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A REVIEW OF THE FACTORS INFLUENCING LEARNING CHEMISTRY IN NIGERIAN SCHOOLS

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Abstract

In this study, a brief description of the Nigerian educational system as well as the need for scientific knowledge and literacy is made. The teaching learning process was viewed along the constructivist approach, but an attempt was made to compare constructivist and behaviourist approaches to learning. From the literature reviewed, it is discovered that poor school and home environments, teacher centred approaches and broad subject content contribute negatively to students' performance in chemistry. With regards to gender, it is discovered that fewer females than male students like chemistry, since in the (females view) chemistry is not related to raising a family. The female scientists are also found not to model younger females to pursue chemistry.

This, is in addition to the discovery that chemistry and science in general are perceived to be a creation of the West, does not align with the cultures of most developing counties in Africa. The process of "enculturation" has therefore been very slow due to cultural barriers. It was however suggested that chemistry teachers should be trained professionals, who should be able to motivate female students to like chemistry; the laboratory be properly equipped to offer student opportunities to practice chemistry process skills; and that chemistry could be taught in a language which the students are most familiar with.

Introduction

This write up is about the factors which influence learning Chemistry by Nigerian secondary school students. The main purposes of the Nigerian secondary school curriculum include the attainment of significant knowledge with understanding, ability to handle and process information and problem solving through acquired knowledge, experimental skills and scientific investigations (FGN, 2004). In the Nigerian context, secondary education is divided into two halves, called junior secondary school (JSS) for ages 12 to 15 years and senior secondary school (SSS) for ages between 15 and 18 years. At the JSS level, students are taught Chemistry, Biology and Physics topics under a single subject called Integrated science. This is intended to introduce them to the sciences and is compulsory for all. At the SSS level, students are at liberty to choose either

science or arts courses. Science students offer Mathematics, Biology, Chemistry, Physics and five other subjects, making a total of eight. At the end of three years of study at the senior secondary school, students sit for common examinations organised by two examination bodies called the West African Examination Council (WAEC), which is a regional examination body, and the National Examination Council (NECO), a national examination body. On successful completion of this three year programme, a student is awarded a senior secondary school certificate (SSSC). Admissions into polytechnics, colleges of education and Universities are based on students' performance in either or both of these examinations, as well as their performance on the Joint Admissions and Matriculation Board (JAMB) examinations. It is pertinent to note that for quite some years now, Nigerian students' performance in Chemistry in both WAEC and NECO examinations has not been impressive. This situation has been reported by Olarundare (2002), who identified students' poor performance in science courses as a recurring problem, which has spanned for over a decade.

The view on Chemistry education in Nigeria, as expressed by scholars and further supported by Edomwonyi-Otu and Avaa (2011), is that Chemistry education has been acknowledged as one of the important foundations for Nigeria's economic growth, which must be given sufficient attention. Their observation can easily be substantiated using the important applications of Chemistry in medicine, Pharmacy, Agriculture, foods and beverages,

petrochemical industry, water and sanitation, etc which are crucial for Nigeria's stability and growth.

In line with this significant role of chemistry and other science courses, the federal government of Nigeria in a policy statement declared that "Government shall popularise the study of the sciences and the production of adequate number of scientist to inspire and support national development" (FGN, 2004). This government effort could be observed through the inclusion of Chemistry in the curriculum, the construction of laboratories and the provision of some laboratory materials, as well as the training and recruitment of chemistry teachers. Despite all these efforts by government, researches on Nigerian secondary schools students' performance by Adesoji & Olatunbosun (2008), Adigwe (1993) and Edomwonyi-Otu and Avaa (2011) revealed that students consistently do not do well in the subject.

This work is therefore aimed at finding out both student teacher and environmental as well as other factors which may be responsible for students' performance in chemistry. This is with a view to make available information on their contributions or otherwise to the learning of chemistry in Nigerian secondary schools.

