UNIVERSITY OF EDUCATION, WINNEBA

FACULTY OF SCIENCE EDUCATION

ASSESSING INTEGRATED SCIENCE TEACHING AND LEARNING TO THE HEARING IMPAIRED AT UNIVERSITY PRACTICE INCLUSIVE JUNIOR HIGH SCHOOL-SOUTH CAMPUS, WINNEBA

KAREN DEDOO

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DECLARATION

STUDENT'S DECLARATION

I declare that this thesis, with the exception of quotations and references contained in published works which have all been identified and dully acknowledged, is entirely my own original work, and that it has not been submitted, either in part or whole, for another degree elsewhere.

Name of Student: Karen Dedoo

Signature:……...……...Date:…….……

SUPERVISORS' DECLARATION

We hereby certify that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of thesis as laid down by the University of Education, Winneba.

Principal Supervisor's Name: Prof. Yaw Ameyaw

Signature:……..**Date::**…..……...

Supervisor's Name: Dr, Joseph Nana Annan

Signature:……..**Date::**…..……...

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DEDICATION

This work is dedicated to my dear husband, Mr. Robert Tetteh Mensah and my children, Bert Okpoti Tetteh, Norbert Laryea Tetteh, Bertha Adjeley Tetteh and Roberta Adjorkor Tetteh.

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ABSTRACT

The purpose of this study was to assess the teaching and learning of Integrated Science to the hearing impaired at the University Practice Inclusive Junior High School at the South Campus, Winneba. The study focused on Integrated Science teachers, interpreters and hearing impaired pupils of the University Practice Inclusive JHS, South Campus, Winneba. The estimated population was forty (40), which were made up of thirteen (13) teachers, three (3) interpreters and twenty-four (24) hearing impaired pupils. Out of a target population, five (5) Integrated Science teachers and three (3) sign language interpreters were purposively sampled from the University Practice Inclusive JHS for the study. However, simple random sampling technique was used to select seven (7) hearing impaired pupils (4 females and 3 males) out of the total of twenty (20) hearing impaired pupils in the University Practice Inclusive JHS at the South Campus, Winneba. The study was conducted using the causal comparative study design, and the methods used to collect data were semi-structured interview, document analysis, formal observation checklist and questionnaire. The results indicated that there was no policy governing science education for students with deafness in Ghana, further, hearing impaired pupils solely depend on the interpreters for information in the classroom and outside the classroom. Also, the Integrated Science syllabus does not favour the hearing impaired pupils, since they are taught like their hearing counterpart which in turn makes the latter not benefit fully from science lessons. Having discussed these findings, it is recommended that The Ministry of Education should introduce a teaching syllabus that lay emphasis on how to teach Integrated Science to the hearing impaired.

CHAPTER ONE

INTRODUCTION

1.1. Overview

This chapter provides the background to the study, statement of the problem, purpose of the study, research questions, and significance of the study, limitations and delimitation of the study. The chapter ends with organisation of the study.

1.2 Background to the Study

Education has been defined as "the systematic upbringing of an individual in a social and cultural setting with the view of inculcating in an individual, cultural, social, political and other socially approved ways of life, so as to make him or her useful to himself or herself, and the society" (Amissah & Sam-Tagoe, 2002).

Education is a life-long process of acquiring new knowledge and skills through both formal and informal exposure to information, ideas and experiences. Many countries the world over, attach great importance to education, and go to all lengths to maintain a high standard of education. The teaching and learning of science plays a very important role in the development of a country, when the knowledge is applied to solve everyday problems known as technology. The current policy on science aims at teaching science to all including children in kindergarten (KG). This is to enable children of all ages to be scientifically literate. Pupils with hearing impairment are not left out, since they also need to be educated for them to benefit themselves and the society.

The 20th century has witnessed the growth of strong advocacy for the inclusion of children with disabilities in regular educational settings. Changes in legislation and policy have led to children with disabilities being placed in regular educational settings (Daniels & Garner, 1999; Foreman, 2007; UNESCO, 1994). Most educational systems in developed countries recognized the rights of children with disabilities to a quality education in an inclusive setting, and providing parents with the right to choose the educational placement for their children (Elkins, Van Krayanoord, & Joblin, 2003). However, not all countries embraced the inclusion paradigm. Some provide a choice of setting range from segregation of partial inclusion (Kivirauma, Kiemela, & Rinne, 2006).

In the last few decades, the view of special education has changed in all societies. Instead of segregating students with special needs in special classes and schools, the ideology of inclusive education is about adopting the schools environment to meet the needs of all students. The educational system is responsible for including students with special needs for appropriate educational experiences. The idea of inclusion seems to be a major challenge in many countries (Flem & Keller, 2000; Snyder, 1999).

Several laws have been proposed to open doors of public schools to students with special educational needs. The first one, which is made up of two acts provide services to children with special educational needs in the USA, was Public Law 94-142, the Education for All the Handicapped Act (1975). This law features two provisions:

- All handicapped children should be provided a *free appropriate public education*, and
- the second is that education must take place in the *least restrictive environment*.

Ghana's concept of inclusive education, however, is aligned with her Free Compulsory Universal Basic Education (fCUBE) policy of increasing access, retention and participation of all students of school going age in education and not the movement and provision of education to children with disabilities in regular schools to offer new opportunities to pupils who may have previously or continue to experience some learning difficulties (Ocloo, Hayford, Agbeke, Gadagbui, Avoke, Boison, 2002). Inclusive Education is considered the official policy position for educating persons with disabilities in Ghana. The Government of Ghana's Educational Strategic plan for 2003-2015 argues for inclusion for all children with disabilities by 2015. With the adoption of inclusion as a placement model, some regular schools in the Effutu Municipality (Winneba), and the country as a whole have started practicing it. It rests on the shoulders of Ghanaian school authorities to find ways of assisting hearing impaired pupils to cope with their hearing colleagues in the classroom. Research on inclusion, however, consistently shows that pupils with hearing impairment in regular classrooms find it difficult to catch up with their hearing counterpart during lessons. Science is one of the subjects that students find it difficult to handle let alone the hearing impaired pupils.

Science teachers therefore have the duty to assist these pupils to become scientifically literate and go further to pursue courses in science. This study is aimed at assessing how science teachers teach science to the hearing impaired, and how they can improve upon these methods to assist these hearing impaired pupils acquire scientific knowledge, and apply it in their everyday life. A deaf nurse, surgeon or doctor is yet to be found in Ghana.

1.3 Statement of the Problem

The position of the researcher as a science teacher at the University Practice JHS, South Campus in Winneba has given her the exposure to teach both the hearing impaired and regular pupils Integrated Science in an inclusive setting. When the performance of the regular pupils are compared to the pupils with hearing impairment, it is observed that the latter perform poorly supported as by the Chief Examiners Report from 2010 to 2015. The science teacher teaches both pupils at the same time with an interpreter translating what is being taught to the hearing impaired. As a result, pupils with hearing impairment rely solely on the interpreters for understanding of concepts in science. It is therefore important to assess whether science teaching and learning is taking place in the inclusive setting, and if, the interpreters even transfer the right information to the pupils to make the teaching and learning of science effective in the inclusive setting.

1.4 Purpose of the Study

The study is aimed at assessing the teaching and learning of integrated science to the hearing impaired pupils at the University Practice Inclusive JHS-South Campus, Winneba.

1.5 Objectives of the Study

The study was directed by four objectives. They are to:

1. find out how Integrated Science is being taught to children with hearing impairment in an inclusive setting at the University Practice Inclusive JHS-South Campus, Winneba.
2. look into the factors that influence effective teaching and learning of Integrated Science to the hearing impaired.

3. assess the role of interpreters and science teachers in teaching and learning of Integrated Science to the hearing impaired.
4. identify strategies to improve teaching and learning of Integrated science to the hearing impaired in the inclusive setting.

1.6 Research Questions

The following research questions were raised to guide the study:

1. In what way is Integrated Science taught to pupils with hearing impairment at University Practice Inclusive JHS- South Campus, Winneba?
2. What factors influence effective teaching of Integrated Science to the hearing impaired in the University Practice Inclusive JHS?
3. What is the role of interpreters in teaching and learning of Integrated Science to pupils with hearing impairment?
4. What strategies could be employed to improve the teaching of integrated science to the hearing impaired?

1.7 Significance of the Study

The study would assess how effective the teaching and learning of Integrated science is to school children with hearing impairment in an inclusive setting at the University Practice Inclusive JHS-South Campus, Winneba. This will help management of the school to make an informed decision on the implementation of the inclusive agenda especially in relation to science education to the hearing impaired in Ghana. This would also inform science teachers about the instructional strategies to employ to teach science more effectively in an inclusive setting.

Additionally, the study would reveal the interpreters' role in imparting scientific knowledge to school children with hearing impairment in an inclusive setting. This can be factored into the training of science teachers who can use sign language in the pre-service teacher preparation in the field. Moreover, the results of the study would add valuable information to the body of literature available in Ghana concerning science teaching to children with hearing impairment in inclusive educational settings, further contribute significantly to existing knowledge and generate new understanding that would prove useful for future researchers.

1.8 Limitation of the study

Since the study was conducted in only one school that is, the University Practice Inclusive JHS-Winneba in view of the fact that it is the only inclusive school in the Effutu Municipality as the findings may not be somewhat sufficient and a basis for generalization.

1.9 Delimitation of the Study

This study was delimited to integrated science teachers, interpreters, parents of pupils and pupils with hearing impairment at University Practice JHS- South Campus, Winneba with particular interest on how science teachers impart scientific knowledge to pupils with hearing impairment. These categories of pupils with special needs were chosen because they were the only pupils with hearing impairment included in the school. Also, the school is the only school which includes hearing impaired children into the mainstream in the Effutu Municipality.

1.10 Definition of Terms

Inclusive education: is explained as taking a full and active part in school-life, be a valued member of a school community, and be seen as an integral member irrespective of one's ability or disability (Farrel, 2000). This implies that educating pupils with disabilities with their non-disabled peers in general education class or setting as a way of increasing their access to, and participation in, all natural settings, will hopefully help to increase their efficiency.

Hearing impairment/ deafness: is defined as the gradual or full decrease in an individual's ability to understand or detect sounds (Heward, 2010).

Effutu municipality: This is the political area with Winneba as it capital located in the Central Region of Ghana. The municipal has been divided into three zones; these are Winneba West, Central and East.

Hearing impaired/deaf: Is a person with partial or total inability to hear in one or both ears.

1.11 Organisation of the Study

The study has been organised into six chapters. The chapter one examines the various issues in relation to the background of the study as well as the statement of the problem, scope and delimitations of the study. Chapter two gives the literature review of the study. Chapter three covers the methodology used in collecting and analysing the data. The forth chapter tackles the presentation and analysis of the gathered data. Chapter five is the last chapter, which covers summary and conclusions, and finally chapter six gives some recommendations drawn from the study, and provides suggestions for further studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This section reviewed related pertinent literature of earlier studies conducted on inclusive education and attitude of peers towards individuals with hearing impairment. The literature was reviewed from research articles, journals, periodicals, magazines, internet, and books written by renowned and experienced authors on inclusive education and counselling children with hearing impairment. The areas discussed are as follows:

1. Theoretical framework
2. Meaning of assessment
3. Forms of assessment
4. The development of Special Education/Inclusive Education-General Overview
5. Education for the hearing impaired
6. Integrated Science curriculum for the hearing impaired
7. The role of culture in science teaching to the hearing impaired
8. Factors that affect Integrated science teaching to the hearing impaired
9. Strategies to improve Integrated Science teaching and learning

Theoretical Framework

The main theoretical framework upon which analysis of data was collected are Vygotsky's socio-cultural theory (Vygotsky, 1993) and Bronfenbrenner's ecological theory which not only emphasises on the immediate and external environments of a person, but also explains

systematically how changes could be achieved in the developmental situation of a person (Bronfenbrenner, 1979). Their theories provide socio-cultural framework to conceptualize the study and examine attitudes of regular children towards people with disabilities and how it affects classroom work. Both theories were used to illustrate complexity of the interconnectivity of the environmental and the cultural elements embedded in the social experiences of every individual child.

There have been several attempts to understand disability from different viewpoints. The individual model of disability, locates the problem of disability within the individual. It also sees the problem stemming from the functional limitations or psychological losses which assume to arise from disability. This study is based on Vygotsky's view that development of a person with disability largely depends on "the attitudes towards that person among the people around him or her" which includes the teacher and this affect a person's learning greatly. Vygotsky suggested that special educators have to change their perceptions towards students with disability to help them learn and become meaningful people. Brofenbrenner's (1979) ecological system was used to examine the dynamics between the child, the impact the environment and the community and their influence on cognitive and the affective development.

On the other hand the social model sees disability as all things impose restrictions on disabled people. This restriction includes individual prejudices, inaccessible public buildings, useable transport systems, segregated educational systems among a host of others. This model is underpinned by the oppression theory. It recognizes that it is society's failure to provide appropriate services that cater for the need of disabled people within the society, which is the

problem. This model insists that disablement has nothing to do with physical body. It is a consequence of social oppression (Oliver, 1996).

The study also draws on theories of intergroup contact theory to inform the impact on integration on regular student's attitudes and social acceptance of peers with disabilities (Allport, 1979, Pettigrew & Tropp, 2006, 2008). Wright's theory of spread indicated that misinformation may lead to distorted views and stereotyping of an 'out-group'. Allport's contact theory on the other hand, proposed that each contact dynamic facilitates learning and increases knowledge of the out group and thus lessons prejudice and increase social acceptance. Researchers also noted that well-structured contact experience that reduces anxiety among the different groups is a significant factor that can facilitate positive contact outcomes (Pettigrew & Topp, 2008).

Meaning of Assessment

Assessment can be defined as a sample taken from a larger domain of content and process skills that allows one to infer student understanding of a part of the larger domain being explored. The sample may include behaviors, products, knowledge, and performances. Assessment is a continuous, ongoing process that involves examining and observing children's behaviors, listening to their ideas, and developing questions to promote conceptual understanding. The term authentic assessment is often referred to in any discussion of assessment and can be thought of as an examination of student performance and understanding on significant tasks that have relevancy to the student's life inside and outside of the classroom (Airasian, 1997)

Constructivism is the idea that learning is an active process of building meaning for oneself. Thus, pupils fit new ideas into their already existing conceptual frameworks. Constructivists

believe that the learners' preconceptions and ideas about science are critical in shaping new understanding of scientific concepts. Assessment based on constructivist theory must link the three related issues of student prior knowledge (and misconceptions), student learning styles (and multiple abilities), and teaching for depth of understanding rather than for breadth of coverage. Meaningful assessment involves examining the learner's entire conceptual network, not just focusing on discreet facts and principles (Airasian, 1997)

The Purpose of Assessment

Critical to educators is the use of assessment to both inform and guide instruction. Using a wide variety of assessment tools allows a teacher to determine which instructional strategies are effective and which need to be modified. In this way, assessment can be used to improve classroom practice, plan curriculum, and research one's own teaching practice. Therefore assessment will always be used to provide information to children, parents, and administrators. The valued outcomes of science learning and teaching are placing greater emphasis on the child's ability to inquire, to reason scientifically, to apply science concepts to real-world situations, and to communicate effectively what the child knows about science. Assessment of scientific facts, concepts, and theories must be focused not only on measuring knowledge of subject matter, but on how relevant that knowledge is in building the capacity to apply scientific principles on a daily basis. The teacher's role in the changing landscape of assessment requires a change from merely a collector of data, to a facilitator of student understanding of scientific principles (Airasian, 1997).

History of Assessment in Science Education

Over the last fifty years, the prevalent approach to assessment in science education has had a very particular form. The emphasis has been on tests designed to elicit brief, exact answers that focus on factual information in a format that requires the student to choose an answer from a set of options within a specified time frame (Klassen, 2006). These tests are usually situated at the end of an educational time period (such as a semester) as final evaluations of knowledge acquisition. This approach to assessment reflects a definition of knowledge as comprised of small, static, and explicit pieces of information that can be acquired through memorization as discrete, decontextualized items organized in series and accumulated progressively. Learning is defined as the ability of the student to recall specific items of information at a given time. Learning in science is not best understood as a decontextualized activity focused on the memorization of factual information organized in a linear progression; rather, like the generation of scientific knowledge itself, it is a creative, constructive process that builds upon the student's prior understanding and evolves beyond what is explicitly taught (Glasersfeld, 1990). This cognitive and constructivist approach characterizes the progression of learning in terms of an active, dynamic interaction between the student and the knowledge that is being taught. Students are not seen as passive recipients of established knowledge, but rather as active agents in the construction of their own knowledge.

With this shift in the characterization of learning, new approaches to assessment have emerged that aim to find ways of collecting data on the higher-order-thinking aspects of science activity. Authentic approaches to assessment allow science educators to capture the complexities of thinking and action that are inherent to science. A much broader range of potential learning objectives for science education can be addressed once the form of assessment is changed. For

instance, approaches such as performance assessment (the collection of data on the student's ability to conduct various specified scientific tasks under test conditions) and portfolio assessment (the collection of a series of student products and documents from within the educational context over a period of time) take a far more contextualized and naturalistic approach to the collection of data on student learning in science. These approaches provide evidence on how students actually conduct, apply, reason, and understand different aspects of scientific activity (Berenson & Carter 1995; Ruiz-Primo & Shavelson, 1996). The basic principle of these forms of assessment is that they are closely related to the actual activities of science and try to model authentic, real-life aspects of being a scientist. This is a very different basis from which to consider evidence of learning outcomes from that produced by multiple-choice tests of factual knowledge recall.

