



Junior High School Science Teachers' Knowledge, Practice and Challenges of Differentiated Instruction in Kpandai District, Ghana

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East African Journal of Education and Social Sciences

Abstract: This study investigated knowledge practice and challenges of Junior High School Science teachers in Differentiated Instruction (DI) in Kpandai District of the Northern Region of Ghana. The study employed the concurrent nested design. Out of 268 teachers, a sample size of 31 science teachers was drawn to participate in the study through questionnaire and a sub-sample of five teachers was purposively selected for interviews. The quantitative data was analysed using descriptive statistics while the qualitative data was analysed thematically. The study concluded that most JHS science teachers in Kpandai District possessed required knowledge on DI and they actually differentiated the instruction in their Science classes. However, they faced some challenges when differentiating their instructions. The study recommends that knowledge of DI possessed by most Science teachers should be strengthened through regularly organizing in-service training for them. This should be done by GES Directorate of Kpandai to enable the teachers improve their knowledge of DI. Teachers should be supported by SISOs to practice every aspect of DI especially when assessing the learners. Finally, the government and other educational stakeholders should ensure that textbooks and other materials/resources are readily made available to Science teachers for effective implementation of DI in schools.

Keywords: Differentiated Instruction; Knowledge; Practice; Junior High School; Science.

How to cite: Bingan, G. S., Amenu, E. S., Agbeko, D. T., and Kwateng, I. (2022). Junior High School Science Teachers' Knowledge, Practice and Challenges of Differentiated Instruction in Kpandai District, Ghana. East African Journal of Education and Social Sciences 3(5)51-60. Doi: <https://doi.org/10.46606/eajess2022v03i05.0219>.

Introduction

The 1992 constitution of Ghana provides that, education is a right for all her citizens. This led to the advocacy for Inclusive Education whose policy holds that all persons who attend an educational institution should be entitled to equitable access to quality teaching and learning. This goes beyond the idea of physical location and constitutes the fundamental values that encourage participation, friendship and interaction (Ministry of Education, 2015). Education trains the individual holistically to become acceptable society members and is an instrument of change in society irrespective of the person's ability.

Ghana provided two parallel systems of education at the basic level for the citizenry in the past. While children without any form of disability were enrolled in regular schools in their communities, their counterparts with some forms of disabilities were enrolled in segregated boarding schools located mainly at urban centers. The main challenge was that, the segregated schools were few and did not expand to provide for the ever increasing population of children with disabilities. As a result, the change of curriculum in Ghana in 2019 placed high emphasis on inclusive education where all students are placed in age-appropriate general education classes that are in their communities to receive high quality instruction with special interventions and support to enable every learner attain some level of success in the core curriculum.

According to Alquraini and Gut (2012), inclusive schools and classrooms works on the principle that, learners with some form of disabilities are as confident and competent as those without disabilities and for that matter, can fully participate in schools in their local school community. This means that all students with disability ought to be educated with their peers without any amount of restriction as much as possible. Teachers must therefore differentiate their instruction to be able to meet the learning ability and style of every individual learner in the classroom. Playing a unique role of teaching to meet the learning needs of every student in the class requires teachers to differentiate their instruction.

According to Palmer and Maag (2010), the paradigm of differentiated instruction is gaining a wide consensus in many contemporary educational circles in the world. This calls for a redirection for teachers to think about their methodologies,

management and contents, and also invite learners to be engaged in the process that will be beneficial to them.

Lauder (2011) defined differentiated instruction as the modification of a blend of the content, process and product in order to meet the readiness, interests, learning style and learning needs of all learners in a particular classroom and a way to ensure that they all have the chance to excel. Gangi (2011) explained the differentiated instruction as a strategy of teaching that accounts for the differing learning needs of learners by accommodating their differences and abilities through the variation of the methods and materials. Consequently, for science to be well inculcated in every child in the basic school classroom, teachers must have a fair knowledge on how to differentiate their science instructions.

The Inclusive Education Policy in Ghana is anchored on the results of a series of consultations and workshops among key stakeholders in the delivery of education. The policy came out of a series of discussions and consultations among numerous stakeholders in the educational sector, particularly, Ghana Education Service, the Girls Education Unit and the Early Childhood Education Unit of the Basic Education Division and the contributions of other state actors like the Ministry of Health, the National Council for Persons with Disability and the Ministry of Gender and Social protection (Ministry of Education (MoE), 2015).

