UNIVERSITY OF EDUCATION, WINNEBA

PUBLIC JUNIOR HIGH SCHOOL INTEGRATED SCIENCE TEACHERS' KNOWLEDGE, PRACTICE AND CHALLENGES OF DIFFERENTIATED INSTRUCTION IN THE AKUAPEM SOUTH MUNICIPALITY

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DECLARATION

Candidate's Declaration

I, **Christine Dzadu** hereby declare that this thesis is the results of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature: ….....

Date: ……..…….

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Education, Winneba.

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Co-Supervisor: ……..……..… Date: ……..……

Name: Dr. Jame Awuni Azure

DEDICATION

I dedicate this research to my children.

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ABBREVIATIONS

CRDD:	Curriculum Research and Development Division
DI:	Differentiated Instruction
EFA:	Education For All
ESP:	Education Strategic Plan
FCUBE:	Free Compulsory Universal Basic Education
GoG:	Government of Ghana
IE:	Inclusive Education
MDG:	Millennium Development Goals
MI:	Multiple Intelligence
MoEYS:	Ministry of Education, Youth and Sports
MoE:	Ministry of Education
SAP:	Special Attention Project
SpED:	Special Education
SPSS:	Statistical Package for the Social Sciences
TLA:	Teaching/Learning Activity or Teacher/Learner Activity
TLM:	Teaching/Learning Materials
Tr.:	Teacher or an Interviewee
ZPD:	Zone of Proximal Development

ABSTRACT

This study sought to investigate public Junior High school science teachers' knowledge, practice and challenges of Differentiated Instruction (DI) in the Akwapem South Municipality in the Eastern Region of Ghana. Utilising a pragmatic paradigm and a mixed-methods approach, the research specifically employed a sequential-explanatory mixed-methods research design. The study implemented both census and purposive sampling techniques, selecting 35 science teachers through census sampling technique, while 10 Integrated Science teachers were chosen using purposive sampling. A questionnaire was administered to a sample of 35 teachers to collect quantitative data and a sub-sampling purposively 10 teachers were sampled for observation and interview to collect qualitative. The quantitative data were analysed through descriptive statistics with the help of the SPSS version 21 and content analysis. The findings indicated that JHS teachers had low knowledge of DI. Also, the qualitative data indicated the extent to which teachers implement DI was low, and time constraint limits the use of DI. The results showed that, teachers showed minimum evidence of differentiating their lesson in terms of content, process and assessment. The study recommends that the municipal directorate of the Ghana Education Service of Ankwapim South Municipality should organise in-service programmes and workshops on differentiated instructional strategies to give teachers hands-on training on DI as required by the NTS guidelines.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter presents an overview of the study, outlining the background, statement of the problem, purpose, objectives, and research questions. It further highlights the significance of the study and discusses its limitations, delimitations, and organisation of the study.

1.1 Background to the Study

Differentiated instruction (DI) in Ghana has developed through a mix of historical influences, policy shifts and growing awareness of learners' diverse needs. During the colonial era, the Gold Coast's education system mirrored British models that emphasised a single, uniform curriculum and left little room for tailoring teaching to individual learners (Wiafe, 2021; Frankema et al., 2021). After independence in 1957 the country concentrated on expanding access to schooling; equal opportunity, rather than personalised instruction, dominated reform agendas (Atuahene & Owusu-Ansah, 2013). The 1987 educational reforms sought to raise both access and quality, but differentiation was not yet a central plank (Wiafe, 2021; Frankema et al., 2021). From the early 2000s a shift began: inclusive education gained traction and the Ghana Education Service started promoting practices designed to meet a wider range of learners' needs, including children with disabilities (Ministry of Education, 2015). Teacher education programmes began to incorporate elements of differentiated pedagogy so that classroom teachers would be better prepared to respond to variability in learners' backgrounds and abilities (Tomlinson, 2015). The formal adoption of an inclusive education policy in 2011 represented a milestone — it signalled a national

commitment to ensuring that every child, whatever their circumstances, could access quality learning (Ministry of Education, 2015). More recently, curriculum reform led by the National Council for Curriculum and Assessment (NaCCA) has emphasised competence-based approaches. These reforms encourage active, learner-centred methods and invite teachers to use differentiated strategies to address varying readiness, interests and learning profiles. Continuous professional development initiatives — workshops, in-service training and seminars — have been introduced to build teacher capacity in DI and related inclusive practices (NaCCA, 2018; Agormedah et al., 2022). The rationale for DI reflects both pedagogy and equity. Leading proponents argue that effective classroom practice recognises and plans for differences in learners' academic levels, cultural backgrounds, languages and socioeconomic circumstances (Santamaria, 2009). A substantial body of research (Tomlinson, 2015; Lawrence-Brown, 2004; Launder, 2011) supports the view that DI delivers meaningful learning opportunities to students across the ability spectrum — from struggling learners to gifted pupils — by adapting what is taught, how it is taught, and how students demonstrate understanding (Cox, 2008; Powers, 2008; Manning et al., 2010). Ghana's policy commitments — including endorsement of Education for All (EFA) and the Free Compulsory Universal Basic Education (FCUBE) initiative — frame education as a right and emphasise the need for accessible, quality provision for every school-age child (MoEYS, 2004; MoE, 2013). The Inclusive Education (IE) policy explicitly aims to restructure school cultures, policies and practices so that diverse learners are supported in regular classrooms through appropriate curricula, instructional strategies and resources (MoE, 2013). Several studies (Gyimah, 2011; Agbenyega & Deku, 2011; MoE, 2013) document the heterogeneous nature of Ghanaian classrooms and call for practical measures to include all learners. Some basic schools have already begun mainstreaming

students with varied abilities, but differentiating instruction systematically remains limited in scope and practice (Casely-Hayford et al., 2011; Opoku-Asare & Agbenatoe, 2015). Evidence points to persistent capacity gaps: many Ghanaian teachers lack adequate training in inclusive strategies and report low confidence in supporting individual learners in often overcrowded classrooms (Gyabeng, 2020; Kuyini & Abosi, 2014). As a consequence, generic, one-size-fits-all teaching methods are commonly used rather than the adaptive practices DI requires. International agencies and national reviews (e.g., UNESCO; Special Attention Project, 2011) have also criticised the system's focus on enrolment numbers at the expense of teaching quality and attention to pupils with specific learning difficulties. In some schools pupils with reading, writing or numeracy challenges remain unrecognised as having special educational needs and receive little formal support (UNESCO cited in MoE, 2013).

Accountability pressures from high-stakes testing regimes — exemplified internationally by policies such as the U.S. No Child Left Behind Act (NCLB) — increase the demands on teachers to raise measured achievement while also responding to diverse classroom needs (Jennings, 2014; Stecher, 2003). Standards-based systems require clarity about expected outcomes, yet how teachers achieve those outcomes must be flexible enough to respect individual learners' starting points (Levy, 2008; McTighe & Brown, 2009). Within this policy frame, DI has been proposed as a pedagogical framework that helps teachers meet curricular standards while differentiating instruction to reach every student (Lawrence-Brown, 2004). At its core, differentiated instruction is an instructional philosophy that acknowledges student variation and intentionally plans multiple pathways to learning. Research shows that responsive classrooms, where students are treated as individuals and supported appropriately, foster improved attitudes and higher academic success (Ryan & Cooper, 2007;

Anderson, 2007). Carol Ann Tomlinson — a leading voice in DI — describes differentiation as grounded in the belief that students of the same age differ in readiness, interests and learning profiles, and that teaching should be responsive to those differences so each learner can progress. In a differentiated classroom teachers vary content, processes, products and learning environments based on students' readiness, interests and preferred modes of learning (Tomlinson & Kalbfleisch, 1998; Tomlinson, 1999–2017). Practically, DI asks teachers to adopt flexible curricula and instructional designs rather than insisting that learners adapt to a single method (Gregory & Kuzmich, 2004; Johnson, 2022). It involves modifying what is taught, how students work with material, the ways learning is demonstrated, and the classroom conditions under which learning takes place. This approach aligns well with contemporary calls for inclusive, learner-centred education and is especially well suited to science teaching, where inquiry, hands-on tasks and multiple representations of phenomena offer natural points for differentiation. Ghana's history of special education provision — from segregated schools for the visually impaired (established in the 1940s) and institutions for the deaf and those with intellectual disabilities in later decades — reflects an early focus on separate provision (Ananga, 2018). Over time the emphasis has shifted towards inclusion: bringing diverse learners into mainstream settings and adapting systems to serve them (Botts & Owusu, 2013). Inclusive education in Ghana now targets groups historically marginalised in schooling (e.g., children living in poverty, girls, remote learners, talented children and learners with disabilities) and insists on flexible pedagogy as a core principle (Dreyer, 2017; Spencer-Waterman, 2014). Despite policy intentions, classroom practice often remains teacher-centred, with traditional lecture-style delivery and a single, unified curriculum still dominant in many science lessons (Ngman-Wara & Acquah, 2015). NaCCA's Creative Curriculum Platform

(CCP) and the recent competence-based reforms seek to shift practice towards enquiry, collaboration, cross-disciplinary learning and DI — emphasising authentic tasks and development of core competencies across subjects (NaCCA, 2019). The rationale is to let teachers tailor support to learners rather than forcing students to adapt to a rigid, uniform system.

Scholars argue that DI supports English language learners and pupils with special needs by offering multiple entry points to content, varied pacing and differentiated challenges — strategies that match well with science education's emphasis on practical work and problem solving (Rahimi, 2023). Nevertheless, barriers remain: many teachers find it difficult to transition from traditional methods due to limited knowledge and practical experience with DI; hence the Ministry of Education recommends sustained in-service training and professional development to build teachers' capacity (Ministry of Education, 2015).

Theoretically, DI resonates with established learning theories such as Gardner's multiple intelligences and Vygotsky's Zone of Proximal Development: both frameworks support the idea that learners differ in strengths and that instruction should be scaffolded to move each learner slightly beyond their current level. In line with Ghana's IE policy and curriculum reforms, DI offers concrete techniques for altering content, process, product and learning environments so that all students — gifted, average, struggling or with special educational needs — can access the curriculum and make measurable progress.

1.2 Statement of the Problem

Classrooms across the globe, including Ghana, are marked by learner diversity in terms of abilities, disabilities, socio-cultural backgrounds, and interests (Okyere et al., 2019; Thompson, 2019). While education policies in Ghana such as the Free Compulsory

Universal Basic Education (FCUBE), the Inclusive Education Policy, and the Special Education Policy recognise these diversities and emphasize equal learning opportunities for all children, classroom practices often fail to reflect these commitments (Okai, 2022; Asamoah et al., 2018; MoE, 2015; Ametepee & Anastasiou, 2015; Nduzor & Ankomah, 2014). Research shows that teachers continue to rely heavily on one-size-fits-all and teacher-centred approaches, despite curriculum reforms encouraging learner-centred pedagogies such as DI (Akore et al., 2022; Milinga et al., 2022; Pozas & Schneider, 2020; NaCCA, 2019).

While global studies highlight DI's potential to address diverse learner needs, Ghanaian studies reveal limited teacher knowledge and inadequate classroom application (Rahimi, 2022; Melesse, 2019; Owusu-Ansah & Apawu, 2022; Abora, 2015). This mismatch between policy directives and classroom realities underscores a persistent gap including policies mandate inclusive, differentiated practices, yet teachers struggle to translate these into effective instructional strategies.

Some literature suggests teachers show basic awareness of DI concepts, whereas other studies reveal that teachers, particularly in Ghana, possess little to no knowledge of DI or equate it with merely using different teaching methods (Agbeko et al., 2023; Mensah et al., 2023; Abora, 2015; Bayuo, 2021). Moreover, while DI is promoted as suitable for all learners including those with special needs, there is debate about its practicality in large classes with limited resources and time constraints (Milinga et al., 2022; Bi et al., 2023; Pozas et al., 2019).

Previous research has failed to resolve how contextual factors such as teacher training, class size, time availability, and resource constraints influence the effective implementation of DI in Ghanaian JHS science classrooms. Studies tend to either focus broadly on inclusive education or report DI's benefits in foreign contexts, but there is

insufficient empirical evidence on the specific challenges Ghanaian Integrated Science teachers face in adopting DI.

Integrated Science is a core subject at the JHS level, serving as the foundation for future STEM learning. If teachers lack knowledge and skills in DI, learner diversity remains unaddressed, risking disengagement and underachievement among both gifted and struggling learners. Investigating the knowledge, practices, and challenges of Integrated Science teachers in Akwapem South is therefore timely and necessary. It provides context-specific insights that can inform in-service training, teacher education, and policy implementation to bridge the gap between inclusive education policy and classroom practice.

Differentiated Instruction was thus considered in this research as it presents a theory-driven and practical response to the gap between inclusive education policy and actual classroom practice. It enables teachers to move beyond generic teaching methods by providing adaptive strategies that address learner diversity in content, process, product, and learning environment. Its adoption is therefore essential for improving the quality of teaching and learning in Integrated Science at the Junior High School level.

1.3 Purpose of Study

The purpose of the study was to investigate Public Junior High school science teacher's knowledge, practice and challenges of Differentiated Instruction in the Akwapem-South Municipality in the Eastern Region of Ghana.

1.4 Research Objectives

The following are the specific objectives. To:

1. Examine the background factors that influence junior high school teachers' knowledge and practices of Differentiated Instruction (DI) in the Akwapem South Municipality.

2. Ascertain knowledge level public junior high school science teachers' about Differentiated Instruction in the Akuapem South Municipality.
3. Explore public junior high school science teachers' classroom practices of Differentiated Instruction in the Akuapem South Municipality.
4. Explore the challenges faced by junior high school science teachers in the implementation of Differentiated Instruction in the Akuapem South Municipality.

1.5 Research Questions

The following research questions were formulated to guide the study

1. What is the knowledge level of Public Junior High School science teachers about Differentiated Instruction in the Akwapemin South Municipality?
2. What is Public Junior High School Integrated Science teachers' practice of Differentiated Instruction in the Akwapem South Municipality?
3. How are the background factors influencing on the Public Junior High School Integrated Science teachers' knowledge and practice of differentiated learning in the Akwapem South Municipality?
4. What challenges do Public Junior High School science teacher's face in the implementation of Differentiated Instruction in the Akwapem South Municipality?

1.6 Significance of the Study

The outcomes of the research are expected to contribute to more effective practices that cater to the diverse learning needs of Junior High School (JHS) science students within the Akwapem South Municipality. The study's findings will provide valuable insights to educational stakeholders regarding the current state of differentiated instruction (DI) in these schools. Such insights will be instrumental in shaping teacher

professional development initiatives and in-service training programs across the municipality. Additionally, the findings could guide the formulation of educational policies, particularly those related to Special and Inclusive Education, ensuring that the needs of all learners are adequately addressed. The study may also serve as a reference for improving the learning environments in JHS science classrooms, prompting district authorities to take necessary actions. Furthermore, the results are anticipated to inspire other researchers to undertake similar investigations in different districts facing comparable educational challenges.

1.7 Delimitation of the study

The research was confined to the Akwapem South Municipality and specifically examined teachers' understanding, implementation, and challenges related to inclusive teaching within the Junior High School (JHS) setting, with particular emphasis on differentiated instruction (DI). Although DI encompasses several dimensions—such as its impact on students' learning outcomes, teachers' perceptions, implementation barriers, and the integration of technology in differentiation—this study was intentionally restricted to exploring differentiated instruction as a pedagogical approach. This delimitation was necessary due to limitations in time and available resources.

1.8 Limitations to the study

Although the study successfully met its objectives, certain limitations were inevitable. Firstly, due to time constraints and limited resources, the research was confined to the Akwapem South Municipality. As a result, the findings may not be fully representative of the entire country. In addition, the scarcity of local studies on differentiated instruction (DI) in Ghana meant that much of the literature reviewed was drawn from international sources. Another challenge encountered was the collection and

organization of data for analysis and discussion, which proved to be the most demanding phase of the study. Extracting relevant information from interview and observation responses and grouping them into meaningful categories required considerable effort. Consequently, the themes and categories developed were influenced by the researcher's interpretations, supported by expert guidance from the academic supervisor.