A Review on Student, Teacher and Environmental Factors Affecting Learning Chemistry

The environment connotes the general learning situation, circumstances or background, whether physical or social which may influence learning, either positively or negatively. For Adesoji and Olatunbosun (2008), Chemistry teaching and learning can only be result-oriented when students are prepared and the teachers positively willing to use suitable approaches and means in educating learners. This is so because the renewed global emphasis on the acquisition of scientific knowledge has placed a demand on the teacher, the learner, the curriculum and the environment. In any teaching/ learning context, the centre of attraction should be the learner. It is because of him/her that schools are built, teachers trained, laboratories built and equipment procured. The learner is surrounded by all these, including his parents and peer group. All these constitute the learners physical and social environment.

Nigeria is a developing economy which is in serious need of knowledgeable chemists to meet the growing needs in industries and other viable sectors of the economy. Despite all these, Adesoji and Olatunbosun (2008) identified factors that include school location, poor procedures of teaching, laboratory insufficiency, teachers' attitude, teachers' poor attendance at workshops and students' poor background as those affecting student performance. Their finding reveals that only school and teacher factors are responsible for students' performance. This may be questioned on the

basis that students' factors, such as home background and other physical and social factors, could cause a decline in students' achievement. They should not be ignored.

In line with the finding above, Adesoji (2008) discovered that the problems solving approach showed more positive results towards chemistry. However, what is not clear is the criteria used for classifying students into experimental and controlled groups. These findings would have been enriched if other methods of data collection (such as the interview) were also used, rather than merely asking students to either agree or disagree with a statement.

Salta and Tzougraki (2004) also came up with what they called the "attitude toward chemistry scale to assess 11 grade (16-17 years old) Greece high school students' attitude toward chemistry. The sample consists of 576 students (247 male and 329 females), all drawn from 7 schools in four towns in Greece. Among their findings is that students' attitudes concerning the extent of the difficulty of chemistry lessons are linked to concepts, symbols and problem solving. They also have difficulties in solving chemical problems requiring mathematical skills. Most of the students also acknowledged that chemistry knowledge is beneficial for understanding most parts of their everyday existence, but only 23 students (4% of the population) indicated interest to study chemistry at higher levels. This, according to Salta and Tzougraki, is because of the low preference accorded chemistry related professions in Greece. This

research used students from schools which were all located in towns where the learning environment may differ from rural setting in terms of the availability of learning materials and staffing, as well as teacher/ student motivation. Some level of balance would have been attained if students from rural schools were also involved to find out other variables, which may be linked to students' attitude to chemistry. However the findings are useful because they tend to associate students' attitude with other variables, such as, the difficulty level of chemistry concepts and lack of mathematical skills as well as the extent to which chemistry is valued. These therefore placed a demand on both the teacher and society.

In Nigerian secondary schools, chemistry class rooms can be described based on the location of the school into the rural and the urban. Based on ownership, there are private and government owned schools. The government owned schools are found in both rural and urban areas, but with varying levels of sophistication. Most urban schools have a high concentration of both qualified teachers and well equipped laboratories; while most of the rural schools are ill-staffed and poorly equipped. Also, while there are many private schools which are well equipped and well-staffed, there are also those that are best described as "magic centres," where the facilities are poor and the teachers are not trained professionals. Hence, the research by Salta and Tzougraki (2004) has not addressed all these categories of schools and so the findings cannot be generalised and relevant to Nigerian rural schools.

Still on students' cognition, Danili and Reid (2006) used multiple choice and a short answer and structural communication grid to test two cognitive styles, which are associated with student's achievement in chemistry. These are field dependent/ field independent and convergent/ divergent cognitive styles. Five classes of chemistry students in the 10th grade (16-17 years) were used. They discovered that the content of the test, format of the test and the psychology of the students affected its performance. In their view, there are individual variations in styles of remembering, thinking and judging, which imply that students have different cognitive styles and are different in intelligence, personality, ability and achievement. They also attributed intellectual abilities, skills, personalities and teaching and learning and performance to individual cognitive styles. That a student who performed well in one format may not perform well in another format, because formats of assessment test different abilities of the students. Which then is the best format? Are the Nigerian chemistry teachers utilising it? These questions require answers because, the art of testing if not well managed could constitute teachers' factors which may influence the teaching/learning process.