The Policy document takes its source from national legal documents such as the 1992 Constitution of the Republic of Ghana, Ghana shared Growth and Development Agenda (GSGDA), the Education Strategic Plan (2010-2020), the Disability Act, the Education Act, among others. This policy posits that every child has the right to and can learn. The Universal Design for Learning (UDL) model therefore forms the structure for the policy to deliver quality and for fair education to all (MoE, 2015).

The efforts of non-state actors like the Ghana Blind Union, the Ghana Federation of the Disabled, the Ghana National Education Coalition Campaign, the World Education and the International Council for Education of People with Visual Impairment, was monumental in all stages of the policy development.

Prof. Naana Jane Opoku Agyemang, Minister for Education for 2013, in her forward of the policy, stated that "the policy is expected to respond to changing priorities and national aspirations as well

as international development trends in provisions for inclusive education” (MoE, 2015). This implies that the policy was intended towards achieving universal primary education for all. Therefore, the Government of Ghana through the Ministry of Education and the Ghana Education Service (GES) had to adopt and implement the policies over the years. The intention was to enable Ghana achieve The Millennium Development Goals that includes inclusive education (MoE, 2015).

The goal of the policy is to redefine the delivery and management of education services to respond to diverse needs of all students within the framework of Universal Design for Learning (Ministry of Education, 2015). Education in Ghana is to ensure that no child of school-going age is denied of quality education. The IE policy takes into consideration the different learning needs of children and provides the opportunities to address these needs of various categories in the educational system under the Universal Design for Learning. It paves way for a learner friendly environment for all. This implies that inclusion is seen as the wider reform of the education system to create a more effective education system and society. The inclusive education approach is to create an education system that is responsive to learner diversity and to ensure that all learners have the best possible opportunities to learn (MoE, 2015).

The philosophy of the policy is that schools must recognize and respond to the diverse needs of their students, accommodating both different styles and rates of learning and ensuring quality education to all through appropriate curricula, organizational arrangements, teaching strategies, resource use and partnerships with their communities (Ministry of Education, 2015). The implication is that, support services should match the special needs encountered in every school (UNESCO, 1994).. Another implication is that when the diverse learning needs of the students under a universal approach and within a learner friendly environment are addressed, it fortifies the quest for Child Friendly Schools (CFS), Community Based Rehabilitation (CBR) and the Universal Design for Learning (UDL).

The policy scope is to provide a framework for addressing issues of inclusive education that relate to persons with mild and severer special educational needs at every level of education. The IE policy is to tackle a range of discrimination issues in classrooms

where persons with diverse and special educational needs, such as slow learners, are excluded from teaching and learning processes (though they are still in the class). The policy acknowledges that all children can learn irrespective of differences in age, gender, ethnicity, language and disability. Again, it provides that all children have the right to access basic education and also the education system should be dynamic to adapt to the needs of children, facilitate and enable structures, systems and methodologies to meet the needs of all children (MoE, 2015).

A multi-disciplinary assessment procedure should be implemented at all levels of education to meet the needs of all learners. The use of alternative assessment procedures may be adopted in educational institutions to respond to the diverse needs of the learners. Practically, this is dependent on the professional level of teachers and class sizes to be done effectively.

The curriculum should be functional and should take into consideration the child’s cultural background, family and community resources, values, interests, aspirations, future goals and opportunities (Ministry of Education, 2015). The Ministry of Education suggested that the national curricula for basic and second cycle institutions should be the same but may have provisions for differentiations and adaptations to meet the unique needs of all learners including those with special needs. Also, regular schools should undertake early identification, referral and intervention through periodic screening of all learners (MoE, 2015).

There should be regular monitoring and periodic assessment aimed at improving the child’s circumstances. In order to make teaching and learning effective and efficient, class size should not exceed 30 for lower primary and 35 for upper primary and junior high schools. This future of the policy in Ghana has not been met as most basic school classrooms are still overcrowded (Nudzor, Oduro, & Addy, 2012).