1.9 Organisation of the Study

This study is structured into five (5) main chapters, each addressing a specific aspect of the research. Chapter One provides an overview of the study, including the background, statement of the problem, purpose, research objectives, research questions, significance, delimitations, limitations, and organization of the study. Chapter Two presents a review of relevant literature, highlighting existing research and summarizing studies related to public Junior High School Integrated Science teachers' knowledge, practices, and challenges in implementing differentiated instruction. Chapter Three outlines the methodological framework of the study, detailing the research approach, design, target population, sampling methods and techniques, research instruments (such as observations, questionnaires, and interviews), instrument validity, and ethical considerations. Chapter Four focuses on the presentation, analysis, and discussion of the data collected. Finally, Chapter Five provides a summary of the study, conclusions drawn from the findings, and recommendations for practice and future research.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

Existing studies indicate that teachers' use of Differentiated Instruction (DI) is influenced by multiple factors: the inherent complexity of adapting instruction, teachers' knowledge and classroom practices, their beliefs about instructional efficacy, and practical obstacles that limit proper implementation. For this study, the principal variables of interest are teachers' knowledge of DI and their classroom practices. The literature review therefore explores how Junior High School Integrated Science teachers understand and apply DI, and the challenges they face. The review is organised under the following headings: theoretical framework, study location, history of education in Ghana, teaching and learning of Integrated Science, research on DI in science, teachers' knowledge of DI, barriers to implementing DI, the conceptual framework, and a summary of the related literature.

2.1 Theoretical framework

A number of widely used educational theories provide conceptual support for differentiated instruction. Two theories, however, are especially influential in justifying DI approaches: Howard Gardner's theory of Multiple Intelligences (MI) and Vygotsky's concept of the Zone of Proximal Development (ZPD). Both frameworks emphasise learner differences and the need for instruction that responds to varying strengths, interests and readiness levels (Lounder, 2011).

2.1.1 The theory of Multiple Intelligences

Howard Gardner introduced the Multiple Intelligences perspective in Frames of Mind (1983). Rather than treating intelligence as a single, unitary capacity, Gardner proposed that human cognitive ability is better understood as a set of distinct but interacting

capacities or "intelligences." In this view, learners differ not only in the degree of a single intelligence but in the profile of several intelligences they draw upon when learning and problem-solving (Gardner, 2009).

Gardner initially described seven intelligences—linguistic, logical-mathematical, spatial, bodily-kinesthetic, musical, interpersonal and intrapersonal—and later proposed additional categories such as naturalistic and existential intelligences. He argued that everyone possesses all of these intelligences to some extent, but that individuals vary in which intelligences are most developed and which are used most readily in particular contexts. Cultural background and genetic factors play roles in shaping how a person's intelligences are expressed and developed.

Applied to classroom practice, the MI perspective suggests that teaching which taps multiple ways of knowing can better meet diverse learners' needs. Instruction that draws on students' relative strengths—whether through visual tasks for spatial learners, hands-on activities for bodily-kinaesthetic learners, or collaborative work for those strong in interpersonal intelligence—can enhance engagement and achievement. Researchers such as Gangi (2011) have noted that designing lessons that attend to students' intelligence profiles can both increase motivation and improve learning outcomes, because learners are more likely to grasp and retain material when it is presented through modes that align with their strengths.

2.1.1.1 Linguistic Intelligence

Linguistic intelligence refers to facility with spoken and written language. Learners who are strong in this area enjoy and excel at activities that involve words — for example reading, storytelling, writing journals, debating, giving speeches, brainstorming, and using recording devices to capture ideas.

2.1.1.2 Logical–Mathematical Intelligence

Logical–mathematical intelligence involves skill with reasoning, numbers and formal logic. Students with this strength favour tasks that require calculation, classification, quantification and logical problem-solving.

2.1.1.3 Spatial Intelligence

Spatial intelligence is the capacity to form mental images of what is read, heard, or described and to manipulate those images. Learners with well-developed spatial ability learn effectively through visual representations (drawings, maps, diagrams) and activities such as puzzle-solving.

2.1.1.4 Bodily-Kinesthetic Intelligence

Bodily-kinesthetic intelligence describes the ability to learn and express understanding through bodily movement and manual manipulation. Pupils with this profile often demonstrate good hand–eye coordination and thrive in role-plays, construction tasks, games, sports and other hands-on activities.

2.1.1.5 Musical Intelligence

Musical intelligence is the aptitude for recognising, creating and appreciating rhythm, melody and timbre. Students who are musically inclined learn readily through songs, chants, rhythm patterns and poetic forms.

2.1.1.6 Interpersonal Intelligence

Interpersonal intelligence is the capacity to perceive and respond to the emotions, motivations and intentions of others. "People-smart" learners work well in cooperative groups, peer-sharing activities, simulations and collaborative projects.

2.1.1.7 Intrapersonal Intelligence

Intrapersonal intelligence refers to self-awareness and the ability to reflect on one's own feelings, goals and learning processes. Learners strong in this area prefer solitary tasks such as independent reflection, goal setting, journaling and self-paced projects.

2.1.1.8 Naturalistic Intelligence

Naturalistic intelligence denotes sensitivity to features of the natural world and the ability to classify and interpret natural phenomena. Students with this inclination are drawn to outdoor learning, exploration of plants and animals, and investigations of ecological or environmental systems.

2.1.1.9 Existential Intelligence

Existential intelligence involves grappling with big-picture questions about meaning, purpose and the relationships among concepts. Learners with this strength enjoy open-ended inquiry, philosophical discussion and tasks that require connecting abstract ideas.

Applying Gardner's MI framework in the classroom implies designing a range of instructional activities that match the different ways students think and learn. By offering varied entry points to content (visual, verbal, logical, kinesthetic, musical, social, reflective, naturalistic or philosophical), teachers increase the likelihood that each learner will encounter material in modes that resonate with their strengths, thereby maximising opportunities for engagement and achievement.

2.1.2 Zone of Proximal Development (ZPD)

Lev Vygotsky's Zone of Proximal Development describes the difference between what a learner can accomplish independently and what they can achieve with appropriate guidance or collaboration. In other words, the ZPD captures the potential level of development that becomes accessible when a learner receives targeted support. The central pedagogical implication is that tasks performed successfully with assistance today can, with scaffolding, become tasks the learner can do unaided tomorrow. Key instructional practices associated with the ZPD include careful assessment of readiness, provision of scaffolded support, flexible grouping, and offering choices that align with learners' current capabilities. Using the ZPD as a guide, teachers can tailor instruction and scaffold learning experiences so that each student is challenged just beyond their present level of competence, promoting progressive mastery (Beheshti et al., 2000; Rezaee & Azizi, 2012; Miller, 2002; Whipple, 2012).

2.2.1 Collaboration in ZPD Assessment

During the teaching and learning process, a learner's Zone of Proximal Development (ZPD) can be assessed through active interaction and collaboration. Such engagement creates an opportunity for imitation, which, according to Shabani, Khatib, and Ebadi (2010), serves as a means of identifying emerging cognitive abilities that are not yet fully developed for independent execution. Vygotsky (1998) emphasized that when cooperation is applied within a learner's ZPD, it enables teachers to understand the learner's stage of mental development—an essential aspect of overall cognitive growth.

2.2.2 Scaffolding within the ZPD

A key concept that stems from Vygotsky's ZPD is scaffolding, which provides temporary instructional support to help learners accomplish tasks they would not yet be able to complete independently. According to Daniels (2001) and Shabani et al. (2010), the concept of scaffolding is deeply rooted in Vygotsky's sociocultural theory of learning and the ZPD framework. Scaffolding, as noted by Whipple (2012), involves the assistance offered by teachers, parents, peers, or any other "more knowledgeable other" to help a learner progress. Rezaee and Azizi (2012) further explained that this support is essential for a learner's advancement within their ZPD, enabling them to develop competence and confidence.

In simpler terms, scaffolding can be likened to the temporary wooden supports used in construction that hold concrete in place until it is strong enough to stand on its own. Similarly, teachers provide step-by-step guidance that is gradually withdrawn as learners gain mastery. Effective scaffolding involves presenting appropriately challenging tasks, responding flexibly to learners' needs, and providing varying levels of support until learners can work independently. As Whipple (2012) suggests, the teacher's flexibility, willingness to offer choices, and encouragement of creativity are

key to successful scaffolding — principles that also form the foundation of Differentiated Instruction (DI).

2.2.3 The Rationale for Integrating the MI and ZPD Theories

Both Gardner's Theory of Multiple Intelligences (MI) and Vygotsky's ZPD share common philosophical foundations that align closely with the principles of Differentiated Instruction. The two theories acknowledge learner diversity and emphasize that students differ in abilities, learning styles, and developmental readiness. Gardner (2006) proposed that human intellectual capability consists of distinct intelligences, while Vygotsky (1998) highlighted that each learner possesses unique developmental and readiness levels. These views resonate with Tomlinson's (2001) assertion that differentiation is designed to address learner variance and promote equitable learning experiences.

Furthermore, both theories reject uniform instructional approaches. Instead, they encourage flexibility and personalized support. Gardner (2006) advocates for teaching through multiple entry points—presenting concepts in varied ways that reflect different intelligences—while Vygotsky's ZPD emphasizes adaptive scaffolding and individualized assistance (Whipple, 2012). Gardner's idea of multiple representations aligns with Vygotsky's notion of stimulating diverse forms of internal development. Together, these perspectives reinforce the principle that there are multiple pathways through which learners can achieve understanding.

Differentiated Instruction builds on these theoretical insights by offering varied content, processes, products, and learning environments tailored to individual learners (Tomlinson, 1995). The MI and ZPD theories both support the need for flexible teaching approaches that accommodate students' varying abilities, experiences, and preferences (Renzulli & Renzulli, 2010). Miller (2002) further identified assessment,

curriculum scaffolding, flexible grouping, and learner choice as fundamental concepts within the ZPD framework—each of which corresponds to DI practices.

Assessment plays a pivotal role in both theories. Vygotsky emphasized readiness assessment to determine learners' developmental levels and provide suitable scaffolds (Miller, 2002; Whipple, 2012), while Gardner (2009) encouraged evaluating learners' intelligence profiles through inventories, questionnaires, and observations. Williams (2002) argued that if lessons are taught through multiple modalities, they should also be assessed through varied means. Differentiated assessment, therefore, captures learners' understanding in diverse ways and reflects their growth (Gangi, 2011; Tomlinson & Allan, 2000; Levy, 2008).

The learning environment, too, is a crucial factor in these frameworks. Both Gardner's MI and Vygotsky's ZPD highlight the importance of providing a stimulating and supportive classroom atmosphere. Gardner (2009) emphasized the need for environments that engage different intelligences, while Shabani et al. (2010) noted that quality teacher–learner interactions are vital for effective scaffolding. Whipple (2012) added that flexibility, learner choice, and creativity should characterize such learning spaces. Differentiated classrooms, according to Wormeli (2007) and Gangi (2011), should be organized in ways that encourage engagement, independence, and collaboration.

Finally, the principle of readiness, as emphasized in Differentiated Instruction, draws directly from Vygotsky's ZPD. The idea is that learning experiences should be slightly beyond the learner's current level of competence to promote intellectual growth (Hall, 2002; Durrett, 2010). Thus, by combining insights from MI and ZPD, educators can create responsive and inclusive classrooms that respect individual differences and provide each learner with an optimal path to success.

2.2 Conceptual Review

2.2.1 Differentiated Instruction

All of the teaching methods, strategies and classroom techniques that aim to respond to learner diversity can be grouped under the broad umbrella of Differentiated Instruction (DI). DI, which has gained increasing attention internationally, asks educators to rethink how they plan lessons, manage classrooms, and select content so that every student is actively involved and benefits from instruction (Palmer & Maag, 2010).

Launder (2011) describes DI as the deliberate adjustment of content, learning processes and assessment products to match students' readiness levels, interests, learning preferences and needs. In similar terms, Gangi (2011) defines DI as an instructional strategy that recognises learner differences and adapts methods and resources accordingly. Edwards, Carr, and Siegal (2006) also characterise DI as a set of classroom practices intended to meet both the academic and behavioural needs of a wide range of pupils within a single class.

Pettig (2000) views DI as a pragmatic call for teachers to change conventional classroom routines in order to enhance learning for all students. Manning et al. (2010) encapsulate the idea succinctly: DI means that each student receives the instruction they need — not necessarily the same instruction that every other pupil receives. These definitions stress the distinction between equality (everyone receives the same input) and equity (each learner receives what they need to succeed), and argue against a "teach-to-the-middle" mentality that overlooks individual learning requirements.

Wormeli (2007) frames DI more holistically, seeing it as a philosophy that can accommodate many instructional strategies. Franz (2009) and others echo this broad view, noting that DI incorporates a wide variety of techniques aimed at enabling every learner to reach their potential. Researchers such as Liu (2006) and McBride (2004) treat DI as an integrative set of theories and practices that promote positive student outcomes. Tomlinson (2000) goes further to suggest DI is not merely a technique but a comprehensive way of thinking about learners and learning.

From this perspective, what matters is not whether DI is labelled a method, a strategy, or a philosophy, but whether it effectively draws out each learner's potential and provides equitable opportunities to succeed. Equity and social justice in education depend on teachers actively addressing learner diversity (Valiande & Koutselini, 2009). Launder (2011) argues that observable classroom diversity obliges teachers to adopt practices that offer all students a genuine chance to learn. Valiande and Koutselini (2009) and others contend that DI is one of the most promising responses to the multicultural, multi-ability realities of contemporary classrooms.

Research suggests practical benefits for both learners and teachers. Studies by Tomlinson (2001), Anderson (2007), Franz (2009) and Gangi (2011) report that DI improves access to the curriculum, deepens understanding, and increases learner enjoyment. DI enables teachers to match instruction to readiness, interests and learning profiles, and to provide appropriate challenges for students who have already mastered material (Levy, 2008). In short, DI equips teachers with tools to push each student toward higher achievement.

A further advantage of DI is its motivational power. When students are offered meaningful choices about tasks and can work in ways that fit their strengths, their intrinsic motivation often increases (Gangi, 2011; Anderson, 2007). Servilio (2009) notes that a differentiated curriculum combined with student choice is particularly effective for students with disabilities and can also improve outcomes for a wider range of learners.

Successful completion of tasks at a personally appropriate level tends to boost learners' confidence and encourages further effort. When teachers differentiate effectively, students across ability ranges show improved comprehension and a more positive learning experience (Franz, 2009). Allowing students to select processes that showcase their abilities also fosters learner autonomy and responsibility: learning becomes more engaging, relevant and self-directed (Painter, 2009).

Teachers gain professional benefits as well. As learners become more self-reliant, classrooms can evolve into active learning environments where the teacher's role shifts toward facilitation. This transformation can, over time, reduce the teacher's workload while improving instructional quality (Franz, 2009). In effect, DI helps teachers to teach students how to learn rather than always doing the learning for them — a pedagogical aim captured in the proverb about teaching someone to fish rather than feeding them.

Importantly, DI supports both remediation for struggling learners and enrichment for gifted students, helping ensure that fewer children are left behind (Sondergeld & Shultz, 2008). In differentiated settings roles change: teachers become guides and coaches; students become active, independent learners (Beecher & Sweeny, 2008). This

orientation toward inclusion has led many education systems to adopt DI as a central strategy for educating diverse student bodies (Palmer & Maag, 2010).

Despite the conceptual clarity and documented benefits, moving from traditional, teacher-centred approaches to sustained, high-quality differentiation is not automatic. Implementation requires sustained training, reflective practice and institutional support. Nevertheless, the preponderance of evidence suggests that DI offers a powerful, equity-focused framework for improving learning outcomes for all students in Ghanaian classrooms and beyond.

2.2.2 Areas of Differentiated Instruction

Tomlinson (2000, 2001) frames differentiated instruction (DI) as teachers' deliberate attempts to respond to the variety of learners in a classroom by adjusting how content is presented and how assignments are designed. Any change a teacher makes to the delivery of a lesson or to the demands of an activity for the benefit of a particular learner constitutes differentiation. Using alternative explanations, varied examples, different resources, or re-teaching the same idea in multiple ways are all practical forms of DI (Tomlinson, 2001).

Central to effective differentiation is attention to three learner characteristics: readiness, interest, and learning profile (Gangi, 2011). Readiness refers to a student's existing background knowledge or preparedness for new material (often called Relevant Previous Knowledge in Ghanaian classrooms). Interest covers the topics and contexts that motivate a learner to engage. Learning profile describes the preferred ways a student takes in and processes information. In planning instruction, teachers should use these three dimensions as the basis for making purposeful adaptations.

Researchers commonly identify four instructional domains through which teachers can differentiate: content, process, product, and learning environment (Tomlinson, 2000; Wormeli, 2007; Levy, 2008; Launder, 2011). Each of these domains should be shaped by students' readiness, interests and learning profiles so that every learner has a fair opportunity to progress academically (Levy, 2008; Cox, 2008). The overarching aim is to provide what each student needs to grow, even when those needs differ, while still working toward comparable levels of mastery (VanSciver, 2005).