In line with this, Edomwonyi-Otu & Avaa (2011) interviewed 80 respondents, consisting of 10 teachers, 60 students and 10 ex-students to find out the teacher, student and environmental factors responsible for students' learning and performance in chemistry. The students and teachers were drawned from three schools

and the students used were in senior secondary class 1 and 2 (15-17 years) drawned from three schools. The teachers were also from these schools. Among the discoveries is the problem of non-professionalism on the part of some teachers, inadequate time on the timetable, too wide syllabus, the absence of practical sessions, large class size, inadequate laboratories and choice of career.
Indeed, the teaching profession in Nigeria is considered as a gateway to better paid jobs, not a preferred choice. Also, some chemistry teachers are rather regarded as teachers of chemistry, because they are mostly graduates in other fields, which are related to chemistry, but are devoid of the methods of teaching. The professional status of the teacher influences his ability to effectively guide students to learn. This is supported by Bauer (2002:16), who emphasised that the teacher's "enthusiasm, teacher effectiveness, teacher content knowledge, students' enjoyment and interest, as well as challenging instruction with demonstration" are some of the features that are linked to positive attitudes by chemistry students.

The influence of parents towards learning was stressed by Henderson and Berla (1994), who observed that the level to which a family participates in a child's learning is the most precise predictor. The effect of the family comes through the level of interaction between family members and the child. The family should be seen to provide enough learning environment for the child. In the Nigerian context, this may not be the case for all the students; because while some parents are literate, some did not go to school. So, the level of consciousness about

the value of education varies. A family's level of income may also be a factor but Henderson and Berla (1994) suggested that schools could bridge this gap by supporting families to create home settings that are conducive for learning, show great beliefs for their children attainment and also become involved in their youths' learning, both at school and in the private.

Furthermore, Jegede (2007) carried out a survey on students' level of anxiety towards chemistry, using 300 students. Among his findings is that both male and female students, rural and urban-based, in Nigeria displayed excessive anxiety on the learning of chemistry. This level of anxiety was discovered to be more in females and rural-based learners than in males and urban based learners. Jegede also found out the causes of this anxiety to include extensive coverage of the syllabus, students' low consciousness of career chances in chemistry, the teacher and his/her instruction approaches and lack of instructional materials and laboratories. Having taught secondary school chemistry in Nigeria for a period of fourteen years, it is indeed true that the syllabus is wide, and the time allotted to it on the time table too short. So, teachers find it practically impossible to teach all the content of the syllabus, as asserted by Jegede (2007). The level of anxiety expressed by female students, from my experience, is hinged on the premise that female secondary school students see chemistry as a male-dominated subject, as shown by their lack of confidence in handling chemicals and apparatus. In most cases, female students tend to rely on their male counterparts to perform experiments related to

manipulation of equipment and reagents. Also, most rural schools are poorly funded and the laboratories are either in bad shape or are poorly equipped. I had to resort to improvisation in order to teach some basic concepts of chemistry in one of the rural schools in 2008. This falls in line with the discovery by Edomwonyi-Otu & Avaa (2011) that laboratory work was not conducted by most teachers.

Also, Olorundare (2002:5) came up with what he termed "the correlates of students' poor performance in science in Nigeria" to include socio-psychological variables, such as self-efficacy, interest in schooling, self-concept, self-esteem, self-confidence, self-regulation and study habits, among others. Other factors which have a direct link on teaching strategies include teacher's knowledge of the content, motivation, laboratory use and non-completion of the chemistry syllabus within the year. He further identified factors which have an indirect influence to include the roles played by parents in their children's education, teacher's competence in the use of language to effectively teach chemistry concepts, use of obsolete teaching approaches which may not foster meaningful learning and the use of academically unqualified and nonprofessional science (chemistry) teachers. In conclusion, Olorundare remarked that if a teacher is active in teaching, the students would likely perform well in class, but if the teacher is incompetent, the learners will perform even most awfully. This is consistent with some of the assertions made by Bauer (2002).

In order to remedy the teacher inefficiencies mentioned by Olarundare, Okorie and Akubuilo (2013) observes that since emphasis is now placed on the possession of scientific knowledge and skills in the 21st century, chemistry teachers must familiarise themselves with reasonable pedagogic knowledge, discipline based awareness and curriculum content and context facts, which are essential for them to effectively and efficiently deliver their lessons to students. In their research, they discovered that even though 80% of Nigeria chemistry teachers were acquainted with chemistry curriculum content, most of them did not follow the pedagogic methods suggested by the curriculum.