Forms of Assessment

Diagnostic assessment provides a way for teachers to chart a course of action, or map out a route, using existing knowledge to build upon. It also allows for identification of gaps or misconceptions in prior learning. These assessments are used to gather information about what students already know and are able to do. (Airasian, 1997).

Formative Assessment

Gipps (1994) defined formative assessment as the process of appraising, judging or evaluating students' work or performance and using this to shape and improve students' competence thus formative assessment is the process used by teachers and students to recognize and respond to student learning in order to enhance that learning, during the learning. According to Newman,

Griffin, and Cole (1989) formative assessment allows students receive feedback on what they know, understand, and can do through the teacher–student interactions during learning. What these mean is that assessment can be considered formative only if it results in action by the teacher and students to enhance student learning. The distinguishing characteristic of formative assessment is that the assessment information is used, by the teacher and pupils, to modify their work in order to make it more effective. Therefore, the process of formative assessment always includes students. It is a process through which they find out about their learning. The process involves them in recognizing, evaluating, and reacting to their own and/or others' evaluations of their learning. Students can reflect on their own learning or they may receive feedback from their peers or the teacher.

Summative assessment is a high-stakes type of assessment for the purpose of making final judgments about student achievement and instructional effectiveness. By the time summative assessment occurs, students have typically exited the learning mode. Summative assessment forms an end point that sums up the performance or learning level of achievement. The evaluation of summative assessments provides a look at student performance as well as an opportunity to evaluate instructional practices. This type of assessment is typically graded (e.g. pass/fail, 0-100) and can take the form of tests, exams or projects. Summative assessments are often used to determine whether a student has passed or failed a class. *(*Mctighe & O'connor, 2005).

The Development of Special Education/Inclusive Education- General Overview

From historical point of view, the attitudes of community members towards persons with disability in terms of willingness to attend to their special needs has been greatly influenced by the existing socio - cultural philosophy, medical knowledge and by the perceived causes of disability (Tibebu, 1995). History tells us that, "prior to the late 1700s the fate of disabled individuals was likely to be a cruel one," and the Greeks, Romans and other early cultures are often cited by their practices of killing the unwanted children (Tibebu, 1995). As time went on, there came a conviction, which considered children with special needs as different from the rest of children with a sense to develop separate educational systems (Hegarty & Pocklington, 1988). Moreover, some professionals initiated the concern of the educational rights of children with disability and as a result, residential schools, special day schools and special classes were opened, respectively (Moores, 2006).

At the beginning, although opinions may differ on reasons for establishing segregated Schools for special needs students, it was assumed that such educational models could serve proper utilization of instructional equipment and for maintaining a one-to-one attention. Such a model was also assumed to encourage feeling of security among special needs of children by avoiding unfair comparison with those who are believed to be more competent students (Jenkinson, 1997). Fish (1985) on his part informed that ideas about special education have been confused by many people. This was partly "due to its history, due to changing professional responsibilities (a change from medical to educational approach) for children with disability, and partly because of recent changes in its relationship to ordinary education".

However, the growing public awareness, the achievement in the technological advancement and the improved legislation in some countries have opened the way for better provision of education to children with special needs (Moores, 2006). Particularly in l950s and 1960s, people came to be aware of a continuous history and practices of segregation in their own societies with the acknowledgement that had "strong value implication". This condition, in return has brought the idea of the integration of special needs children with their natural peers with a wish to move away" from segregated educational practices. According to Fish (1985), it was in 1980s that revolutionary changes took place in special education with the aim of educating children with special needs. Similarly, it was indicated that one of the 1960s significant achievements in the area of special education was the conceptualization of the delivery of special educational services as a continuum of vices known as the "Cascade model". Viewing the regular school classroom as the most natural and least restrictive option (Tibebu, 1995). As noted in several sources, the historical development of special education seems to differ from country to country.

For instance, special education for pupils with special needs was a relatively recent development in Great Britain (Hegarty & Pocklington ,1988), and in the United States, it was at the beginning of the nineteenth century. As reported by Jenkinson, (1997), at the beginning, centers for the provision of special education were set up by Voluntary Organizations for students with specific disability till governments increasingly assumed responsibility for the education of all students.

The Ghanaian Context

Until recently, a greater percentage of Ghanaians discriminated against persons with disabilities for various reasons according to Ocloo, Hayford, Agbeke, Gadagbui, Avoke and Boison (2002).

This was confirmed by Pecku cited in Ocloo *et. al.* (2002), that majority of Ghanaians regarded persons with disabilities as misfits, social outcast and as persons who could not be integrated into the mainstream of society. However, due to the ever increasing literacy rate among many Ghanaians, majority of them now have some scientific knowledge about persons with disabilities. Many chiefs, queens and traditional elders are educated, and as such have taken the lead in educating their people to develop positive attitudes towards persons with disabilities (Ocloo*, et. al*. 2002).

Ghana shares the UN's agreement to provide all children with a holistic education so as to develop their potential to the fullest. Ghana has a strong public educational system, one that is recognized for producing high levels of achievement (Gadagbui, 1998). Inclusive Education in Ghana informally began as integration into schools, since 1959-Accelerated Educational Plan Act for free education, which resulted in increases in basic enrolment (Gadagbui, 1998). Then the Jomtien World Conference in Education of Education for All (1990) set the goal of Education for All. UNESCO alongside with other UN Agencies and NGOs worked towards the achievement of this goal together with the efforts made at the country level. For example, the 1992 constitution of Ghana had emphasized the free compulsory Universal Basic Education (FCUBE-1995), which also increased access to basic school.

However, Gadagbui (1998) mentioned again that all these educational measures did not provide what it takes to run an effective inclusive education. Rather, access to special schools was possible for some and those integrated had no equal opportunity. In reality, inclusive education in Ghana is at the nascent stage, characterised by pilot schemes and adhoc initiatives by NGOs

(Gadagbui, 1998). Society or educational system had not changed, the child was rather expected to change to have hearing aid; the teacher or peer is not expected to learn to sign; the child has to pass the standardized test in class to be promoted or if he fails he or she repeats or drops out (Gadagbui, 1998).

The government of Ghana intends to introduce inclusive education by 2015 (MoE, 2003; MoESY, 2004), which is understandable. Currently, all countries are at differentl points of the journey to inclusion signposted by the Salamanca statement. The term inclusion has itself been on a journey since it was initially introduced within an educational context. Firstly, it is now understood to concern a far wider range of pupils vulnerable to exclusion than those identified as having special educational needs.

Educating hearing impaired learners

Over the years, people have had divergent views on what and how deaf children should be educated. Due to limited knowledge about the nature of disability, the consequences of physical and sensory impairments were conceived as "an unalterable static characteristic of the child" (Hegarty & Pocklington, 1988). Moreover, it has been believed that sensory disabilities were caused by evil spirits and the reaction of society in those times was more of inhuman. In early times, Greek philosophers, like Aristotle, considered the ear as an organ of instruction and hearing was taken as a major factor contributing to intelligence (Moores, 2006). As a result, owing to misconceptions attached to hearing impairment, hearing impaired children had been denied their educational rights for many years (Moores, 2006). Initially, the major concerns were centred on defining the legal and religious rights of hearing impaired, and "Education for the

hearing impaired was not a consideration in countries in which the majority of the population was illiterate" (Moores, 2006). In the long run, educators and other professionals began to have an insight into the possibility of educating the hearing- impaired children. As noted by Goldstein (1989), in the 16th century, there was a renewed interest in Europe, and institutions were opened to educate even the profoundly deaf children. As a result, most hearing-impaired children began to attend their schools separately "either in residential schools or in day school for the deaf" (Moores, 2006). However, Stainback and Stainback (l992) indicated that, "care must be exercised to ensure that any organized grouping of people does not violate their interests, needs, and basic rights". Hence, to ensure better educational provision, it will be highly pertinent to examine the attitudes of teachers and students in order to make fair educational placement.

Integrated science curriculum for the hearing impaired

In this section, education for deaf learners is discussed with regards to: (1) an overview of the curriculum, (2) the issue of literacy, (3) language and communication, (4) prior experiences and knowledge, (5) cognitive engagement, and (6) motivation and expectation.

An overview of the curriculum

Moores (2006: 41) states that for a long period of time educators of the deaf labored under some seriously flawed assumption. There was great emphasis on developing oral language skills of deaf children, based on the underlying belief that speech and language were equivalent. The goal of deaf education was that of “normalization,” which could be achieved by training deaf children to speak like hearing children. The field of education of deaf children has undergone major changes, which have had significant implications for curriculum and instruction. According to

Moores and Martin (2006: 3), traditionally, educators of deaf students have struggled with three important questions:

a) Where deaf children should be taught?

b) How should they be taught?

c) What should they be taught?

In the past, the curriculum for deaf learners' education emphasized English, Mathematics and Moral development (Moores & Martin, 2006: 4). Most of the activities for deaf learners related to English, which included speech, speech reading and English structure. Content areas, such as Mathematics, Social Studies and Science received minimal attention. Deaf learners' success was based on the fluency of their communication in English. This issue is reiterated by Molander, Pedersen and Norell (2001: 201). They state that a survey of literature regarding deaf education shows that research on deaf children's learning focuses mainly on language acquisition.

By the start of the 21st century, equity and academic achievement became the goals for deaf education (Moores & Martin: 2006). This resulted in the recognition of the challenges that deaf learners experience with regards to learning content based subjects, such as Science. One of the major challenges that deaf learners face is difficulty with literacy.

The issue of literacy

Regarding literacy, Andrews, Leigh and Weiner (2004: 90-91) state that literacy is often thought of as being only a decoding and graphic, perceptual motor activity. But it is more than that. Reading enables very young children to think, develop ideas, communicate and reflect about

written language. All of this happens slowly, predictably and naturally if the right conditions are set up, and if adults are able to explain to children what print means, in either sign or spoken language.

It is well documented that deaf learners generally experience great difficulty with literacy (Lang & Albertini, 2001; Muthukrishna, 2001; Scheetz, 2004; Andrews*, Leigh & Weiner,* 2004; DEAFSA, 2006 and Moores & Martin 2006). Deaf learners' exhibit pronounced difficulties with knowledge of English vocabulary and syntax, which become apparent when these students read and write (Lang & Albertini, 2001:260). Moores (2006:45), states, "*Deafness, per se, has no effect on the acquisition of literacy skills*". According to Moores (2006: 45), a deaf child has the same intellectual capacity as a hearing child, however deaf children are likely to experience difficulties as a result of the following factors:

-Children with hearing loss are not identified as early as possible.

- Deaf children and their families are not getting appropriate advice, training and support.

- Teachers are not developing better ways to instruct deaf learners.

In their discussion of literacy and content based subjects, Andrews *et. al*. (2004:100), stated that very little research has been done on the ways deaf readers' use reading and writing in content subject areas, such as Mathematics, Science and Social Studies. To become science literate, the reader must not only understand the concepts of science and the technical science vocabulary but also know how to use reading and writing in the science laboratory and classroom. Marschark, Covertino and LaRock (2006:189), state that, "the relatively poor literacy achievement of deaf children is often ascribed to early language delays".

Language

In her discussion of language acquisition, and having a similar viewpoint to that of Moores (2006), Schirmer (2001:62) stated that, "*children who are deaf have the same* cognitive *ability to learn language as children with hearing*". However, she argues that deaf children learn language from individuals (adults and other children) around them. If language is used consistently by individuals around deaf children, it becomes easier for them to learn language. On the other hand, if individuals around deaf children use language inconsistently around them, it becomes difficult for deaf children to learn language.

Andrews *et. al*. (2004:166), stated that "*successful language development in deaf children tends to be facilitated by effective mother/ child communication, enrolment in early intervention programs, and early use of sign language*… Andrews *et. al*. (2004:91), discussed how early parent/ child conversations are essential to provide a scaffold or support for the child. These early conversations may include eating, reading, playing or book reading. Through this interaction children learn vocabulary, syntax and the social rules of language. Moores (2006:42) stated "*human language is not a product of our tongues, teeth and lips; it is a product of our minds*". The distinction that he makes between language and literacy is that language is learned within a social context and literacy is taught.

Language is central to the lives of all individuals because it is a means of communicating with others and for thinking and learning. As children enter school, they use language to access academic subjects and this is done through literacy. Scheetz (2004:83) stated that language originates in the home and is influenced by the cultural and ethnic background of the family unit.

Deaf children born to hearing parents begin life in a linguistically altered environment. From the onset they are faced with the challenge of developing language through their visual domain, filling in the gaps when words are not understood. As they enter school, they are faced with the challenge of developing a language base that is auditory in nature, while simultaneously mastering the information placed before them.

Reading

Moores (2006:46) commented that a hearing child typically begins kindergarten with a mastery of phonology, morphology, syntax, vocabulary and has some home experiences that provide a foundation for formal literacy instruction (reading and writing). The average 17 year-old deaf child, however, reads at approximately class three or four level of the hearing person or regular student (Moores, 2006:46). This poses great challenges for deaf learners as they strive towards access to an equitable curriculum. According to Moores and Martin (2006:9), "*the emphasis on academic content increases the importance of reading and writing for all, especially deaf students*". Moores and Martin (2006), argue that the standardized tests that are being used are in reality tests of reading, as well as of Science, Mathematics and Social Studies knowledge.

The reader brings prior knowledge and experiences that shape his or her expectations of the material (Schirmer, 2001:71). As these expectations are confirmed, or not confirmed, the reader develops understanding. Every child's experiences are different, therefore their specific and general knowledge will differ. A child's comprehension will thus depend on their experiences and prior knowledge. Lee (2002:68) suggests using home language to enhance comprehension and understanding and use culturally appropriate communication, analogies and examples.

According to studies cited by Scheetz (2004:80), research indicates that several factors pose potential comprehension problems for deaf readers. These include vocabulary, multiple meaning words, indefinite pronouns, figurative language and inferences. In agreement with this view (Schirmer, 2001:72) discusses the importance of vocabulary knowledge in reading comprehension and being able to distinguish between levels of vocabulary knowledge. Schirmer (2001:75) states, "*An important factor in reading ability is metacognition. Metacognition refers to thinking about thinking or reflecting on one's own cognitive processes*". She also discusses how metacognition, when applied to reading can enable the reader to know when and what they do not understand, and invoke strategies for obtaining the needed information. Research cited in Schirmer (2001:75), states "*Deaf learners benefit from instruction on metacognitive strategies*".

Writing

Writing is the most widely used response mode in academic settings. Through written communication deaf individuals can relate to those that can hear. According to Scheetz. (2004: 82), "*numerous studies lead to the general conclusion that the average deaf 18- year-old writes on a level comparable to that of a hearing 8-year-old*". Research studies, Scheetz (2004:82), examined the written language of deaf children highlight their lack of syntactic and semantic knowledge. In addition, findings indicate that deaf children tend to have smaller and more concrete vocabularies, frequently omit words and use fewer adverbs and conjunctions as compared to their hearing peers. Schirmer (2001:77) states that educators typically consider deaf children to have more difficulty with writing than reading, however this criteria is based largely on assessment of their writing along one criterion only – correct usage of English sentence

structures. When they are taught the qualities of good writing and their writing is analysed along more than one dimension, deaf students demonstrate abilities in areas such as making ideas clear, descriptions, etc.

According to Scheetz (2004:83), research indicates that mediated learning experiences may help learners with writing difficulties. Educators can 'bridge' familiar language to decontextualized language by engaging learners in activities that will enhance their semantic and syntactic language development. This is reiterated by Lang and Albertini (2001:260), who state that research on writing by deaf students has broadened to include informal, interactive analyses of content and rhetoric, which indicate that in expressive and creative contexts, deaf students write with clarity and force. However, Lang and Albertini (2001:260) state that there is a need for additional research on writing to learn in specific areas such as Science and Mathematics.

Language and communication

There are different modes and philosophies that are used in the teaching and learning contexts of deaf learners. It is of significance to understand the different modes and philosophies and how they impact on the education of deaf learners. According to Ocloo *et. al.* (20002), language and communication for deaf learners are as follows:

The *oral approach*, which advocates speech and lip-reading as the means to the *oral approach*, which advocates speech and lip-reading as the means to communicate and educate the deaf child. The deaf child relies on technological devices, such as hearing aids and cochlear implants to 'hear' and speak.

Total communication, a philosophy where every possible means of communicating is used with deaf children. In educational settings, it usually means using signed and spoken languages at the same time. Although, total communication improves the general communication skills, it does not lead to the full development of sign language skills or to the improvement of written or spoken skills. Children who are educated through total communication still experience serious problems with their language skills, especially with regards to reading, writing, understanding concepts and vocabulary.

The *bilingual-bicultural* approach, which is becoming the most appropriate teaching method for deaf children in most countries, including South Africa. In this approach, sign language and the spoken/written languages are kept separate in use and in the curriculum. Sign language is respected as the first language for deaf people and is also used as a language of instruction. The emphasis here is on the deaf child learning his or her first language in a natural way. A good command of the first language is crucial to success with the second language because second language users use their first language as a point of reference in the acquisition of a second language.