2.2.2.1 Differentiating the Content

Content refers to the knowledge, concepts and skills students are expected to learn. In a differentiated classroom the teacher may adjust what is taught or how much of a topic is introduced for different learners (Tomlinson & Allan, 2000). Modifications can be made according to readiness (e.g., simplified texts or accelerated materials), interest (e.g., topics framed in personally meaningful contexts), and learning profiles (e.g., presenting the same idea through visual, verbal or kinesthetic formats). Using a range of texts and resources is a common strategy for varying content so that each student encounters material at an appropriate level and in an accessible form (Tomlinson, 2001; Gangi, 2011).

2.2.2.2 Differentiating the Process

The process denotes the ways students come to understand and practice the content—i.e., the classroom activities, instructional methods and learning experiences. Differentiating process means providing multiple pathways for students to engage with concepts, practise skills and apply understanding (Wormeli, 2007; Levy, 2008). Activities may be tiered in complexity, organised in flexible groups, or varied by pace and support so that learners work at levels matched to their readiness and preferences (Tomlinson & Allan, 2000).

While some authors (e.g., Wormeli, 2007) suggest that changing process is often easier than changing content, it is important not to understate the role of sound pedagogy. Effective strategies—clear modelling, purposeful questioning, collaborative routines and scaffolded tasks—remain crucial for learning regardless of whether process or content is varied. Scholars such as Imran (2008), Palmer and Maag (2010), and Valiande and Koutselini (2009) emphasize that high-quality instructional methods are essential to make any differentiated activity genuinely productive. In short,

differentiating process means offering learners several well-designed routes to grasp the same core ideas (Anderson, 2007).

2.2.2.3 Differentiation through Products

One of the ways teachers can apply differentiated instruction is by modifying the product, which represents the outcome or evidence of student learning. According to Gangi (2011), the product reflects what learners are able to create or demonstrate after engaging with a lesson. In this sense, it reveals how effectively learners can apply the knowledge and skills they have acquired (Tomlinson & Allan, 2000; Levy, 2008). Products also serve as a key indicator through which teachers determine whether learning objectives have been achieved (Wormeli, 2007).

Launder (2011) explains that students express their learning by producing various outcomes such as projects, written assignments, or assessments. Just like content and process, teachers can adapt products to suit students' readiness levels, interests, and learning profiles (Levy, 2008). Gangi (2011) further notes that teachers may adjust the level of difficulty or the amount of guidance provided during product creation, thereby ensuring that each learner demonstrates understanding at a level suitable to their capabilities.

2.2.2.4 Differentiating through Affect and Learning Environment

Another vital dimension of differentiation is the learning environment, which encompasses both the physical and emotional conditions in which learning occurs (Launder, 2011). Elements such as classroom layout, availability of materials, established routines, and the general atmosphere can be adapted to support diverse learning needs (Tomlinson, 2000). Gangi (2011) highlights that an effective differentiated classroom should foster motivation and engagement, with displays and learning artefacts that reflect ongoing lessons and skills.

Wormeli (2007) describes the learning environment as not only the physical space and its arrangement but also the affective domain — the social and emotional climate that influences learning. He emphasizes that teachers should create an atmosphere where learners feel emotionally secure, respected, and confident enough to take intellectual risks. This requires adjusting classroom management and interpersonal interactions to accommodate the unique needs and personalities of individual learners or groups.

2.2.2.5 Differentiating through Assessment

Assessment serves as a cornerstone of differentiated instruction because it informs teachers about learners' progress and readiness levels (Whipple, 2012). Tomlinson and Mbeau (2010) argue that assessment should be continuous and multifaceted, encompassing pre-assessments, formative assessments, and summative evaluations. Through pre-assessment, teachers identify students' prior knowledge and skills, allowing them to tailor instruction appropriately.

Ongoing formative assessment helps educators track learners' understanding throughout the teaching process and make adjustments to instruction as needed. Summative assessments, on the other hand, provide evidence of what has been learned at the end of an instructional period. By integrating these various assessment approaches, teachers can better align their teaching strategies with the individual learning needs and styles of students, thereby enhancing the overall effectiveness of instruction (Tomlinson & Mbeau, 2010).

2.2.3 Inclusive Education in Ghana (mid 1990s to present)

Since the Salamanca Statement (UNESCO, 1994) called for inclusive education, international norms have increasingly shaped Ghana's special-education agenda. Prior to Salamanca, global instruments had limited visible impact on Ghana's policies for

learners with special educational needs; after Salamanca, however, intergovernmental frameworks began to exert clearer influence. A notable milestone is Ghana's ratification of the United Nations Convention on the Rights of Persons with Disabilities (CRPD) on 31 July 2012. Article 24 of the CRPD stresses the provision of individualized supports in learning settings that maximise both academic and social development and that move towards full inclusion — a phrase the Convention uses without offering a single, definitive interpretation. As with other human-rights treaties, the CRPD is supported by expert committees that review state reports and issue guidance, although the legal weight and precise role of those recommendations remain debated (Meyer, 2013). Unlike the Salamanca and CRPD instruments, which set principles rather than deadlines, the Dakar Framework for Action (2000) required countries to prepare comprehensive national Education for All (EFA) plans by 2002. At the national level, Ghana's Education Strategic Plan (ESP) 2003–2015 subsequently became the principal policy document guiding provision for learners with special needs.

To evaluate Ghana's position in 2008 with respect to general, special and inclusive education, researchers have used measurable indicators drawn from typologies such as the Anastasiou & Keller (A&K) framework. Anastasiou and Keller (2011) developed a typological approach that classifies national education systems and their special-education subsystems along three dimensions: (a) the extent to which a country provides education for its entire school-age population, (b) the scope of special-education services, and (c) the degree of inclusive provision. This A&K typology extends the Education for All framework by incorporating both economic indicators (for example, gross national income per capita) and measures of special-education coverage, thereby enabling more systematic international comparisons. Building on the

Dakar goals, Anastasiou and Keller used EFA-related educational variables together with indicators of special-education coverage to profile how countries serve exceptional learners (Anastasiou & Keller, 2011; Anastasiou & Keller, 2014).

The Dakar Framework (UNESCO, 2005) set six broad EFA objectives: (1) expand early childhood care and education; (2) provide free, compulsory primary schooling for every child; (3) promote learning and life skills for youth and adults; (4) increase adult literacy by 50%; (5) achieve gender parity (by 2005) and gender equality (by 2015); and (6) improve education quality. Comparable international data for some targets are scarce — for example, reliable cross-country indicators for Goal 1 (early childhood provision) are limited, and valid measures for outcomes under Goal 3 remain problematic (Carr-Hill, 2010). For the present analysis we therefore rely on the available EFA-related indicators together with the A&K measures (including special-education coverage) to assess how Ghana addresses the education of learners with disabilities within the broader national system.

Anastasiou and Keller's concept of special-education coverage (SPEDC) — the proportion of a country's student population receiving special-education services across settings — provides a useful standardized metric for international comparison (Anastasiou & Keller, 2014). Using SPEDC alongside other educational and socio-economic indicators makes it possible to compare the scale and orientation of special-education provision across countries in ways that simple headcounts or national descriptions alone cannot.

At the national policy level, successive Ghanaian administrations have affirmed education as central to socio-economic development and have implemented measures to expand access at all levels. Historical reforms — including accelerated development plans in the 1950s that expanded primary enrolment and teacher training — set the groundwork for the post-independence expansion of schooling (Graham, 1971). Subsequent legislation and constitutional commitments reinforced this trajectory: the Education Act of 1961 included provisions aimed at increasing access to primary and middle schooling, and the 1992 Constitution articulated the goal of making basic education free and compulsory by 2005 (Korankye et al., 2022).

These national commitments fed into a broader matrix of policy documents and international obligations. Ghana's policy architecture draws on instruments such as the Ghana Shared Growth and Development Agenda (GSGDA), the Education Strategic Plan (2010–2020), the national Disability Act, and international agreements to which Ghana is party — for example, the UN Convention on the Rights of the Child (1990) and the UN Standard Rules on the Equalization of Opportunities for Persons with Disabilities (1993). Together, these national and international commitments shape the country's approach to inclusive and special education and provide the legal and policy context for ongoing reforms.

2.3 Empirical Review

2.3.1 Teachers' Knowledge of Differentiated Instruction

Adlam (2016) explored elementary school teachers' understanding and application of differentiated instruction (DI) strategies in the classroom. The research involved 72 participants from the Greater Essex County District School Board (GECDSB) and employed both qualitative and quantitative survey tools to assess teachers' knowledge and frequency of DI use across various subject areas. The findings revealed that educators employed diverse strategies such as learning contracts, tiered assignments, independent projects, curriculum compacting, interest centres, learning centres, flexible grouping, and pre-assessment, though the extent of their application varied among teachers.

In a mixed-method study, Siam and Al-Natour (2016) examined teachers' implementation of differentiated instruction and the challenges they faced when teaching learners with disabilities. Their 75-item questionnaire assessed six key domains of DI—content, process, resources, product, assessment, and learning environment. The results indicated generally low mean scores across all domains, highlighting minimal use of DI strategies. The study identified several barriers, including limited administrative support, inadequate parental involvement, insufficient time, and a lack of instructional materials.

In Ghana, Kyeremeh, Amoah, and Sabtiwu (2021) conducted a study among in-service mathematics teachers in the Tano South Municipality to determine their knowledge of DI. The study revealed no statistically significant difference between general in-service teachers and special in-service teachers in terms of their understanding of DI. Based on these findings, the researchers recommended that teacher education programmes revise their mathematics curricula to include greater emphasis on differentiated instructional methods.

Similarly, Ako et al. (2019) investigated Junior High School (JHS) teachers' knowledge and use of DI strategies in the Kwadaso Municipality of the Ashanti Region. The study revealed that while teachers demonstrated a high level of theoretical knowledge about DI, their classroom practices did not align with DI principles. Observations showed limited differentiation in content, process, and assessment, as most teachers continued to rely heavily on traditional, one-size-fits-all instructional methods.

In the Efutu Municipality, Agamboka (2023) evaluated teachers' understanding and practice of differentiated instruction in basic schools. The findings showed that teachers exhibited strong knowledge of DI strategies and implemented them regularly across subject areas, with only a small proportion (3.3%) reporting no use of DI techniques in their teaching.

A study by Owusu-Ansah and Apawu (2023) focused on JHS mathematics teachers in the Winneba Municipality, examining their perspectives and use of DI. The results indicated that teachers frequently utilized strategies such as tiered assignments, flexible grouping, end-of-unit projects, ICT tools, and worksheets. Interviews further revealed that DI had a positive influence on students' learning outcomes. However, the study also identified major challenges, including time constraints, high implementation costs, and inadequate teaching resources in public schools.

Bingan et al. (2022) also investigated JHS science teachers' knowledge, practice, and challenges regarding DI in the Kpandai District. The results showed that most science teachers possessed sound knowledge of DI and actively applied it in their lessons. Nonetheless, several challenges—such as inadequate resources and limited training—hindered effective implementation. The researchers recommended that teachers' knowledge of DI be strengthened through regular professional development and in-service training.

Despite its proven benefits in addressing learners' individual needs, the application of DI among integrated science teachers remains inconsistent and infrequent (Nedellec, 2015). Many science teachers tend to misinterpret the concept of differentiation, leading to hesitation in its implementation. As Tomlinson (1999) explained, the inherent complexity of DI contributes to teachers' reluctance to adopt it fully, especially when they must balance diverse learner needs with strict curriculum demands. Dixon et al. (2014) similarly noted that these pressures make it challenging for teachers to effectively cater to students' differences through DI strategies.

Although many integrated science teachers acknowledge the diversity in students' abilities and recognise the limitations of traditional, uniform teaching methods, the practical use of DI remains low (Nedellec, 2015). Even teachers who attempt differentiation often fail to apply it consistently. One major reason for this gap is the lack of comprehensive knowledge about DI strategies. Teachers need adequate pedagogical content knowledge to effectively modify content, process, product, and the learning environment according to students' readiness, interests, and learning profiles.

This claim is supported by previous empirical studies linking teachers' knowledge of DI to its implementation. For example, Chien (2015) conducted a qualitative study among Taiwanese elementary English teachers and found that insufficient knowledge and competence were key factors discouraging teachers from adopting DI strategies. Similarly, Nedellec (2015) discovered through interviews with 20 elementary teachers that professional training significantly influences teachers' application of DI in the classroom. Abbati (2012) also found that higher levels of competence and confidence distinguished teachers who frequently implemented DI from those who rarely used it.

2.3.2 Teachers' Practice of Differentiated Instruction

A number of empirical investigations have emphasized the significance of differentiated instruction in enhancing student learning outcomes. For instance, Tieso (2005) examined the influence of differentiated curriculum and flexible grouping strategies on learners' achievement in mathematics. The study involved 31 teachers who taught 4th and 5th-grade gifted learners. Participants were divided into groups according to prior knowledge levels—high, medium, and low—and exposed to different instructional treatments. These included a control group using standard textbooks, a revision group utilizing refined curriculum content, and a differentiated group where instruction was adapted to learners' interests and strengths through flexible grouping. The treatment lasted three weeks, amounting to 16 hours of instructional time. Findings revealed that both the revision and differentiated groups outperformed the comparison group, indicating that even minimal curricular adjustments can enhance student learning. Furthermore, the differentiated group recorded the highest improvement, suggesting that differentiated instruction coupled with flexible grouping significantly improves mathematics achievement (Tieso, 2005).

Similarly, Baumgartner et al. (2003) investigated the impact of differentiated instruction on reading performance among elementary and middle school learners who struggled with reading motivation and comprehension. Conducted across grades two, three, and seven in a suburban school district, the study spanned nineteen weeks. A variety of assessment tools, such as phonemic awareness tests, teacher-made checklists, and reading attitude surveys, were employed to determine students' reading levels and needs. Learners were grouped flexibly based on these assessments, and instruction was adjusted to match individual abilities and interests. The results demonstrated marked improvement in reading comprehension, phonemic awareness, and overall reading levels across all grades. Additionally, students' attitudes toward reading became more positive, and there was an increase in voluntary reading at home. The authors concluded that the small-group mini-lessons and flexible grouping strategies were instrumental in achieving these gains (Baumgartner et al., 2003).

In another example, McAdamis (2001) reported on the Rockwood School District in St. Louis, Missouri, where differentiated instruction was systematically introduced across schools beginning in 1995. With over 22,000 students across 18 elementary schools, the district launched a comprehensive plan to ensure equitable learning opportunities. A core team of teachers received professional development in differentiation strategies and later acted as peer coaches to expand the practice districtwide. Teachers participated in study groups, collaborative lesson design, and action research, supported by administrative policies and professional release time. Although some educators initially resisted, differentiated instruction eventually became a standard instructional practice across schools. Consequently, the district recorded consistent improvement in student academic achievement in multiple subject areas (McAdamis, 2001).

In a similar vein, Beecher and Sweeney (2008) detailed how one elementary school in the United States successfully adopted differentiated instruction as part of its school improvement strategy to close learning gaps among students. The school restructured its mission to focus on learner engagement, enrichment, and inclusion. Teachers received ongoing professional support through training, coaching, and collaboration. Differentiation was integrated into the curriculum across reading, writing, mathematics, and social studies. In reading, the traditional basal reader system was replaced with Fountas and Pinnell's (2001) Reader's Workshop, allowing flexible grouping, leveled texts, and learner choice. Writing instruction followed Calkins' (1994) Writer's Workshop Model, emphasizing individual conferencing and skill-based support. Mathematics instruction adopted open-ended problem-solving and interest-based group work, guided by experts in conceptual math teaching. These changes resulted in notable improvements in students' engagement, motivation, and standardized test performance, with reduced achievement gaps across socioeconomic groups (Beecher & Sweeney, 2008).

2.3.3 Influences of Teacher's Background Factor on their Knowledge and Practice of Differentiated Instruction

Dixon et al. (2014) conducted research to explore how professional development influences teachers' ability to effectively implement differentiated instruction and their sense of self-efficacy. The study examined several variables, including teachers' educational settings, years of experience, level of schooling, and the number of professional training programs they had attended. Findings revealed that teachers with higher qualifications and more exposure to professional development demonstrated greater confidence and effectiveness in applying differentiated instructional strategies. The results therefore suggested a strong positive correlation between teachers'

professional training and their competence in employing differentiated instruction in the classroom.

