Challenges Inhibiting Effective Implementation of Integrated Science by science teachers at the Junior High Schools in Kwahu West Municipality, Ghana

Beatrice Asante Somuah and John Aluko Orodho

Ms. Beatrice Asante SOMUAH[1] is a Doctorate Student from Ghana enrolled in the Department of Educational Management, Policy and Curriculum Studies, School of Education, Kenyatta University, Kenya.

John Aluko ORODHO[2]**is** an Associate Professor of Research and Statistics in the Department of Educational Management, Policy and Curriculum Studies, School of Education, Kenyatta University, Kenya

Abstract

This study examined the challenges inhibiting effective implementation of integrated science by scienceteachers at Junior Secondary school level in Kwahu West Municipality in Ghana.The study used a descriptive exploratory survey research design.Purposive sampling was used to select 60 science teachers, 8 circuit supervisors and 8 science coordinators yielding a sample size of 76 subjects. The main data collection tools were questionnaires and interview schedules. The study established that the major challenges inhibiting effective implementation were: breadth of curriculum content to be covered, inadequate and poor state of instructional resources and workshops, low experience on hands-on techniques in handling science practical and inadequate in-servicing of science teachers. These challenges compromised the adoption ofhigh -impact teaching for science including:low teacher's enthusiasm, inadequateexcursions and field-visits, low exposure to laboratory practicals and group-work amongst others. It was apparent that implementing science lessons with one or more elements of highimpact teaching may lead towards makinga difference, particularly if these teaching practices produce in students positive long-term memories about their science education.It was, therefore, recommended that there is the need for provision of science workshops andequipment as well as regular in-servicing of science teachers on modern high impact teaching strategies by the Ghana Education Service to help them deal with the challenges [215 words].

Key words: Challenges,IntegratedScience, Ghana, Junior High Schools, support services,Kwahu West Municipality,

I. Introduction to the Study

1.1. Background

This study that examined the challenges experienced by science teachers while teaching integrated science was conceived against the backdrop that thedevelopment of science and technology is recognized worldwide as vital for a nation's overall economic development (UNESCO, 2010; 2012). The development of effective science and technology rests on the efficient implementation of the science and technology curriculum. The overall task of curriculum implementation rests squarely on the shoulders of practicing classroom teachers, whose major task revolves around daily, face-to- face contact with learners in the classrooms, laboratories, workshops and in-field settings (Ampofo & Orodho, 2015). The role of science teachers who are expected to implement various types of curricular is more daunting especially when they are expected to tailor teaching to specific outcomes such as ensuring science and technology improves productivity and meets the needs of the society (Orodho, 2012; United Nations, 2012; 2013). This has been demonstrated in the developed countries and more recently in the newly industrializing countries, where science and technology have been responsible for more than half of the increase in productivity(Anderson, 2006).

Teachers generally enter the profession to make *a difference to students'*lives (Neal, McCray, & Webb-Johnson, 2001). Some conceptualize teaching as *a calling* (Hansen, 1995; Schwarz, 1998), and as a way to have positive effects on *student's thinking for real-life learning* (Alder, 2002; Nodding's, 2001). Making a difference to students' learning may be linked to effective teaching (Knobloch, 2003).However, determining the long-term effectiveness of teaching can be difficult to ascertain. Test results may indicate current levels of understanding particular knowledge and other forms of assessments, such as observation of students' work and student'sportfolios, can also present evidence of students' learning. Yet, *making a difference*assumes going beyond immediate assessment results. Making a difference has more to do with long-term impacts on students' thinking and possibly life actions as a result of effective teaching (Knobloch, 2003; Larrivee, 2000), which may not be evident from tests and assessments at school levels(Orodho,2013).

It is in line with this that Sjoberg(2002) asserted that there is a natural inter-dependence between development of science and technology and the development of society. He continued that the progress and development of any nation depends largely on the quality of scientific and technological research the people are able to undertake. He added that education in science and technology are the most important areas of the curriculum to enable people to make sense of the world and to use the resources at hand (Sjoberg, 2002). It is in view of this that a country like Ghana needs scientific literate citizens who can make informed choices in their personal lives and approach challenges in the workplace in a systematic and logical order. They also need to become competent professionals in the various scientific disciplines who can carry out research and development at the highest level (Orodho, Waweru, Ndichu&Thinguri,2013). It is against this background that this study which examined the challenges containing effective implementation of integrated science in Juniorsecondary schools in Kwahu Municipality, Ghana, was hinged.