According to Zaitseva Pursglove and Gregory (1999:10/11), Vygotsky acknowledged that sign language was the natural means of communication among deaf people and that denying sign language would result in restricting deaf children's intellectual development. However, from the point of view of Vygotsky, sign language, unlike written/ spoken language was not a complete language with the full range of linguistic properties, therefore according to this its use could be of

a restricted nature. Therefore (as far back as the 1930s'), he saw it essential that there should be an interaction between the first language of society (sign language) and the dominant language of the society (written or spoken language), the result of which was bilingualism. Thus the two contemporary systems of teaching deaf children, total communication and bilingual teaching can be considered following in the steps of Vygotsky (Zaitseva *et. al*., 1999:12). Research studies cited in Muthukrishna (2001: 159) state that, two principles for effective instruction for the deaf are as follows:

- Deaf learners will benefit from high levels of sign language, as through sign language, tasks and activities can be explained in a meaningful way.
- There needs to be an emphasis on the development of metalinguistic skills, such as the ability to think and talk about language, to recognize the characteristics and explore the structure of language.

Stewart (2006) advocated for the instructional and practical communication (IPC) to teaching deaf learners. This involved the presentation of a framework within which English and ASL can be used. Stewart (2006: 207) states that "the consequence of this stance is that teachers will possess the skills to use both languages and the understanding of pedagogy to make sound judgments about when to use English in its print, speech and sign modalities". Stewart (2006: 215) states that deaf children who acquire SL as a first language still face the challenge of learning English, which is a key barrier to the ability to learn curricular content therefore his justification is that, "*despite two decades of use as the primary language of instruction in a number of deaf education programs, no research evidence shows that on average deaf children*

whose first language is ASL attains a level of English proficiency that is commensurate with their grade level".

He also discusses a similar circumstance with children who are exposed to English-based signing. Stewart (2006: 216) states that in IPC approach, signing is determined by how teachers feel they can best achieve their lesson objectives. The advantage of IPC is that ASL gives deaf students a means for acquiring a first language and English-based signing provides a means for deaf students acquiring English literacy skills. By having this, the teacher can devote more time and energy to accomplishing the actual instructional objectives.

Relevant Previous knowledge

McIntosh, Sulzen, Reeder, and Kidd (1994) state that deaf children might be less likely to have experienced "normal, unstructured" play in which incidental learning occurs, therefore they arrive at school with disparate backgrounds and abilities. It is not easy for deaf children to acquire information through television and radio, unless they are exposed to captioned television programs and can comprehend the captions. Deaf children will learn a great deal about the world through reading, only if their language development and reading skills are up to par, Andrews *et. al*. (2004:169).

Hearing children, on the other hand, are exposed to science through media such as magazines and programmes on television. They also 'hear' scientific terminology (such as carnivore, velocity, force, etc.) and explanations which stimulates them to think, question and discuss. "Deaf children are generally excluded from this way of meeting science" Molander *et. al.* (2001:210). As a

result pupils memorize theories, concepts and therefore perceive science as uninteresting and of little relevance to their lives.

Cognitive engagement of deaf learners

According to Vacca, Vacca and Grove M. (1999:138), schemata are the "building blocks" of cognition. Cognitive psychologists use the term schemata to describe how humans organize and store information in their heads. Schemata also reflect the background, knowledge, experiences conceptual understandings, attitudes, values, skills and procedures of an individual. The schemata theory provides a basis for understanding how deaf learners make sense of new concepts and knowledge. Vacca *et. al*. (1999:139) state that for comprehension to happen, learners must activate or build a schema that fits with the new information. This occurs in three ways:

- the schema provides a framework that allows learners to 'organize' and 'integrate' new information
- Schema allows learners to make inferences, which assist in skills like prediction_ schema helps learners engage in cognitive activity that involves speculation, judgment and evaluation

Research by schema theorists indicates that abstract concepts are best understood after a foundation of concrete, relevant information has been established. The general knowledge provides a framework into which the newly-formed structure can be fitted.

The difficulty that deaf learners experience with new information may be attributed to a lack of or inadequate schemata.

Therefore, the importance of play in general and in the cognitive and social development of the deaf child cannot be overemphasized. Andrews *et. al*. (2004:166) state, "*The level of sophistication in symbolic play exhibited by deaf children may be a function of their level of language development, social behaviour characteristics and cognitive abilities*".

The relationship between cognition and language is an interdependent one. Schirmer (2001:104) states that, "*Language acquisition occurs as a result of the child's innatecognitive abilities, cognitive strategies and conceptual knowledge*".

Schirmer (2001:111) stated that deaf individuals have stereotypically been characterized as concrete thinkers. Research cited by Schirmer (2001) found that deaf children tended to rely on visual/ perceptual skills, whereas hearing children rely on abstract thinking skills. Although there is no evidence to indicate that deaf learners are unable to think abstractly, it appears that deaf children need to be guided in developing their thinking at levels beyond the concrete. Unfortunately, early studies, as stated by Marschark *et. al*. (2006) supported the view that deaf children were concrete and literal in their thinking (unlikely to master metacognitive skills), which led to teaching techniques that focused on narrower, more limited approaches to thinking and learning. This in turn resulted in the self-fulfilling prophecy as emphasis on literal language discourages diverse problem solving.

In their discussion of metacognition, Marschark *et. al.* (2006) explain that metacognition involves students having some awareness of their own cognitive processes, and include aspects such as problem solving and comprehension. Marschark *et al*. (2006) also state that "*although*

relatively few studies have examined metacognition of deaf children, what research is available suggests that deaf students are less likely than hearing students to consider alternative approaches to a task prior to undertaking it or while working through it". Andrews *et. al*. (2004: 83), argue that metacognition skills do not depend on hearing per se, but they do depend on students having many experiences and opportunities for incidental learning so they can formulate metacognitive strategies.

Many deaf students who come from hearing families with limited communication skills in the home have not had these incidental and formal opportunities to develop metacognitive skills. One likely explanation for many deaf students' failure to apply metacognitive skills could be as a result of parents and teachers of deaf students often taking a more concrete and directive approach to problem solving with deaf children, to ease the 'communication' (Andrews *et. al*., 2004:83).

Another strategy, mediated learning experiences (MLE) is discussed by Andrews *et. al.* (2004). According to Andrews *et al.* (2004: 84), Feuerstein's MLE has been implemented in schools for the deaf (in the United States) and research results indicated positive behaviours in the motivation to learn, and in academic performances of the students. According to Harcombe (2003:51) and Feuerstein's (1991) view of cognitive development is based on the notion that intelligence is modifiable. Feuerstein's work is based on the premise that if the interaction or mediation between adult and child is optimal, the child's cognition will be improved. Feuerstein has termed this interaction Mediated Learning Experience.

Feuerstein maintains that if a child receives adequate MLE from fairly young, he or she is likely to develop cognitively up to the potential allowed by genes. In their discussion of "educationally relevant cognitive characteristics of Deaf students, Marschark *et. al*. (2006:187) explain the empirical consideration of cognitive differences between deaf and hearing students in order to determine whether hearing loss per se is a causal factor in the differences. Marschark *et. al*. (2006:187) claim that, "*With regards to visual processing, for example, deaf signers perform better than either hearing or deaf individuals who use spoken language*". They mention other research studies indicate that deaf and hearing signers are faster in generating and manipulating mental images than are non-signing peers. It is also argued that the mode of communication (speech versus sign) may have some influence. Marschark *et. al*. (2006:187) support their argument by the fact that such advantages are not found among deaf individuals who rely on spoken language indicates that the results are more related to the effects of sign language rather than hearing loss.

Andrews *et. al*. (2004:81) state that, the study of deaf children and adults has provided scientists with the opportunity to study the effects of deafness on bilingualism, intelligence and thinking. Early research in deafness and cognition pointed to the negative viewpoint that bilinguals were intellectually inferior. However, there is no empirical research that states that bilingualism has a detrimental effect on cognition and it is now generally accepted that there are cognitive benefits to bilingualism, such as creative thinking, cognitive flexibility and metalinguistic awareness. Schirmer (2001) claims that when children are not fluent in the language of instruction, understanding complex and abstract concepts increases the demand from their cognitive and

linguistic abilities, which make it difficult or even impossible for the child to be an engaged learner. This issue will be elaborated on in the next topic.

Motivation and expectation

The role of the teacher determines what is taught, how it is taught and to an extent how deaf children in the classrooms feel about themselves (McIntosh *et. al*.,1994). Andrews *et. al.*(2004), discuss the importance of the expectation that teachers have of their students. They state that new teachers need to be aware of the danger of not stereotyping deaf students who have low reading levels and difficulty mastering English. In spite of those facts, they should believe that deaf students are capable of learning and expect more from them. When children are accepted for who they are and what they are praised for what they are capable of doing, their self-esteem is enhanced. Lang (2006), states another factor that strongly influences people's confidence is motivation.

A person who is highly motivated to complete a task will be more likely to have a higher level of confidence in the end result. Motivation can also affect the amount of observational learning a person experiences. McCombs (1984:200) defines motivation as, a dynamic, internally mediated set of metacognitive and affective processes (including expectations, attitudes and beliefs about the self and the learning environment) which can influence a student's tendency to approach, engage in, expend effort on, and persist at learning tasks on a continuity, self-directed basis. Sometimes parents and family of deaf learners establish lowered expectation for them. Frequently deaf children are denied access to daily conversations and incidental learning

experiences. In this way deaf children are not provided with the scaffolding required for their development, Scheetz (2004: 141) Vygotsky (1978:86) describes the Zone of Proximal Development as: The distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers.

The implication here is that if adults want to assist learners to reach their "full potential", they need to provide learning opportunities. Another factor is that deaf children raised in hearing families may struggle with communication and experience difficulties academically. This may affect their self-esteem. Scheetz (2004:56) defines self-esteem as the reflection of individual's self-worth or self-image. From early parent-child interactions, children begin to form their perceptions of who they are and if children do not receive the emotional support and social approval they need, their self-image can remain low.

Science Curriculum for Hearing Impaired Learners

The science curriculum in Ghana is designed to be used by both the hearing and the deaf students. It is therefore adopted for deaf students in deaf schools and inclusive schools. The science curriculum for deaf learners is discussed according to the following headings: (1) The introduction of science, (2) curriculum in Ghana, (3) language as a determinant of access to the science curriculum, (4) sign language and (5) the language of science.

Introduction of science in Ghana

Science was being practiced informally by our ancestors through taboos and other practices. Example: a woman who menstruates doesn't cook for the family until she has completed her cycle, this was to prevent contamination of blood with food. Farmers and fishermen did not go to the farm or sea on specific days which ensures rest. Certain species of fishes were not eaten or animals hunted for which tend to preserve these organisms.

Formal science was introduced by the colonial masters and was being taught in schools as gardening to help the people grow their own food and engage in good cultural practices, then as health science to produce health workers to ensure healthy life styles of people. After Ghana's independence in 1957, Dr Kwame Nkrumah the then Prime Minister wanted to promote science and technology, so that successive government could also continue as a basis for the country's development (Anderson, 2006). Ghana became a republic in1960 the first African country in sub-Sahara to gain independence. The then accelerated development plan with science and technology as it engine to enhance the development of the country motivated him to establish institutions in this respect. The University of Science and technology in Kumasi was established to train engineers, architects, scientists etc. to operate industries. This together with the University of Ghana in Accra, the University of Cape Coast and in addition to the polytechnics and other Diploma Awarding Institutions, Teacher Training Colleges and Technical Schools instituted admission policy that favoured the admission of more pupils into sciences (Anderson, 2006).

Science curriculum

The curriculum is designed to offer a body of knowledge and skills to meet the requirement of everyday living, and provide adequate foundation for those who want to pursue further education and training in science and other science related vocations. Specific issues covered are as follows:

1. Science for all students including the deaf or hearing impaired
2. Science as an active inquiry process.
3. Science and the satisfaction of individual needs
4. Science as a profession.
5. Science and culture.

The aim of the curriculum is categorized under the following objectives:

Objective 1: Scientific Investigations

The learner will be able to act confidently on curiosity about natural phenomena, and to investigate relationships and solve problems in scientific, technological and environmental contexts.

Objective 2: Constructing Scientific Knowledge

The learner will be able to interpret and apply scientific, technological and environmental knowledge.

Objective 3: Science, Society and the Environment

The learner will be able to demonstrate an understanding of the interrelationships between science and technology, society and the environment.

Although there has been changes in the education system, "invisible barriers" continue to exist for deaf learners. This will be explained with regards to the access of the science curriculum that deaf learners in Ghana have.

Language as a determinant of access to the Science curriculum

Hodson (1993: 690) states Language is a cultural artifact. The ways, in which we use it for remembering, reasoning, evaluating, communicating, and so on are socioculturally determined and have to be learned. In the context of multicultural science education, there are several aspects to the "language problem": diversity of mother tongue, the language of science (specialized terminology, use of everyday words in specific, restricted contexts, and style of written communication), the stylized language of the classroom interaction in general and the use of language based activities to bring about learning. Most hearing parents in Ghana cannot communicate with their deaf children and this means that deaf children are getting no form of language input until they start school. Very little communication takes place.

By this stage, it is often too late for the deaf child to acquire the natural language foundation needed for acquisition of other languages, such as English, Fante or Ewe. In addition to this, another significant issue facing deaf educators in Ghana today is that of deaf children whose families belong to diverse ethnic and use a language other than English or ASL as their primary mode of communication. Such language may include English and other foreign languages. The implication of this to science education is that these deaf learners may be learning science in a third or fourth language.

Lee (1997: 221) states that "*the norms of science instructional practices have significant implications for students from diverse cultures and languages. These students bring with them*

their own ways of looking at the world that are representative of their cultural and language environments". Learners' ways of knowing and thinking may be incompatible with the norms associated with science. When students' language and cultural experiences are in conflict with science practices, they may avoid learning science. In agreement with this, Hodson (1993: 690) adds that when learners with limited linguistic skills can become frustrated when faced with an early insistence of precise terminology (vocabulary is emphasized in textbooks) and formal writing style. This can lead to withdrawal or even alienation from science.

The learning Milieu of Science

Science is organized into fields, such as Biology, Chemistry and Physics because of the overwhelming amount of knowledge available to us. However, Lang (2006:57) states that, in the field of science education for deaf learners, we have only recently begun to develop a body of knowledge. He comments that although observation and experimentation have been conducted, a basic theory of instruction has not been defined.

Lang (2006: 60), states that studies of learning styles of deaf adolescents indicate that they rely on organization and structure in the instructional environment and may be classified as "dependent learners". Lang explains that dependent learners are those that look to authority figures for guidelines on what to do. They find it difficult to develop skills for autonomy and self direction.

Deaf students also arrive at school with disparate backgrounds and abilities. Therefore process oriented type of instruction, as opposed to content oriented instruction (which focuses on

listening, reading and memorizing) is appropriate. As process oriented teaching advocates student-centered learning, learners have control over their learning experiences and are encouraged to 'discover' things for themselves (Lang & Propp, 1982). In this way process oriented teaching allows for a more suitable fit between the child's frame of reference and academic expectations. This may also assist learners to overcome language difficulties.

Lang (2006: 58), states that many dedicated teachers are enthusiastic about teaching deaf students, but they lack effective guidance, training and resources based on educational research. McIntosh *et. al*. (1994:481) differentiate between "hands-on" and "minds-on" science activities. They state that teachers may confuse experimental competence with cognitive abilities. Some activities disguise the passive learning that takes place while learners' hands are busy. In comparison, "minds-on" involves active learning, on the other hand, involves students initiating experiments, activities and problem solving. The textbook continues to play a central role in classrooms and many of these books include "hands-on" experiments.

McIntosh *et. al.* (1994) stated that "*unless hands-on science is embedded in a structure of questioning, reflecting and re-questioning, probably very little will be learned*".

Lang (2006:59), states that science teachers must take reading comprehension into consideration in all aspects of instruction, especially in the use of textbooks and multimedia. Lang (2006:), states that the lags of deaf students reading relative to hearing peers tend to increase throughout their school years and this influences deaf learners' access to science learning opportunities. Innovative teaching strategies that have become popular in science are using children's literature and the use of journals to encourage reflective thinking, McIntosh *et. al.* (1994:481). Children

need opportunities to understand how to use and appreciate technology. Lang and Propp (1982: 863) states that "*A majority of hearing-impaired science students appear to be additionally handicapped by a restrictive learning environment. Although science can be taught effectively in the kitchen of any home, one may also hypothesize that there is a relationship between the quality of facilities and the quality of instruction*".

With regards to cognitive strategies and Science, Lang (2006:59), discusses research results which indicate that minds-on instruction activities, where deaf learners are active, interactive, participative and engaged are associated with advanced academic achievement. He states that some factors that inhibit the cognitive engagement of deaf learners in science may include pace of the instructional activity, the number of speakers involved, language and cultural differences, use of space and communication methods.

Molander, Pedersen and Norell (2001:210) discuss the results of their research study that involved *Deaf pupils reasoning about scientific phenomena*. According to their findings, related to chemistry and physics, they state that when pupils are prompted to present scientific arguments, the pupils respond by saying "*I've learnt this but forgotten it*" or "*I'm not very good at this*". Molander *et al*. (2001) also observed that there was little evidence of pupils mixing scientific reasoning with life-world reasoning and they felt that the pupils regarded science as something entirely different from and in fact, irrelevant to their world. That science can as a 'culture and an institution' welcome and support some identities is clearly evident.