Every child, irrespective of any kind of disability has the right to education. This education should be beneficial and should prepare the child towards associating and functioning well in their society. Teachers must therefore accept children with disabilities and cater for them in the classroom to ensure that they learn. The different category of learners can all be helped to enjoy learning in the classroom through proper planning of lessons and

differentiation of instructions by teachers to meet the learning needs of every individual learner in the classroom (Bui, Quirk, Almazan, & Valenti, 2010). Differentiated instruction (DI) stresses that a single teaching style will not accommodate every student, especially when the teaching style is not matched with a student's learning style (Levine, 2002) and its adoption propels teachers to use different learning activities, modes of assessment and create conducive classroom environments that will support the growth of each learner (Tomlinson, 2014). Teachers should therefore be equipped with pedagogical skills to meet their children's learning needs especially those with special needs.

Several studies reached that, the adoption and practice of DI has contributed greatly on students' achievement (Wilujeng, 2012; Tomlinson, 2005; Beloshitskii & Dushkin, 2005; Tomlinson, 2014) with few of such studies conducted locally (Kyeremeh, Amoah, & Sabtiwu, 2021; Owusu, 2016; Abora, 2015).

The practice of the approach by most Ghanaian teachers appear to be low and problematic (Kyeremeh, *et al*, 2021). This could be due to the level of knowledge they possess in DI, their perception towards the adoption and practice of the approach or other factors. Hence, the need to investigate knowledge, practice and challenges facing JHS Science teachers in DI in the Kpandai District. Kpandai District is one of the many districts that had received various interventions and support from NGOs such as PLAN Ghana, RighttoPlay, UNICEF, IBIS, among others whose principal focus is to give access and improve education in the area. However, the performance of most students in Basic Education Certificate Examination has always been poor especially in Science as captured in the 2018-2019 report of the Ghana District League Table (DLT II) (Center for Democratic Development [CDD]-Ghana, 2020).

Review of Related Literature

Differentiated Instruction is an instructional approach used by educators to meet the academic and behavioral needs of diverse learners within the same classroom setting (Edwards, Carr, & Siegal, 2006). According to Pettig (2000), Differentiated Instruction is a practical approach that challenges teachers to change their classroom practices to improve the classroom learning for all learners. This lays emphasis on the relevance of fairness and respecting equity over equality in the classroom. It

also confirms the need to meet the learning needs and the need to help every learner to benefit from learning, rather than teaching for curriculum needs and assessment purposes. Another implication is that, for all learners to realize their potentials, teachers ought to plan their instructions to meet the learning needs of each child in the classroom. Teachers will do this more effectively if they possess a fair knowledge of Differentiated Instruction (Abora, 2015).

Franz (2009) is of the view that, when teachers possess the right knowledge on Differentiated Instruction, they may likely integrate it into their classroom instructions. He asserts that the effectiveness of differentiated instruction requires deep knowledge of its process, theories and ways through which the theories are translated into action. This is in line with the findings of Tomlinson (2005) that many teachers see differentiated instruction to be beneficial to learners, yet they often believe that its execution in their classrooms is inconvenient because of inadequate knowledge and expertise in it. Whipple (2012) postulated that teachers' understanding of DI is consequential to its implementation and practice by them. These authorities point to the fact that teachers need a fair knowledge of this important instructional strategy to be able to utilize it effectively in their Science classrooms. A fair knowledge may also have an effect on teacher attitude which will eventually lead to their practice or no practice of the approach (Tomlinson, 2014). Tomlinson again argued that the attitudes that teachers hold regarding their students, their capacity to learn, their willingness to work hard and their worth as individuals influence all exchanges between the teachers and the students in the classroom.

¹ Florian and Hawkin (2011) reached that the practice of DI by teachers is manifested when they are able to identify individual learner needs which enable them gain an insight on how to enrich and extend the basic things to offer in a classroom lesson or activity. This is necessitated by the fact that some learners require something different from or additional to that which teachers ordinarily offer. Anecdotally, teachers know that in class, there is diversity in students with regards to their learning readiness, abilities, learning styles and economic status. They adopt specific organizational measures such as varying-grouping, varying time-to-task and investing more or less time (Heacox, 2012). According to Suprayogi and Valcke (2016), coping

can be realized by ability grouping, presenting alternatives that fit different learning styles and building on different life situations of learners. Fogarty and Pete (2011) advised that teachers should know that all students have variations and learn in different ways. This is buttressed by McQuarrie and McRae (2010) who revealed that effective classrooms where DI is practiced, futures of flexible grouping exist and that allows for student interaction. In accordance with this, Fogarty and Pete (2011) again suggested that teachers should always adjust their teaching process to the learning needs of their students.