From my classroom experience, this non adherence to prescribed pedagogic procedures is largely due to insufficient time allotted on the time table for teaching chemistry and teachers' emphasis on teaching students to sit for examinations (which promotes rote learning), as well as lack of effective supervision by school inspectors. Linked to the school environment, as observed by Adesoji and Olatunbosun (2008), some school administrators who are not science biased do not always bother about what goes on in the chemistry classroom or laboratory and so would not bother to provide both the needed manpower and the materials for effective teaching. This therefore leads to laxity on the part of teachers. And as Bauer (2002) stated, teacher enthusiasm and effectiveness play vital roles in determining students' attitude towards chemistry. Furthermore, Schools in most developing countries are categorised as urban or rural-based on location. Indeed,

most urban children are aware of the values of science, but that alone cannot make them study chemistry. This is because there are also individual and teacher centred factors, which affect interest as well as motivation (Bauer, 2002; Kahle, 1990).

The literature reviewed shows that the learner should be the main focus of the teaching/learning process, since it is because of him/her that schools are built, teachers trained and recruited to teach, laboratories constructed and equipment procured. In addition, poor teaching procedures, laboratory insufficiency and students' poor background in chemistry have been identified as being responsible for the poor performance in chemistry. The extent of the difficulty of chemistry lessons have also been linked to symbols, concepts and solving problems involving mathematics. This is in addition to the formats of the tests administered to students and their psychology, non-professionalism of teachers, inadequate time on the time table and large class size, as well as the interaction between the learner and his/her family members.

The Gender Factors influencing Learning Chemistry

The chemistry class room consists of both male and female students in some settings; while in some, the boys are always separated from the girls. However, the ratio of boys to girls has been discovered to be high in favour of the boys by most researchers. Kahle (1990) in her book titled "Real Students Take Chemistry and Physics," stated that most girls do not go for chemistry and physics

because most of them do not have the confidence to choose the courses. Linked to this was her observation that girls often get out of advanced level classes due to negative influence by parents and gender discrimination by male teachers; who in her view failed to stimulate girls intellectually through higher order questions; did not provide intervention activities to encourage girls to enrol in the subjects and dominated laboratory activities, instead of facilitating the girls' learning. Danili and Reid (2006) also affirmed that individuals within a class may differ in their intellectual abilities, which requires the teacher's effectiveness and challenging methods of instruction, as proposed by Bauer (2002).

Cheung (2009) examined the effect of gender on students attitude to chemistry and discovered that male students like chemistry lessons more than their female colleagues; male interest in laboratory work reduced at higher classes, while the females maintained a constant likeness for it (laboratory work). Cheung (2009:76), like Kahle (1990) blamed students' negative attitudes on teacher inadequacies by stating that "most of what goes on in science class rooms is not attractive to the students". The way out of this gender dichotomy in the choice of chemistry, as suggested, is to use an approach that is based on the needs/interest of students in designing the curriculum, so that it will be attractive to female students. These researchers used a huge population of students. The ratio of the girls to boys participants was 1:3, which also signifies that males enrolled in chemistry more than females.

A similar study was conducted in the US by Miller, *et al*, (2006) on 79 high school students (16-18 year old) out of which 40 were females and 39 males. Using a questionnaire; the opinions sampled from the students suggested that most female students disliked chemistry and chemistry teachers. While most male students, they indicated love for mathematics/physical sciences; only 10 out of the 40 girls had a similar interest. Alternatively, most female students liked biology and courses in the humanities. To support this finding, Miller *et al*. (2006) further observed that fewer women (than men) had Bachelor's, Master's and doctorate degrees in most phases of science and engineering in the US. Reasons identified by these researchers include:

i. Females mostly find chemistry unexciting and the scientific way of life unappealing. They did not see the connection between it and raising a family.
ii. Chemistry teaching does not engage females (it is not enjoyed by them).
iii. Lack of mentoring from few females that are in the field.

This study used a small sample of students, but the ratio of females to males was the same. Also important is the racial diversity of the participants, which makes the findings easily extended to the Nigerian context. Furthermore, the study not only confirmed the disparity in enrolment between male and female students; but further gave reasons to support their discovery.