Hodson (1993:686) states that it seems that the science curriculum does little to raise the self esteem of children from some minority ethnic groups and is seen by many as irrelevant to their

experiences, needs, interests and In Ghana , the introduction of the Science curriculum involved a shift from content focused to competence focused education. Due to deaf learners 'language barriers' (issues with sign language and literacy), they generally work at a slower pace than mainstream learners. The assessment standards of each outcome are based on content that is progressive.

Many deaf learners do not achieve competency in all the assessment standards of a grade, but progress to the next grade. This results in the learners having an insufficient foundation, 'gaps' in their knowledge and an incomplete understanding of concepts. The curriculum does consider alternative assessment methods for deaf learners. Therefore, the Department of Special Education in Ghana consider the following for deaf learners:

- Sign language interpreter
- Video recording
- Additional time (up to 30 minutes per hour)

GNAD is concerned about the general practice that individual schools for deaf learners are allowed to set so-called "internal papers" for examinations. This creates situation where some learners are unfairly advantaged in that they are not assessed on the complete amount of work. In addition, obtaining a qualification on this basis does not constitute equality and equity. It may also create problems in employment situations as employers will have false expectations of deaf employees

Sign Language

Zaitseva *et. al.* (1999:11) discuss Vygotsky's attitude toward sign language. As far back as the 1930's, Vygotsky asserted that sign language is a complex language with its own syntax, "*a very richly developed language*" fully capable of expressing different abstract concepts, including ideas, thoughts and facts of a socio political nature. According to Vygotsky, "*sign language is not only a means of interpersonal communication among deaf people, but also a means of inner thought in the child himself/ herself*', Zaitseva *et. al.* (1999: 11). In support of this, Molander *et. al*. (2001: 200) in their discussion of sign language in Sweden, state that "*sign language plays a key role in the special school. It enhances pupil's thinking and creativity*…" Molander *et. al.* (2001: 200) also state that in schools for the deaf instruction is aimed at promoting bilingualism, with sign language.

In Ghana, the regular compulsory schools and schools for the deaf use the same curriculum in science. The only language that can be the first language of deaf learners in Ghana, American Sign Language (ASL), is not offered as an official school subject in the General Education and Training Band or in the Further Education and training Band, Gadagbui (1998). As a result, deaf learners face disempowering educational experiences and this is evident by the low literacy levels of the majority of the Deaf people and the fact that very few deaf learners register at Higher Education Institutions.

According to Gadagbui (1998), a few schools in Ghana and other African countries have attempted teaching sign language as a subject, however, the educators involved have received no formal training in ASL linguistics, literature or teaching methodology. This has resulted in

learners receiving restricted instruction, and many learners end up doing vocational training instead of receiving academic training.

Deaf learners have little access to the regular curriculum because the majority of educators' are not proficient in ASL. A recent survey indicated that only 14% of educators in schools for the deaf can sign proficiently. Many educators have indicated their need for support in ASL. According to GNAD, many attempts by special educators to assist the Department of Education in formal training of educators in Ghanaian sign language (GSL) and ASL were not successful.

Molander *et. al.* (2001: 211) raise questions about the relationship between scientific vocabulary and SSL. They discuss an example from their research, where a learner uses the sign for seconds when he talks about atoms. The absence of uniform signs leads to confusion and can pose serious problems in the understanding of concepts that are stringently defined. This has resulted in divergent views regarding the "language" of instruction in the teaching of science to deaf learners. It is important to note that Moores (2006: 48) expresses his agreement with Stewart's (2006) position regarding Instructional and Practical Communication for deaf students. Moores justifies his stance by the need for deaf students to be proficient in English, as science, mathematics, literature, history and social studies texts are all in English. As a result, Moores (2006) feels that despite its limitation, English-based signing can be a bridge to English literacy, which in turn would make science more accessible to deaf learners.

The Language of Science

Wellington and Osborne (2001: 1) are of the opinion that research over the past 30 years shows that one of the major difficulties in learning science is the language of science.

Learners need to access the 'knowledge' and 'skills' in science through language**.**

According to Muthukrishna (2001: 158), in many countries, a major concern in the education of the deaf is that the literacy levels of deaf learners are much lower than those of their hearing peers. As a result of deaf learners experiencing difficulty with literacy, science education, which is in many ways, like learning a new language (Ford & Peat, 1988; Lemke, 2000**;** Wellington & Osborne, 2001) becomes an even greater challenge. Wellington and Osborne (2001: 5) maintain that 'science is like learning a language' for the following reasons:

- Firstly, the concepts and terminology in science have a precise and exact meaning in everyday life. For example, conceptual words such as work, energy and power.
- Secondly, science education also involves introducing new words, sometimes in familiar contexts and other times in unfamiliar contexts.
- Thirdly, the language that science teachers use include words, such as modify, compare, evaluate, hypothesize, infer, etc. learners' come across these words mainly through the educators and examinations – but rarely at home or at social events.

Wellington and Osborne (2001: 5) also discuss the need for learners to be taught the technical and specialist vocabulary of subjects and how to use and spell these words.

With regards to science, this may include language to express chronology, logic, exploration, hypothesis, comparison and how to ask questions. Learners need to learn the language of science so that they can read critically and actively develop an interest in science. Lang (2006: 60),

concurs with this idea, as he states, vocabulary practice should be introduced before deaf students begin the lesson. The language of science should not be 'watered down' excessively, however. Ideally a science teacher should provide progressively challenging language structures in all reading materials, so that both science literacy and English literacy are developed.

The Role of Culture in Science Teaching to the Hearing Impaired

The role of culture in education will be explained by discussing five factors. These are defining culture, deaf culture, culturally responsive education and instructional strategies, the culture of science, cultural border crossing.

Defining Culture

It is culture that provides the tools for organizing and understanding our worlds in communicable ways, Bruner (1999: 149). Bruner maintains that individuals 'make meaning' of things and experiences based on situating encounters in their appropriate cultural contexts. Thompson (1990: 132) reiterates this, when he states, "*Culture is the pattern of meanings embodied in symbolic forms, including actions, utterances and meaningful objects of various kinds, by virtue of which individuals communicate with one another and share their experiences, conceptions and beliefs*". Culture, therefore plays an important role in teaching and learning. Broadly defined, culture is a system of meaning and significance. In addition to race and language, there are other significant factors that influence the construction of meaning and are thus part of cultural identity. These may include economic and educational levels, occupation, gender and religion

Deaf Culture

Deaf people all over the world view themselves as belonging to a linguistic minority with its own culture. DEAFSA (2007) states that Deaf culture has its own history, shared values, social norms, customs and technology which are transferred from one generation to the next. In their discussion of culture, Storbeck and Magongwa (2006: 120-121) comment that despite the primary identity evident within the Deaf community, it is becoming more evident that Deaf culture is affected by the plurality of an individual's culture. They discuss the need for deaf children who are born in countries where there is acknowledgement of multiplicity of languages and cultures to be able to learn about deafness, Deaf culture, as well as the language and culture of the general hearing community. This is known as the plurality of identity.

Storbeck and Storbeck and Magongwa (2006: 121), state that intercultural difference can lead to misunderstanding. They use the example, contextualized in South Africa, that if a child from the Black community initiates eye contact, it may be seen as a sign of disrespect; however, according to the Ghana association for the deaf, it is important to establish eye contact before beginning communication with a deaf person. According to Ogunniyi (1997: 88), in traditional cultures, Black children are to be seen and not heard. Student initiated talks and questions are regarded as gross misconduct and disrespect. Educators need to be aware of these cultural characteristics, so that they plan and implement appropriate instructional strategies and ensure that deaf learners are educated.

Culturally Responsive Education and Instructional Strategies

According to McIntosh *et. al.* (1994: 481), instructional strategies are a key aspect of the role of the teacher. The teacher's interpretation of his or her role, what is taught, how it is taught, use of resources, attitudes and belief's determines how the learners feel about themselves and what they are learning. Certain cultural values and practices may predispose students to accept teachers' authority unquestioningly. Learners may be reluctant to raise questions or challenge knowledge claims as this may be seen as a sign of disrespect (Lee, 2002: 67). It becomes necessary for educators to consider factors such as attitudes and values, as they influence the investigation, construction and application of scientific concepts in science education for deaf learners. In addition to knowing about Deaf culture and how to sign fluently, teachers of deaf learners must be familiar with the values, beliefs, prejudices and stereotypes related to deaf learners (Andrews, 2004: 130).

This will empower educators to adequately plan for the needs of their Fox and Gay (1995: 69), state that "*the extent to which teachers know, appreciate and are able to 'bridge' these cultural differences in the classroom instruction*" will directly affect educational opportunities and outcomes for students from marginal groups. They are of the opinion that effective teaching for diverse learners involves culturally responsive teaching. Gay (2002: 106) defines culturally responsive teaching as, "*using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching more effectively*". Educators need to use appropriate pedagogical actions, such as *cultural scaffolding.* This involves using students own culture and experiences to expand their intellectual horizons and academic achievement (Gay, 2002: 109). Educators can also encourage learners to help (scaffold) each other, according to

their abilities. Bruner (1999: 162) states, when learners 'scaffold' for each other, they become self reliant and learn to work with each other. This can contribute to the learners developing stronger sense of self esteem. Similar to culturally responsive teaching, is the notion of "instructional congruence" perpetuated by Lee (2002: 66), which is described as the process of merging academic disciplines with students' linguistic and cultural experiences to make the academic content accessible, meaningful and relevant for all students. Teachers need to engage in culturally appropriate communication, cultural artifacts, examples and analogies (Lee, 2002: 68). In this way science education may be seen from a socio cultural perspective.

The Culture of Science

According to Lemke (2000: 296), a socio-cultural perspective on science education means viewing science/ science education as human social activities conducted within institutional cultural frameworks (these may include family, school and community centres). In support of this perspective, Aikenhead (1996: 8) suggested that it was possible to regard learning science as a cultural acquisition. To acquire the culture of science, students must travel from their everyday life world to the world of science found in their classrooms. Students must cross the border to learn science. The learner has to understand and accept the subculture of science and the "norms, values, beliefs, expectations and conventional actions of a group".

Grossman and Stodolsky (1995: 237) state that teachers work in subject-specific contexts and hold a number of subject-specific beliefs related to teaching and learning. With some subjects, such as English they may feel that they have more autonomy than subjects such as science and mathematics. Subject subcultures may be characterized by both beliefs about subject matter and

by norms regarding the teaching practice and curricular autonomy. For example, science is generally perceived as a high status subject and that only 'serious students' are capable of studying science.

Cultural 'border crossing'

Aikenhead and Jegede (1998: 10) discussed the metaphor "teacher as a cultural broker". A science educator who is a cultural broker will guide pupils between their life-world culture and the culture of science and help them resolve any conflict. A culture broker identifies the culture in which students' personal ideas are contextualized and then introduces another cultural point of view in the context of the students' knowledge (Aikenhead, 2001). Crossing the cultural border involves more than mere translation.

An educator who assumes a culture broker role must be sensitive to the culturally embedded meanings of words. There is a need to take cognizance not only of learners' ways of knowing and communicating in science, but also how they come to know what they know. Aikenhead and Jegede (1998: 3) discuss three issues related to successful science education:

- The degree of cultural difference that students perceive between their life-world and their science classrooms.
- How effectively students move between their life-world culture and the culture of science.
- The assistance students receive in making these transitions easier.

Learners' knowledge and world views are products of history and socio-cultural influences, as well as individual construction (Aikenhead & Jegede, 1998: 3). Success in science depends

largely on how pupils can move between their life-world culture and culture of science, therefore it is important to understand how these border crossings take place so that effective and appropriate plans can be developed. Lee (2002: 67) states, academic disciplines such as science have ways of producing and evaluating knowledge that have been defined by western tradition, however when cultural and linguistic experiences are used as intellectual resources, students with limited science experience and those from diverse languages and cultures are capable of becoming science literate.

According to Gay (2002: 112), cultural characteristics provide the criteria for determining how instructional strategies should be modified for diverse students and that teachers should learn how to multiculturalize formal and informal aspects of the education process. Differences in culture can create barriers to the learning of science for deaf learners. These barriers may include issues, such as instructional strategies, language, values, beliefs and attitudes that arise due to the learner belonging to a different culture. In addition to a deaf learner belonging to the deaf community, he or she may also belong to a racial or religious community that perpetuates specific norms, values and behaviour. It becomes imperative for science educators of deaf learners in 'multicultural' Ghana to consider these cultural differences so that they can be sensitive and accommodating to the needs of these learners.

Factors Influencing Effective Science Teaching and Learning to the Hearing Impaired

Many factors come to play when it comes to effective science teaching and learning. While some studies point out that teachers' play a major role in effective science teaching (Kuester,2000), other studies reveal that students or learners make science teaching and learning. The discussion

that follows considers some of the factors raised by previous research, which may have influenced effective science teaching and learning students with disabilities into inclusive classes.

Training Regarding Teaching Students with Disability

It would appear that teachers perceive themselves as unprepared for inclusive education because they lack appropriate training in this area (Moores 2006). Inadequate training relating to inclusive education may result in lowered teacher confidence as they plan for inclusive education (Schumm, & Vaughn, 1994). Teachers who have not undertaken training regarding the inclusion of students with disabilities, may exhibit incompetence in their way of teaching in an inclusive setting. (Schumm, & Vaughn, 1994), while increased training was associated with more positive attitudes toward the inclusion of students with disabilities (Briggs, Johnson, Shepherd, & Sedbrook, 2002). Training in the field of special education appears to enhance understanding and improve how teachers impart knowledge in an inclusive setting. Also, introductory courses offered through teacher preparation programmes may sometimes be inadequate in preparing the general educator for successful inclusion (Kuester, 2000).

Age, Teaching Experience and Teachers' Qualifications

There are several studies which have investigated whether there is any significant correlation between a teacher's age, years of experience and qualification to that teacher's attitude toward the inclusion of students with disabilities into regular classrooms. Some studies record that older teachers appear to foster less positive attitudes than younger teachers (Lampropoulou & Padelliadu, 1997). Younger teachers appear more accepting of inclusive trends than their more

experienced counterparts (Harvey, 1998). It would also seem that the most experienced educators have the lowest level of acceptance of inclusion (Forlin, Douglas, & Hattie, 1996). Further to this, researchers are of the view that older, more experienced teachers are uncomfortable with inclusive practices, because they face an intrusion into their rooms by support personnel. The presence of other adults in the room may result in tension and discomfort especially as they perceived the visitor as an observer and not as additional support (Hallahan & Kauffman, 1991). They concluded that a teacher's level of educational qualification did not significantly influence how they teach students with disabilities in regular classes (inclusive) thus a teachers competence helps in effective teaching and learning of science.

Class Size

Large classes may be viewed as an obstacle to the successful implementation of inclusive education (Agran, Alper, & Wehmeyer, 2002). Larger classes place additional demands on the regular educator, while reinforcing concern that all students may not receive proper time or attention (Agran *et. al.,* 2002). These authors make reference to Italian Law 517, which refers to the inclusion of students with disabilities into regular classes. Class sizes cannot exceed 20 if there is one student with a disability in an inclusive and consistency in terms of class size has allowed Italian teachers to be more supportive of inclusive education (Agran *et. al.,* 2002). Therefore the smaller the class the better a teachers attention for learners.

Level of Confidence

Sigafoos and Elkins (1994) concluded that inclusive educators generally lacked confidence as they attempted to include students with disabilities into their classes. This may be as a result of

lacking proficiency about modifying the regular education curriculum to suit students with individual learning needs (Sigafoos & Elkins, 1994). Further, Avramidis, Bayliss and Burden, (2000) and Briggs, Johnson, and Sedbrook (2002), support the view that teachers who perceive themselves as competent inclusive educators, often have more positive attitudes toward inclusive education. Teachers acquire increased competence as a result of increased training in the field of inclusive education (Avramidis *et. al*., 2000). Thus, inadequate knowledge with regard to instructional techniques and curricular adaptations, which contribute to decreased confidence, may be factors which influence a teacher's attitude toward inclusive. Training in the field of special education appears to enhance understanding and improve how teachers impart knowledge in an inclusive setting.

Previous Experiences of Teaching Students with Disabilities

Possessing previous experience as an inclusive educator appears to positively predispose teachers' towards inclusive education (Avissar, 2000; Avramidis *et. al*., 2000) and this tends to affect how they teach these children. It would appear that previous experience in this field, allows inclusive teachers to feel more comfortable within the inclusive classroom (Avissar, 2000). Direct experiences of including students with disabilities into mainstream settings appeared to be an essential factor in shaping teachers' views and how they teach in inclusive settings (Avramidis *et. al*., 2000). However, Briggs *et. al.* (2002) point out that the nature of previous contact should be positive as it is this that results in commitment towards how they teach children with hearing impairment in inclusive schools

The Severity of a Student's Disability

Teachers' way of teaching is greatly influenced by the type and the degree of the disability of the student concerned (Agran *et. al*., 2002). There is concern from teachers regarding the inclusion of students with more severe disabilities (Forlin *et. al*., 1996; Sigafoos & Elkins, 1994). Teachers view the move to include students with multiple disabilities into the mainstream classroom, as impractical (Sigafoos & Elkins, 1994). The study by Sigafoos and Elkins (1994) found that teacher attitudes were less favourable about including students with multiple and physical disabilities into the regular class. But, Avramidis *et. al.* (2002) found that students with emotional and behavioural disorders attract the least positive attitudes from teachers within inclusive classroom. Thus with a poor attitude a teacher teaching effectively becomes questionable.