2.3.4 Teachers' Challenges in implementing Differentiated Instruction.

A study by Abu-Hamourand and Al-Hamouz (2013) revealed that the full realization of inclusive education remains distant, primarily because many teachers lack adequate training in applying differentiated instruction to support learners with special needs in inclusive classrooms. Similarly, Lora et al. (2014) found that aside from inadequate training, another major obstacle to the effective use of differentiated instruction is the significant time commitment it requires. Their study emphasized the importance of continuous professional development to help teachers manage classroom diversity and apply differentiation strategies that cater to the individual learning needs of all students.

Prain et al. (2013) further noted that although science teachers recognize that students learn differently, they often find it difficult to adapt their teaching to meet these diverse learning needs. This difficulty is compounded by several factors, including negative teacher attitudes, limited knowledge of differentiation techniques, and inadequate administrative support (Roiha, 2014). The following sections discuss these barriers in greater detail.

2.3.4.1 Teachers' Attitudes Towards Diverse Learners

Teachers play a pivotal role in shaping student performance in the classroom (Dee, 2011). Although teacher attitude is not the only determinant of student success, it has a significant influence (Woodcock, 2013). Educators working with students of varying abilities often express mixed feelings about the responsibility of addressing diverse learning needs (Fuchs, 2010). Many teachers report feeling underprepared to teach students with different ability levels and experience additional stress due to assessment

demands, particularly when students with disabilities are part of their classrooms (Pearcy & Duplass, 2011). This perceived pressure makes it challenging for them to balance curriculum coverage with the individual needs of students.

Negative teacher attitudes toward inclusion can hinder student progress both academically and socially (Smith & Tyler, 2011). It is therefore essential that teachers receive adequate training to understand the implications of inclusion and the accommodations required for students with Individualized Education Plans (IEPs) (La Salle, Roach, & McGrath, 2013). Some teachers mistakenly assume that all students should learn at the same pace and in the same way, without realizing that students with disabilities often require modified approaches (Wu, 2013). Teachers' attitudes are central to student success. A positive and empathetic approach can enhance classroom relationships and student motivation (Troxclair, 2013). Conversely, a negative outlook can affect student behavior, learning outcomes, and the success of inclusive programs (Fuchs, 2010). To promote inclusivity, teachers must develop a deep understanding of each student's learning style and ability level, ensuring that tasks are appropriately challenging (Herrelko, 2013; Wu, 2013).

However, some educators continue to resist inclusive education, arguing that students with special needs should not be placed in mainstream classrooms (Grskovic & Trzcinka, 2011). Even though most learners with disabilities have mild to moderate impairments, resistance to inclusion persists (Brandes & Crowson, 2009). Such attitudes often lead to a lack of differentiated instruction for these students. Hence, ongoing training and professional development are necessary to strengthen teachers' confidence and ability to accommodate diverse learners (Sadioglu et al., 2013).

A positive mindset toward inclusive education has been shown to be as crucial as subject matter expertise (Horne et al., 2008). While many teachers possess strong content knowledge, they often lack the pedagogical skills required to teach students with mixed learning needs effectively (Hwang & Evans, 2011). Teachers who have received specialized training in inclusive education tend to view the inclusion of students with disabilities positively and report feeling competent and confident in adapting their instruction (Malak, 2013).

2.3.4.2 Lack of teacher training

Several studies have highlighted that many teachers feel inadequately prepared to teach in classrooms with students of varied learning abilities, primarily because they have not received sufficient professional training (Sadioglu et al., 2013). Research shows that numerous teacher education institutions do not mandate special education courses as part of their programs (Costello & Boyle, 2013). Consequently, many educators acknowledge the need for more comprehensive preparation before entering the profession (Glazzard, 2011). Some have even indicated that their training programs did not sufficiently equip them to handle the diversity present in today's classrooms (Fullerton et al., 2011).

Experienced teachers often report that their education focused mainly on content knowledge rather than inclusive or special education strategies (Glazzard, 2011). To address teacher shortages, alternative certification programs were introduced across the United States in 2007, providing faster routes to licensure (Grskovic & Trzcinka, 2011). However, these programs typically did not include training in special education, leaving new teachers underprepared to support students with learning differences (Quigney, 2010). For example, in the 2005–2006 academic year, approximately 69,000 teachers

received certification through such alternative routes, many of whom lacked special education training (Grskovic & Trzcinka, 2011).

Managing classrooms with students of mixed abilities can be demanding, as teachers must design lessons that accommodate diverse learning needs (Ashby, 2012). Educators frequently express frustration over insufficient training to meet these challenges (Horne, Timmons, & Adamowycz, 2008). Although inclusive education promotes equality, many teachers still lack the necessary competencies to apply differentiated instruction effectively (Voss & Bufkin, 2011). Research by Horne et al. (2008) revealed that training was one of the key resources teachers desired to improve their instructional practices. When teachers feel ill-prepared to handle diversity in the classroom, their attitudes toward inclusion may become negative, which can affect the overall learning climate (Sharma, 2012). Conversely, when teachers receive proper training, their confidence and attitudes improve, which positively influences student performance (Loreman et al., 2013).

Teachers' limited exposure to special education often shapes their perception of inclusive teaching (Hsien, Brown, & Bortoli, 2009). They need professional development opportunities that address classroom management in diverse learning environments (Hwang & Evans, 2011). In addition, teachers require strategies for supporting students with disabilities while maintaining classroom expectations (Grskovic & Trzcinka, 2011). School administrators also play a vital role; therefore, they too need training to become effective instructional leaders who can guide teachers (Hertberg-Davis & Brighton, 2006). Similarly, special education teachers must receive

ongoing training to serve as consultants for general educators (Hamilton-Jones & Vail, 2014).

Since student achievement is directly influenced by teacher quality, the lack of proper preparation for handling diversity can hinder learning outcomes (Park & Oliver, 2009). When teachers are not trained to support students with disabilities, those students may not receive adequate instructional assistance (Horne et al., 2008). Cooper et al. (2008) found that about half of the teachers surveyed felt unprepared to meet the needs of students with disabilities alongside their general education students, which often led to classroom tension (Dee, 2011).

A major challenge is that many teacher education programs separate general education from special education training (Fullerton et al., 2011). This division leaves many teachers without the skills necessary to manage inclusive classrooms effectively (Dee, 2011). As a result, novice teachers often rely on administrators for support, yet many administrators themselves lack adequate knowledge in inclusive practices (Orr, 2009). Because professional development is often coordinated by these administrators, the cycle of insufficient training persists (McHatton et al., 2010).

Given that teacher competence is a critical factor in student achievement, insufficient preparation for differentiated instruction remains a serious issue (Smith & Tyler, 2011). Teachers need targeted training on the principles and application of differentiated instruction, along with continuous mentoring and planning time to successfully implement these practices (Kappler-Hewitt & Weckstein, 2012). Research shows that while many teachers are aware of differentiated instruction, they lack the practical

knowledge to apply it effectively in their classrooms (Chesley & Jordan, 2012; Dee, 2012).

Initial teacher training programs should, therefore, integrate inclusive education principles to better prepare teachers for diverse classrooms (Forlin et al., 2011). Unfortunately, both new and veteran teachers often report that their pre-service and in-service training do not adequately prepare them for inclusive settings (Ko & Boswell, 2013; Smith & Tyler, 2011). Hence, teacher education programs should require all educators to undergo training on supporting students with special needs and other diverse populations such as English Language Learners (Grskovic & Trzcinka, 2011).

Recent trends indicate that more institutions are now embedding special education content into general education courses (Fullerton et al., 2011). Nevertheless, many current teachers completed their education before these reforms and thus lack formal preparation in inclusive teaching (Grskovic & Trzcinka, 2011). Studies further reveal that some preservice teachers have never observed differentiated instruction during their teaching practice, leaving them without models to emulate (Martin, 2013).

It is increasingly expected that teachers, particularly at the high school level, possess the skills to support students with disabilities, as most of these students spend a significant portion of their day in general education settings (Fuchs, 2010; Grskovic & Trzcinka, 2011). This underscores the importance of inclusive education not merely as a temporary trend but as a long-term commitment to equity and access (McMaster, 2013; Orr & Goodman, 2010). Ultimately, equipping teachers with the appropriate training to implement differentiated instruction effectively can help them overcome

classroom challenges and significantly enhance students' academic achievement (Dixon et al., 2014).

2.4 Conceptual Framework

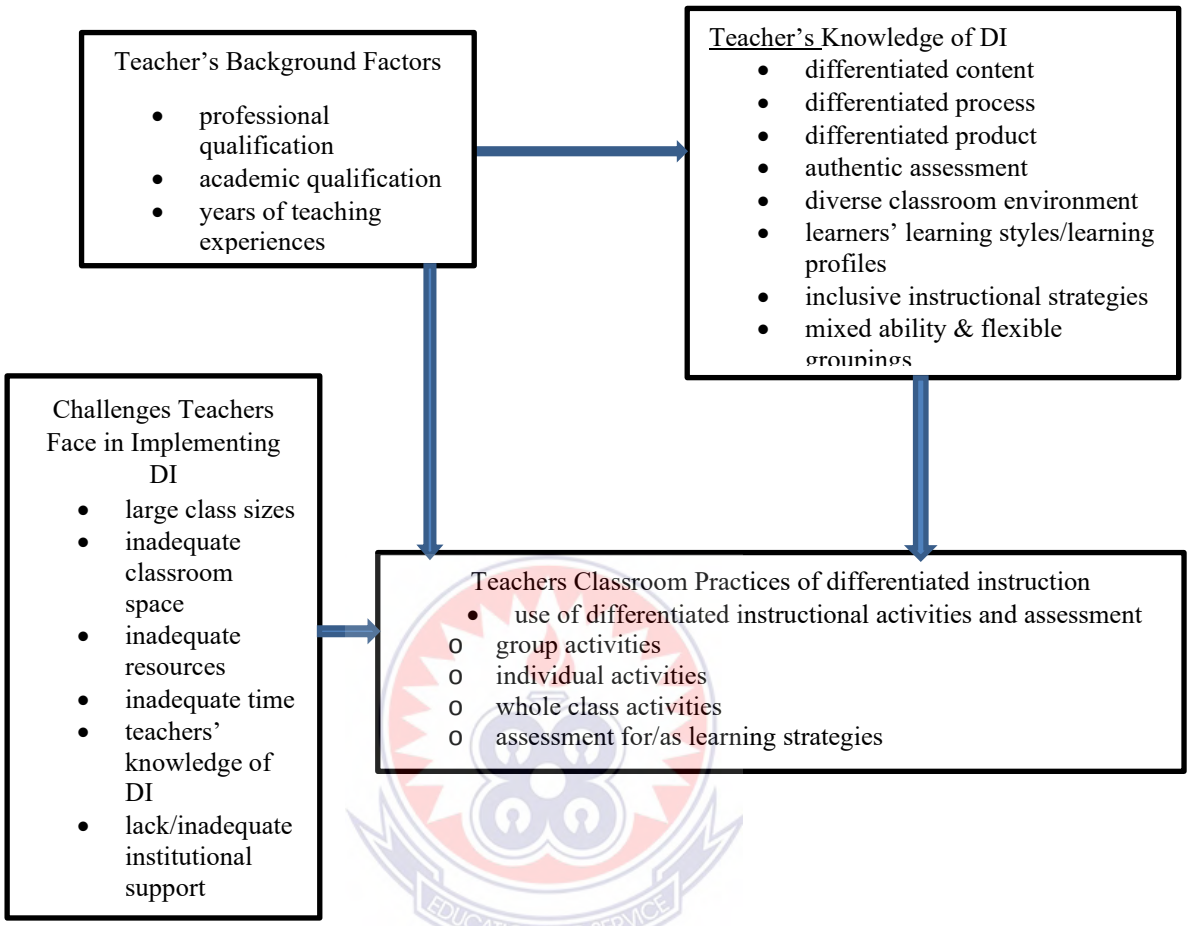
The conceptual framework for this study draws on both theoretical foundations and empirical evidence. Theoretically, it is anchored in Tomlinson's (1999) Differentiated Instruction (DI) model, which serves as the basis for examining how teachers implement DI in their classrooms. Within this framework, the extent to which teachers apply DI strategies is assessed through four key dimensions—content, process, product, and learning environment—outlined in Tomlinson's model.

Beyond the theoretical underpinning, insights from existing literature further inform the framework. Empirical studies reviewed earlier in this work highlight the interrelationships among teachers' self-efficacy, perceptions, knowledge, and their practical application of differentiated instruction. These findings have significantly shaped the conceptual orientation of the study and guided the formulation of the hypothesized relationships among the key variables, as illustrated in Figure 1.

Figure 1 provides a schematic representation of the conceptual framework, illustrating how teachers' background characteristics and their knowledge of differentiated instruction influence their classroom practices. It also highlights the various challenges teachers encounter when implementing DI. The framework emphasizes the dynamic interconnection between teachers' knowledge and their instructional practices, showing that effective implementation of DI depends largely on the teacher's understanding of its principles, theoretical foundations, and ability to integrate them into pedagogical processes. The model, adapted and modified from Hellman (2007), portrays the interactive relationship between teachers' knowledge, practice, and the challenges associated with differentiated instruction.

Figure 1

Conceptual framework



The conceptual framework maps how the study's variables interact. It posits that teachers' knowledge of differentiated instruction is shaped by their professional and academic qualifications as well as by their accumulated years in the classroom. National policy initiatives—most notably the Ministry of Education's inclusive-education reforms—have influenced teacher training curricula by introducing modules on special and inclusive education, thereby raising awareness of learner diversity at the primary level. In addition, in-service training workshops have exposed practising teachers to differentiation principles and strategies (Opoku, Nketsia, & Gyimah, 2021).

Length of service is also relevant: more years in the profession typically expose teachers

to a wider range of student needs (varying interests, learning preferences, and cognitive readiness), which in turn encourages the development of adaptive instructional techniques to meet those needs (Kuyini & Abosi, 2014). Experienced teachers often experiment with alternative approaches and resources to reach pupils who differ in readiness and learning style.

Nonetheless, implementing differentiated instruction is constrained by practical obstacles. Commonly reported barriers include oversized classes, limited classroom space, insufficient instructional materials, restricted teaching time, gaps in teachers' DI knowledge, and uneven institutional support. Traditional classroom layouts—rows of fixed desks facing a chalkboard—are widespread and make it difficult to reorganize seating for mixed-ability groupings or other flexible arrangements. These infrastructural and logistical problems undermine the routine practice of DI. Given these realities, the present study set out to assess teachers' knowledge of DI, how effectively they apply it, and how the factors above influence classroom implementation (Alhassan & Abosi, 2014).

Differentiation is motivated by the need to respond to each learner's individuality—differences in strengths, interests, background, and modes of thinking. This principle aligns closely with Gardner's theory of Multiple Intelligences (MI), which views cognition as plural and explains why students process and represent information in diverse ways (Gardner, 2003). The literature shows that MI and DI share foundations: both call for multiple access points to content and multiple ways for students to demonstrate understanding.

Teachers occupy a central role in translating DI theory into classroom practice. Their depth of knowledge about DI principles, methods, and assessment approaches strongly affects whether and how differentiation occurs. While some instructors may apply isolated differentiation techniques without formal training, those efforts are often sporadic and less effective than the practices of teachers who possess solid conceptual and pedagogical grounding in DI. Research suggests that teachers who understand the philosophical and procedural bases of DI are better positioned to design lessons that routinely accommodate learner differences (Tomlinson, 2010; Franz, 2009). Conversely, lack of knowledge and limited expertise deter many teachers from attempting sustained use of differentiated strategies (George, 2005; Whipple, 2012).

A supportive classroom environment is essential for DI to succeed. Theories such as Vygotsky's Zone of Proximal Development and Scaffolding, Cambourne's Conditions for Natural Learning, Clay's Emergent Literacy, Gardner's MI, and Piaget's cognitive-developmental perspectives all stress the importance of an inviting and responsive learning atmosphere. Practical elements of such an environment include well-organised routines and procedures, flexible furniture arrangements, accessible materials, and a positive emotional climate (Tomlinson, 2000). Affect—students' social and emotional states—matters a great deal; teachers should cultivate conditions in which learners feel safe, respected, and willing to take intellectual risks (Wormeli, 2007). When these environmental and affective conditions are in place, teachers can more readily differentiate other aspects of instruction.

