positively affect student outcomes, sustained effectiveness depends on supportive educational contexts.

Need for Ongoing Support

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Participants consistently emphasized the need for continuous professional development, collaboration among teachers, and administrative support. Teachers highlighted that ongoing support is necessary to sustain inclusive practices and improve instructional effectiveness.

These findings align with Sharma and Sokal (2022), who found that teacher efficacy in inclusive education improves when teachers receive continuous professional learning and institutional support.

Synthesis

Overall, teachers reflected positively on the effectiveness of inclusive teaching practices. Participants observed increased student engagement, confidence, participation, and collaboration when inclusive instructional strategies were implemented. However, teachers also emphasized that the sustainability and effectiveness of inclusive practices depend on ongoing professional development, collaboration, and institutional support. These findings demonstrate that inclusive teaching practices positively influence both academic and social outcomes while highlighting the importance of systemic support in sustaining effective inclusion.

Corollary Question 4: Based on the findings of the study, what output may be proposed?

Based on the findings of the study, an **Inclusive Science Teaching Guide for Secondary Science Teachers** is proposed. The rationale for developing this output emerged from participants' expressed need for practical instructional resources, differentiated lesson examples, inclusive assessment strategies, and classroom-based guidance for implementing inclusive science instruction.

The proposed guide is supported by Themes 3, 4, and 5. Theme 3 highlighted the instructional strategies commonly implemented by teachers, including differentiated instruction, scaffolding, collaborative learning, multimodal instruction, formative assessment, and technology integration. Theme 4 identified barriers that hinder effective implementation, particularly insufficient professional development and limited instructional resources. Theme 5 emphasized teachers' need for ongoing support and system alignment.

The proposed Inclusive Science Teaching Guide will contain practical instructional strategies, sample lesson adaptations, differentiated assessment tools, classroom accommodations, technology integration strategies, and reflective teaching activities. The guide will also include examples of multimodal instructional approaches and scaffolding techniques aligned with Universal Design for Learning principles.

The proposed output is expected to serve as a practical instructional resource that will support teachers in implementing flexible, learner-centered, and accessible science instruction. Furthermore, the guide may contribute to strengthening teacher competence, improving instructional effectiveness, and promoting equitable participation among diverse learners.

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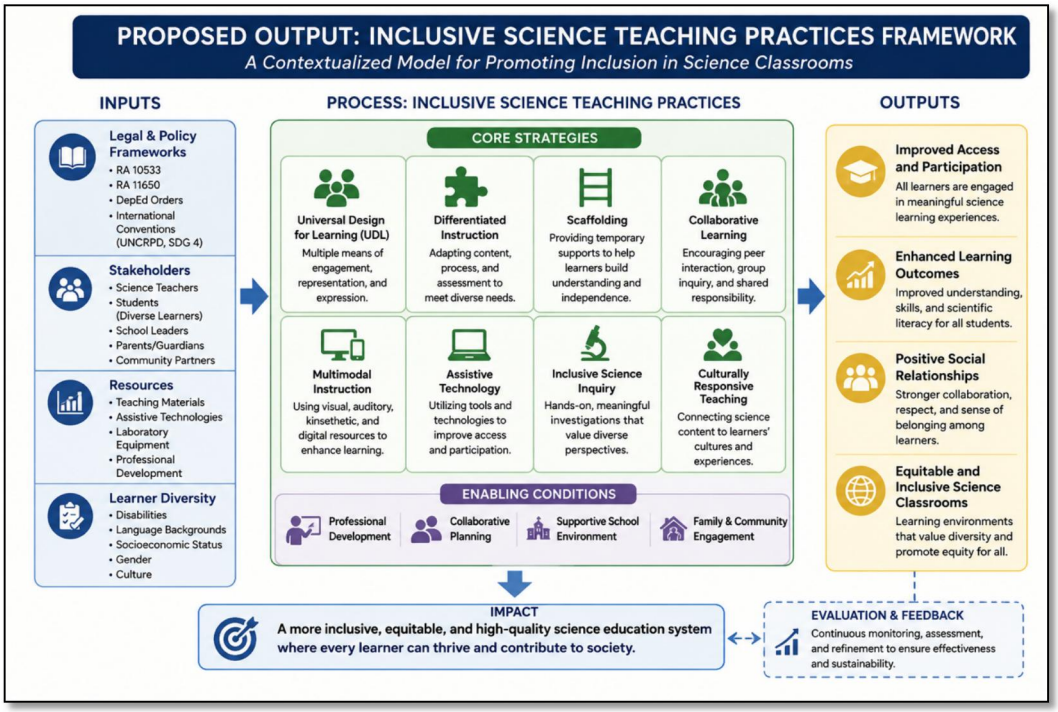


Image 1: Schematic Diagram showing the Proposed Output

Overall Synthesis of Findings

The findings of the study revealed that secondary science teachers implemented inclusive teaching practices through instructional adaptation, learner-centered pedagogies, and responsive classroom practices. Teachers employed differentiated instruction, scaffolding, collaborative learning, multimodal instruction, formative assessment, and technology integration to address learner diversity and promote meaningful participation.