Support from Administrative Staff

Administrative support has also been cited as a significant factor in determining how a teacher teaches, as the teacher feels reaffirmed if the school principal and heads fosters a positive learning environment for both teachers and students (Idol, 1997). Teachers believe that the support of the principal/heads and other school leaders is critical in order for them to implement inclusive practices (Idol, 1997). The author refers to a "visionary" principal, who will accept the challenge to create an inclusive environment for all students. Principals/heads need to accept ownership of all students and support inclusive placement, in order to inspire these feelings among other school personnel (Idol, 1994). However, research suggests that administrators' attitudes toward students with disabilities are less than positive; thereby impacting on the process of inclusion in schools (Moores, 2006). Clayton (1996) noted that administrative staff lacks

sufficient understanding and expertise regarding the delivery of services to students with disabilities (Clayton, 1996). Further research commented that administrators may hold positive views of inclusion as they are further away than mainstream teachers, in terms of actual experiences (Clayton, 1996).

The Role of the interpreter in Educating Persons with Hearing Impairment

In some situations the nature of social environment within the school set up can lead students (especially the hearing- impaired) to react unfavourably towards inclusion. Therefore, the overall school situation should be considered while assessing how teachers teach non- hearing and hearing students in integration.

When deaf students enter school, it is likely that they will not be as socially, emotionally, and academically prepared as his or her hearing peers. Researchers (Moores, 2006) have confirmed that, for a variety of reasons, deaf children experience delays in social and emotional development, creating a unique situation and a challenge for interpreters working in our public schools. Legislation has been enacted to address the needs of students with disabilities including deaf and hard-of-hearing students (Moores, 2006). However, public school programmes for the deaf are left with deciding how the interpreter can help these students.

Meeting the interpreter's role with regard to needs of deaf students in public schools is a relatively new phenomena and merits investigation. Prior to the passage of Public Law 94-142 (Education of all Handicapped Children Act, 1975), deaf students were primarily educated at large state schools for the deaf (Moores, 2006). Deaf students in inclusive schools depend mostly

on their interpreters for information in the classroom and outside. Interpreters apart from interpreting lessons also serve as a counsellor and the ear of the deaf. Schools for the deaf used to have access to the plethora of services, including counselling and psychological services, provided by the residential facility. Since the early 1970s, there has been an exodus of students leaving residential schools for the deaf and enrolling in their neighbourhood schools. (Moores, 2006) have identified several historical trends in the education of deaf students. In particular, the migration of deaf students from residential schools began a few years prior to the passage of Public Law 94-142 and continues today, while interpretation as a profession was still fairly young in education of the deaf and hard of hearing especially in inclusive schools((Moores, 2006).

Recent research on hearing impaired students indicates that they have specific needs with regards to communication that often are not addressed properly in elementary and secondary school (Reis & Colbet, 2004). The primary function of the school interpreter is to work individually and collaboratively with others to implement a comprehensive developmental school programme which will benefit the hearing impaired student and other school children (Prinstein & La Greca, 2004). This programme should focus on the academic, career, and personal or social developmental needs of all students, including those with special needs. Inconsistencies in the roles of practicing school interpreter and as a counsellor in educational programmes have caused some scholars to begin to address the emerging role of the inerpreter regarding students with special needs (Greene, Biederman, Faraone, Wilens, Mick, & Blier, 1999).

Recent research indicates that elementary school interpreter are well suited to serve a pivotal role in both providing information related to how to identify students with disabilities and overseeing the various collaborative roles associated with working with special needs students (Prinstein & La Greca, 2004). Many interpreters do not know how to develop appropriate intervention programs for students with disabilities due to a limited understanding of approaches (i.e., attitudes, values, beliefs) and inadequate skills to address the needs of this group (ASCA, 2004). Without appropriate knowledge and understanding of the needs and characteristics of specific groups of students with disabilities, school counsellors and interpreters may not know how to contribute to their academic, career, and personal or social development. This will help the learner's disabilities not to mask their abilities. An interpreter also can help to probe whether and how classroom experiences contribute to a student's relationship with other students, and whether he or she displays characteristics such as low self-esteem, feelings of inferiority, negative attitude, feelings of learned helplessness, or lowered self-concepts and self-confidence which can mare the learners progress (Cohen, 1995)

Strategies for teaching science to students with deafness

The nature attributes and learning needs of an individual with hearing impairment/deafness requires some strategies and techniques on the part of the teacher/learning facilitator if improved learning outcomes are to be achieved. The Longman Active Study Dictionary explains technique as a special skill or way of doing something while strategy is denoted as a plan or procedure used in the achievement of a set goal, target or objective.

The most effective strategy as denoted by Diedong (2005) in the education of individuals with hearing- impairment/deafness is the careful planning and individualization of teaching methods. This, he added is to make lessons more meaningful, relevant and interesting to each student. To achieve this feat, Oppong (2003), has suggested the drawing up of an individualized educational plan/programme (IEP) for each hearing-impaired child. This he said will help determine the actual hearing level of the child, his learning experiences and also the appropriate placement of each one of them. He explained that such a plan will enable the teacher provide the special services needed by the child specifically, the curriculum most suitable for the child and the provisions that must be set in place for each child to succeed in the educational climate. This he added is necessary due to the fact that hearing -impaired children have varying degrees of hearing levels, different times of onset of the handicapping conditions, divergent experiences, and so on. As a result of this, when an IEP is drawn for each child, then the teacher can identify a congruent point at which if and when the need arises all the children can be handled from and communicated with meaningfully as a whole class. Based on this, the teacher needs to adjust him/herself in the science teaching and learning process to meet the individual needs of each of the children in the classroom.

Secondly, Smith (1998) has noted that the ability of an individual to learn effectively depends on his/her attitude. Attitude, he explained, is the individual's consistent way of anticipating, evaluating and responding to a situation or condition. He cautioned that attitude can be described as positive or negative and that most individuals depict a positive attitude when they are in a relaxed and friendly atmosphere. He added that, with a positive attitude, learning takes place with minimum stress hence; in teaching science to students with deafness, the teacher of a child with

hearing-impairment/deafness should create a relaxed and friendly atmosphere that will to an appreciable extent reduce the psychological stresses associated with deafness in the classroom. This the teacher can do by providing adequate science teaching and learning materials in order to gear the students towards improved learning outcomes. As much as possible therefore, the science teacher should avoid creating anxiety in the classroom since anxiety and stress promotes a negative attitude which does not auger well for objectivity and sobriety thereby affecting the acquisition of knowledge, skills and concepts. Anxiety in a science classroom for students with deafness can be reduced if the teacher provides comfort and encouragement (motivation).

Fontana (1984) argued that learning took place adequately when it was done using the play way method, that is, the science teaching and learning process must involve the use of a multi-sensorial approach/method and manipulative skills. The multi-sensorial approach/method provides an opportunity for the use of all the major senses of an individual in the acquisition of knowledge. This method, he explained, offers the individual an avenue to learn without stress and the chance to move at his/her own pace in addition to the formation of acceptable guided opinions based on his/her own experiences under the guidance of the learning facilitator or teacher. Based on this, it can be reiterated that in teaching science to individuals with hearing-impairment/deafness stresses and anxiety in the classroom can be reduced by the creation of a relaxed teaching-learning environment which is friendly to the child, coupled with the provision of adequate science teaching and learning tools to be manipulated. With such an approach, a student with hearing -impairment/deafness can be expected to succeed in the study of science subjects because they will find it easier to assimilate scientific concepts, skills and processes.

Nyadu (2005) has suggested that children with an appreciable amount of hearing impairment benefit much from smaller groups of learning activities. Due to this, large classes should be broken into smaller units so that the learning facilitator/teacher can effectively assist the learners/children with their individual needs and difficulties and to ensure that all the children have a go at the learning activity in order to overcome every challenge associated with the concept or skill being imparted. Thus, in a science lesson when students with deafness are put in smaller groups, it offers the science tutor an ample opportunity to illustrate and demonstrate effectively taking into consideration the needs of each of the groups especially when the tutor is using same ability groupings. In addition to this, Nyadu (2005) further encouraged teachers to be patient with the children and to direct the classroom proceedings according to the pace dictated by the performance of the children and where necessary, remedial teaching should be organized for children who need it since all the children do not have equal learning/assimilation rates. He concluded emphatically that teachers should not underestimate the hearing impaired child's intellectual abilities, potentials and competencies due to the fact that deafness is an impairment of the sensory organ of hearing and not an intellectual handicap thus, the most important thing is to assist the children with hearing- impairment/deafness in every way possible to acquire the basics of the scientific concepts, skills and knowledge being imparted and they will forge ahead.

According to Carbo, Dunn and Dunn (1986), the teacher's facial expression should be seen clearly by all the children. This, they explained, is because facial clues help speech reading and understanding thus when a teacher talks facing the chalkboard, or turns away from the hearing impaired/deaf child on the assumption that they cannot perceive sound then, much information is lost. Thus in the science teaching and learning process among individuals with deafness, the teacher should not talk simultaneously with demonstrations and illustrations due to the fact that

the students cannot observe the two activities at the same time. They also emphasised that the teacher should ensure that enough light is reflected adequately on his/her face to promote and encourage adequate observation and speech reading.

Among other things Gadagbui (1998b), has stated that as much as possible, the teacher should regulate his movements in the classroom. She explained that moving too fast makes it difficult for students with hearing-impairment/deafness to concentrate on the information being given although the teacher does not have to be static. She added that if the teacher remains at one place for a long time, the children may develop neck pain and boredom as a result of looking at one place over a period of time. In conformity to this assertion, Essel (2003) has advocated the use of other modes of communication like gestures to make learning easier for the hearing- impaired child. In a practical science lesson, science tutors can use gestures to prompt students with deafness to take cognizance of events such as the pop-sound of hydrogen test, observation of effervescence, etc.

In addition to this, the children should be encouraged to ask questions and give answers and responses through other means like drawing, gesturing and so on. This she concluded is to enable students with hearing-impairment/deafness reveal their problem areas in addition to the giving of ample and appropriate exercises to depict each child's level of understanding.

Additionally, computer aided instructions (CAI) which are basically an audio- visual mode of communication and an extremely useful way of acquiring and imparting knowledge, concepts and information can be used in the teaching of science to students with deafness by making scientific concepts real and meaningful through the addition of special effects even on plane

figures and objects thereby making CAIs an ideal way of teaching individuals with hearing impairment/deafness. By this teaching strategy, science tutors are better able to help the children with hearing-impairment/deafness to derive scientific knowledge and the understanding of concepts and processes without much explanation via speech and or sign language (Lockheed & Verspoor, 1991). As a result of this discovery, science tutors should not believe that some concepts are above the child with hearing-impairment/deafness because based on this assumption teachers may tend to ignore such knowledge, concepts and skills but rather, they should deduce the appropriate pedagogy and communication modes that will facilitate the enhancement of a pleasant learning experience of students with hearing- impairment/deafness in the science teaching learning environment to promote their understanding and assimilation of these topics, concepts and processes.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter discusses the sequence of activities the researcher used to collect data for the study and analysis. It describes the research design, the population, sample and sampling techniques, instruments for data collection, validity and reliability, data collection procedures and the data analysis used for the study concludes the chapter.

3.1 Research Design

Avoke (2005) explained that a research design is a strategy for doing research, which involves an empirical investigation of a particular contemporary phenomenon within its real context using multiple sources of evidence. To maximize richness and accuracy of data, as well as transferability of the findings, a group case study was carried out at the University Practice JHS, Winneba. Case studies allow the researcher to become familiar with the data in its natural setting and fully appreciate the context. The research design used for the study was a case study research design. The researcher used this design so as to have an in-depth understanding of how scientific knowledge is transferred to pupils with hearing impairment at University Practice JHS-South Campus, Winneba where inclusive education is practiced.

3.3 Population

Population according to Seidu (2006), is the sum aggregate of a phenomenon which is of interest to the researcher. The population involves all the people, objects and institution which are the

subjects of the study. It refers to the entire measurement that the researcher is investigating. The target population for the study was fifty (50) and composed of twenty-four (24) hearing impaired pupils, five (5) integrated science teachers and three (3) sign language interpreters of the University Practice JHS School at the South Campus, Winneba. This school was chosen for the study because it happens to be the only basic school integrating pupils with hearing impairment with their hearing counterparts in the same environment in the Effutu Municipality.

3.4 Sample and Sampling Techniques

The researcher employed purposive sampling technique to select all the five (5) integrated science teachers and three (3) sign language interpreters in the University Practice Inclusive Junior High school. The use of purposive sampling for teachers and the sign language interpreters is to buttress the importance of acquiring rich information from respondents to enable the researcher address the purpose of the study (Nakhado, 2002). Simple random sampling technique was used to select seven (7) hearing impaired pupils (4 females and 3 males) out of the total of twenty-four (24) hearing impaired pupils in the University Practice Junior High school for the study using the lottery method.

3.5 Instrumentation

Three instruments was used for the study. These are Barbados Science Teaching Observation Schedule for the hearing impaired (BARBADOS STOS-HI), semi-structured interview schedule and a five piont likert scale questionnaire. The BABADOS observation checklist is a classroom observation on tool that presents a teachers approach on his/her organization, presentation, interaction and content knowledge.The BARBADOS STOS-HI was used to measure the science

teaching and learning practices for the hearing impaired. Likert scale questionnaire was also be given to science teachers to assess their performance in teaching integrated science to the hearing impaired pupils.

Bailey (1994: 243–4) identifies the following inherent advantages in the participant observation approach:

- Observation studies are superior to experiments and surveys when data are being collected on non-verbal behaviour.
- In observation studies, investigators are able to discern ongoing behaviour as it occurs and are able to make appropriate notes about its salient features.
- Because case study observations take place over an extended period of time, researchers can develop more intimate and informal relationships with those they are observing, generally in more natural environments than those in which experiments and surveys are conducted.
- Case study observations are less reactive than other types of data-gathering methods. For example, in laboratory-based experiments and in surveys that depend upon verbal responses to structured questions, bias can be introduced in the very data that researchers are attempting to study.

The semi-structured interview was used to collect information from science teachers and interpreters on their qualification, knowledge and instructional practices used in teaching science to the hearing impaired. Documentary research was used to assess their progress in science over the years.

3.6 Validity of the Instrument

Validity of an instrument is about whether the instrument measures what it purports to measure. To ensure validity, the research instruments was given to my supervisors to subject it to corrections and make inputs. The corrections and suggestions made by the experts were incorporated into the final instrument.

3.7 Reliability of the Instrument

Reliability of a study instrument is the consistency of the instrument. According to Muijs & Reynolds (2005), a test is reliable when the scores it produces are consistent and dependable. Reliability therefore is the extent to which an instrument is consistent when it is repeated. The concept of reliability concern the degree to which a measuring instrument is free from measurement error (Fishbein & Ajzen, 1975). To ensure the reliability of the research instruments, the researcher developed the questionnaire under the guidance and direction of some lecturers in the researcher's department of study. Furthermore, a reliability test was conducted by subjecting the instruments (Likert scale questionnaire and the observation check list) to Cronbach's Alpha test of reliability. This is because Cronbach Alpha is a much more general form of `internal consistency than other forms of test of reliability. Cronbach's Alpha reliability value/coefficient of 0.88 was obtained for the instrument used in the study. According to Borg, Gall and Gall (1996) co-efficient of reliability values above 0.75 are considered adequate.

3.8 Data Collection Procedure

There were three stages of data collection. The first stage involved gathering data from the case schools regarding the number of hearing impaired pupils in the school. The second stage consisted of interviewing the pupils. The interviews took thirty minutes for an individual. The interview technique employed is the semi-structured or focused interview.

The BARBADOS STOS-HI was used by two observers including the researcher during a science lesson. This was done to determine the agreement of inter-rater consistency of the instrument. The BARBADOS STOS-HI was pilot-tested to ascertain the reliability and validity of the instrument and as to whether the tool was worthwhile to use.

The reliability of the classroom observation will be determined by using the Cronbach alpha.

3.9 Data Analysis

The researcher used the Statistical Package for Social Sciences (SPSS) version 20 to analyze the data obtained from the BARBADOS STOS-HI. Simple descriptive statistics was used to analyze the interview schedules. Thus themes were built to guide in the analysis. The data was presented in tables with frequency count and percentages. As described in the previous section, data for this study was collected by and interviewing and classroom observations. Interview data was transcribed first into a Word document. Inductive coding techniques was employed, and aimed at discovering the codes from within the data itself.

CHAPTER FOUR

RESULTS/FINDINGS

4.0 Overview

This chapter presents the results and findings of the study. The results are presented in tables and bar charts.

The results are presented according to the following research questions:

1. In what way is integrated science taught to children with hearing impairment at the University Practice Inclusive JHS- South campus, Winneba?
2. What factors influence effective teaching of integrated science to the hearing impaired in University Practice Inclusive JHS- South campus, Winneba?
3. What is the role of interpreters in the teaching and learning of integrated science to pupils with hearing impairment?
4. What strategies could be employed to improve the teaching of integrated science to the hearing impaired?

Research question 1

In what way is integrated science taught to children with hearing impairment at the University Practice Junior High School, South campus, Winneba?

To answer this question, Barbados classroom observation schedule was used to observe 5 integrated science teachers in ten lessons. In Table 1 integrated science teaching to the hearing impaired was quite satisfactory. Teachers attained mean score of 2 and above for many of the behaviors observed. This means that more emphases were recommended for many of them. An examination of the classroom activities revealed that they were under organization (1, 2, 3, 4, 5),

presentation (6-14), and content knowledge (22, 23). This means that the teachers performed well on these areas. However, they attained low mean scores for interaction (15-21).