Differentiation can be enacted across multiple instructional domains. Researchers commonly identify four primary areas for modification: content (what students learn),

process (how students come to understand ideas), product (how students demonstrate learning), and learning environment (where and under what conditions learning takes place). Planning is sometimes listed as a fifth dimension, because thoughtful design precedes effective differentiation (Tomlinson & Allan, 2000; Wormeli, 2007; Levy, 2008; Launder, 2011). Effective differentiation in each of these areas should be driven by three learner characteristics: readiness (prior knowledge and skill), interest (topics that motivate engagement), and learning profile (preferred modes of learning) (Gangi, 2011; Tomlinson, 2001).

Practical DI strategies span a wide array of classroom techniques. Examples include flexible lesson planning, respectful tasks that match learners' readiness, flexible grouping, ongoing formative assessment, learning contracts, interest-based groups, tiered assignments and products, Bloom's-taxonomy-informed tasks, choice boards, scaffolding, learning games, mini-lessons, independent study, reciprocal teaching, ICT integration, pre- and post-assessment, rubrics, self-assessment, timely feedback, learning corners, and peer tutoring. Teachers do not need to deploy every strategy simultaneously; rather, they should select a purposeful combination of approaches tailored to the learners and the instructional goals.

Underpinning all of these practices are the core DI commitments: acknowledgement of learner diversity, respect for individual differences, equitable access to learning opportunities, and the provision of multiple pathways to mastery. When educators design instruction around these principles, they move away from a one-size-fits-all model and toward a classroom in which every student can progress according to his or her unique profile (Tomlinson & Imbeau, 2010; Reis, 2018).

2.5 Summary of Related Literature Review

Worldwide, policymakers and educators share a common goal: to provide high-quality education that reaches every learner. Nations invest substantial resources toward this aim and continuously search for classroom approaches that improve learning outcomes. Among the various pedagogical options discussed in the literature, differentiated instruction (DI) frequently emerges as a recommended way to address diverse student needs.

Researchers have described DI in many different ways — as an approach, a philosophy, a strategy, a set of practices, or a way of organising teaching — rather than offering a single, universally accepted definition. Despite this conceptual variety, the literature consistently highlights two points: (1) classrooms contain learners who differ widely in prior knowledge, interests, learning preferences and readiness levels; and (2) instructional systems that ignore these differences are unlikely to enable every student to succeed. These observations form the rationale for DI and explain why many scholars and practitioners endorse it even though its implementation can be complex.

At its core, DI is learner-centred. It shifts attention from teaching that simply covers the required syllabus to teaching that actively adapts to what individual students need to learn and how they best learn it. When teachers tailor content, learning activities, assessment tasks and the learning environment to students' characteristics, curriculum goals and assessment targets are more likely to be met as a by-product of improved engagement and understanding. In practice, teachers commonly vary lessons through changes in planning, the materials and content presented, the learning processes used, the forms of student products or assessments, and the organisation of the classroom environment.

Empirical studies reported in the literature document both successes and challenges with DI. Many investigations show gains in student motivation, engagement and achievement when instruction is responsive to learner diversity. Other studies point to obstacles such as the additional planning time required, resource constraints, and uneven teacher preparation. Collectively, the evidence suggests that DI has strong potential but that its impact depends heavily on teacher knowledge, school support structures and thoughtful design of instructional tasks.

Carol Ann Tomlinson is widely recognised for articulating DI as a comprehensive way of thinking about teaching and learning; her work provides a conceptual backbone for many DI initiatives. Nevertheless, important gaps remain in the research base. In particular, there is limited, context-specific evidence about how integrated science teachers understand and put DI into practice, and about the professional learning they need to do so effectively.

To address these gaps, the present study focused on teachers' perspectives and practices in inclusive junior high school settings in Enugu State, Nigeria. The investigation examined the extent to which teachers use DI strategies, the difficulties they encounter when attempting to implement differentiation, the areas in which they require more information or support, and their professional development priorities related to DI. A range of differentiated strategies and classroom techniques was reviewed to contextualise these questions and to describe practical options for teachers.

The next chapter outlines the research design used for this study and provides a detailed account of the methods, instruments and procedures employed to gather and analyse data.

CHAPTER THREE

METHODOLOGY

3.0 Overview

The success and credibility of any research depend largely on how well relevant data are collected and analysed to address the problem under investigation. To ensure this, researchers employ systematic procedures and appropriate instruments for gathering information. The effectiveness of these methods directly influences the accuracy, reliability, and validity of the findings.

This study sought to explore the knowledge and classroom practices of differentiated instruction among Integrated Science teachers in public junior high schools within the Akwapem-South Municipality of Ghana's Eastern Region. This chapter, therefore, outlines the methodological framework adopted for the research. It presents detailed discussions on the research design, the study area, the target population, the sampling techniques and sample size, as well as the instruments used for data collection. Additionally, the chapter describes the pilot testing of the research instruments, the procedures followed during data collection, and the analytical methods employed to interpret the data.

3.1 Research Design

This study was anchored on the pragmatic research paradigm and employed a mixed-methods approach using a sequential explanatory design. This design was considered appropriate because it allowed the researcher to gain a more comprehensive and in-depth understanding of Integrated Science teachers' knowledge, practices, and challenges in applying differentiated instruction (DI) at the junior high school level. The mixed-methods approach integrates both quantitative and qualitative strands to provide a broader perspective of the research problem, helping to offset the weaknesses of each individual method.

Although quantitative research is often criticized for lacking contextual depth and qualitative research for potential subjectivity or limited generalizability (Ritchie, Lewis, Nicholls, & Ormston, 2013), combining the two ensured a more balanced and holistic interpretation of the data. The quantitative component involved administering a structured survey to assess teachers' knowledge and classroom application of DI. This approach made it possible to gather data quickly, maintain respondent anonymity, and generate statistically analyzable results. The qualitative component, on the other hand, complemented the quantitative findings by providing detailed insights into the experiences and challenges teachers faced in implementing differentiated instruction.

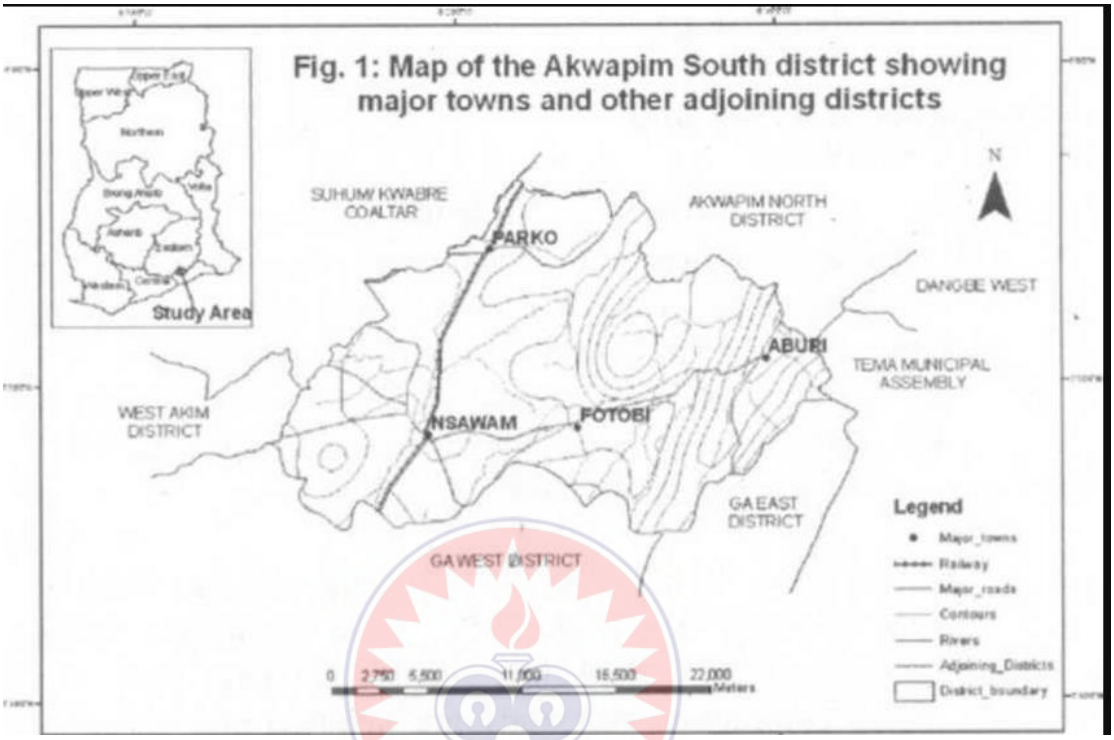
3.2 Study Area

The research was conducted in the Akuapem South Municipality, located in Ghana's Eastern Region. The municipality was established in 2012 through Legislative Instrument (L.I.) 2040 after being separated from the Nsawam/Adoagyiri Municipality, with Aburi designated as its administrative capital. It lies along the Accra–Koforidua highway and spans latitudes 5.5°N to 5.58°N and longitude 0.0°W, covering a total land area of about 224.13 square kilometers. According to available records, the municipality has a population of approximately 37,501 residents.

Akuapem South shares boundaries with Nsawam-Adoagyiri Municipality to the west, Kpone–Katamanso District to the southeast, Ga East Municipality to the south, and Akuapem North Municipality to the northeast. The area is noted for its strength in agriculture and tourism, which form the backbone of local economic activities. Consequently, municipal development plans are largely focused on promoting these sectors to stimulate growth in other areas. The municipality also hosts several educational institutions, including Aburi Girls' Senior High School, Adonteng Senior High School, Aburi Craft Village, and Ashesi University College located at Brekuso.

Figure 2

The Map of Akwapim South District



Source: Ghana Statistical Service (2021)

3.3 Population

The Akwapem South Municipality was selected as the site for this research primarily because of its proximity, accessibility, and the researcher's familiarity with the area, which made it easier to coordinate data collection activities effectively. At the time the study was conducted, the municipality had a total of 35 public junior high schools.

The target population included all Integrated Science teachers working in public basic schools within the municipality. However, the accessible population specifically focused on Integrated Science teachers teaching at the junior high school level in public schools within Akwapem South. In total, there were 35 Integrated Science teachers, each assigned to one of the 35 junior high schools in the area. These schools were

organized under four educational circuits, namely the Pakro Circuit, Nsaba Circuit, Kitase Circuit, and Aburi Circuit..

3.4 Sample Size

All the 35 Integrated Science teachers in the 35 public junior high schools in the Municipality were used for the study.

3.5 Sampling Technique

The census sampling technique was employed for the first phase of the study. This approach involved including every member of the accessible population in the research process. According to Parker (2011), a census sampling method is appropriate when the population size is relatively small and allows for the collection of data from all participants. Although this technique can be time-consuming and may require more resources, it offers key advantages, such as ensuring that each individual in the population is represented and providing comprehensive demographic information. Based on these merits, the researcher included all 35 Integrated Science teachers from the public junior high schools within the municipality to participate in this phase. These teachers completed a structured questionnaire developed by the researcher.

For the second phase, the study utilized a purposive sampling technique to select a subsample of 10 Integrated Science teachers. These participants were chosen based on their availability and willingness to take part in the follow-up stage. This phase involved classroom observations of the teachers during their lessons, followed by interviews to gain a deeper understanding of how they implemented differentiated instruction in their teaching practices.

3.6 Data Collection Instruments

The study employed three main data collection instruments: a questionnaire, an observation checklist, and an interview guide. The questionnaire was designed to gather

information on teachers' understanding of differentiated instruction and to examine how their background characteristics such as qualification, experience, and training affected their knowledge and use of this approach. The observation checklist and interview guide were administered to a smaller group of participants to obtain firsthand insights into how differentiated instruction was applied in their classrooms and to identify the difficulties they encountered in implementing it effectively.

3.6.1 Questionnaire

Using an existing research instrument is often more efficient than designing a new one, as it saves time and ensures the tool has been previously validated. For this reason, the Integrated Science Teachers' Knowledge and Practice of Differentiated Instruction Questionnaire (ISTKPDIQ) was adapted from earlier studies related to differentiated instruction. The questionnaire was used to collect information from junior high school Integrated Science teachers regarding their knowledge, classroom application, and challenges in implementing differentiated instruction. The ISTKPDIQ contained both closed-ended and open-ended questions (see Appendix B).

The instrument comprised 38 items divided into three sections. Section I included eight items that gathered participants' demographic information, such as gender, age range (21–59 years), educational qualification (degree, master's, or doctorate), area of specialization (general or special education), class level taught (JHS 1–3), years of teaching experience (1–30 years), and type of professional training received.

Section II focused on teachers' knowledge of differentiated instruction, consisting of 10 closed-ended items arranged on a four-point Likert scale, ranging from Not

Important (1) to Very Important (4). Respondents were required to tick the option that best represented their opinion for each statement.

Section III assessed teachers' classroom practices of differentiated instruction and included 11 closed-ended items measured on another four-point Likert scale, ranging from Never (1) to Always (4). Participants selected the response that best reflected how often they applied specific differentiation practices in their teaching.

Finally, Section IV contained nine open-ended questions that explored the challenges teachers faced when implementing differentiated instruction. This section enabled the collection of both quantitative and qualitative data for deeper analysis and interpretation.

3.6.2 Observation Schedule

The classroom observation component of this study was designed to validate and supplement the responses provided by teachers in the questionnaire regarding their knowledge, classroom practices, and challenges in implementing Differentiated Instruction (DI). Through direct observation, the researcher obtained first-hand evidence of how Integrated Science teachers in Junior High Schools applied DI principles during actual lessons. An observation checklist consisting of 25 items was used for this purpose. Of these, 15 items assessed teachers' knowledge of DI, six items focused on their classroom practices, and four items examined the challenges encountered in implementing DI strategies (see Appendix C).

3.6.3 Interview Guide

Following the classroom observations, semi-structured interviews were conducted to gain deeper insights into the findings from both the questionnaire and observation phases. This approach allowed participants to express their views openly and elaborate

on specific issues identified during observation. The interview guide, developed by the researcher with guidance from supervisors, contained 10 open-ended questions that aligned with the main research questions.

Specifically, three items addressed teachers' knowledge of Differentiated Instruction, four items focused on their practical application of DI in classroom settings, and three items explored the challenges teachers faced in implementing DI (see Appendix D). The open-ended nature of the questions encouraged participants to provide detailed and reflective responses, enriching the qualitative data collected.

Although interviews are valuable for obtaining in-depth explanations and clarifying observed behaviours, they may also present challenges such as interviewer bias, time constraints, and complex data analysis procedures. Nonetheless, their inclusion strengthened the study by offering a comprehensive understanding of teachers' experiences and perspectives regarding the implementation of Differentiated Instruction.

3.7 Validity of the Instruments

To establish validity, the research instruments were reviewed by the researcher's supervisor, three academic colleagues, and two experienced Integrated Science teachers. Their task was to assess whether each item aligned appropriately with the study's objectives and to evaluate the face validity of the instruments (Wallen & Fraenkel, 1991). Based on their feedback, necessary modifications were made to improve the clarity, relevance, and structure of the items. Issues such as vague instructions, unclear wording, and ambiguous statements were carefully revised or removed to strengthen the overall validity of the instruments.

3.8 Reliability of the Questionnaire

To determine the reliability of the questionnaire, a pilot study was conducted in the Akwapem North Municipality involving ten Integrated Science teachers. The use of ten participants was justified based on Field's (2013) assertion that a pilot sample may consist of about one-third of the intended study population. Responses to the closed-ended items were analysed to compute the Cronbach's alpha reliability coefficient, which yielded a value of 0.94. This high coefficient demonstrated that the questionnaire was highly reliable. According to Mieloo, Hein, and Wilma (2012), a Cronbach's alpha score of 0.70 or higher reflects an acceptable level of internal consistency, ensuring that the instrument can produce dependable and consistent results for the main study.

3.8.1 Trustworthiness of the interview Guide

The trustworthiness of the interview guide and the open-ended items in Part IV of the questionnaire was carefully ensured. As noted by Bryman and Cramer (2012), trustworthiness in qualitative research is grounded in four key components: credibility, transferability, dependability, and confirmability.

Credibility was established by ensuring that participants could identify their own experiences in the research findings. To achieve this, the researcher maintained prolonged engagement with the study participants, allowing sufficient time to understand their perspectives deeply and to minimize any possible distortions in the collected data. A member-checking procedure was also applied to enhance the accuracy and authenticity of the interview data. After each interview, both the audio recordings and their transcriptions were returned to the participants, giving them the opportunity to review and confirm that their views had been correctly represented. Confirmability was ensured by maintaining neutrality throughout the research process. This meant that findings were grounded in the participants' accounts rather than in the researcher's personal biases or assumptions. Bryman and Cramer (2012) explained that when a study demonstrates credibility and relevance, it also achieves confirmability.