Mengistie (2020) in a study found that there was a lower degree of implementation of Differentiated Instruction in Ethiopia as compared to teachers' level of understanding. His study revealed that differentiation of content was the lowest practiced area and that teachers were not regularly differentiating instruction in their classrooms. Similar findings were revealed in Ghana by Abora (2015) and Kyeremeh *et al.* (2021) that though most teachers hold a reasonable knowledge of DI, their practice of the approach is appalling.

Teachers are trying their best to become more inclusive in their practices but the challenge of how to respect and address individual differences continuously exist in regular classroom (Florian, 2007; Agbeko, 2020). Extending what is available to all learners is a complex pedagogy and meeting these challenges create the burden of using simple and common teaching and learning approaches that work for most learners to something additional or different for those who experience difficulties. Other challenges of the practice of DI include but not limited to lack of knowledge of specific strategies, the time constraints relating to preparing differentiated instructional lessons, lack of relevant resources, large class size and inadequate opportunities to plan ahead and reflect on work due to extremely high work load (Mengistie 2020). Despite all these challenges, Tomlinson (2014) believes that creation of a rich learning community to provide learning opportunities for every learner in the classroom is prudent to help them take part in classroom life.

Methodology

Research Design

The study employed a mixed method as the main approach to gathering the data. Mixed method allows researchers gather data from multiple

sources. Patton (2002) postulated that in educational settings, it is important for researchers to have information from varied sources to give the findings a strong base. Using mixed methods can effectively offset the weaknesses of using a single approach (Tashakkori & Teddlie, 2003). The Concurrent nested design was adopted in the triangulation of data. The term 'concurrent' indicates that the qualitative and quantitative data are being collected at the same time. However, in concurrent nested studies, one of the methods may dominate whilst the other one is embedded or nested in it. In this study, the quantitative was dominant.

Population and Sampling

The target population for the study was 28 public JHS teachers in the Kpandai District with a teacher population of 268. This constitutes 214 males and 54 females. A sample of 31 science teachers consisting of 28 males and 3 females were used for the study. This was made up of at least one science teacher from each school. The sample was selected through a census technique.

Table 1 Population and Study Sample

Target population	Males	Females	Total
Study sample	214	54	268

Data Collection

The instruments used for data collection in this study were questionnaire and interview. Data collection was done in two phases. The questionnaire was distributed to respondents by the researchers through the eight School Improvement Support Officers (SISOs) formerly known as Circuit Supervisors (CS) in the district to be given to all the Science teachers in their respective circuits. This was to ensure that the data collected came from all corners of the district. Each SISO received questionnaires in respect of the number of public JHS present in their respective circuits. It took 14 days to distribute and retrieve the questionnaire.

Questionnaire

The questionnaire sought to elicit general information such as age, gender, number of years in teaching and the highest level of education from the participants. This constituted the "part A" of the questionnaire while "part B" sought to elicit information on the teachers' knowledge, practice and perceived challenges encountered in differentiating instruction in their Science lessons.

Closed-ended items designed on a five-point Likert Scale were used for the questionnaire.

Interview

Interviews were conducted among selected Science teachers to establish their knowledge, ways they practice DI when teaching Science and the challenges they encounter when differentiating instruction. Semi-structured interview is usually used to ensure that participants have the opportunity to express themselves without restriction when addressing the topic in detail (Kvale, 1996). Five (5) JHS Science teachers were purposively selected for the interview. The questions were centered on teachers' knowledge, practice and challenges of DI. These questions were pre-determined and standardized to ensure that the researchers get relevant information. The interviews lasted for 10-20 minutes and were audio-taped. The recorded tapes were transcribed verbatim and the transcripts were sent back to the interviewees to confirm. This was done for the purpose of validation (Braun & Clarke, 2006).

Statistical Treatment of Data

The quantitative data was first collated, sifted, cleaned up, then it was coded and entered into the

Statistical Package and Service Solutions (SPSS) software version 25. With the aid of the software, descriptive statistics (Frequency counts, Percentages, Means and Standard Deviations) was used to analyze the data. Interviews were recorded, transcribed (in vivo), and were thematically analyzed (inductive analysis) using ATLAS.ti, a qualitative data analysis program. The process of detecting, analyzing and reporting patterns (themes) within data is known as thematic analysis (Braun & Clarke, 2006).

Results and Discussion

This section presents the results based on data which was collected from the field. The analysis starts with the demographic characteristics of respondents and then results for research questions were presented.