Table 1: Means and standard deviations of class observation for the teachers

S/N	ITEM	N	M	SD
1.	Presents overview of lesson	5	2.80	0.45
2.	Paced lesson appropriately	5	2.40	0.55
3.	Presented topic in logical sequence	5	2.40	0.55
4.	Related lesson to previous lesson	5	2.20	0.84
5.	Summarized major points	5	2.60	0.55
6.	Explained major/minor points with clarity	5	2.20	0.84
7.	Defined unfamiliar terms, concepts or principles	5	2.00	0.00
8.	Used good examples to clarify points	5	2.40	0.55
9.	Showed all the points in solutions to homework problems	5	2.20	0.84
10.	Varied explanations for complex or difficult material	5	2.00	0.00
11.	Emphasized important points	5	2.20	0.45
12.	Writes key terms on blackboard	5	2.00	0.71
13.	Integrates material from real world	5	2.60	0.55
14.	Favored active, collaborative and cooperative learning over Passive learning	5	2.00	1.00
15.	Actively encouraged questions	5	1.00	0.00
16.	Asks questions	5	1.20	0.45
17.	Waited for students to answer questions	5	1.00	0.00
18.	Listened to students' questions	5	1.60	0.55
19.	Responded to students' questions	5	1.60	0.55
20.	Restated questions and answers when necessary	5	1.60	0.55
21.	Demonstrate respect for diversity	5	1.40	0.55
22.	Presented material at an appropriate level	5	1.60	0.55
23.	Presented material to the purpose of the lesson	5	2.60	0.55
24.	Demonstrated command of the subject matter	5	2.60	0.89

Research question 2

What factors influence effective teaching of Integrated Science to the hearing impaired in University Practice Inclusive JHS?

To answer this question, Likert-type questions accessing the teaching of integrated science was answered by the teachers. The scale had five responses, that is strongly agree, agree, neutral,

disagree and strongly disagree. One of the factors that influence the teaching of integrated science to the hearing impaired is teacher interest or willingness.

As shown in Table 2, 20% of teachers agreed that they enjoy teaching science to children with hearing impaired whiles 60% disagree and 20% strongly disagree. Another factor is communication whereby 60% of the teachers strongly disagree that it is easy to communicate with children with hearing impaired whiles 40% disagree. It was noted that 40% disagree that the interpreter makes teaching to the hearing impaired easy, 40% strongly disagree and 20% were neutral or undecided. Eighty percent (80%) of the teachers strongly agree that hearing impaired children need extra tuition whiles 20% agree. Forty (40) percent of teachers strongly agree that school feeding programme should be introduce to children with hearing impaired, whiles 60% agree to that.

Table 2: Percentage responses of the teachers

		SA	A	N	D	SD
		%	%	%	%	%
1.	Teachers enjoy teaching science to children with hearing impairment	-	20	-	60	20
2.	It is easy to communicate with children with hearing impairment	-	-	-	40	60
3.	The interpreter makes the teaching and learning of science easy		-	20	40	40
4.	Hearing impaired children contribute a lot in class	-	-	20	40	40
5.	Hearing impaired children perform better in class	-	-	-	40	60
6.	The TLM makes teaching impaired children easy	20	20	-	60	-
7.	Hearing impaired children need extra teaching aid at home	80	20	-	-	-
8.	Science teachers in inclusive schools need additional motivation	80	20	-	-	-
9.	School feeding programme should be introduced to special schools	40	60	-	-	-
10	I will like to continue teaching science to children with hearing impaired	60	-	40	-	-

The mean scores and the standard deviation as shown in Table 3 confirmed the results in Table 2 above.

Table 3: Descriptive statistics of accessing science teaching to the hearing impaired

	N	Min	Max	M	SD
1. Teachers enjoy teaching science to children with hearing impairment	5	1.00	4.00	2.20	1.09
2. It is easy to communicate with children with hearing impairment	5	1.00	2.00	1.40	.547
3. The interpreter makes the teaching and learning of science easy	5	1.00	3.00	2.00	1.00
4. Hearing impaired children contribute a lot in class	5	1.00	3.00	1.80	.836
5. Hearing impaired children perform better in class	5	1.00	2.00	1.40	.547
6. The TLM makes teaching impaired children easy	5	2.00	5.00	3.00	1.41
7. Hearing impaired children need extra teaching aid at home	5	4.00	5.00	4.60	.547
8. Science teachers in inclusive schools need additional motivation	5	4.00	5.00	4.80	.447
9. School feeding programme should be introduced to special schools	5	4.00	5.00	4.40	.547
10. I will like to continue teaching science to children with hearing impaired	5	3.00	5.00	4.20	1.09
Valid N (list wise)	5				

Research question 3

What is the role of interpreters in the teaching of Integrated Science to children with hearing impairment?

As indicated in Table 4, the role of interpreters in teaching integrated science to the hearing impaired is not satisfactory. It was observed that many of the interpreters mean scores were below 2. This suggests that many activities in classroom were not observed or needs more emphasis for these interpreters. The interpreters had mean scores of 2 and above for few activities observed (6,11,14,18,19,24).

Table 4: Means and standard deviations of class observation for interpreters

S/N	ITEM	N	M	SD
1.	Presents overview of lesson	5	1.60	0.45
2.	Paced lesson appropriately	5	1.80	0.55
3.	Presented topic in logical sequence	5	1.80	0.55
4.	Related lesson to previous lesson	5	1.80	0.84
5.	Summarized major points	5	1.80	0.55
6.	Explained major/minor points with clarity	5	2.00	0.84
7.	Defined unfamiliar terms, concepts or principles	5	1.20	0.00
8.	Used good examples to clarify points	5	1.40	0.55
9.	Showed all the points in solutions to homework problems	5	1.80	0.84
10.	Varied explanations for complex or difficult material	5	1.80	0.00
11.	Emphasized important points	5	2.00	0.45
12.	Writes key terms on blackboard	5	1.60	0.71
13.	Integrates material from real world	5	1.60	0.55
14.	Favored active, collaborative and cooperative learning over passive learning	5	2.00	1.00
15.	Actively encouraged questions	5	1.80	0.00
16.	Asks questions	5	1.60	0.45
17.	Waited for students to answer questions	5	1.60	0.00
18.	Listened to students' questions	5	2.00	0.55
19.	Responded to students' questions	5	2.00	0.55
20.	Restated questions and answers when necessary	5	1.60	0.55
21.	Demonstrate respect for diversity	5	1.40	0.55
22.	Presented material at an appropriate level	5	1.80	0.55
23.	Presented material to the purpose of the lesson	5	1.60	0.55
24.	Demonstrated command of the subject matter	5	2.20	0.89

N : Number **M**: Means **SD**: Standard Deviation

Research question 4

What strategies could be employed to improve the learning of integrated science to the hearing impaired?

As indicated by the data in figure 1, the role of the interpreters in teaching and learning of integrated science to the hearing impaired was not satisfactory compared to their regular teachers. Most of the activities had a mean score below 2. This also suggest that many activities of the interpreters were not observed. The interpreters had mean scores of 2 and above for few activities observed (6, 11, 14, 18, 19, and 24). On the contrary, the teachers' role in teaching of integrated science was highly encouraging. According to the data 16 out of the 24 activities were observed. These 16 activities had a mean score of 2. Again, few activities (1,5,8,9,11,13,23,24) by the teachers recorded a mean scores above 2. The indication is that teachers are more active in the teaching of integrated science than their counterpart interpreters.

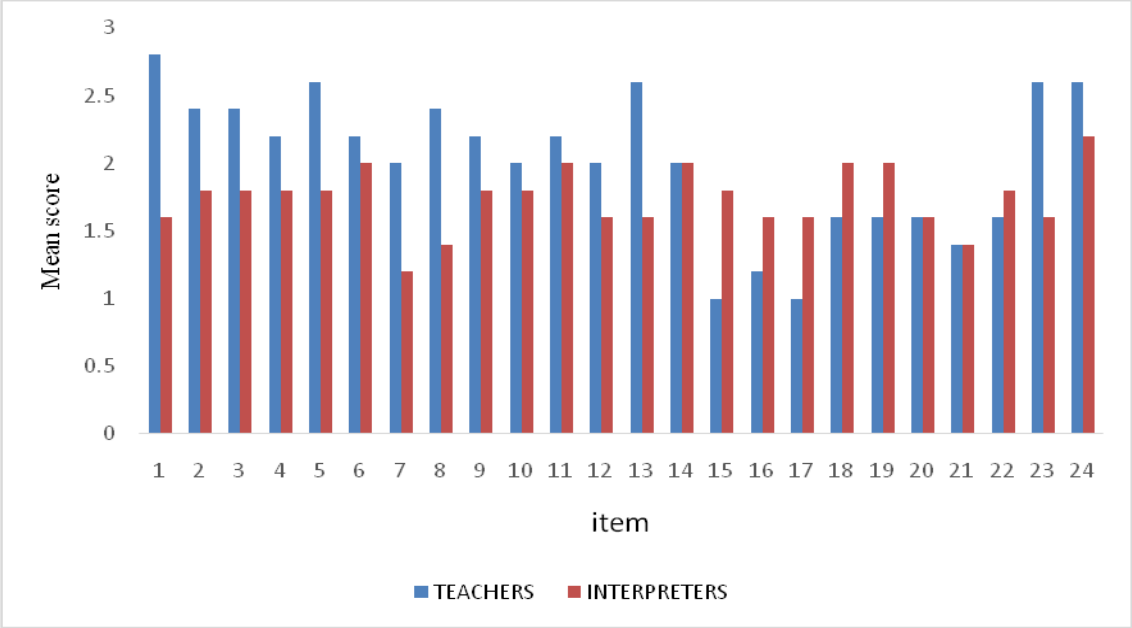

Figure 1: Mean scores of the teachers and interpreters.

Table 5 shows the results of descriptive statistics components of lesson delivery by teachers in the process of teaching integrated science to the hearing impaired. For example, the data was analyzed indicated that in terms of organization of lessons, the minimum score was 1.40 while the maximum score was 2:80 with a mean score of 2:12 and a standard deviation of .482. In terms of presentation of lessons as shown in table 6, the mean score was 1:94 with a standard deviation of .472. Also, the mean score as shown by the data on teachers' interactions with pupils with hearing impairment was 1.52 with the standard deviation of .350. With the content knowledge of teachers, the mean score was 2.06 with a standard deviation of .624 which was significantly higher than the other components observed.

Table 5: Descriptive statistics components of lesson delivery

	N	Minimum	Maximum	Mean	Std. Deviation
Organization	10	1.40	2.80	2.12	.482
Presentation	10	1.22	2.67	1.94	.472
Interaction	10	1.14	2.29	1.52	.350
Content Knowledge	10	1.33	3.00	2.06	.624
Valid N (listwise)	10				

Percentage Observation for Teachers in Organization of Lesson Delivery

Table 6 shows the percentage distribution of observation of teachers' organization in their lesson delivery in integrated science. For example, with the presentation of overview of lesson 20% more emphasis was recommended whilst 80% was achieved very well. Also, with the pace of lesson and presentation of topic in logical sequence 40% and 60% were recorded as more emphasis recommended and advised very well respectively while 20%, 40% and 40% were also

recorded as not observed, more emphasis recommended and achieved very well respectively. The table again shows that teacher summarized major points in their lesson delivery with 40% as more emphasis recommended and 60% achieved very well.

Percentage Observation for Teachers in Lesson Presentation

Table 6 again shows the percentage distribution on integrated science lesson presentation by teachers in the school. In the presentation of lesson, the data revealed that teachers explained major points with clarity. In fact while 40% was recoded as more emphasis recommended and anther 40% was achieved very well. The table further indicated that teachers defined unfamiliar terms, concepts or principles to pupils representing 100% more emphasis recommended. With respect to the use of good examples to clarity points 40% more emphasis were recommend while 60% was achieved very well. Table 7 further shows a mixed outcome of results as to whether all points in solving homework problem. In fact, 20% was not observed while 40% each was more emphasis recommended and 40% was achieved very well.

The data again shows a 100% more emphasis recommended on varied explanations for complex or difficult materials. With the emphasized important points during teaching and learning of science in the school 80% more emphasis recommended observed while 20% was achieved very well. Writing key terms on black board saw a mixed reaction by the data as 20% was not observed, another 20% was achieved very well while 60% recorded more emphasis recommended. With regard to whether teachers who teach integrated science integrates materials from real world, the data revealed 40% more emphasis recommended and 60% achieved very well respectively.

Percentage Observation for teachers on interaction

Table 6 shows that the interaction between teachers and pupils with hearing impaired during teaching and learning process is very poor with 100% not observed at all. In terms of asking questions during teaching and learning, 20% more emphasis recommended while 80% not observed. On the issue of waiting for students to answer questions recorded a huge set back with 100% not observed. Meanwhile, listening to students' questions by teachers during teaching of integrated science to hearing impaired pupils revealed that 40% was not observed while 60% had more emphasis recommended. Responding to students' questions and relating questions and answers when necessary had 40% not observed and 60% of more emphasis recommended, while demonstrating respect for diversity scored 40% more emphasis recommended with 60% not observed.

Percentage Observations for teachers on content knowledge

Table 6 shows percentage observations for teachers on content knowledge during teaching and learning of integrated science to the hearing impaired pupils in the school. In terms of presenting materials at an appropriate level and presenting materials to the purpose of the lesson show 40% not observed and 60% of more emphasis recommended. However, demonstrating command of subject matter revealed that 20% was not observed while 80% shows more emphasis recommended.

Table 6: Percentage observations for the teachers

S/N	Organization	NO %	MER %	AVW %
1	Presents overview of lesson	-	20	80
2	Paced lesson appropriately	-	60	40
3	Presented topic in logical sequence	-	60	40
4	Related lesson to previous lesson	20	40	40
5	Summarized major points	-	40	60
	Presentation	**NO %**	**MER %**	**AVW %**
6	Explained major/minor points with clarity	20	40	40
7	Defined unfamiliar terms, concepts or principles	-	100	-
8	Used good examples to clarify points	-	60	40
9	Showed all the points in solutions to homework problems	20	40	40
10	Varied explanations for complex or difficult material	-	100	-
11	Emphasized important points	-	80	20
12	Writes key terms on blackboard	20	60	20
13	Integrates material from real world	-	40	60
14	Favored active, collaborative and cooperative learning	40	20	40
	Interaction	**NO %**	**MER %**	**AVW %**
15	Actively encouraged questions	100	-	-
16	Asks questions	80	20	-
17	Waited for students to answer questions	100	-	-
18	Listened to students' questions	40	60	-
19	Responded to students' questions	40	60	-
20	Restated questions and answers when necessary	40	60	-
21	Demonstrate respect for diversity	60	40	
	Content Knowledge	**NO %**	**MER %**	**AVW %**
22	Presented material at an appropriate level	40	60	-
23	Presented material to the purpose of the lesson	40	60	-
24	Demonstrated command of the subject matter	20	80	-

NO: Not Observed **MER**: More Emphasis Required**AVW**: Achieved Very Well

Percentage observation for interpreters.

Table (7) shows the results of the observations made during teaching and learning with respect to interpreters.

Percentage observation for interpreters in lesson organization

Table 7 shows that in presenting overview of lessons 60% was not observed while 40% was more emphasis recommended. In terms of appropriate lessons pace and presenting topics in logical sequence, 20% was not observed while 80% more emphasis recommended.

With regard to teachers relating lessons to previous lessons and summarizing major points, the data showed that 20% was achieved very well while 40% more emphasis was recommended and 40% not observed.

Percentage observation for teachers in lesson presentation

Table (7) shows percentage observations for interpreters during teaching of integrated science to the hearing impaired in the school. The question as to whether teachers explain major/minor points with clarity, 20% was achieved very well, another 20% was not observed with 60% given more emphasis recommended. In the case of defining unfamiliar terms, concepts or principles to the pupils, the date shows 20% more emphasis recommended while 80% percent was not observed.

Again the data show that majority of the teachers do not use good examples to clarify points as 40% more emphasis recommended and 60% not observed. Meanwhile, as to whether teachers show all the points in solutions to homework problems, and varied explanations for complex or difficult materials same results was realized with 20% achieved very well, 40% more emphasis recommended and 40% not observed.

Furthermore, with emphasis on important points during teaching and learning in the school, 40% was not observed while 60% more emphasis recommended. Again, writing key terms on the chalkboard. 40% was not observed with 60% more emphasis recommended. The data once again shows that teachers' integration of material from real world during teaching of integrated science was not prioritized as 20% more emphasis recommended with 60% not observed.

Percentage observation for interpreters on interactions

Table 7 shows the percentage observations for interpreters on their interactions during teaching and learning of integrated science in the school. On the issue of whether interpreters actively encouraged questions in class saw mixed reactions with 20% achieved very well with 40 more emphasis recommended and 40% not observed.

Asking of questions and waiting for students to answer questions in class by the interpreters had 40% not observed each as well as 60% more emphasis recommended respectively. On the other hand, as to whether interpreters listen to students questions in class according to the data saw a mixed revelation with 20% more emphasis recommended and 40% achieved very well and not observed respectively.