3.9 Data Collection Procedure

3.9.1 Quantitative Data Collection

An introductory letter (Appendix A) obtained from the Department of Basic Education at the University of Education, Winneba, was presented to the Municipal Director of Education in the Akuapem-South Municipality to request permission to conduct the study in the selected schools.

The researcher personally delivered the letters to the participating schools and spent six days gathering quantitative data from all respondents. Prior to administering the questionnaire, the researcher met with the Integrated Science teachers to discuss suitable times for participation. During data collection, the purpose and significance of the study were clearly explained to the participants, ensuring their understanding and voluntary involvement.

3.9.2 Qualitative Data Collection

For the qualitative phase, ten Integrated Science teachers participated in classroom observations and interviews. Each teacher was visited twice — the first visit was to agree on appropriate dates and times for the observations and interviews, while the second visit involved observing the lessons and conducting the interviews immediately afterward.

The researcher acted as a non-participant observer, using an observation checklist to record how differentiated instruction strategies were applied in class. Each observation lasted for about 70 minutes, corresponding to a double lesson period, and was scheduled according to the regular school timetable to avoid disrupting normal activities.

Before conducting the interviews, participants were asked for permission to record the discussions. Afterward, each audio recording was played back to the respective interviewee to confirm that it accurately reflected their responses and experiences.

3.10 Data Analysis

The data was analysed both quantitatively and qualitatively.

3.10.1 Quantitative data analysis

The quantitative data for this study were gathered from Part II and Part III of the questionnaire as well as from the observation checklist. All quantitative data were analyzed using the Statistical Package for the Social Sciences (SPSS Version 16). Descriptive statistics such as frequencies and percentages were employed to summarize the data, and the results were displayed in tables for clarity. The findings of this analysis are presented in Chapter Four. Information obtained from the classroom observations was also compiled into frequencies, converted into percentages, and presented in tabular form for easy interpretation.

Additionally, a Spearman's Rank-Order Correlation (Spearman Rho) test was carried out to examine the relationship between teachers' knowledge and practice of differentiated instruction and their background characteristics, including educational qualifications and years of teaching experience.

3.10.2 Qualitative Data Analysis

The qualitative data, which addressed Research Question Four, were derived from the interviews and the open-ended items in Part IV of the questionnaire. All interviews were audio-recorded and later transcribed verbatim to ensure accuracy and completeness. The transcribed data were analyzed using the typological analysis approach, which involves organizing data into categories based on pre-established themes or typologies related to the study's research questions.

The researcher developed these typologies in line with the specific objectives of the study. Each transcript was carefully read, and relevant information was identified and highlighted according to the established categories. The researcher then summarized the main points from each interview on summary sheets. These summaries were reviewed and compared to identify recurring ideas and emerging patterns, which were subsequently refined into major themes representing the key findings from the qualitative data.

3.11 Ethical Considerations

The researcher adhered strictly to key ethical principles in conducting this study, particularly those related to voluntary participation, anonymity, and the protection of participants from any potential harm. Every step of the process was guided by established ethical research practices to ensure that the rights and dignity of participants were upheld throughout the study.

To maintain academic integrity, the researcher made deliberate efforts to avoid plagiarism by properly citing and acknowledging all sources of information used in the work. Relevant literature and previous studies referenced to support the discussions and analysis were accurately cited in-text and appropriately listed in the reference section.

Regarding informed consent, formal letters of introduction were sent to school

authorities to obtain approval before the commencement of data collection. These letters clearly outlined the purpose and objectives of the study, ensuring that both school heads and potential respondents were well-informed. Participation was entirely voluntary, and consent was obtained from all respondents before their involvement in the study.

To guarantee confidentiality and anonymity, participants were assured that their identities would not be revealed in any part of the research report. Each respondent was assigned a unique identification number instead of using their names on the questionnaire, ensuring that individual responses could not be traced back to them. This measure enhanced trust and encouraged honest participation.

Furthermore, participants were informed of their right to withdraw from the study at any point without facing any consequences. All completed instruments and recorded data were securely stored in a locked cabinet accessible only to the researcher. This was done to safeguard participants' information and uphold the ethical standards of confidentiality and data protection, as emphasized by Surmiak (2018).

CHAPTER FOUR

PRESENTATION OF DATA ANALYSIS AND DISCUSSING OF FINDINGS

4.0 Overview

This chapter presents the findings obtained from the data collected with the instruments used in the study. Descriptive statistics were used to analyse the quantitative data obtained from participants' responses to the closed-ended items of the questionnaire and from the classroom observations while the data from the open-ended items of the questionnaire and the interviews conducted were analysed using typological analytical approach. The outcomes of the descriptive statistics were presented in tables. The findings were used to answer the research questions. The findings were presented in two main sections. The first section was used to present the quantitative data of the respondents while the second part was used to present the qualitative data.

4.1 Research Question 1: **What is the knowledge level of Junior High School Science Teachers about differentiated instruction (DI)?**

Research question two sought to examine Integrated Science teachers' knowledge about DI in the Akuapem South Municipality. A questionnaire was used to collect data which was analysed descriptively. The results of the analysis are presented in Table 4.2.

Table 1

Mean of Teachers' knowledge of Differentiated Instruction (N=35)

Statement	SD F (%)	D F (%)	A F (%)	SA F (%)	MS	SD

1. I know individual student's interest and can relate it to instructions.	1 (2.9)	6 (17.1)	14 (40)	14 (40)	3.17	0.822
2. I know individual student's culture and expectations and can relate to instruction.	1 (2.9)	9 (25.7)	15 (42.9)	10(28.6)	2.97	0.822
3. I know individual student's life situations and how it may impact their learning.	1 (2.9)	4 (11.4)	15 (42.9)	15 (42.9)	3.26	0.780
4. I teach by assuring that each student works towards their highest potential.	2 (5.7)	0 (0)	16 (45.7)	17 (48.6)	3.37	0.770
5. Learners play a role in my designing/selecting learning activities.	1(2.9)	4 (11.4)	14 (40)	16 (45.7)	3.29	0.789
6. I adjust my teaching for diverse learner needs through scaffolding, tiering instruction.	2 (5.7)	6 (17.1)	13 (37.1)	14 (40)	3.11	0.900
7. The pace of my instruction varies to meet individual learner's needs.	3 (8.6)	1 (2.9)	12 (34.3)	19 (54.3)	3.34	0.906

Source: Field Data, (2022)

The table presents the percentage frequency distribution, mean scores, and standard deviations of participants' responses regarding their knowledge of Differentiated Instruction (DI). The mean scores of respondents' answers ranged between 2.97 and 3.66, while the standard deviations varied from 0.684 to 0.906. The item with the lowest mean score (M = 2.97, SD = 0.906) stated that teachers were aware of individual students' cultural backgrounds and expectations and could relate these to instruction. This suggests that teachers showed an average level of knowledge in that particular aspect of DI.

Conversely, the highest mean score (M = 3.66, SD = 0.684) corresponded to the item stating that assessment should be conducted at the end of each lesson to evaluate students' understanding. This indicates that most teachers strongly agreed on the importance of end-of-lesson assessments as part of differentiated instruction. The overall mean score of 3.30 (SD = 0.70) revealed that the majority of Junior High School (JHS) Integrated Science teachers possessed a moderate level of knowledge of DI, suggesting that they were generally capable of applying DI strategies in their lessons.

These results align with findings from Papanthymou and Darra (2023), who observed a significant positive relationship between teachers' knowledge of DI and the frequency of its implementation for learners with diverse needs. Similarly, Mengistie (2017) reported that although primary school teachers demonstrated a fair understanding of DI, their actual classroom application—especially in differentiating content—was limited. Furthermore, Pozas, Letzel, Bost, and Reichertz (2022) identified that teachers' attitudes, interest, and self-efficacy levels significantly influence how often they implement DI strategies. Likewise, Pozas, Letzel, and Schneider (2019) found that even when teachers use DI techniques, they tend to apply them infrequently. Supporting these findings, Amoakwah and Donkoh (2023) highlighted that many Ghanaian teachers have not received sufficient training in DI, which adversely affects both their understanding and classroom implementation of the approach.

4.4 Research Question 2: **What is Junior High School integrated science teachers' practice of differentiated instruction in the Akuapem South Municipality?**

Research question three aimed to explore the extent to which Junior High School (JHS) Integrated Science teachers in the Akuapem South Municipality apply Differentiated Instruction (DI) in their classroom practices. To address this, participants responded to the third section of the questionnaire, which contained 11 items measured on a four-point Likert scale. The response options were coded as follows: Never = 1, Less than once a month = 2, One to two times per month = 3, and One to two times per week = 4. The data gathered from these items were analysed using descriptive statistics, and the summary of the results is presented in Table 4.3..

Table 4.2: Percentage frequency distribution of the Sample's practice of Differentiated Instruction

Statement	Never (1) % freq.	Sometimes (3)% freq.	Often (2) % freq.	Always (4) % freq.
1. I keep a journal of my implementation of Differentiated Instruction.	12 (34.3)	12 (34.3)	9 (25.7)	2 (5.7)
2. I adjust content to meet each individual teacher's level of prior knowledge.	1 (2.9)	12 (34.3)	11 (31.4)	11 (31.4)
3. I adjust my instructional methods to align with students' learning.	2 (5.7)	11 (31.4)	9 (25.7)	13 (37.1)
4. I group my students according to their interests.	5 (14.3)	14 (40)	4 (11.4)	12 (34.3)
5. I provide alternative activities to accommodate the range of students learning styles in my classroom.	4 (11.4)	13 (37.1)	7 (20)	11 (31.4)
6. I adjust assessments to match the differentiated content.	2 (5.7)	16 (45.7)	8 (22.9)	9 (25.7)
7. I provide opportunities for students to choose their learning styles.	6 (17.1)	14 (40)	10 (28.6)	5 (14.3)
8. I provide resources that vary in familiarity to include all students in my class.	5 (14.3)	13 (37.1)	8 (22.9)	9 (25.7)
9. I group my students according to their learning styles.	5 (14.3)	12 (34.3)	10 (28.6)	8 (22.9)
10. I provide a variety of resources to meet individual students' learning styles.	4 (11.4)	13 (37.1)	9 (25.7)	9 (25.7)
11. I provide variety of assessment tasks to include all students in my class.	7 (20)	11 (31.4)	6 (17.1)	11 (31.4)

Source: Field Data, (2022)

Table 4.3 provides a summary of analysis of teachers' responses on their practice of DI. Considering students responses on the issue of "I keep a journal of my implementation of DI" 12 (34.3%) of the respondents responded never to the statement and 12 (34.3%) of the respondents sometimes kept a journal on their use of differentiated instruction. A further 9 (25.7%) of the respondents sometimes kept a journal while 2 (5.7%) of the respondents always kept a journal. about 34 % of the respondents often adjusted content to meet each individual teacher's level of prior knowledge while 11 of the respondents (31.4%) always differentiated the content. Similarly (31.4%) respondents sometimes differentiated content of their lessons.

With regards to "I Adjust my instructional methods to align with students' learning" about 37.1% of the respondents always did that while others (31.4%), often, (25.7%) sometimes, (5.7%) often, sometimes and never aligned instructional methods with students' learning respectively. On the item "I group my students according to their interests" 40 % of the respondents sometimes did that while 12 (34.3%) always and 11.4% often grouped their students based on their interests. However, 14.3 % of the respondents sometimes and 14.3% never group their students on the basis of their interests.

With respect to "I Provide alternative activities to accommodate the range of student learning styles in my classroom" a third (37.1%) of the respondents often did that while 11 (31.4%) often provide such alternatives. On the other hand, 7 (20%) of the respondents sometimes did that. Considering the teachers' responses to the item "I Adjust assessments to match the differentiated content" about half, 16 (45.7%) of the respondents while 9 (25.7%) often and always did that respectively. A further 8 (22.9%) of the respondents sometimes did that. An insignificant number of the respondents (2, 5.7%) never adjusted assessments to reflect differentiation of content.

In terms of "I Provide opportunities for students to choose their learning styles" 40 % (14) of the respondents often addressed learning styles of learners, while 5 (14.3%) respondents often did that. However, 10 (28.6%) sometimes addressed learning styles of their pupils and 6 (17.1%) of never considered the learning styles. Reference to "I Provide resources that vary in familiarity to include all students in my class" 13 (37.1%) of the respondents often provided resources for the lessons while 9 (25.7%) always provided resources. However, 8 (22.9%) of the respondents sometimes did that while 5 (14.3%) of them never provided varied resources.

The participants responses to the item "I group my students according to their learning styles" indicated about a third (12, 34.3%) of the respondents often grouped learning according to their learning styles while 8 (22.9%) of them always did. Ten (28.6%) respondents sometimes grouped learners according to their learning styles. The remaining five (14.3%) respondents never formed groups based on the learning styles of their pupils when forming groups.

With regard to "I Provide a variety of resources to meet individual teachers' learning styles" 13 (37.1%) of the respondents often provided variety of resources while 9 (25.7%) of the respondents sometimes did. Yet another 25.7% of the respondents always provided variety of resources. A small number of the respondents 4 (11.4%) never provided variety of resources to their learners. Concerning the issue of "I provide variety of assessment tasks to include all teachers in my class" about a third of 11 (31.4%) of the respondents often used variety of assessment tasks to assess their pupils while a similar number of respondents 11 (31.4%) always provided variety of assessment tasks to their pupils. A further 6 (17.1%) of the respondents sometimes used variety of assessment tasks.

Based on the responses in Table 4.3, it is established that the majority of the respondents indicated that they sometimes practised DI strategies in their integrated science lessons. This demonstrates that teachers practice DI strategies in the Akuapem South Municipality. This finding confirms those of Pozas, Letzel, and Schneider (2020), who found that while many teachers report using differentiated instruction, the frequency is often "sometimes," rather than "always." This finding also aligns with Milinga, Amani, & Lyakurwa (2023), who reported varied perceptions and implementation of DI for high-achieving students in Tanzanian secondary schools. This finding further

contradicts the study of Nedellec (2015) who states that even teachers who truly do differentiate their instruction may not do it on a regular basis.

4.3 Research Question 3: **How are the background factors influencing on the Public Junior High School Integrated Science teachers' knowledge and practice of differentiated learning in the Akwapem South Municipality?**

Part I of the questionnaire gathered data on the respondents' demographic data covering gender, age, level education, type of teacher, and current grade taught. The result is presented in Table 4.1

Table 4.3: Background Factors of Respondents (N= 100)

Variable	Frequency	Percentages (%)
Sex Distribution of Respondents		
Male	26	74.3
Female	9	25.7
Age Distribution of Respondents		
26-30	9	25.7
31-35	14	40
36-40	6	17.1
41-45	3	8.6
46-50	2	5.7
above 50	1	2.9
Level Education		
Bachelor's Degree	24	68.6
Master's Degree	1	2.9
Doctoral Degree	0	0
Others, please specify	10	28.6
Type of teacher		
General Education Teacher	34	97.1
Special Education Teacher	1	2.9
Current grade taught		
JHS1	16	45.7
JHS2	11	31.4
JHS3	8	22.9
Years of teaching experience		
1-5	7	20
6-10	14	40
11-15	5	14.3
16-20	4	11.42
21-25	2	5.71
26-30	2	5.71
31 +	1	2.86

Source: Field Data (2022)

From the Table 4.1, 35 teachers were sampled for the study out of which 26 representing 74.3% were males, while 9 representing 25.7% were females. The implication is that, the male respondents relatively dominated in the study.

The table also indicates that the age of majority of the respondents ranges from 26-30 years representing 14 representing 40% of the respondents. This was followed by those whose age ranges from 31-35 years who were 9 representing 25.7% of the respondents. The age of 6 representing 17.1% of the respondents ranges from 41-45 years. Further 3 representing 8.6% of the respondents' age range from 41-45years. While the age of 2 representing 5.7% of the respondents range from 46-50 years. Only 1 representing 2.9% of the respondents have the age above 50. The implication of this is that, the age of majority of the respondents ranges from 26 – 30 years in the Akuapem South Municipality.

The Table 4.1 further indicates that, majority of the respondents, 24 representing 68.6%, obtained Bachelor Degree as their highest level of education. While only 2.9% of the respondents had a Master's Degree as the highest level of education. Also 10 respondents, representing 28.6%had Diploma certificates. The implication is that, majority of the teachers who participated in the study had first degrees as their highest level of education.

The Table 4.1 also shows that, 34 representing 97.1% of the respondents were general education teachers, while 1 representing 2.9% of the respondents was a Special Education Teacher. Respondents who were general education teachers relatively dominated in the study. Table 4.1 indicates that 16 representing 45.7% of the respondents at the time of the study taught in JHS1, while 31.4% and 22.9% of the

respondents taught in JHS 2 and JHS 3 respectively. The implication is that, majority of the teachers who participated in the study taught in JHS1.