Demographic Information

Gender of Respondents

Table 2 shows the demographic information of the JHS Science teachers. Results from the table indicate that 28 respondents were male teachers while 3 were female teachers.

Table 2: Demographic Data of Teachers.

Variables	Attribute	Frequency	Percent (%)
Gender	Male	28	90.3
	Female	3	9.7
	Total	31	100.0
Highest Qualification	Diploma	20	64.5
	Degree	11	35.5
	Total	31	100.0

Table 3: Distribution of Years of Teaching Experience of the Respondents

Duration	Frequency	Percent (%)
1-3years	15	48.4
4-6years	5	16.1
7-9years	6	19.4
10years and above	5	16.1
Total	31	100.0

Education Level of Respondents

From table 2, respondents possessed either diploma or bachelor degrees. Out of the 31 respondents, 20 qualified to teach with a diploma while 11 had attained a bachelor degree.

Years of Teaching Experience

Table 3 shows the teaching experiences of teachers in years. Fifteen teachers (48.4%) had taught for 1 to 3 years while 5 (16.1%) had taught for 4 to 6 years.

On the other hand, 6 teachers had taught for 7 to 9 years and 5 (16.1%) teachers had taught for 10 years and above. Therefore majority of the teachers had taught for more than three years.

Analysis of Research Questions

This section presents the results based on the research questions that guided the study as follows:

Research Question 1: what is the level of knowledge of the JHS Science teachers on Differentiated Instruction?

Tables 4 present the established JHS Science teachers knowledge on Differentiated Instruction. The scale for mean score interpretation was as follows: 3.50-5.0= YES, 2.50-3.49 = UNDECIDED and 1.00-2.49 = NO.

Results from table 4 indicate that respondents agreed that all pupils in classrooms have different learning characteristics. They also agreed that every learner's interest, cultures and expectations should be considered when teaching and that lessons should be planned considering pupils' differences.

Furthermore, the interview results indicated that most of the teachers possessed some knowledge on Differentiated Instruction. Four out of five interviewed teachers explained Differentiated Instruction as a strategy of teaching which employs different techniques of teaching and varying teaching activities to meet the needs of students in the class. Teachers also unveiled through the interview that, the use of mixed ability grouping, remedial classes, use of varied materials and activities, moving round and supporting individual pupils in class and giving opportunities to every learner to work according to their ability are all ways of differentiating instructions. For example, TR3 said "DI is the teaching strategy where different techniques of teaching are employed to help each student in the class understand the lesson. For example, one can use audio-visuals, pictures and even concrete materials to help learners understand the lesson." These findings match with principles for Differentiated Instruction as outlined by Florian and Hawkin (2011).

Table 4: JHS Science Teachers Knowledge on Differentiated Instruction

SN	Item in the Questionnaire	Mean	Std. Dev	Interpretation
1	All pupils in my classroom have different learning characteristics.	4.74	.45	YES
2	Every learner's interest, cultures and expectations should be considered when teaching.	4.42	.67	YES
3	Each learner learns through a particular style.	4.16	.52	YES
4	Lessons should be planned considering pupils' differences.	4.35	.99	YES
5	Content must satisfy the curriculum needs or examination requirements instead of individual learner needs.	2.61	3.74	UNDECIDED
6	I have enough knowledge on inclusion and differentiation.	1.38	.86	NO

Table 5: Practice of Differentiated Instruction by Science Teachers

SN	Item in the Questionnaire	Mean	Std. Dev	Interpretation
1	I employ a variety of assessment tools before, during and after teaching and learning.	4.68	0.54	YES
2	The teaching and learning materials and activities I employ during teaching and learning are mainly centered on individual pupil need.	4.00	1.15	YES
3	I provide my students opportunity to choose to work alone, in pairs or smaller groups during teaching and learning.	3.83	1.24	YES
4	I form learner groups in my class based on learners' abilities, interests, styles, and learning preferences.	3.39	1.23	YES
5	I teach strictly to complete the syllabus rather than varying my instructions to satisfy the needs of my learners.	2.03	1.14	NO

Table 4 further indicates that respondents were not sure whether content must satisfy the curriculum needs or examination requirements instead of individual learner needs and also they confessed that they did not have enough knowledge on inclusion and differentiation. The implication of this finding is that, teachers are likely to neglect individual learner needs and rather focus on the whole class. This again may lead to most learners

leaving school because their learning interest may not be met due to teachers' low knowledge in DI.