1.2. The State of Art Review

According to Hayward (2003) the word "science" originally meant 'knowledge'. However in schools and universities it tends to indicate the group of three closely linked subjects – Biology, Chemistry and Physics and even Mathematics and Agricultural Science in some schools and universities (Zumbach, Schmitt, Reimann & Starkloff, 2006). Science becomes integrated when the related disciplines such as Chemistry, Physics, Biology and Agricultural Science are combined as one subject to be studied. Integrated Science is therefore a straight-forward, easy-to-read but substantial introduction to the fundamental behaviour of matter and energy and living and non-living systems (Zumbach et al., 2006). Hence, according to the Ministry of Education, Science and Sports the Integrated Science curriculum is one which incorporates all the aspects of science into a unit as a conscious effort to raise the level of scientific literacy of all students (MoESS, 2007). At the Junior High School (JHS) in Ghana, the science which is taught is referred to as Integrated Science and is compulsory for all pupils at this level. The subject areas of Integrated Science are Physics, Chemistry, Agricultural Science and Biology (including Botany, Zoology and Health Science) with very little on technology.All pupils at this level of education are required to have a pass in Integrated Science in Basic Education Certificate Examination (BECE) before they are able to secure admission to Senior High School.

In support of the goals for science education mentioned above, international organizations and non-governmental organizations and agencies, who have the concern for quality of teaching and learning in basic schools in Ghana, have continued to provide assistance and intervention to improve education in basic schools. Some of these international organizations include the European Union, World Bank, World Vision International and United States Agency for International Development(USAID).

When considering teaching strategies, experienced teachers understand the powerful influence of the teacher's affective domain. This domain includes the teacher's emotions, motivations, attitudes and values. A

teacher who displays enthusiasm for teaching science demonstrates positive emotions about science, which can influence students' attitudes (Simpson, Koballa, Oliver, & Crawley, 1994).

Therefore, the general aims for science education at the basic level are meant to help pupils to:

a. Develop understanding of scientific concepts and principles;
b. Develop an appreciation for the application of science to life;
c. Think and act scientifically; and
d. Develop scientific attitudes towards life(MoESS, 2007:1).

Defining the effective teacher is difficult; nevertheless effective primary science teachers tend to develop their own lessons and "make their own curricular decisions" (Ball & Feiman-Nemser, 1988, p. 421). Effective teaching evolves from experiences and beliefs about teaching (Wideen, Mayersmith, & Moon, 1998, p. 130), particularly as beliefs "are part of the foundation upon which behaviors are based" (Enochs & Riggs, 1990, p. 694). The difficulties in defining effective science teaching are embedded in the numerous characteristics and roles of the classroom teacher. It is generally accepted by researchers and educators (e.g., Hattie, 2005; Loughran, Mulhall, & Berry, 2004) that effective science teaching requires an understanding of the subject matter, which needs to be taught in engaging ways. There is also empirical research and scholarly debate about what constitutes effective learning. Some of these theories include authentic learning (Herrington & Oliver, 2000), problem-based learning (Savery & Duffy, 1996), constructivism (Vygotsky, 1986), and social cognitive theory of learning (Bandura, 1986; Orodho, Waweru & Getange, 2014).

The quality of the teacher can make a difference to a student's education (Ampofo & Orodho, 2014; Vogt, 2002; Wong, Britton, & Ganser, 2005; UNESCO, 2012). A teacher's unpretentious, caring nature can motivate students to work to their fullest potential (Alder, 2002; Easton, 2002). Students have offered perspectives on describing good teaching, which mainly focuses on teachers' interpersonal qualities and subject expertise. A research was done (Wright, 1984) on perspectives of students regarding qualities of good science teachers and the students listed positive stereotypical terms such as nice, warm, friendly, and interesting. When asked what makes an effective teacher,students listed the following characteristics and qualities: caring, understanding, encouraging, helpful and patient; communicates and makes learning enjoyable; fair discipline and unbiased; effective classroom management; and knows the subject. Yet, teaching practices cannot assume long-term learning without linking it to research that aims to identify high-impact teaching practices.