Meanwhile, a 100% more emphasis was recommended for responding to students' questions in class by the interpreters. Again, relating questions and answers when necessary recorded 40% not observed and 60% more emphasis recommended. The table again saw a 40% more emphasis recommended with respect to the interpreter demonstrating respect for diversity and 60% not observed at all.

Percentage observation for content knowledge for the interpreters.

Table 7 shows percentage observations for interpreters on content knowledge. Presenting materials at an appropriate level recorded 20% achieved very well and 40% each for more emphasis recommended and not observed respectively. In terms of presenting materials to the purpose of the lesson, 20% each was recorded for achieved very well and more emphasis recommended while 60% was recorded for not observed. Meanwhile, as to whether the interpreters demonstrated command of the subject matter recorded a significant increase for more emphasis recommended with 80% while 20% was recorded for achieved very well.

Table 7: Percentage observations for the interpreters

S/N	**Organization**	**NO %**	**MER %**	**AVW %**
1	Presents overview of lesson	60	40	-
2	Paced lesson appropriately	20	80	-
3	Presented topic in logical sequence	20	80	-
4	Related lesson to previous lesson	40	40	20
5	Summarized major points	40	40	20
		NO	**MER**	**AVW**
	Presentation	**%**	**%**	**%**
6	Explained major/minor points with clarity	20	60	20
7	Defined unfamiliar terms, concepts or principles	80	20	-
8	Used good examples to clarify points	60	40	-
9	Showed all the points in solutions to homework problems	40	40	20
10	Varied explanations for complex or difficult material	40	40	20
11	Emphasized important points	20	60	20
12	Writes key terms on blackboard	40	60	-
13	Integrates material from real world	60	20	20
14	Favored active, collaborative and cooperative learning	20	60	20
		NO	**MER**	**AVW**
	Interaction	**%**	**%**	**%**
15	Actively encouraged questions	40	40	20
16	Asks questions	40	60	-
17	Waited for students to answer questions	40	60	-
18	Listened to students' questions	40	20	40
19	Responded to students' questions		100	-
20	Restated questions and answers when necessary	40	60	-
21	Demonstrate respect for diversity	60	40	-
		NO	**MER**	**AVW**
	Content Knowledge	**%**	**%**	**%**
22	Presented material at an appropriate level	40	40	20
23	Presented material to the purpose of the lesson	60	20	20
24	Demonstrated command of the subject matter		80	20

NO: Not Observed **MER**: More Emphasis Required**AVW**: Achieved Very Well

Percentage responses on accessing Science teaching to the hearing impaired.

These results was derived from the status of science teaching to the hearing impaired in the school with ratings on satisfactory and not satisfactory. The number 2.90 was recorded for not satisfactory with a standard deviation of 100 while 3.10 was recorded as satisfactory.

Table 8: Percentage responses on accessing science teaching to the hearing impaired

	status	N	M	SD
Status of Science Teaching	not satisfactory	3	2.90	.100
	satisfactory	2	3.10	.000

SUMMARY OF INTERVIEW TEACHERS

The interview conducted for the teachers revealed that they do not enjoy teaching integrated science to the hearing impaired. This is because communicating with the hearing impaired pupils is difficult, since they do not understand sign language which makes them depend on the interpreter for transferring knowledge and interacting with the pupils in and outside the classroom. The teachers also made it clear that, they use more gestures and use demonstrations for most of the lessons to help the hearing impaired pupils to understand the lessons. They also seek assistance from pupils who understand sign language.

They integrated science teachers suggested that they need more TLMs such as videos of processes in science to help the hearing impaired pupils understand concepts well. Some of the teachers suggested that there should be a new syllabus that will benefit the hearing impaired pupils, as well as, organising regular workshops for both the interpreters and integrated science teachers to bring about collaboration between them.

SUMMARY OF INTERVIEW FOR HEARING IMPAIRED PUPILS

The interview for the hearing impaired pupils proved that they do not enjoy integrated science lessons because they do not understand most concepts. They communicate with their integrated science teachers through interpreters which makes ideas not fully expressed n concepts not clearly understood. They also said that though teachers relate well with them in class it doesn't help much. They suggested that extra tuition and more TLMs at home and in school can help better.

CHAPTER FIVE

DISCUSSIONS OF RESEARCH FINDINGS AND CONCLUSIONS

5.0 Overview

The aim of this study was to assess the performance of hearing impaired students in the teaching and learning of integrated science at university practice inclusive junior high school south campus, Winneba. The study asked a range of methods: the BARBADOSSTOS-H1, observation to gather data.

5.1 Discussion of findings

This section provides the discussion of the findings of the study. The discussions were done under the following themes embarked in the research questions: teaching of integrated science to children with hearing impairment, the role of interpreters in the teaching of integrated science to the children with hearing impairment, factors influencing effective teaching and learning of integrated science to the hearing impaired children and strategies to employ to improve the learning of integrated science to children with hearing impaired.

Teaching and learning of integrated science to pupils with hearing impairment

The teaching and learning of integrated science to hearing impaired students at the university practice inclusive junior high school-south campus Winneba, according to the findings of this research was heighted as a core that can be a motivating factor enhancing the successful implementation of the programme in the school. These findings contradict those made by Moores & Martin (2006). They argued that most of the activities for deaf learners are related to English, which included speech, speech reading and English structure.

Content areas, such as mathematics, social studies and integrated science received minimal attention. The reason being that deaf learners' success was based on the fluency of their communication.

Transcriptions from the teachers interview on whether they enjoy teaching integrated since to children with hearing impairment in the school revealed that not all the teachers enjoy teaching of integrated science in the school, thus, the nature of their attitudes toward science teaching was unlikely to be same among all teachers in the school. It appeared that the teachers in the school have a relative positive attitudes towards the teaching of integrated science to children with hearing impairment. For example while two teachers stated that "we don't really enjoy teaching them because their understanding is very bad because of limited vocabulary and they find it very difficult to understand the concepts……..." the teacher said "….they are okay if we try harder they will. I think they should be given separate syllabus that will help."

Again, the interview discussion with the children with hearing impairment on the teaching and learning of integrated science in the school did not yield positive results. They said that the existing barrier should be removed first, thus communication by their teachers during teaching and learning. When they were asked whether they enjoy learning science in their school. Out of the seven children who took part in the interview almost all of them came out that they do not understand and that do not enjoy learning integrated science. For example, while three of the pupils answered……..”small small" other three pupils also said…" we don't understand the concepts except small topics." and the last students also buttressed the point made by their colleagues earlier by saying……" I understand some of it……" the responses from the pupils confirm the outcome of the research of Moores and Martin (2006) which they came out that by

the start of the 21st century, equity and academic achievement became the goals of deaf education. This resulted in the recognition of the challenges that deaf learners experience with regards to learning content based subjects, such as integrated science and that one of the major challenges that deaf learners face is difficulty with literacy.

Also, the result from the Barbados classroom observation schedule used to observe five integrated science teachers in the classroom showed in (Table 1) revealed that integrated science teaching to the hearing impaired is quite satisfactory. The reason being that teachers attained mean score of 2 and above for many of the behavior observed. This implies that more emphasis were recommended for many of them. Furthermore, an examination of the classroom activities revealed that they more under (1, 2, 3, 4, 5) presentation (6-14), and content knowledge (22-23). This means that the teachers performed well on these areas. Meanwhile they attained low mean score for interaction (15-21).

Factors influencing effective teaching and learning of integrated science to pupils with hearing impairment

Data from the analysis of teachers' transcriptions on factors that influence effective teaching and learning in the school revealed mixed reactions from the teachers. While majority of the teachers strongly disagreed and viewed the teaching of integrated science in the inclusive setting as unattractive and for that matter do not enjoy teaching the subject, 60% only few teachers expressed their agreement which constituted 20%. This response clearly indicated that most of the teachers do not like teaching integrated science to pupils with hearing impairement. This situation agreed with the outcome of the result of the research by Moores and Martin (2006) in their quest to review the curriculum of deaf education.

According to them, traditionally, educators of deaf students have struggled with three important questions such as where deaf children should be taught, how they should be taught and what should they be taught? They continued to argue that in educating deaf learners the emphasis was on English, Mathematics and more development. They again noted that most of the activities for deaf learners related to English which include speech, speech reading and English structure. The confusion of these teachers in the school might have risen as a result of how they should be taught which the teaching of integrated science is no exception.

Also, the analysis uncovered that teachers in the school find it difficult to communicate with children with hearing impairment. For instance, 60% strongly disagreed that it is easy to communicate with children with hearing impairment. Another 40% strongly disagreed that it is easy to communicate with the hearing impaired children. This results confirmed what Molander, Pederson and Norell (2001) discovered in their work on communicating with that content areas, such as Mathematics, social studies and science received minimal attention. On the other hand, they retreated that deaf leaner's success was based on the fluency of their communication in English. Moreover, Moores and Martin (2006) came out that by the start of the 21st century, equity and academic achievement became the goals of deaf education. This resulted in the recognition of the challenges that deaf learners experience with regards to learning content based subjects, such as science. They pointed out that one of the major challenges that deaf learners face is difficulty with communication with people around them. On the other hand though the teachers found it very difficult to communicate with the children with hearing impairment the presence of the interpreters is not a solution to the problems of communication. The reason being that the analysis indicated that (40% of the teacher and 40% respectively responded disagree and

strongly disagree) when responding to whether the interpreter makes the teaching and learning of integrated science easy.

Additionally, the analysis revealed that the learning impaired children do not contribute a lot in integrated science class. This has negatively affected their performance in the subject. For example with regards to whether the hearing impaired student contribute a lot in class, (40%) of the teachers disagreed while the same percentage of teachers (40%) strongly disagreed. Again, more than half of the teachers (60%) disagree strongly while 40% of the teachers disagreed that hearing impaired pupils perform better in class. These revelations was due to the fact that teachers in the school who teach integrated science cannot use sign language which is the medium of communication for the deaf pupils. On the other hand, the pupils also do not understand the communication of the integrated science teachers, hence, their inability to contribute a lot in class during teaching and learning of science. This situation is consistent with Scheetz (2004). Scheetz states that language is central to the lives of all individuals because it is a means of communicating with others and for thinking and learning. According to Scheetz, as children enter school, they use language to access academic subjects and this is done through literacy. Also, language originates in the home and is influenced by the cultural and ethnic background of the family unit. This implies that deaf children born to hearing parents begin life in a linguistically altered environment. So, from the onset they are faced with the challenge of developing language through their visual domain, fill gabs when words are not understood. This children are faced with the challenge of developing a language base that is auditory in nature, while simultaneously master the information placed before them. Hence their poor performance in the science subject.

Furthermore, from the analysis of data in the previous chapter, it was apparent that the children with hearing impairment need extra teaching after a normal class at school. For instance, the teachers (80% strongly agree and 20% agree respectively) clearly demonstrate that teachers in the school advocate for extra tuition for the hearing impaired child after school science lessons to complement what they learn during the normal school hours. However, the response on as to whether the teaching and learning materials makes teaching integrated science to the hearing impaired pupils easy was surprising. For example (20% strongly disagreed while 20% agreed with majority 60% disagreed). This revelation confirm a study by Oliver, 1996 who recognize that it is the city's failure to provide appropriate services that cater for the educational need of disabled people within the society, which is the problem. One could wonder why teacher disagreed that the use of teaching and learning materials could not make the teaching and learning of integrated science to the hearing impaired children easier. Even though the normal children who do not have problem have always been taught with science apparatus, chart emotional plots, films, pictures aids etc. refusing to accept that teaching and learning materials play an influential role and for that matter a crucial factor that influence the teaching and learning of integrated science to children with hearing impairment is a course for an alarm.

The role of interpreters in the teaching and learning of integrated science to children with hearing impairment.

Data from teachers observation made by the researcher on the role of interpreters in the teaching of integrated science in the school also revealed unsatisfactory results, with a mean scored below 2. Respondents were strong in their expression of a need for the interpreter to explain major or

minor points with clarity to the children with hearing impairment during teaching and learning of integrated science. This is in conformity with (Moores, 2006) which stated that deaf students in inclusive schools depend mostly on their interpreters for information in the classroom and outside. The main aspect of what is expected as the role of the interpreters in helping the children with hearing impairment to be able to learn science in the school and what is on the ground indicate that the interpreters are not really playing their role as expected.

The frustration of the hearing impaired children about the role of the interpreters was reiterated by the children with hearing impairment themselves during a focus group interview. The transcript of the interview in the previous chapter revealed that all the children would have channel their opinions be it questions or answering a question through the interpreters to be able to understand any concept being learnt during science lesson. For example; three of them answered when asked how they communicated their problems about learning science to their teachers, they said "the interpreters tell the teacher because the teacher do not understand sign language" while the other four pupils also had this to say "at times I tell them myself but they don't understand, unless the interpreters tell them".

As to whether the interpreters' emphasis important points to the children with hearing impairment, the responses of the participants revealed a mean score of 2 and a standard deviation of 0.45. This findings is validated by previous studies on the role of interpreters which allude to the need for interpreters in deaf education.

Moores (2006) identified several historical trends in the education of deaf students. In particular, the migration of deaf students from residential school began a few years prior to the passage of

public law 94-142 and continues today, while interpretation as a profession was still fairly young in education for the deaf and hard of hearing especially in inclusive school (Moores, 2006). However, another recent research on hearing impaired students indicate that they have specific needs with regard to communication that often are addressed properly in elementary and secondary school through interpreters (Reis & Colbet, 2004).

Furthermore, the response of the participants also revealed that listening and responding to students with hearing impairment in the class during teaching and learning of integrated science lied through the unrelenting support and important role played by the interpreters. This was affirmed by all the children with hearing impairment during the interview discussion. They responded to the question as to how they communicate their problems about learning science to their teachers; they had this to say: "…….at times I tell them myself but they don't understand, unless the interpreters tell them……." Another set of deaf student also stated that" "…..the interpreters tell the teachers because the teacher do not understand sign language….." that notwithstanding the mean scores of the respondents to these questions was 2 each with standard deviation of 0.55 respectively.

This revelation confirmed the research result by Prinstein and La Greca (2004) which indicated that the primary function of the school interpreter was to work individually and collaboratively with others to implement a comprehensive developmental school programme which will benefit the hearing impaired pupils and other children. They further stated that this programme should focus on academic, career and personal or social developmental needs of all students including those with hearing impairment. On the other hand, the inconsistencies in the roles of practicing school interpreter as a counsellor in educational programmes have caused some scholars to begin

to address the emerging role of the interpreter regarding student with special needs (Greene, Biedeman, Faraane, Wilens, Mick & Blier, 1999).

Finally, respondents were also strong in their expression of the need of interpreters and for that matter the crucial role they play in educating the children with hearing impairment. Data from the previous chapter on the role of the interpreters revealed that they (interpreters) demonstrate comment of the subject matter. The mean score was 2.20 with the standard deviation of 0.89. On the contrary the responses from the hearing impaired during the interview discussion indicated that they do not always grasp the concept. Two of the children with hearing impairment said; "….I don't understand most of it except small topics…" also one of them said "I don't understand all…", whiles three of them did not give any response at all. The meaning of "small topics" by one of the pupils is also a great concern which needs to be looked at.

The above responses from the children and the results from the analysis from the previous chapter is not congruent with a recent research which indicated that elementary school interpreter are well suited to serve a pivotal role in both providing information related to how to identify students with disabilities and overseeing their various collaborative role associated with working with special needs students (Prinstein & La Greca, 2004). Meanwhile many interpreter do not know how to develop appropriate intervention programmes for students due to limited understanding of approaches (ie. Inadequate skills to address the needs of this group (ASCA, 2004).

What strategies could be employed to improve the teaching and learning of integrated science to the hearing impaired?

Tables 4, 5 and 6 show the results of BARBADOS STOS –HI observational checklist, which was used to observe teachers and the strategies they employed to teach integrated science to the hearing impaired pupils in the school. The data of the previous chapter revealed that there were clear contradictions as to how teachers in the school teach integrated science and the professional strategies on the ground. In the analysis teachers organization of lesson had a mean score of 2.12 with a standard deviation of 0.482 while the knowledge of teachers on the content of the subject gave a mean score of 2.06 and a standard deviation of 0.624. These figures as revealed by the analysis showed that though teachers in the school who teach integrated science are doing their best to assist the hearing impaired children learn science, on the contrary, strategies for teaching science to pupils with hearing impairment or deafness do not toe the conventional methods of teaching pupils with hearing. As a result, the findings contradicts clearly what Diedong (2005) indicated.

According to him, the most effective strategy in teaching science or educating individuals with hearing impairment require a careful planning and individualization of teaching methods. This, he added will make science lessons more meaningful, relevant and interesting to each student. This strategy has been supported by Oppong (2003), as he suggested the drawing up an Individualized Educational Plan programme (IEP) of each hearing impaired child. This he said will help determine the actual hearing level of the child, his learning experiences and the appropriate placement of each of them.

Data from the observational analysis on teachers' strategies employed to teach the pupils with hearing impairment also revealed another contradicting outcome. In Table 7 of the previous chapter, as to whether teachers present overview of lesson, 80% of the respondents indicated accomplished very well, while 40% accomplished very well on lesson pace, presentation of lesson in a logical sequence as well as relating lesson to previous lessons respectively. These findings are not in conformity with the findings by Nyadu (2005) who suggested that children with appreciable amount of hearing impairment benefit much from smaller groups of learning activities. Due to this, large classes should not be encouraged as pertained in the school. He suggested that large classes should be broken down into smaller units so that the learning facilitator or teacher can effectively assist the learner with their individual needs and difficulties, and to ensure that all children have a go at the learning activity in order to overcome every challenge associated with the concept or skill being imparted. This accession by Nyadu (2005) implies that in integrated science lessons when students with hearing impairment are put in smaller groups, it offers the science teacher an ample opportunity to illustrate and demonstrate to effectively taking into consideration the needs of each groups especially when the teacher is using same ability groupings. Though Nyadu's accession may work well in teaching and learning of other subjects, more rigorous approach would be required in the teaching and learning of integrated science.