Table 4.4 indicated that the respondents had varied years of teaching experience. The number of years of teaching experience ranged from a range of 1-5 years to more than 30 years. The cluster for years of teaching experience had seven levels. The respondents with 6-10 years of teaching experience constituted the largest level (14, 40 %) while the level of more than 30 years of teaching experience at the time of the research had only one respondent.

4.5* Testing the Research Hypotheses*: What is the influence of the background factors of Junior High School science teachers on their knowledge and practice of differentiated instruction in the Akwapem South Municipality?

Null Hypothesis (H_0): There is no significant relationship between teachers' background characteristics and their knowledge and practice of differentiated instruction.

Alternative Hypothesis (H_1): There is a significant relationship between teachers' background characteristics and their knowledge and practice of differentiated instruction.

To test these hypotheses, a Spearman's Rank Order Correlation (Spearman's Rho) analysis was conducted. This statistical test was used to examine the degree of association between teachers' background variables—such as educational qualification and years of teaching experience—and their knowledge and implementation of differentiated instruction. The outcome of this analysis is summarized in Table 4.4.

Table 4.4: Results of Spearman Rho Correlations between Teachers' Background Factors and their Knowledge and Practice of DI

Items	Number (N)		Teacher's Knowledge	Teacher's Practice
Years of teaching experience	35	r	-.468	.104
		p-value	.050	.691
Educational Level	35	r	-.251	-.238
		p-value	.315	.358

Significant at p < 0.01 level (2-tailed).

The results of the correlational analysis indicated that teachers' background factors did not show a statistically significant relationship with their knowledge and practice of differentiated instruction. Specifically, years of teaching experience showed a negative, non-significant correlation with teachers' knowledge of DI [r(35) = -.468, p = .050] and a positive, non-significant correlation with their practice of DI [r(35) = .104, p = .69]. Similarly, educational level had a negative, non-significant correlation with teachers' knowledge [r(35) = -.051, p = .315] and practice [r(35) = -.238, p = .358] of differentiated instruction. Despite the lack of statistical significance, the results suggest that teachers' knowledge of DI could potentially improve with higher educational qualifications.

These findings align with Owusu and Mensah (2022), who reported that teachers' background characteristics, such as years of experience and educational attainment, were not significant predictors of their knowledge or implementation of DI, indicating that formal qualifications or length of service alone may not guarantee effective practice. Likewise, the results support the observations of Adjei (2023), who found non-significant correlations between teachers' demographic variables and their use of differentiated instruction, although higher educational levels were associated with somewhat greater familiarity with DI principles.

4.6 Research Question 4: What **challenges do Science Teacher's face in the implementation of Differentiated Instruction in the Akuapem South Municipality?**

Part IV of the questionnaire focused on identifying the challenges that Integrated Science teachers encounter when implementing differentiated instruction in the Akuapem South Municipality of the Eastern Region of Ghana. This section included

nine open-ended items designed to capture the teachers' perspectives on difficulties related to DI implementation. The participants provided brief written responses to each question. The qualitative data collected from these responses were then summarized and organized according to the specific items to highlight the main challenges reported by the teachers.

Item 42: Teachers' perceptions of assessments with students with disabilities

Item 42 sought to understand how Integrated Science teachers feel about conducting assessments when students with disabilities are present in their classrooms. The responses indicated that teachers faced challenges in implementing differentiated instruction in these situations. Many teachers expressed discomfort with assessments involving students with disabilities. For instance, one teacher noted: "I feel it slows down the pace of assessment; it makes assessment difficult." This suggests that teachers have had prior difficulties and feel uneasy about evaluating students when DI principles need to be applied.

Item 43: Differentiated instruction strategies used in classrooms

Item 43 explored the strategies that Integrated Science teachers employ to implement differentiated instruction in their lessons. The responses revealed that some teachers used ability grouping and motivational strategies, while others reported using inclusive teaching approaches. A few teachers mentioned providing individualized attention, whereas others admitted having limited knowledge of differentiated instruction strategies. Overall, the responses suggest that many teachers do not consistently apply DI strategies in their classrooms.

Item 44: DI strategies for special needs students

Item 44 aimed to determine which differentiated instruction strategies were specifically used for special needs students. Most teachers indicated employing general instructional strategies such as reading buddies, audio resources, role-playing, and assigning leadership roles, rather than specific DI strategies tailored to the needs of these students. This indicates that teachers generally lack adequate knowledge of proper DI strategies for special needs learners.

Item 45: Challenges in addressing the needs of special needs students

Item 45 sought to identify the challenges teachers face in meeting the needs of special needs students. Teachers reported several difficulties, including lack of support from the education office, large class sizes, time constraints, insufficient teaching resources, and limited funding. These responses suggest that teachers encounter multiple barriers in effectively addressing the needs of special students.

Item 46: Adaptations needed for special needs students

Item 46 asked teachers to describe the types of adaptations necessary for special needs learners. Many teachers admitted they were unaware of the specific accommodations required. Some responses mentioned the need for stationery, uniforms, financial assistance, or laptops for typing exercises. These responses indicate a general lack of knowledge among teachers regarding appropriate accommodations for special needs students.

Item 47: Support from school administration

Item 47 examined the support that teachers receive from the Akwapem South Municipal education office. Most respondents indicated that they did not receive any support from their administration.

Item 48: Positive effects of administrative support

Item 48 investigated whether the support, if any, provided by the administration had positive effects on the teachers. The responses revealed that, since most teachers did not receive support, no positive effects were reported.

Item 49: Negative effects of administrative support

Item 49 explored whether any negative effects resulted from the support provided by the administration. Teachers largely indicated that, due to the absence of administrative support, no negative effects were experienced.

4.8 Participants Responses to the Interview Questions

The study collected qualitative data using a 22-item interview guide, which was administered to 10 Integrated Science teachers (labeled T1 to T10) in the second phase of the research. These interviews explored findings from the questionnaire, focusing on the teachers' knowledge, practices, and challenges regarding differentiated instruction (DI).

To assess the influence of teachers' background factors on their knowledge and practice of DI, participants were asked whether they had any prior experiences or training that informed their understanding of DI. For instance, T1 stated that the only relevant experience was a special needs program workshop attended years ago, noting: "Not really. The only workshop I can relate to differentiation was the special needs program we had years ago. That was the only one; since then, I haven't encountered anything else." T2 indicated no prior background knowledge in DI, saying: "I do not have any background knowledge about differentiated instruction; I only know different general teaching methods."

Analysis of the interview data revealed that most teachers in the Akuapem South Municipality had limited understanding of DI. When asked about their knowledge level, T3 described it as: “Differentiated instruction is just about using different methods to teach so that students can understand the concept.” Similarly, T4 remarked: “I do not have much knowledge, but I understand it somewhat as teaching students from different backgrounds, considering their interests and culture.” These responses demonstrate that teachers possessed only a basic or partial understanding of DI concepts.

Consequently, their classroom practices reflected this limited knowledge. When asked which DI strategies they applied, T5 admitted: “Since I do not know much about differentiation, I cannot differentiate or say if I am implementing it.” T6 similarly noted: “I have never heard of differentiated instruction, so I do not know how to apply it in class.”

Regarding challenges in implementing DI, teachers mainly reported general classroom difficulties rather than DI-specific issues. Common obstacles included insufficient teaching and learning materials, large class sizes, and time constraints. For example, T7 stated: “Lack of teaching and learning materials, time constraints, and class size are my main challenges.” T8 echoed this, adding: “The main problems are getting adequate teaching resources and managing the large class size.”

Observations made by the researcher largely confirmed these responses. Teachers demonstrated limited knowledge of DI and, as a result, were unable to implement it in their classrooms. Consequently, when asked about challenges, teachers focused on general teaching difficulties rather than issues specific to differentiated instruction..

4.9 Discussion of the Findings

4.9.1 Science Teachers' Knowledge about Differentiated Instruction in the Akwapem South Municipality

The study examined Integrated Science teachers' knowledge of differentiated instruction (DI) across ten sub-concepts, including learner diversity, learner interest, learning styles, lesson planning, lesson content, teaching processes, and assessment strategies. The findings revealed that teachers demonstrated low levels of knowledge in DI, with an overall mean score of 3.30 (SD = 0.70). This suggests that while teachers generally agreed with the statements, their understanding of the various aspects of DI was limited.

This finding aligns with Whipple (2012), who reported that many teachers lacked sufficient knowledge of DI concepts. The current study similarly found that Junior High School Integrated Science teachers had minimal understanding of DI. However, these results contrast with those of Kyeremeh, Adzifome, and Amoah (2022), whose study indicated that teachers possessed strong DI knowledge after receiving specialized training. In the present study, teachers exhibited some awareness of DI despite not having undergone formal training, which prompted classroom observations to investigate how DI principles were applied in teaching, including lesson content, delivery methods, and assessment practices.

Observations revealed that teachers in the Akuapem South Municipality largely did not differentiate lesson content effectively. Instead, instruction often followed traditional, one-size-fits-all approaches, which have been shown to be less effective (Tomlinson et al., 2003). These findings highlight the need for teachers to adjust their instructional

methods to address the unique needs and characteristics of each learner to promote quality learning. Kameenui and Carnine (1998) caution that instructional strategies that fail to consider learners' diverse needs may increase the risk of academic underachievement.

Even though teachers demonstrated awareness of DI sub-concepts, classroom practices showed that lessons were not consistently designed to meet learners' varied needs, potentially putting students at greater risk of poor academic outcomes. Gardner (2009) emphasizes that learners possess distinct intelligence strengths and benefit from multiple entry points into learning. The teachers' limited application of DI indicates a gap in implementing multiple intelligences principles, as lessons were not consistently tailored to these strengths.

Similarly, Vygotsky's (1998) theory of scaffolding highlights the importance of adapting tasks to learners' readiness levels. The study found that teachers frequently relied on uniform teaching methods, neglecting opportunities to scaffold learning within students' zones of proximal development (ZPD), which reflects their limited practical understanding of differentiated instruction..

4.9.2 Integrated Science teachers' practice of Differentiated Instruction in the Akwapem South Municipality

The findings of this study indicated that most participants reported only occasionally implementing differentiated instruction (DI) strategies in their classrooms. This aligns with Abora's (2015) study, which found that teachers demonstrated limited application of DI despite having a fair understanding of its principles. Similarly, Whipple (2012) observed that teachers often understand DI concepts more than they actually implement them. As a multi-layered and complex instructional approach, DI requires Integrated

Science teachers to adjust their daily teaching practices significantly. Research on teaching in mixed-ability classrooms shows that although teachers recognize student diversity, especially academically, many do not take meaningful steps to address it (Kuyini & Desai, 2008).

Although the literature emphasizes the importance of instructional adaptations such as curriculum compacting, flexible grouping, tiered activities, and learning centers (Tomlinson, 2001), this study found minimal evidence of these strategies being employed. Interviews with teachers revealed that most commonly, they relied on co-teaching and small-group instruction. A few teachers also mentioned individualized teaching as a strategy they used to differentiate instruction.

However, Roy et al. (2013) caution that differentiated instruction should not be confused with individualized instruction. While DI does aim to address individual learner needs and provide multiple pathways to learning, it does not necessarily require separate assignments for each student (Tomlinson, 2001). Instead, DI involves balancing whole-class teaching, small-group instruction, and individual attention, ensuring that all students engage meaningfully with core concepts while fostering a sense of community within the classroom.

The study also highlighted limited use of strategies aligned with the principles of multiple intelligences (MI), such as music, spatial, or bodily-kinesthetic approaches, which suggests that teachers were not fully implementing “multiple entry points” for learning. Effective DI should involve scaffolding and flexible grouping to match tasks with students’ developmental readiness, consistent with Vygotsky’s zone of proximal

development (ZPD). The teachers' restricted use of DI strategies indicates that these scaffolding practices were not widely applied in their classrooms.

4.9.3 The influence of the background factors of Differentiated instruction science teachers on their knowledge and practice of differentiated instruction in the Akwapem South Municipality

The correlational analysis presented in Table 4.4 (p. 72) revealed that there was no statistically significant relationship between teachers' educational level and their knowledge or practice of differentiated instruction. Similarly, the analysis showed no significant correlation between teachers' years of teaching experience and their knowledge and application of differentiated instruction. These results align with the questionnaire findings, which suggested that while respondents demonstrated moderate knowledge of differentiated instruction, several factors hindered their effective implementation in integrated science lessons. Interview data further highlighted challenges such as limited familiarity with specific DI strategies, insufficient preparation time, lack of adequate teaching resources, and, in some cases, large class sizes. Interestingly, 40% of respondents reported having six to ten years of teaching experience, yet these challenges still limited consistent use of differentiated instruction. Despite these obstacles, most teachers indicated that they occasionally applied DI strategies in their classrooms.

Although it might be expected that teachers' educational qualifications would significantly influence their knowledge and practice of DI, the results did not show this effect. This is notable because professional and academic qualifications are generally associated with teaching quality and pedagogical competence (Hightower et al., 2011).

Similar findings by Ngman-Wara (2012) indicate that science teachers' professional qualifications are positively related to their knowledge of science instruction, and other studies have emphasized that higher educational attainment can enhance effective DI practices (Anamuah-Mensah et al., 2007).

Additionally, teachers with six to ten years of experience might be expected to demonstrate stronger implementation of DI, assuming their experience would expose them to diverse instructional methods and innovative strategies to meet students' varied learning needs. Prior research suggests that teachers' effectiveness in DI is often linked to both years of experience and educational level (Goe, 2007). Experienced teachers are more likely to have attended professional development programs, workshops, or in-service trainings that introduce novel classroom practices designed to enhance student engagement and understanding (Ngman-Wara, 2012).

Constraints such as limited time, inadequate resources, and large class sizes hinder teachers from customizing lessons to match learners' multiple intelligence strengths, as recommended by MI theory. These limitations also prevent effective scaffolding and individualized support within students' zones of proximal development (ZPD), reducing the potential for guided collaboration and adaptive learning in the classroom.

4.9.4 Challenges Differentiated instruction science teacher's face in the implementation of Differentiated Instruction in the Akwapem South Municipality

While differentiated instruction (DI) has been shown to enhance student learning, it presents several practical challenges for teachers. One of the most significant obstacles is managing large class sizes alongside limited time, which makes it difficult to implement differentiated strategies effectively. Teachers in the study reported that

keeping a large number of students focused on tasks often reduces the time available for planned learning activities. They also mentioned that organizing students into groups and providing immediate feedback through assessments is time-consuming. This aligns with findings by Amadio et al. (2014), who noted that additional time demands on top of daily responsibilities, such as grading, club supervision, and administrative tasks, are among the main challenges in implementing DI. Similarly, Joseph et al. (2013) described DI as a labor-intensive process requiring extensive planning, organization, and scheduling, particularly in large classrooms.

Addressing learner diversity requires teachers to understand each student's current knowledge and readiness levels. The findings from this study revealed that many teachers lacked the skills to assess and respond to students' varying academic needs, which limited their ability to tailor instruction effectively. Differentiated instruction can only be successful when teachers are able to identify and address both individual and collective readiness levels. Teachers also noted that limited administrative support hindered their practice of DI. For successful implementation, school leadership should provide necessary teaching resources and facilitate professional development programs to equip teachers with effective pedagogical strategies.

Weber and Brown (2013) highlighted that effective DI implementation depends on three key factors: support that builds teacher confidence, classroom practices that facilitate differentiated strategies, and attributes that can either enhance or impede differentiation. Collaboration and guidance from experts are essential to ensure that DI strategies are applied effectively across curricula.

Other challenges identified by teachers included insufficient classroom space for group activities and the pressure of preparing students for standardized tests. Tomlinson (1995) similarly identified concerns about student assessment and test preparation as barriers to DI. Little (2001) argued that reform demands often move faster than the pace of learning, meaning that the time required to implement DI exceeds what is expected by standards-based policies. By emphasizing rigorous, standards-aligned learning for all students, Little suggested that frameworks such as Understanding by Design could support effective implementation of DI principles.

4.10 Summary of Key Findings

This chapter presented and analyzed the study's findings in relation to the research objectives and questions. The results revealed that Junior High School Integrated Science teachers in the Akuapem South Municipality demonstrated a generally low level of knowledge regarding differentiated instruction (DI). While some teachers showed familiarity with aspects such as learner diversity, readiness levels, and scaffolding, most did not possess a full understanding of DI as a teaching approach.