Research Question 2: how do JHS Science teachers practice differentiated instruction in their classrooms?

Having established the knowledge of teachers on the Differentiated Instruction, it was necessary to

establish how the teachers practiced the differentiated instruction in their classrooms as reflected in table 4. The scale for mean score interpretation was as follows: 3.50-5.0= YES, 2.50-3.49 = UNDECIDED and 1.00-2.49 = NO.

Results from table 5 indicate that they employ a variety of assessment tools before, during and after the teaching and learning process. They also agreed that the teaching and learning materials and activities they employ are mainly centered on individual pupil need, that they provide students with opportunity to choose to work alone, in pairs or in smaller groups during teaching and learning process and that they form learner groups in the classes based on learners' abilities, interests, styles and learning preferences. Finally, respondents disagreed that they teach strictly to complete the syllabus rather than varying my instructions to satisfy the needs of my learners.

This suggests that the main focus in their teaching is meeting the individual needs of the learners rather than completion of the syllabus. The interview further revealed that most of the Science teachers

gave the same questions and working time to all their learners in the class without considering the learners' ability levels. All the five teachers interviewed agreed that they set the same questions and vary time based on individual abilities of learners. For example Teacher 3 said, ".....as for me, during assessment, I give the same questions to all the children to answer within 10 or 15 minutes." These findings indicate that teachers under investigation did not practice well the Differentiated Instruction approach. Tomlinson (2014) argued that every individual child must be assessed based on their ability in DI classroom.

Research Question 3: what challenges do JHS Science teachers face when differentiating instruction in their science classroom?

Having established the knowledge and the actual use of the Differentiated Instruction, it was necessary to establish challenges the JHS Science teachers faced when differentiating the instruction as indicated in table 6. The scale for mean score interpretation was as follows: 3.50-5.0= YES, 2.50-3.49 = UNDECIDED and 1.00-2.49 = NO.

Table 6: Perceived Challenges of Practicing Differentiated Instruction by Science Teachers

SN	Item in the Questionnaire	Mean	Std. Dev	Interpretation
1	Large class size obstructs differentiation of instruction.	4.19	1.01	YES
2	Lack of relevant resources to effectively differentiate instructions.	4.13	1.09	YES
3	Time constraints in preparing differentiated instructional lessons.	3.97	.71	YES
4	To respect and respond to individual differences is complicated.	3.39	1.36	UNDECIDED
5	There are no usually adequate opportunities to plan ahead and reflect on work due to extremely high work load.	3.32	1.38	UNDECIDED

Respondents indicated that large class size obstructs differentiation of instruction, that lack of relevant resources to effectively differentiate instructions was a challenge and that time constraints in preparing differentiated instructional lessons was also a challenge they faced in the implementation of the Individualized Instruction. The same challenges were also indicated through interview sessions. For instance, Tr2 said that "our classes are very large in terms of student population, I have more than 75 students in my class and this makes it extremely difficult to attend every child". Tr5 also said, "I have a blind student in my class and there is no braille for her and even if we are given one, we can't even use it so you see?"

This indicates that large classes, lack of teaching and learning resources and time constraints were major challenges faced during the Differentiated Instructional lessons. The implication of this finding is that much attention cannot be given due to the

large number of students in classes. This is in agreement with the findings of Mengistie (2020) that lack of knowledge of specific strategies, the time constraints relating to preparing differentiated instructional lessons, lack of relevant resources, large class size and inadequate opportunities to plan ahead and reflect on work constitute major challenges in DI

Conclusions and Recommendations

This section presents conclusions of the study and then gives the recommendations as follows:

Conclusions

The study concludes that most JHS science teachers in the Kpandai District possessed high level of knowledge on differentiated instruction and they actually differentiated the instructions in their Science lessons. However, they faced some challenges when differentiating their Science instructions. Some of the challenges faced include

insufficient curriculum materials and large class sizes.

Recommendations

The study recommends that knowledge of DI possessed by most Science teachers should be strengthened through regularly organizing in-service training for them. This should be done by GES Directorate of Kpandai to enable the teachers improve their knowledge of DI. Teachers should be supported by SISOs to practice every aspect of DI especially when assessing the learners. Finally, the government and other educational stakeholders should ensure that textbooks and other materials/resources are readily made available to Science teachers for effective implementation of DI in schools.

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