What are high-impact teaching practices? One high-impact factor on students' learning appears to be the teacher's affective domain. Knobloch (2003:1) states: "effective teachers who make a difference in the lives of their students are likely to be affectively motivated and caring teachers"

1.3 Statement of the problem

Despite the great deal of activities that are being directed towards the teaching of science, studies have shown that a large number of students seem to learn very little science at school.The quality of science teaching and learning becomesquestionable because of the poor performance of a great number of junior high school students in Integrated Science. For example,Bonney (2009) reports that just a little over 50 per cent of the candidates who sat for the Basic Education Certificate Examination (BECE) in 2009 qualified for placement into Senior High Schools and Technical Institutes(Daily Graphic, August 27, 2009). This was because most of them could not get a pass in all the four core subjects, especially in Integrated Science. Also, the Chief Examiners' Reports for BECE (West African Examination Council [WAEC], April, 2008) and (WAEC, April, 2009) confirmed this by reiterating the poor performances of students in Integrated Science. Since these results represented a summary of the total performances of the pupils across all districts in the country, Kwahu West Municipality was not an exception to this

sad phenomenon. To confirm this, data collected from the Kwahu West Municipal Education Officeshowed that out of the 2,036 candidates presented for the Basic Education Certificate Examination(BECE) in 2008, 884 pupils failed (that is, making grades above aggregate 5) in Science. This represents 43% of the total number of candidates who wrote the examination that year. In 2009, out of the 2,125 candidates who wrote the examination, 1,216 passed representing 57% of the total number of candidates presented by the schools in the Municipality. Again, 909 candidates failed in Science, representing 43% of the total number of candidates who wrote the examination that year. The picture was not different in 2010 as depicted in the summary of the results shown in Table 1.

Table 1:Summary of BECE Passes in Science

Year	No. of Students	No. passed	%	No. failed	%
2008	2036	1154	57.0	884	43.0
2009	2125	1216	57.0	909	43.0
2010	2038	1167	57.0	872	43.0

Source: Municipal Education Office, Kwahu West

Based on the above analysis, it may be concluded that the future looks gloomy for the Kwahu West Municipality if for three consecutive years as many as 43% of the pupils who completed Junior High Schools could not gain access into the Senior High Schools because they failed in Science which is a core subject. The questions that readily come to mind are: How is the teaching of Integrated Science done in theJunior High Schools Kwahu West Municipality? What resources in terms of books and science equipment are available for teachers and pupils? How strong is the support services for both pupils and teachers in theJunior High Schools in Kwahu West Municipality in relation to the teaching and learning ofscience?

1.3 The purpose and objectives of the study

This study is therefore an investigation into the challenges facing teachers in the teaching of Integrated Science in Junior High Schools in the Kwahu West Municipality in an attempt to gain an insight into the situation on the ground. This is necessary in the light of the importance the nation attaches to the role science and technology plays in the development of the country. This study is therefore aimed at investigating the challenges constraining effective implementation of Integrated Science in the Junior High Schools in the Kwahu West Municipality, Ghana.

II. Research Methodology

2.1. Research Design

The research design used for the study was the descriptive exploratory survey. According to Orodho (2009, 2012) a survey research design deals with the incidence, distribution and interrelationships between educational variables. With a survey, one can collect a lot of information on a large sample within a short period of time. It gives researchers the opportunity of asking same questions or questions prepared in a written questionnaire to a large number of individuals (Mitchell &Jolley, 2004; Fraenkel & Wallen, 2000). The descriptive survey research design is the most commonly used descriptive method in education and social science. These characteristics of the chosen design is justified on the grounds that it can be used to easily facilitate theanalysis of the relationships, differences and trends that contribute to the challenges teachers

face in the teaching of Integrated Science in the Junior High Schools. By this approach, the researcher could find clues to answer research questions which involved classroom related challenges (Cohen, Manion & Morrison, 2000; Sarantakos, 2005). Fraenkel and Wallen (2000) identified three major difficulties associated with descriptive surveys which included the difficulty in ensuring that the questions to be answered are clear, getting respondents to answer questions thoroughly and honestly and the difficulty of getting sufficient number of questionnaires completed and returned for a meaningful analysis to be made. The above problems were overcome through the use of simple words, appealing to respondents to be frank and truthful and also making follow-ups during questionnaire administration (Orodho, 2009; 2012).