Despite their commitment to inclusion, teachers encountered several barriers, including time constraints, large class sizes, limited instructional resources, insufficient professional development, curriculum pressures, and inadequate institutional support. Nevertheless, participants remained committed to supporting diverse learners and reflected positively on the effectiveness of inclusive practices in improving student engagement, confidence, participation, and collaboration.

Collectively, the findings demonstrate that inclusive science teaching is a dynamic and multifaceted process that requires both instructional flexibility and systemic support. The findings further support Vygotsky's Social Constructivist Theory and the principles of Universal Design for Learning by emphasizing the importance of collaboration, scaffolding, instructional flexibility, and equitable access to learning opportunities. The study also highlights important implications for educational practice, policy development, teacher preparation, and future research aimed at strengthening inclusive science education.

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CHAPTER 5
Summary of Findings, Conclusions, and Recommendations

This chapter presents the summary of findings, conclusions, and recommendations of the study entitled *"Inclusive Teaching Practices in Secondary Science Education: A Qualitative Study on Strategies, Barriers, and Teacher Perspectives."* It synthesizes the major findings in relation to the research questions, presents conclusions drawn from the study, and offers recommendations for improving inclusive science education.

Summary of Findings

This study explored the inclusive teaching practices implemented by secondary science teachers in supporting diverse learners. Using a qualitative phenomenological research design, data were collected through surveys, semi-structured interviews, and focus group discussions involving eight secondary science teachers. The collected data were analyzed using Braun and Clarke's (2021) Reflexive Thematic Analysis, resulting in five major themes that addressed the main research question and corollary questions of the study.

The findings revealed that secondary science teachers implemented inclusive teaching practices by recognizing learner diversity and ensuring meaningful access and participation in science learning. Teachers viewed learner diversity as a natural characteristic of contemporary science classrooms and acknowledged differences in students' academic abilities, language backgrounds, communication skills, cultural experiences, and socioemotional needs. Participants emphasized that inclusive teaching requires instructional flexibility, responsiveness, and learner-centered practices to address diverse learner needs effectively.

With regard to the instructional strategies employed by teachers, the findings showed that secondary science teachers utilized a wide range of inclusive instructional practices. These included differentiated instruction, scaffolding, collaborative learning, multimodal instruction, formative assessment, peer-assisted learning, and technology-assisted teaching. Teachers continuously modified lesson delivery, learning activities, assessment methods, and instructional materials to accommodate varying learner needs and promote equitable participation in science learning.

Differentiated instruction and scaffolding emerged as the most commonly implemented strategies in inclusive science classrooms. Teachers provided alternative learning activities, flexible assessment options, guided support, visual aids, demonstrations, and structured instructional activities to facilitate understanding and improve accessibility. Collaborative learning and peer-assisted strategies were likewise utilized to encourage student interaction, strengthen comprehension, and foster meaningful participation among diverse learners.

The findings further revealed that teachers employed multimodal instruction, formative assessment, and technology integration to support diverse learning preferences and monitor student progress. Participants regularly used videos, experiments, simulations, interactive activities, and digital resources to increase engagement and accessibility. Teachers also

emphasized the importance of continuously assessing student understanding and adjusting instruction based on learner responses and performance.

Despite their commitment to inclusive education, participants identified several barriers affecting the implementation of inclusive science teaching. Teachers reported challenges related to large class sizes, limited instructional resources, insufficient practical professional development, curriculum pressures, limited preparation time, and inadequate institutional support. These barriers constrained teachers' ability to consistently implement differentiated and individualized instruction within inclusive classrooms.

Teachers also reflected positively on the effectiveness of inclusive teaching practices. Participants observed increased student engagement, participation, collaboration, confidence, and classroom interaction when inclusive instructional strategies were implemented effectively. However, teachers emphasized that the sustainability and effectiveness of inclusive education depend not only on teacher commitment but also on supportive leadership, adequate resources, continuous professional development, and collaborative institutional efforts.

Based on the findings of the study, the researcher proposed the development of an **Inclusive Science Teaching Guide for Secondary Science Teachers**. The proposed instructional material is intended to provide practical classroom-based strategies, differentiated lesson adaptations, scaffolding techniques, multimodal instructional approaches, assessment tools, and reflective teaching resources. The guide aims to strengthen teachers' capacity to implement flexible, learner-centered, and accessible science instruction within inclusive classroom settings.