In the Nigerian context, attempts at exploring gender differences in performance include an investigation

carried out by Adesoji and Babatunde (2009), who analysed the difficulty and misconceptions of 320 (160 male and 160 females) senior secondary school 3 students (18 years old) in inorganic chemistry. They found out that more females than males had misconceptions and difficulties in chemistry. This was blamed on too much emphasis on the content of science rather the process of science; as well as evaluation methods, which lay emphasis on testing memorization instead of understanding.

Since students all differ in cognitive styles and abilities Danili and Reid (2006) suggests that the use of a single method of teaching for all of them may not foster learning among all the students. That is why the suggestion by Kahle (1990) for the use of humanistic approaches (which exhibit the teacher's love and affection for the students' personal growth and general awareness, as well as his/ her choices and responsibilities) for instruction is quite apt. Until students are uniformly motivated to learn, their attitude to the subject is improved and all their learning needs are adequately catered for. It may be unfair to use a single test to assess their performance.

Also consistent with the findings by Kahle (1990), Cheung (2009) and Adesoji & Babatunde (2009) are the findings by Jegede and Inyang (1990), who carried out an extensive research on 2,800 (1,454 males and 1,336 females) junior secondary school students (mean age 14.7 years), using the Integrated Science Achievement Test (ISAT). The results suggest that male students

achieved more than their female counterparts in integrated science. The students' performance in this subject is the only determinant for getting admission into the science class at the senior secondary school level. Since there were differences in performance among male and female students at the junior level, its manifestation at the senior secondary school level tends to indicate that the causes identified by Adesoji & Babatunde (2009) were not addressed.

Similarly, Bell (2001:484) posits that "the depth of processing of information by both male and female students is a critical factor to their performance in science." This "depth" in his view is influenced by dissimilarities in attitude and previous knowledge, which are influenced by the types of activities boys and girls engage in, as well as the type of learning atmosphere parents and mates provided. This is consistent with the findings on students' attitude by Cheung (2009) and Kahle (1990) and the influence of parents by Berla (1994).

The literature reveals expose that boys have a higher enrolment ratio than girls in most chemistry classes due to lack of confidence by the girls. This lack of confidence/ interest has been linked to the inability of teachers to motivate the girls to actively participate in classroom activities. More female chemistry students than male had difficulties/misconceptions due to too much emphasis on content of chemistry instead of the process of chemistry. Furthermore, the depth of information processing among male and female students

has been linked to differences in attitude and previous knowledge both of which are influenced by the type of activities boys and girls engage in as well as the type of learning atmosphere parents and peers provide

A Review on the Eco-cultural Factors Affecting Students' Performance

Guo (2007) carried out a survey on science teaching in 12 developing countries four of which were from Africa and discovered that the amounts expended on each secondary school student in rich developing countries is five thousand (5000) dollars each year; while the poorest countries spend less than fifty (50) dollars per child. Some countries were found to spend less than one dollar on each child per year. This low spending on science education cannot be attributed to poverty, but may be linked to the values such countries attach to the acquisition of scientific knowledge/ literacy. In line with this, Pomeroy (1994) observed some of the issues identified by the American science educators and policy makers to include the rising inequality amongst cultural/ gender demography, around the scientific societies at all stages; the overall inability of the system to train scientifically cultured students; and that more white males are into research, academics and science policy formulation than all other groups combined. This suggests that even in rich and technologically advanced nations, there are people who are less motivated to acquire scientific knowledge. This could also be linked to cultural values attached to science. That is why Aikenhead (1996) observed that a huge percentage of

learners regard what he call “enculturation into Western science” as an effort at integration into an imported culture, which they hate integrating into despite its global impact on their lives. And that this lack of interest decreases their active involvement in activities related to science and technology.

If science is a foreign culture to some learners, it means the process of integrating them into it should be flexible enough to allow the use of some aspects of the learner’s culture. For example, chemistry is mostly taught in Nigeria in English, which most learners do not understand. As a result, most of the chemistry concepts are not easily understood, not because they are difficult, but because of students language inefficiencies. This situation was properly coined by Aikenhead (2001:338):

> Schooling negates the subjective, socio-cultural constituted voices develop from their lived experience ... and to the extent that teachers insist that dialogue can only occur on their terms, schooling becomes an instrument of power that serves to perpetuate the social class and racial inequities that are already inherent in society.