Regarding classroom practice, the study found that teachers occasionally applied DI strategies, including small-group activities and individualized attention. However, evidence from lesson observations and interviews indicated that the use of DI was limited, inconsistent, and often conflated with general instructional methods.

The analysis of teachers' background factors, such as years of teaching experience and educational qualifications, showed no significant effect on their knowledge or practice of DI. This suggests that formal training and professional development programs are more critical than experience alone in developing teachers' capacity to implement differentiated pedagogy effectively.

Teachers also identified several barriers to implementing DI in their classrooms. These included insufficient teaching and learning materials, large class sizes, limited time for lesson preparation and execution, and lack of support from school administration. Observations and interview responses confirmed these challenges. The findings indicate a clear gap between teachers' limited understanding of DI and their classroom practices. They also reveal systemic constraints that hinder the effective integration of differentiated instruction in Junior High School science lessons. These insights provide the foundation for the conclusions and recommendations outlined in the subsequent chapter.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

This chapter is the final chapter which provides a brief overview of the study and reports the main findings of the study. It also presents the recommendations for practice and new areas for further research.

5.1 Summary of the Study

The study investigated public junior high school integrated science teachers' knowledge and practices of DI in the Akuapem South Municipality, Eastern Region of Ghana. The following research objectives were formulated to guide the study to:

1. Determine Junior High School Science Teachers' knowledge of Differentiated Instruction in the Akuapem South Municipality.
2. Explore Junior High School Science Teachers' classroom practices of Differentiated Instruction in the Akuapem South Municipality.
3. Examine background factors that influence Junior High School Science Teachers' knowledge and practice of Differentiated Instruction (DI) in the Akuapem South Municipality.
4. Explore the challenges faced by Junior High School Science Teachers face in the implementation of Differentiated Instruction in the Akuapem South Municipality.

The researcher employed a mixed-methods approach for this study, as it was deemed the most suitable for addressing the research questions. Specifically, an explanatory mixed-methods design was adopted. The study population consisted of teachers from the Akuapem South Municipality. For the first phase, which involved the collection of quantitative data, a census sampling technique was used to include all 35 teachers in

the study. For the second phase, which focused on lesson observations and semi-structured interviews, 10 participants were selected using convenience sampling.

Data were collected through a questionnaire, an observation checklist, and a semi-structured interview guide. Quantitative data were analyzed using descriptive statistics, including frequencies and percentages, while qualitative data were examined through thematic analysis. The analysis yielded the following key findings.

5.2 Main Findings

1. The overall mean for the items was (3.30, SD=0.70) which indicated that JHS integrated science teachers generally agreed to the statements which suggested their fair knowledge of differentiated instruction and they should be able to successfully implement differentiated instruction in their integrated science lessons
2. The respondents indicated that they sometimes practised differentiated instruction strategies in their integrated science lessons. This demonstrates that teachers practice DI strategies in the Akuapem South Municipality.
3. The result of the correlational analysis showed that two of the background factors had no statistically significant correlation with upper primary integrated science teachers' their knowledge and practice of differentiated instruction
4. The respondents reported a number of challenges that inhibit their practice of DI. These included: teachers' limited knowledge of differentiated instruction, inadequate teaching and learning resources, time constraint to implement differentiated instructional strategies, and large class sizes discouraged teachers' use of DI strategies.

5.3 Conclusion

The findings of the study indicated that participants generally had limited understanding of differentiated instruction (DI). While Junior High School teachers showed some awareness of how to support different groups of students—such as fast, average, and slow learners—they lacked knowledge of concrete strategies to manage mixed-ability classrooms effectively and engage all students simultaneously. The study also revealed that the actual implementation of DI was lower than the level of understanding. Differentiation of lesson content was the least practiced aspect.

Several factors contributed to the infrequent use of DI in classrooms. These included insufficient knowledge of specific strategies, limited time to prepare differentiated lessons, and a lack of teaching and learning resources. Additionally, some teachers reported that large class sizes constrained their ability to apply DI effectively. The demands of teaching, including extra responsibilities, also restricted opportunities for lesson planning and reflection, further limiting the practice of differentiated instruction.

5.4 Recommendations

On the basis of the conclusion made in this study, an attempt is made to forward the following relevant recommendations:

1. Based on the findings of the research, it has been recommended that the Akwapem-South Municipal Directorate of the Ghana Education Service should organize in-service programmes, workshops, seminars and short courses on the differentiated instructional strategies to give teachers hands-on training on DI.
2. Most Integrated Science teachers reported insufficient time to implement differentiated instruction due to large class sizes. Therefore, it is recommended that the Ghana Education Service provide additional classrooms in the various Junior High Schools in the Akwapem South Municipality to reduce class sizes.

This would give teachers greater opportunities to work individually with students, thereby enhancing the effective implementation of differentiated instruction.

3. Head teachers of public junior high schools in the Akwapem South Municipality should organise ongoing professional development with attention to instruction, materials, and assessments that are especially appropriate for diverse students.
4. The Ghana Education Service, in collaboration with schools, should ensure adequate supply of teaching and learning resources to support the effective practice of DI in science classrooms. This includes instructional materials, technology, and space for flexible grouping.

5.5 Suggestion for Further Research

The scope of the study was limited to the Akuapem-South Municipality, and as such, the findings may not be applicable to other areas. It is recommended that future research be conducted across all schools in the municipality to provide a more comprehensive understanding of how differentiated instruction is implemented.

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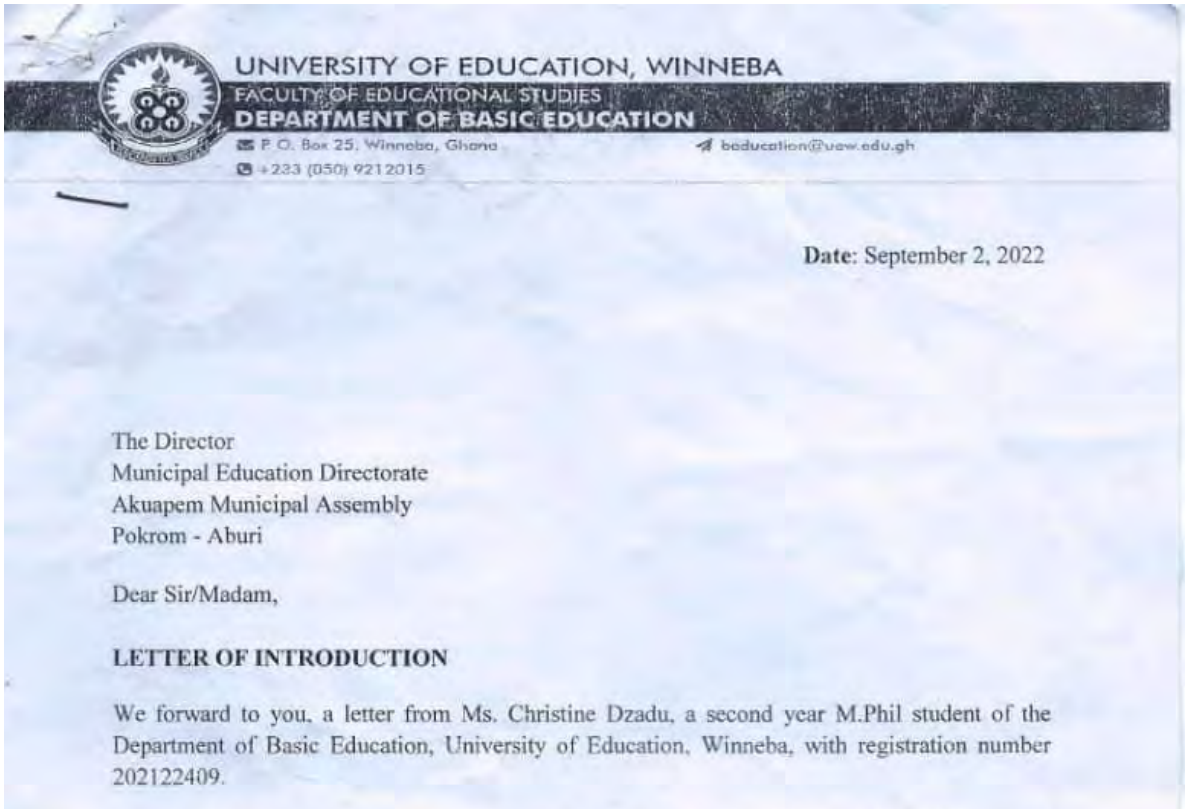
APPENDICES

APPENDIX 'A'

INTRODUCTORY LETTER FROM THE DEPARTMENT OF BASIC EDUCATION UNIVERSITY OF EDUCATION, WINNEBA



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Date: September 2, 2022

The Director
Municipal Education Directorate
Akuapem Municipal Assembly
Pokrom - Aburi

Dear Sir/Madam,

LETTER OF INTRODUCTION

We forward to you, a letter from Ms. Christine Dzadu, a second year M.Phil student of the Department of Basic Education, University of Education, Winneba, with registration number 202122409.

APPENDIX 'B'

Teachers' Knowledge, Practice and Challenges of Differentiated Instruction Questionnaire (TKPDIQ)

Part I: Background Data

Please complete the following questions by ticking in the appropriate box: √

1. Gender:

(1) Male ☐ (2) Female ☐

2. Your age range is:

(1) 21-25 years ☐ (2) 26-30 years ☐ (3) 31-35 year ☐ (4) 36-40 years ☐

(5) 41-45 years ☐ (6) 46-50 years ☐ (7) 51-59 years ☐

3. Education Level (check all that apply):

(1) Bachelor's Degree ☐ (2) Master's Degree ☐ (3) Master's Degree ☐

(4) Doctoral Degree ☐ (5) Others ☐

Please specify _____

4. What type of teacher are you?

(1) General Education Teacher ☐ (2) Special Education Teacher ☐

5. Current grade taught

(1) JHS1 ☐ (2) JHS2 ☐ (3) JHS3 ☐

6. How many years have you been teaching?

(1) 1-3 years ☐ (2) 4-10 years ☐ (3) 11-15 years ☐ (4) 16-20 years ☐

(5) 21-25 years ☐ (6) 26-30 years ☐ (7) 30+ years ☐

8. If you have been trained in Differentiated Instruction, what type of training have you had (tick all that apply)?

(1) Course from college ☐ (2) University ☐ (3) Teleconference ☐

(4) Learned on my own through readings ☐ (5) Mentored by a colleague ☐

(6) In-service activity ☐ (7) Conferences, meetings, or workshops ☐

(8) Other: ☐ Please specify _____

Directions

This questionnaire asks you to provide your expressed opinions on the items in respect of your knowledge, practice and challenges of differentiated instruction in your school. It is not a test and there is no right or wrong answer. The Researcher is interested in your views on differentiated instruction which would be useful in improving the use of differentiated instruction in our classrooms

Please indicate with a tick (√) under the appropriate column under your selected expressed opinion: (Strongly Disagree =SD; Disagree =D; Agree =A; Strongly Agree =SA) on the item or statement.

Part II: Knowledge of/about Differentiated Instruction

S/N	Statement	SD	D	A	SA
9	I know individual student's interest and can relate it to instruction.				
10	I know individual student's culture and expectations and can relate to instruction.				
11	I know individual student's life situations and how it may impact their learning.				
12	I assess at the end of the lesson to determine knowledge acquired by the students.				
13	I teach by assuring that each student works towards their highest potential.				
14	Learners play a role in my designing/selecting learning activities.				
15	I adjust my teaching for diverse learner needs through scaffolding, tiering instruction.				
16	I adjust my teaching for diverse learner needs by providing the student choice in learning activities				
17	The pace of my instruction varies to meet individual learner's needs				

Part III: Practice

Please indicate with a tick (√) under the appropriate column under your selected expressed opinion: (Never = 1; Less than once a month = 2; 1 to 2 times per month = 3; 1 to 2 times per week = 4; 3 to 5 times per month) on the item or statement.

S/N	Statement	1	2	3	4
18	I keep a journal of my implementation of differentiated Instruction				
19	I adjust content to meet each individual students' level of prior knowledge				
20	I adjust instructional methods to align with students' learning Rate				

21	I group my students according to their interests
22	I provide alternative activities to accommodate the range of student learning styles in my classroom
23	I adjust assessments to match the differentiated content
24	I provide opportunities for students to choose their learning Activities
25	I provide resources that vary in familiarity
26	I group my students according to learning styles
27	I provide a variety of resources to meet individual students' learning styles
28	I provide variety of assessment tasks

Part IV: Challenges

Please indicate by writing on the appropriate space, your opinion to the following statements below.

29 How do you feel about assessments when students with disabilities are in your clas room?.....

.....

30 What differentiated instruction strategies do you use in your classroom?.....

.....

.....

31 What challenges did you face when using these differentiated instruction strategie?

.....

.....

32 What differentiated instruction strategies did you use for special needs students in your class?.....

.....

33 What challenges did you encounter in meeting the needs of the special needs students in your class?.....

.....

34 Could you tell me about the types of accommodations that are needed for the special needs child/children in your class?.....

.....

.....

35 What supports did you receive from the administration?.....

.....

.....

36 Were there any negative effect from having this support at number 48 above? (Plea se elaborate)……

……

37 Were there any negative effects of the support from at 48 above?.....

.....

.....

APPENDIX 'C'

Checklist to Observe Differentiated Instruction by Teachers at Work

ITEMS	YES	NO	COMMENT

The structure, organization, and development of a lesson

Are tables and seating arrangements varied to accommodate student group work?

Are there areas for collaborative activities and other areas for solitary, independent work?

Has the lesson been structured in a particular way to accommodate student differences?

Are there explicit displays of classroom roles, expectations, and routines?

Are there schedules on display that indicate a systematic plan for the lesson's activities?

Is there a statement of the rules and behavioural expectations within the classroom?

Classroom Management

Is there evidence of overt and explicit classroom management strategies in place?

Are there procedures in place to minimize unacceptable behavior and reinforce acceptable behavior?

Are there visual cues (for example wall charts) that outline the consequences of unacceptable behaviour?

Is the teacher's role one of a facilitator and participant in this setting?

Has the flow of the lesson been timed to allow for smooth transitions between activities and teaching?

Differentiated strategies/techniques during teaching

Have varied activities and techniques been utilized during the teaching segment of the lesson?

Is there a combination of whole-group and small-group teaching as part of the lesson?

Are groups formed flexibly or along ability levels?

Is the lesson paced appropriately to accommodate different ability levels and learning styles?

Is key information presented in different ways repetitively during the course of the lesson?

Differentiated activities, materials, and teaching aids

Are the activities and materials used during the lesson age/grade-appropriate and engaging to students?

Have the activities considered the varying interests/learning profiles and ability levels in the classroom?

Is technology used as part of the lesson?

Is the use of technology (such as iPads, laptops, and computers) negotiated well to accommodate different learning profiles?

Are the activities an extension of the lesson, and do they reinforce skills taught?

Differentiated assessments and application

Are there different assessment tasks offered to students to demonstrate their understanding of the knowledge or concept?	
Are the assessment tasks sensitive to student diversity?	
Are students permitted to demonstrate understanding using different mediums (for example, presenting information through a video clip as opposed to a written piece?).	
Is the assessment task mindful of the relevant policy documents that govern evaluation and progression at different grade/year levels?	
Are tasks modified to accommodate students with additional learning needs?	

Source: (Richards & Farrell, 2011)

APPENDIX 'D'

TEACHERS INTERVIEW GUIDE

Teachers Interview Questions

1. Tell me about your teaching experience.

2. What grades do you currently teach?

3. What is your current classroom size?

4. How does differentiated instruction fit into an ideal classroom?

5. How did the differentiated instruction training at the Columbia Union office prepare you for implementing this teaching method into your classroom?

6. Following the training, how did you go about implementing differentiated instruction in your classroom?

7. What was easiest about implementing differentiated instruction?

8. What was the hardest part of the implementation?

9. What helped you most in your implementation?

10. How have these tools been useful?

11. Have you used any support methods during your implementation?

12. If yes, how have these methods helped you?

13. If no, why not? How would it have helped you more if support methods were available?

14. What barriers have you experienced in implementing differentiated instruction?

15. How has differentiated instruction changed your teaching practice?

16. Has differentiated instruction changed your classroom?

17. If yes, how?

19. If no, why do you think it hasn't?

20. What preparation was needed in the implementation of differentiated instruction?

21. What have you learned from your implementation that you would recommend to other teachers who might be trying to implement differentiated instruction?

22. If you were to give advice to another teacher wanting to implement Differentiated Instruction, what would you say to them and to their supervisors?