2.2. Population and Sampling procedures

The study adopted a census sampling technique which was appropriate because the population was not large enough to be sampled. This is in line with the view of Nwana (1993, p.58) that every member of the population should be studied "when the population size of the whole population is small". Also, according to Krejcie and Morgan (1970) as cited in Sarantakos (2005) for smaller populations, say N=100 or fewer, there is little point in selecting a sample; rather the entire population must be surveyed. Based on the above assertions, the study had a sample of 60 Integrated Science teachers drawn from seven circuits in the Municipality. It was realized from the data collected that 30 science teachers each were located in the urban and rural areas of the Kwahu West Municipality. Again, information gathered from the biographic data also showed that most of the science teachers held either a Teachers' Certificate "A", Diploma or Degree in Education. This implies they have all undergone professional training to qualify as teachers. The Integrated Science teachers who formed part of the sample were all selected. This technique was more appropriate because they were the right people from whom the needed information could be solicited to meet the purpose of the study and also the view of every member was considered as important (MacMillan, 2004; Nwana, 1993).The combinations of purposive sampling strategies used thus far selected 60 science teachers, 8 circuit supervisors and 8 science coordinators yielding a sample size of 76 subjects.

2.3. Research Instruments, Data Collection and Analysis

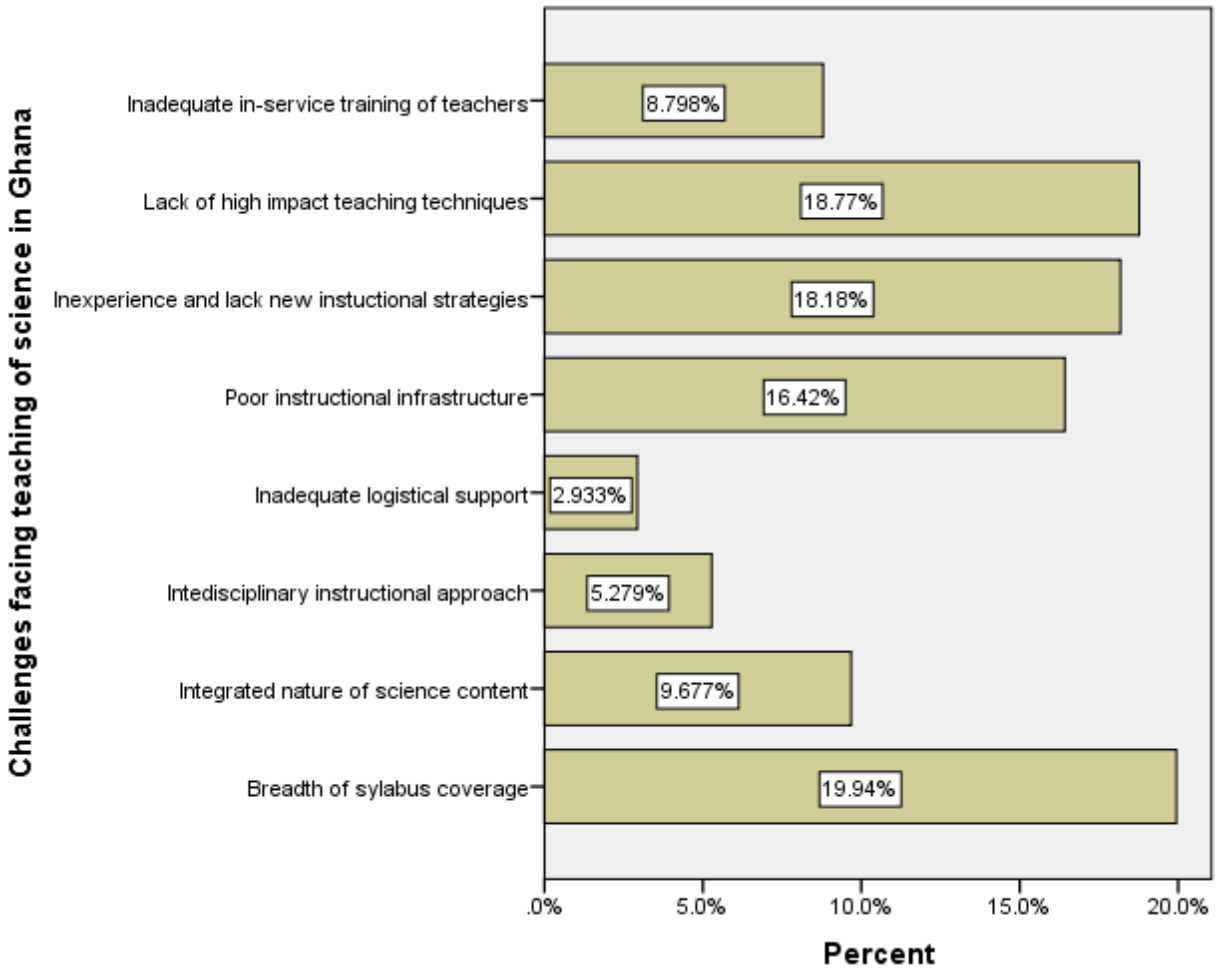
Questionnaires and interview schedules were the main instruments used to collect quantitative and qualitative data, respectively.The questionnaireswere used to gather quantitative information from the Integrated Science teachers and heads of public Junior High Schools while the semi-structured interview guides helped in gathering qualitative data from the circuit supervisors and the science coordinators. The questionnaires and the interview guides were developed through the extensive use of literature and consultations with fellow researchers. The questionnaire was pilot – tested and it yielded Cronbach's Alpha value of 0.79, which suggests that the items were measuring the same thing (Orodho, Ampofo, Bizimana & Ndayambaje, 2016; Orodho, 2009, 2012; Vogt, 1999).