Again, data from the observation of teachers strategies of teaching integrated science to the hearing impaired revealed that this category of science teachers were not the best. For example as to whether teachers actively asked pupils with hearing impairment questions in class, 100% of the behaviour was not observed, thus, teachers do not wait on pupils to ask questions nor wait on them to answer questions. This revelation might have occurred due to the fact that teachers are

not good in sign language. Meanwhile, the observation data on the interpreters showed that 60% of presentation of overview of lesson were not observed while 80% and 60% respectively were also not observed and defined unfamiliar terms, concept or principles and demonstration of respect for diversity. These findings were also inconsistent with Carbo, Dunn and Dunn (2005) that teachers' expression should be seen clearly by all children. This they explained as because facial expressions help speech reading and understanding, thus when a teacher talks facing the chalkboard, or turn away from the hearing impaired or deaf child on the assumption that they cannot perceive sound then much information is lost. These findings also denies Carbo, *et. al.* (2005) which recommended that in the teaching of science to hearing impaired children demonstrations and illustrations should not be done simultaneously since the students cannot observe the two activities at the same time and make meaning out of it. They require one activity at a time and should be involved in the lesson.

CHAPTER SIX

SUMMARY OF THE FINDINGS, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER RESEARCH

6.0 overview

This chapter gives the summary of the study, recommendations and conclusions and suggestions for further studies

6.1 Summary of the Findings

The aim of the study was to assess integrated science teaching and learning to the hearing impaired at the University Practice JHS-South Campus. The study involved a sample of ten (10) participants purposively selected from group of hearing impaired pupils and science teachers. Semi-structured interview protocols, a questionnaire and participant observation checklist were used to generate data for the study.

The outcomes of the study were as follows:

- Integrated Science is taught in abstract due to inadequate resources and facilities available for teaching in the school.
- There is difficulty for science teachers to communicate with the hearing impaired pupils and vise versa.
- Interpreters play a key role in transmitting scientific knowledge to the hearing impaired. However due to limited vocabulary they are unable to do so effectively
- During lessons teachers must use gestures, group activities, and demonstrations. They should also use of more TLMs.

6.2 Conclusions

Based on the findings of this study, it was possible to draw the following conclusions:

- Firstly, the total response as expressed by the respondents was an indication that, there is no immediate plan of action in place to make the Integrated Science programme enjoyable to deaf pupils.
- Secondly, the responses indicate that even though Ghana is a signatory to the UN, the Ministry of Education and the Ghana Education Service who are the policy makers and implementers respectively seem not to be making education equal and accessible to all people in Ghana.
- Strategies being used by science teachers in teaching pupils with hearing impairment doesn't help these children to understand scientific concept properly.

6.3 Recommendations

Based on the findings of the study, the following recommendations were made:

- The Ghana Education Service should build science laboratories and provide equipment in Inclusive Schools for effective teaching of integrated science to the hearing impaired.
- Integrated science teachers should be encouraged to use concrete and semi concrete materials like videos to teach integrated science concepts such as cycles and processes.
- Ghana Education Service (GES) should organize periodic workshops for interpreters for integrated science lessons to enable them have basic knowledge in science.

- Ghana Education Service (GES) should organize periodic workshops on sign language for integrated science teachers to enable them communicate basic information directly to the hearing impaired.

6.4 Suggestions for further research

The results of the current study suggested a number of directions for further study. Firstly, there is the need to conduct a study and suggest appropriate policies governing the implementation of inclusive education and integrated science teaching and learning.

There is also the need to explore the views of individuals with deafness in the society on the study of integrated science in the inclusive basic schools in Ghana.

A study should also be conducted into the possibility of using modified science apparatuses and syllabuses to aid Integrated Science teaching and learning in the University Practice Inclusive JHS in Winneba. This will help sustain interest of hearing impaired pupils in Integrated Science and pursue other science related courses at the Senior High School level and other related careers.

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APPENDIX A

Semi-Structured Interview Questions for Hearing Impaired Pupils

1. Do you learn integrated science in your school?
2. Do you enjoy learning integrated science in your school?
3. Do you clearly understand the concepts or what the teachers teach during integrated science lessons?
4. How do you communicate your problems about learning of integrated science to your teachers?
5. Do you like the methods science teachers' use to teach in your school?
6. How do teachers who teach integrated science relate to you in the classroom?
7. Would you always like to be in the integrated science class?
8. Would you like to continue learning integrated science after completing JHS?
9. Do you need extra teaching and learning materials at home to improve your performance in integrated science?
10. Do you think the school feeding programme should be introduced in all special schools in Ghana to enhance your performance in science?

APPENDIX B

Interview Questions for Science Teachers

1. Do you enjoy teaching integrated science to children with hearing impairment?
2. How do you communicate with children with hearing impairment during your lesson?
3. How has the role of the interpreter helped or hindered the teaching of integrated science in your school?
4. Do you encounter problems in the course of your teaching?
5. Do the hearing impaired pupils contribute or ask questions in your class?
6. How is the performance of the hearing impaired pupils compared to their regular counterparts in science?
7. What are some of the strategies you employ to teach pupils with hearing impairment effectively?
8. What teaching methods are more effective to use?
9. What account for the effective teaching and learning of integrated science in the school?
10. Would you like to continue teaching integrated science to the hearing impaired in the school?
11. Do hearing impaired pupils need extra tuition and TLMs at home to help improve upon their learning of integrated science?
12. Should the school feeding programme be introduced to special schools to enhance the performance of hearing impaired pupils?

APPENDIX C

QUESTIONNAIRE FOR ASSESSING INTEGRATED SCIENCE TEACHING AND LEARNING TO THE HEARING IMPAIRED (INTERGRATED SCIENCE TEACHERS)

All information provided here shall be for research purpose only and would be kept confidential. The following statements are about assessing integrated science teaching and learning to the hearing impaired. Please, read each statement and decide how much you agree with it. Use this scale to answer. [Strongly disagree – Disagree – 2, Neutral – 3, Agree – 4, Strongly agree – 5]

S/No.	Statement	Tick only one option 1-5				
		1	2	3	4	5
1.	Teachers enjoy teaching integrated science to children with hearing impairment					
2.	It is easy to communicate with children with hearing impairment					
3.	The interpreter makes the teaching and learning of integrated science easy					
4.	Hearing impaired children contributes a lot in class					
5.	Hearing impaired children perform better in class					
6.	The teaching methods and TLMs used to teach the hearing impaired pupils makes integrated science teaching and learning easy					
7.	Hearing impaired children need extra teaching aids at home to enhance their performance in integrated science					
8.	Teachers who teach integrated science in inclusive schools need additional motivation					
9.	School feeding programme should be introduced to all special schools to motivate the hearing impaired children to be regular in school					
10.	I will like to continue teaching integrated science to children with hearing impairment					

APPENDIX D

Classroom Observation Checklist for Interpreters

Interpreter: ……..Observation Number 1 2 3 4

Date:……

Respond to each statement using the following scale:

1=Not observed *2=More emphasis recommended* *3=Accomplished very well*

Organisation

Presented overview of lesson.	1	2	3
Paced lesson appropriately.	1	2	3
Presented topics in logical sequence.	1	2	3
Related today's lesson to previous/future lessons.	1	2	3
Summarized major points of the lesson.	1	2	3

Presentation

Explained major/minor points with clarity.	1	2	3
Defined unfamiliar terms, concepts, and principles.	1	2	3
Used good examples to clarify points.	1	2	3
Showed all the steps in solutions to homework problems.	1	2	3
Varied explanations for complex or difficult material.	1	2	3
Emphasized important points.	1	2	3
Writes key terms on blackboard.	1	2	3
Integrates materials (examples, cases, simulations) from "real world".	1	2	3
Active, collaborative, and cooperative learning favoured over passive learning.	1	2	3

Interaction

Actively encouraged hearing impaired pupils questions.	1	2	3
Asked questions to monitor hearing impaired pupils t understanding.	1	2	3
Waited sufficient time for hearing impaired pupils to answer questions.	1	2	3
Listened carefully to hearing impaired pupils questions.	1	2	3
Responded appropriately to hearing impaired pupils questions.	1	2	3
Restated questions and answers when necessary.	1	2	3
Demonstrates respect for diversity and requires similar respect in classroom.	1	2	3

Content Knowledge and Relevance

Presented material at an appropriate level for hearing impaired pupils.	1	2	3
Presented material appropriate to the purpose of the lesson.	1	2	3
Demonstrated command of the subject matter.	1	2	3

Summary Comments

21. What were the science teacher's major strengths as demonstrated in the observation?

22. What suggestions do you have for improving the science teacher's skills or methodology?

23. What progress did you discern in the science teacher's skills?

APPENDIX E

Classroom Observation Checklist

Integrated science teacher ……..Observation Number

1 2 3 Date:……

Respond to each statement using the following scale:

1=Not observed *2=More emphasis recommended* *3=Accomplished very well*

Organisation

Presented overview of lesson.	1	2	3
Paced lesson appropriately.	1	2	3
Presented topics in logical sequence.	1	2	3
Related today's lesson to previous/future lessons.	1	2	3
Summarized major points of the lesson.	1	2	3

Presentation

Explained major/minor points with clarity.	1	2	3
Defined unfamiliar terms, concepts, and principles.	1	2	3
Used good examples to clarify points.	1	2	3
Showed all the steps in solutions to homework problems.	1	2	3
Varied explanations for complex or difficult material.	1	2	3
Emphasized important points.	1	2	3
Writes key terms on blackboard.	1	2	3
Integrates materials (examples, cases, simulations) from "real world".	1	2	3
Active, collaborative, and cooperative learning favoured over passive learning.	1	2	3

Interaction

Actively encouraged hearing impaired pupils questions.	1	2	3
Asked questions to monitor hearing impaired pupils t understanding.	1	2	3
Waited sufficient time for hearing impaired pupils to answer questions.	1	2	3
Listened carefully to hearing impaired pupils questions.	1	2	3
Responded appropriately to hearing impaired pupils questions.	1	2	3
Restated questions and answers when necessary.	1	2	3
Demonstrates respect for diversity and requires similar respect in classroom.	1	2	3

Content Knowledge and Relevance

Presented material at an appropriate level for hearing impaired pupils.	1	2	3
Presented material appropriate to the purpose of the lesson.	1	2	3
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Summary Comments

21. What were the science teacher's major strengths as demonstrated in the observation?

22. What suggestions do you have for improving the science teacher's skills or methodology?

23. What progress did you discern in the science teacher's skills?

APPENDIX F

TRANSCRIPTS OF HEARING IMPAIRED PUPILS INTERVIEW

Do you enjoy learning integrated science in your school?

Std 1: small small.

Std 2: don't understand.

Std 3: don't understand.

Std 4: small small.

Std 5: some of it.

Std 6: Some of it, not all

Std7: Don't understand most of it except small topics.

Do you clearly understand the concepts or what the teachers' teach during integrated science lesson?

Std 1: not all

Std 2: not all

Std 3: it is difficult.

Std 4: Science is difficult

Std 5: I don't understand all my water and plants

Std 6: no response.

Std 7: no response.

How do you communicate your problems about learning of integrated science to your teacher?

Std 1 The interpreter tells the teacher because the teachers do not understand sign language

Std 2: The interpreter tells the teacher because the teachers do not understand sign language

Std 3: The interpreter tells the teacher because the teachers do not understand sign language

Std 4: At times I tell them myself but they don't understand , unless the interpreter tells them

Std 5: The interpreter

Std 6: The interpreter tells him

Std 7: The interpreter tells him.

Do you like how the teachers teach integrated science?

Std1: At times I like it, when I see what they are teaching I like it so much

Std 2: Not all the lessons, but some of them, when I see the thing he/she is talking about I like it

Std 3: Not all at times the learning pupils are happy and smiling but we don't understand what they are doing

Std 4:Not all the lessons but some of it

Std 5:Not all the lessons

Std 6: Not all the lessons, small part of it

Std 7: Almost all the topics, the words are difficult to understand.

How do Teachers who teach integrated science relate to you in the class room?

Std 1:The teachers are friendly and want us to get the

answers correct but we get it wrong most of the time

std 2: The teachers are nice to us

std 3: The teachers teach us well and are happy when they see us

std 4: The teachers are friendly and nice

std 5: The teachers are friendly

std 6: The teachers love us

std 7i: They teach us well and like us

Do you think the school feeding programme should be introduced in all special schools in Ghana to enhance your performance in science?

Std 1: Yes because most of us are poor.

Std 2: yes

Std 3: Yes, so we can eat well and do better

Std 4: yes

Std 5: Not important

Std 6: Not important

Std 7i: yes

Do you need extra teaching and learning materials at home to improve your performance in integrated science?

Std 1: yes

Std 2: yes

Std 3: yes

Std 4: yes

Std 5: yes

Std 6: yes

Std 7: yes

APPENDIX G

TRANSCRIPTS INTERVIEW FOR SCIENCE TEACHERS

Do you enjoy teaching science to children with HI?

Three teachers said they do not enjoy teaching science to the hearing impaired. These are the comments made by the teachers:

T1: .... Not really.

T2: .... No, I don't they find it difficult to understand the concepts.

T3 ... I don't really enjoy teaching them because the understanding is very bad because of limited vocabulary.

Two teachers said they enjoy teaching science to the hearing impaired.

T4: ……They are okay if we try harder they will understand. I think they should be given separate syllabus, that will help.

T5: I like teaching them.

How has the role of the interpreter helped in the teaching of science in you school?

Four of the teachers affirm that the interpreters do not help them much. Whiles one teacher said that the interpreter helps them in the teaching.

T1: The interpreter doesn't help much though we don't have any option, we have to manage.

T2: The interpreter slows down the pace of the lesson you can't even tell whether he is even saying the correct thing

T3: The interpreter at times misinform the HI pupils when it comes explanation of concepts thus he hinders the progress. If I understand sign language it could have been better

T4: The interpreter help to explain the concepts to the children and its good that he is there.

T5: The interpreter distracts the class, at times the learning pupils lend to observe the sign instead of paying attention.

What problems do you encounter during the course of teaching?

In response to this question, one teacher (T3) said that the students lack vocabulary. Another teacher (T2) said they are slow to understand and that they ask unnecessary questions. Two teachers said the cause distractions in the class.

T1: Not much a few distractions here and there from the pupils, when they do not understand what you are teaching the chat among themselves

T2:They are slow to understand what you are teaching so they drag the lesson. They also like asking unnecessary questions.

T3:They do not have much vocabulary thus it is difficult for them to understand fully what is being taught.

T4:They like disturbing the class with unwanted sound which distracts the lesson.

T5: The other pupils tend to observed the sign language instead of paying attention.

How is the performance of the HI compare to their hearing counterpart? This is what teachers had to say:

T1: Their performance is poor on the average

T2: Some are good such that with a little push they can excel especially faith

T3: Their performance is not encouraging and at times you wonder what they are doing in school.

T4: They don't perform well at all. Its so discouraging. Unless they copy the answers

What strategies do you employ to teach students with HI effectively?

T1: I normally question them a lot so they can pay attention in class.

T2: Even when you use teaching a lots, at times they don't get the full concept but I like using TLMs because of them.

T3: I encourage them to ask questions so that they feel involved in the lesson

T4: Like grouping them with the hearing who understand sign language and I realize it helps a lot.

What teaching methods are more effective to use?

T1: Grouping them with the hearing and use of TLMs

T2: Demonstration and Discussion method.

T3: Practical lesson are most successful for them and use of videos.

T4: They like demonstrations and hands on activities.

What account for the effective teaching and learning of science in your school?

T1: The teacher who can sign is able to explain things well because he know what he is saying .

T2: Use of more TLMs especially videos are more effective. At times I download them and play it for them.

T3: When you attend to them individually too it helps a lot.

T4: Mixed ability grapping Demonstration and hands on activity helps.

Do hearing Impaired pupils need extra tuition and TLMs at home to help improve upon their learning of science?

T1: Yes I think so

T2: Yes they do

T3: They really do and they also need sign language teachers to help.

T4: If they have the TLMs at home and no one is there to help it want help much but it will be better.

Would you Like to continue teaching science to the HI in the school? Two teachers said they will like to continue teaching science to the hearing impaired. Three teachers said they will not continue. This is evidenced in the following extract:

T1: Not really

T2: I don't like teaching them so I wouldn't like to continue.

T3: No, I don't feel comfortable because I don't like teaching when I can't tell what information is being given to pupils.

T4: Yes I would like to continue teaching them, I love to see them make fine progress

T5: Yes I would like to continue teaching them.

Should the School feeding programme be introduced to all special schools to enhance the performance of HI pupils?

T1: It's not necessary they can take care of themselves

T2: I agree because most of them come from poor homes and they really need help to enhance their performance.

T3: It's not necessary they need support though.

T4: They need the school feeding programme very will it will help

T5: I think they need it more schools who are now benefiting.