Conclusions

Based on the findings of the study, the following conclusions were drawn:

1. Secondary science teachers implemented inclusive teaching practices by recognizing learner diversity and responding to students' varied academic abilities, language backgrounds, communication skills, cultural experiences, and socioemotional needs. Teachers viewed learner diversity as a natural and expected characteristic of science classrooms and adopted learner-centered and flexible instructional approaches to support all learners.
2. Secondary science teachers employed a variety of inclusive instructional strategies, including differentiated instruction, scaffolding, collaborative learning, multimodal instruction, formative assessment, peer-assisted learning, and technology-assisted teaching. These instructional adaptations enabled teachers to provide equitable access, meaningful participation, and accessible science learning experiences for diverse learners.
3. Instructional adaptation served as the foundation of inclusive science teaching. Teachers continuously modified lesson delivery, classroom activities, learning materials, and assessment practices to address learner variability and ensure that students with different abilities and learning preferences could actively participate in science learning.
4. The implementation of inclusive science education was influenced by several structural and systemic barriers, including time constraints, large class sizes, limited instructional

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resources, insufficient practical professional development, curriculum pressures, and inadequate institutional support. These barriers affected teachers' capacity to consistently implement differentiated and individualized instruction.

5. Despite existing challenges, teachers demonstrated commitment, creativity, and adaptability in implementing inclusive instructional practices. However, the sustainability and effectiveness of inclusive education require stronger support systems, accessible instructional resources, and practical teacher preparation programs to strengthen teachers' capacity to address learner diversity effectively.
6. Inclusive teaching practices positively influenced student engagement, participation, confidence, collaboration, and classroom interaction. Teachers perceived inclusive instructional strategies as effective in promoting meaningful participation and improving the accessibility of science learning for diverse learners.
7. Effective implementation of inclusive science education requires collaborative efforts among teachers, school administrators, policymakers, and educational institutions to ensure alignment among inclusive education policies, instructional practices, curriculum expectations, and learner needs. Sustainable inclusive practice cannot rely solely on teacher initiative but requires comprehensive institutional and systemic support.
8. The proposed **Inclusive Science Teaching Guide for Secondary Science Teachers** may serve as a practical instructional resource that supports the implementation of flexible, learner-centered, and accessible science instruction. The guide has the potential to strengthen teachers' instructional practices and promote more effective inclusive science education within diverse classroom settings.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are presented:

For Secondary Science Teachers

1. Secondary science teachers should continue implementing differentiated and learner-centered instructional strategies that support equitable participation and meaningful learning among diverse learners.
2. Teachers should strengthen the use of scaffolding, collaborative learning, multimodal instruction, formative assessment, and technology-assisted teaching to improve accessibility, engagement, and comprehension within inclusive science classrooms.
3. Teachers should engage in continuous professional development programs focused on practical and classroom-based inclusive instructional strategies to improve competence and confidence in inclusive science education.
4. Teachers should participate in reflective teaching practices and collaborative planning activities to share effective inclusive teaching strategies, instructional resources, and classroom experiences.

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5. Teachers should maximize the use of technology, interactive instructional materials, visual aids, and inquiry-based activities to support students with varying learning preferences and communication needs.

For School Administrators

1. School administrators should strengthen institutional support for inclusive education by ensuring access to instructional resources, assistive materials, and supportive classroom environments.
2. Administrators should promote collaborative planning, mentoring programs, and professional learning communities that encourage inclusive instructional practices among teachers.
3. Schools should provide practical and sustained professional development opportunities focused on inclusive science teaching and differentiated instruction.
4. Administrators should consider manageable class sizes and balanced teacher workloads to improve the implementation of individualized and differentiated instruction.
5. School leaders should strengthen monitoring systems and instructional support programs that promote effective inclusive educational practices within secondary science classrooms.

For Educational Policymakers and Curriculum Developers

1. Educational policymakers should strengthen the implementation of inclusive education policies through sustained, accessible, and practice-oriented professional development programs for teachers.
2. Curriculum developers should provide flexible instructional frameworks and differentiated learning resources that support diverse learner needs within science education.
3. Educational systems should allocate adequate funding and institutional support for instructional technologies, inclusive classroom resources, and teacher support systems.
4. Policies related to curriculum pacing and instructional expectations should allow flexibility to accommodate inclusive teaching practices and learner diversity.
5. Educational institutions should strengthen partnerships with teacher education programs to improve teacher preparation in inclusive science education.

For Future Researchers

1. Future studies may explore inclusive teaching practices across different subject areas, educational settings, and grade levels to broaden understanding of inclusive pedagogy.
2. Researchers may conduct quantitative or mixed-method studies examining the relationship between inclusive teaching strategies and student engagement, achievement, and participation.

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3. Future research may investigate the perspectives of students, parents, and school administrators regarding inclusive science education.
4. Additional studies may examine the effectiveness of professional development programs and instructional interventions designed to strengthen inclusive teaching practices.
5. Future researchers may explore inclusive education implementation within underserved, multicultural, or resource-limited educational contexts.

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