This situation is so despite Jegede and Aikenheads’ (1999:48) assertion that “the prior or indigenous knowledge of the learner is of significance in accomplishing the construction of meaning in a new situation”. That as soon as a student enrols in the science classroom, it immediately becomes that science is another culture like the community, peer group and

home cultures, which s/he has to strike a balance between. Even though this refers to science generally, it does make a lot of sense with regards to the teaching/learning of chemistry in Nigeria.

Okebukkola and Jegede (1990) discovered that Nature and background affect the beliefs of people. That children in mechanized settings have positive attitudes towards science, because they are aware of its usefulness. While those in rural regions where things are done manually considered science as a form of knowledge without appreciating its practical values and may have adopted a serious lack of interest in science. Students who had superstitious believes performed poorly than those who reason empirically

In summary, the literature enumerated some eco cultural factors to include poor funding of chemistry teaching/ learning by government. In the United States, whites are said to be involved in science research, academics and science policy formulation than other races, thereby alluding to the saying that science in general is a creation of the West. Furthermore, it has been stressed by some authors that science generally has become a second culture to some students due to language variation.

Discussion of Findings from the Literature

This research work reviewed some literature in which students and teachers' views concerning learning chemistry and science in general were identified. Among the teacher factors outlined by authors is that the quality

learning of chemistry should be student centred. This implies that systematic effort should be towards ensuring that the teachers' teaching approaches and the learning materials provided as well as the general learning environment should be such that motivate/ raise the student's interest to learn. Teachers' enthusiasm, effectiveness, content knowledge and challenging instruction with demonstration have also been discovered to create positive attitudes among students (Adesoji, 2008; Bauer, 2002). Despite this, poor teaching/learning procedures, laboratory insufficiency and students poor background in chemistry have been identified in the literature as responsible for students' poor performance in the subject. The inadequacy of laboratories implies that students are taught mostly theoretical concepts without practical work, which is essential for the acquisition of process skills. Students' poor background in chemistry could be a teacher as well as an environmental factor in the sense that if the students are not properly taught integrated science at the junior level, it will hinder their understanding of some basic concepts at the senior levels; just as it has been discovered in the literature that students have difficulty in areas such as chemical symbols and chemical concepts as well as solving problems that involve mathematics (Salta and Tzougraki, 2004). The environment could also pose a threat to learning due to the non availability of laboratories and other teaching/learning materials.

Also, teaching is a profession which requires a sound grasp of pedagogical approaches as well as knowledge of

content. Despite this, most authors identified non professionalism and lack of knowledge of content as responsible for some chemistry teacher inability to motivate students to learn. Lack of motivation also indicates lack of interest all of which are important factors to students' learning and performance in chemistry. It has been discovered that when the teacher provides guidance to students, they tend to use their initiative and effort to learn, leading to improvement on their achievement in chemistry . But when the lecture type method is used, the teacher tends to cover a substantial part of the syllabus without students' understanding. That way the aims of the teaching/ learning process are not achieved (Adesoji, and Olatunbosun, 2008).

Students attitudes to chemistry have also been linked to their cognitive abilities, styles of remembering, location of school, family background, lack of consciousness of careers, their anxiety levels, gender discrimination and misconceptions due to too much emphasis on content (Danili, and Reid, 2006; Henderson and Berla, 1994; Jegede, 2007, Kahle, 1990; Cheung, 2009; Miller et al. 2006). Students differ in the ways they respond to instruction, because of their differences in cognition. They also differ in the ways they remember or recall ideas, which suggests that their learning styles are different, so also their rate of retention of learned materials; as well as the teaching approaches, which can be adopted to meet their learning needs. The literature reviewed tends to suggest that most chemistry teachers are not conscious of this and that a single approach is

often used to teach all the students. In the Nigerian context, the chemistry curriculum has been discovered to be loaded with too much content for which there is no adequate provision on the time table. This makes it impossible for teachers to teach all the topics.