Permission was sought from the Municipal Director of Education, Kwahu West, who is in charge of the schools selected for the study, to seek the approval for access to the schools. Two weeks were devoted for the distribution of the questionnaire in all the seven circuits. The collection of the questionnaire also took another two weeks. In all, four weeks were used for data collection which were administered by the two researchers and had a return rate of 100 percent. The quantitative data was analyzed using the statistical package for social sciences (SPSS) for Windows Computer programme and appropriate statistics generated (Orodho, Ampofo, Bizimana & Ndayambaje, 2016; Orodho,2012)

III. Findings and Discussion

The main thrust of this paper was to examine thechallenges inhibiting effective implementation of Integrated Science in the Junior High Schools of Kwahu West Municipality, Ghana. The science teachers and supervisors were requested to indicate the main challenges constraining effective implementation of integrated science. The results of their responses is displayed in Figure 1. The results carried in the Figure indicate that the highly ranked challenge constraining effective implementation of integrated science in Junior High schools in Ghana, cited by 19.94% of all respondents, was the breadth of the syllabus to be covered.

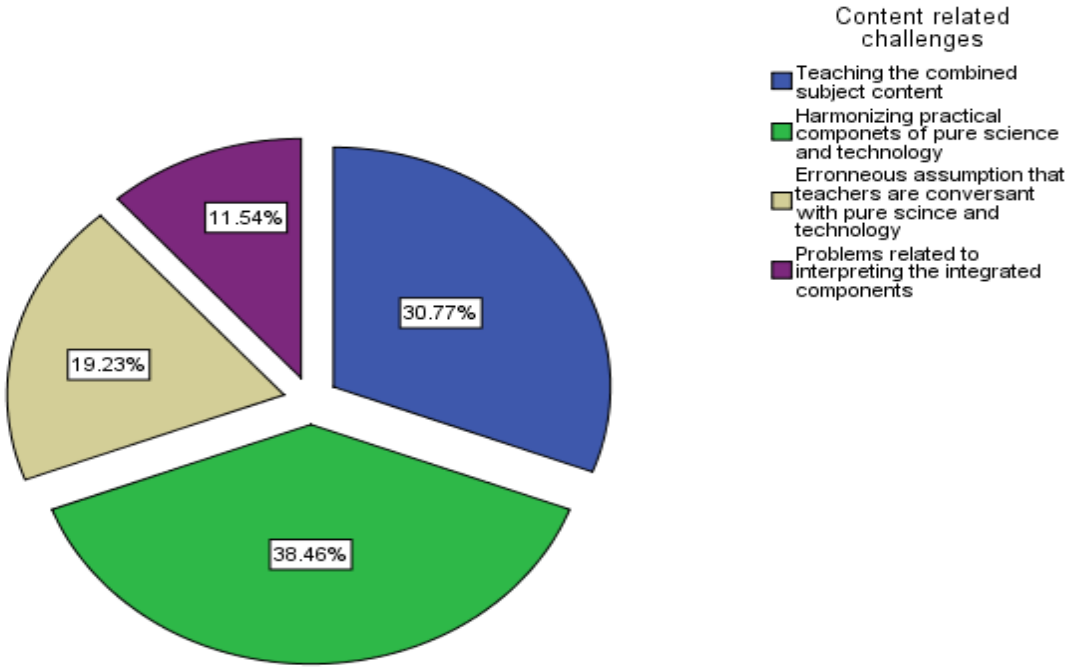
The second factor hindering effective implementation of integrated science, cited by 18.77 % of all respondents, was lack of high-impact science teaching strategies among the science teachers. The third factor closely related to the second factor was the inexperience of science teachers as reflected in lack of hands on practical experience in teaching the practical components of the syllabus content. The fourth highly ranked challenge, cited by 16.47% of all respondents, was dilapidated nature of most instructional infrastructure in most junior High Schools in the Municipality.