The family's role was also identified to be critical, because it provides the child the needed motivation through the type of activities s/he is engaged in. These activities have been linked to the parents' level of education. Nigerian chemistry students come from both literate and illiterate backgrounds and the educational attainments of some parents do not make the home environment conducive enough for learning chemistry. As a result, most students find it difficult to make career choices. This lack of consciousness about career choices along with some teacher and environmental factors mentioned above, have also been identified as the causes of anxiety among students. Females have been identified to have more anxiety than male students; because they do not see the link between chemistry and managing a home. Older female chemists do not provide good mentorship and chemistry teachers in general use teaching methods that discriminate against women. Anxiety among students could also connotes nervousness, discomfort or apprehension which affect interest and the students' level of motivation.

Also linked to this is the discovery that female students have higher levels of misconceptions than their male counterparts (Adesoji and Babatunde, 2009). In Nigeria, the girl child suffers discrimination both at home and in

the school; where most parents prefer to educate their male children than the females, because he is seen as the heir of the family, who will succeed the parents. While the girl is perceived to be a part of her would-be-husband's family. Also, performance based on gender has been linked to the activities boys and girls do. This implies the type of play (domestic or school) students embark on. Male students have always been involved in little explorations that involve the use of energy, while the females may resort to less vigorous activities (Bell, 2001). This may make the boys bolder and better able to participate in learning activities that involve the manipulation of equipment (Cheung, 2009).

The scientific culture, as identified by this study, has been described as "Western" and is therefore alien to non-Western cultures (Jegede and Aikenhead, 1999). The methods of transmission have also been identified to involve the use of media (example, language), which are alien to the non-western worlds. This has therefore led to the non-integration of the scientific culture among these cultures, despite its global significance. Linked to this are the peoples' taboos and belief systems, which have also been identified to pose a hindrance to the learning of chemistry. A general disparity has been identified in the pursuit of scientific knowledge among cultures (white and other ethnic groups) in Western nations (the United States of America), thereby confirming the Western element of science education (Aikenhead,1996). In Nigeria and other developing nations of Africa, the educational systems are driven by colonial experience and so science education is alien to most Africans, who

had their ways of doing things before they were colonised. Colonialism tends to dilute and even destroy most African crafts and traditional ways of relating with nature, thereby replacing them with a scientific culture which can only be acquired using equipment and materials made by our colonial masters. This is in addition to the medium of instruction (English), which is alien to us.

Conclusion/ Implications of the Findings

The results of this study have some implications for the chemistry teacher, education policy makers, parents and the Nigerian government. The teacher's role is to facilitate learning and not to dispense knowledge. For him/her to be effective, s/he must be trained and be abreast of teaching/ learning procedures that meet the needs of the learner. The theatre for acquiring scientific knowledge (laboratories and classrooms) also needs to be made conducive through the adequate provision of structure and science equipment that will engage students in the construction of their knowledge through the guidance of the teacher. This therefore requires adequate budgetary provision and supervision by government. This is in addition to carrying out a comprehensive review of the chemistry curriculum to reduce the theoretical content, as well as making time available on the time table for easy coverage of the content. Furthermore, the curriculum should be such that topics/ concepts learned at the Junior Secondary School are not only linked to the content to be taught/ learned at the Senior Secondary School level in order to give the

students the needed background for understanding such topics/ concepts.

In order to reduce gender inequality in performance, teaching/ learning not only reflect the needs of both sexes but should also offer them the right motivation as well as equal opportunities to learn chemistry concepts. Teachers could engage all the students in laboratory work instead of manipulating such activities alone. Teaching/learning chemistry concepts should be geared towards the understanding of chemistry concepts, not the mere memorization of content and fact. This can be achieved through the integration of theory with practical work. A general awareness may be conducted for students of both sexes to intimate them of the opportunities the study of chemistry avail them of. This will not only help in motivating and raising student interest, but will make them set future goals and also pursue them.

The medium of communication in most chemistry classroom is English, which most chemistry students have as a second language. Science itself is another culture entirely to the students which could be better learned if most of its concepts are translated into the language or the language best understood in a certain region within Nigeria, for examples, Hausa, which is spoken and understood by most tribes in the north could be made a medium of learning science since almost everyone understands it. In the absence of that, teachers are left with no option than to always ensure that the language they use in chemistry classrooms is full of words which are too advanced for their students.

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