The fifth and sixth challenges, cited by 9.67% and 8.79%, were the integrated nature of the syllabus content and inadequate in-servicing of science teachers to cope with new innovations in science teaching, respectively. The other challenges cited by 5.28% and 2.93% were the interdisciplinary nature of the syllabus and lack of logistical support by the schools, respectively.

The science teachers were further requested to specifically state the content related challenges that inhibited effective implementation of integrated science. The results are carried in Figure 2. A critical examination of the information contained in Figure 2 revealed that science teachers were finding it extremely difficult to harmonize the practical components of pure science and technology during their teaching. This concern was raised by more than one third of all teachers, constituting 38.45 % of the total sample. This revelation implies that teachers had resorted to mere chalk and talk methods of instruction which compromise the modern high impact student-centered practical strategies. Figure 2 also indicated that slightly less than one third of the respondents revealed that teaching the combined or integrated science was a headache. It was also noted that about 20 percent of all teachers were of the opinion that the ministry of Education in Ghana had an erroneous assumption that all teachers were competent in teaching the integrated science course, yet they had been trained to handle individual science components. Finally, the results in Figure 2 indicate that about one tenth of all respondents reported that they were experiencing problems related to interpreting the integrated components of the syllabus. Cumulatively, this made teaching less meaningful and compromised the modern high-impact instructional strategies.

Figure 2: Content related constrains to effective implementation of science



The results are in tandem with the assertion made by the WAEC (April, 2008) that most students found it difficult to answer questions on practical work. It was revealed that a large majority of respondents were in agreement that teachers must possess knowledge in pure science and technology to be able to handle the subject well. This outcome is consistent with the argument raised by Interstate New Teacher Assessment and Support Consortium (INTASC, 2002) that being prepared adequately, in terms of coursework in science, seems likely to be critical for becoming an effective science teacher. The indication from the results is that majority of science teachers in the Kwahu West Municipalitywere overwhelmed by the broad and the diversity nature of Integrated Science. This was confirmed by the circuit supervisors and the science coordinator during the interview session.

A circuit supervisor remarked that science teaching ought to be practicalbut with the lack of the teaching and learning resources and expertise (MoESS, 2007),most lessons taught were theoretical and abstract. He added that some teachers also complained of the broad and diverse nature of the subject during the interactions they had with the teachers after supervision sessions.

The science coordinator, during the interview session, explained that:

> There were some topics which were quite technical and most teachers found it a bit difficult to handle as portrayed by the results. The implication is that more emphasis should be placed on the teaching of science disciplines such as Physics and Chemistry in our Colleges of Education. Also regular in-service which is content-specific could be organized for the teachers to help them overcome their difficulty and improve upon their confidence(Science coordinator, 01).

A distinguishing revelation that could be seen from the results is that all the respondents indicated that there was no science workshop or laboratories in their schools. This suggests that science practical lessons were not conducted under the required conditions and at the appropriate places. Since the availability and accessibility of relevant teaching and learning resources are significant in having a high-impact on the performance of both teachers and students (Ofori, 2005), then, a serious lack of them as portrayed in this result could impact negatively on the performance of both teachers and students. This is in tandem with WAEC (2008) which indicated that many students lacked practical experience and therefore could not answer questions based on practical work. It therefore encouraged science teachers to expose the students to simple practical work.

The science coordinator confirmed this anomaly and said that:

> Effortsare being made to have a common workshop to serve a cluster of schools. When this materializes the few science resources left in the schools would be pulled together to be used and maintained by the schools (Coordinator, 03).

It could also be noted that just about half of the respondents reported having science equipment in their schools. This was confirmed by 32 (53.3%) of the teachers. They indicated that the available equipment were both inadequate and in poor state as depicted in the results. This outcome agrees with the

assertion made by Levin and Lockheed (1993) that the learning resources that many developing countries are able or willing to allocate to educational institutions are sometimes inadequate.

The study established that teachers hardly used modern high-impact instructional strategies when teaching yet science knowledge is socially constructed (Orodho, 2009; Vygotsky, 1986).Group involvement seemed to have an impact on these participants' long-term memories. The discovery or investigation of science with peers provided opportunities for social interaction and an element of fun.For instance, Participant 37 wrote: "Experimenting with magnets. It was a fun group activity".

Group involvement provided opportunities for independent discovery amongst the few who reported that they regularly involved learners in laboratory practical: "Doing an experiment on electricity,we were actually allowed to do it on our own. So because we could conduct it ourselves it made it more enjoyable" (Participant 57). Once again, science concepts were uncovered as a result of high-impact teaching that facilitated group involvement.

IV. Conclusions and Recommendations

The thrust of this study was to examine the challenges constraining effective implementation of integrated science at Junior High School level in Kwahu West Municipality in Ghana.In a nutshell, it is concluded that there were multifarious and intertwined challenges inhibiting effective implementation of integrated science at Junior High school level in the Kwahu West Municipality, Ghana.

It was evident that there was lack of high-impact teaching for science. The factors behind this include the teacher's personal attributes (i.e., enthusiasm for teaching the subject), group involvement in practical and field excursion which provides the basis for sharing understandings of scientific concepts with usable and practical science lessons. Hands-on experiences were also highlighted by these participants as inadequate, yet these included interactivity with life and active participation on science-based excursions. Participants claimed that teachers who articulated clear purposes for conducting science activities motivated student involvement. High-impact teaching for science has been summarized as:

- ✓ use of practical and group work in workshops and labs
- ✓ Enthusiasm from teachers
- ✓ Usable and practical scientific knowledge
- ✓ Interconnectivity with lifelong learning
- ✓ Purpose of syllabus clearly stated
- ✓ Excursions for science understanding.

Although teaching approaches can vary between different educational levels and an individual's preferred learning style may change with age and experience, these high-impact teaching practices have a student-centered focus that may be adapted to suit individual styles. Indeed, exemplary science teaching practices may be interchangeable and relevant to effective teaching practices regardless of the level. The high-impact teaching for science indicated in this study can have relevance at all levels of education.

It can also be concluded from the study that the science teachers in the Kwahu West Municipality faced some content-related challenges as far the teaching of Integrated Science in the Junior High Schools is concerned. This was closely linked with the lack of appropriate and adequate teaching and learning resources such as science equipment and science workshops. These challenges seemed compounded with inadequate support from their respective schools as well as parents, subject associations and science coordinators and lack of regular content-specific in-service training programmes to enable the science teachersto deal with the challenges they faced.

In the light of the findings and conclusion, the following recommendations are made:

1. The Ghana Education Service (GES) need to place more emphasis on the regular organization of content-specific in-service training programmes for both beginning and experienced teachers in Integrated Science especially before a new school term begins. Alternatively, the Municipal Science Coordinators could be well resourced to enable them play this vital role.
2. Due to the lack of science workshops for the schools as depicted in the study, the GES must consider setting up science workshops (laboratory) to serve cluster of schools in the Municipality. These workshops could be maintained by the schools which would patronize the workshops.
3. The Ghana Education Services (GES) should encourage concerted efforts amongst a wide cross-section of education stakeholders such as parents' teachers associations, non-governmental organizations and philanthropists to support the high- impact teaching of integrated science not only in Kwahu Municipality but also other regions experiencing similar challenges and constraints.

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