SCIENCE TEACHERS' ATTITUDES TOWARDS ICT-SUPPORTED TEACHING AS PREDICTORS OF EFFECTIVE LEARNING IN NIGERIAN HIGH SCHOOLS

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ABSTRACT

Active learning in a classroom is dependent on how the classroom learning environment supportslearner engagement in the achievement of effective learning. Factors that could enable this include ICT-supported instructional modes, teachers' teaching experience, attitude, adaptability and skills in classroom management and control. This study assesses the level of constructivism in the classrooms of beginner (0-5years) and experienced (>10years) teachers in Nigerian secondary schools as a predictor of improved learner through ICT-supported instructional modes. 71 science teachers from 12 secondary schools in 2 local government areas responded to items in the Actual version of the Classroom Learning Environment Survey (CLES-Actual). Findings indicate that the classrooms of older, more experienced teachers are less active (constructivist) than those of their younger, less experienced counterparts with a tendency towards the old traditional approach to teaching.

Keywords: Classroom Learning Environment, Constructivism, Active learning, Beginner teacher, Experienced teacher, Nigeria, ICT-supported Education

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Introduction

Traditional schooling is based on an educational paradigm that has been around for a long while. During the industrial revolution, the purpose of education was to prepare people for jobs on assembly lines. So, the organized classroom evolved, where students sat and received their training from a teacher. Active learning is the new paradigm for effective education as it puts the learner in control of the learning process. The goal is to give students the ability to explore subjects/topics on their own and not to spoon-feed them specific facts, thus placing students in charge of their learning whereby they can customize their educational experience. The teacher trying to be a subject expert is a truly impossible task in this age of information; instead, he now oversees the learning process (Funderstanding, 2008).

Learning Environments

Rutter et al. (1979) believe that students would have spent up to fifteen thousand (15, 000) hours at school by the time they finish senior high school and as such, should have a large stake in what happens to them there. Richardson &Arker(2010) also posits that the teacher's personality will affect a number of aspects of classroom interaction and this bears a direct effect on students' learning. Studies have shown that the student is a product of the environment and the classroom learning environment and teaching materials exert some dominant influence on learners' academic performance (Obameata, 1995).

Classroom environment on one hand can be affected by factors including teachers' competence in class management, cleanliness, emotional atmosphere, the social climate of the classroom (Adeyemo et al., 2009) and the availability of instructional aids and on the other hand it affects both the teacher and students and consequently the learning activity. The effects of classroom situation on learners' motivation are also reported by Adeyemo&Adegbola, (2009).

Young (2008) believes that the classroom should be home-away-from-home for both teachers and students in order to make for effective learning; whileOtote&Alufohai (2009) also believethat certain basic variables must be in place;these include proper seats and seating arrangement, position of the white/black board, visual displays, lighting, temperature and good ventilation among others. Research reveals that the best learning environment should be of high challenge but low stress where the learner gets exposed to a variety of new materials that facilitateseffective individualized learning. It should also be one that fosters and

encouragesindependent and active learningthrough the use of visual displays which are capable of improving recall and attention by up to 80% (The Highland Council, 2006). The teaching process, including teaching methods also bear a direct impact on learning. Ibraheem&Oludipe (2008) reported the use of archaic teaching methods and the teacher-centered mode of teaching as a major problem confronting science teaching in Nigerian schools.

Various research reports indicated that active learning strategies are central to meaningful learning (Adeyemi, 2002;Ibraheem&Oludipe, 2008) as it provides the learners with the opportunity to work in small groups, negotiate meaning and construct conceptual understanding (Johnson et al, 1991; Cohen, 1991). The constructivist approach is central to this process. According to Bereiter&Scardamalia (1989), learners in supportive environments have high levels of self-efficacy and self-motivation.

The learning environment is the sum of the total influences (internal and external)a learner experiences during the course of learning (Wiki, 2006). It includes the physical (classroom setting, instructional methods, teaching aids, etc.) as well as the abstract content (social, emotional and psychological state of both instructor and learners, teachers' knowledge of subject matter, conduciveness and comfortability) of the environment of learning.Good (2008) in his analysis of a music school identified 10 components of an ideal learning environment to includelearning objects, open access, passionate peers, elders, models, professionals, opportunities to try, showcase/perform, learning from each other and learners in the driver seat. These components compare well with the six principles of learning and teaching according to Victoria (2008) which includes a supportive and productive learning environment that promotes independence and self-motivation; in whichthe teaching and learning (T&L) is programmed based on students' varied characteristics; an environment that challenges the learner to develop critical thinking skills and in which assessment practices are a fundamental part of T&L and one that promotes real life applications of learning.

An investigation of factors related to student achievement in science by the International Association for the Evaluation of Educational Achievement (IEA) conducted a study on factors related to student achievement. 12 countries were involved in the study and in spite of the incomparable educational systems between the countries, findings show that in all, there is an increased practical work component in science achievement by students; the variability in

science achievement outcomes from school to school provides further evidence that the learning environment affects achievement outcomes (Young, 1994).

Science Education and its Significance

From its early beginnings, science has developed into one of the greatest and most influential fields of human endeavour. Today, different branches of science investigate almost everything that can be observed or detected, and science as a whole shapes the way we understand the universe, our planet, ourselves, and other living things (Encarta, 2005). Science education therefore is very important in the entire educational process. Its basic aim is to enable students among other things to become healthy and creative members of the society with some necessary scientific literacy (Kim, Fisher & Fraser, 2008; Adewuyi, 2009). Science is certainly a very fascinating subject to learn as it arouses learner's curiousity about the nature and whatever happens in everyday life. Learning science is also very beneficial as it has been linked with other subjects such as Geography, Mathematics and English. This will certainly help the learners in so many ways as they get to learn many things at a time (Shbie, 2008). The importance of science is also observable in the contributions of science and technology to human life.

The Challenge with Science Education

However, in spite of the obvious importance of science education, however, and especially in the current globalized world, students' performance in Nigeria shows no improvement in either the traditional or the vocational science subjects. According to the report of the West African School Certificate Examination (WASCE) results for Nigeria for the years 2006-2008, performance in science subjects including the traditional, social and vocational sciences shows credit passes below 50% for most subjects (Osun State Ministry of Education, Osogbo). Apart from reasons including poor infrastructure (laboratories, libraries, classrooms, etc) due to poor funding of the education sector, another important reason is the abstract nature of many of these science subjects, which makes it difficult for students to relate with the content. Major culprits are the physical sciences: chemistry, physics and mathematics.

Elements of the Education Process

Among the elements involved in the education process are the teacher, the teaching methods, learning environments, the information conveyed, the materials used and the student (Obameata, 1995; Sawage, 1999). Results from studies in this process shifted emphasis from devices and materials to the teaching-learning process with research in learning environments (LE) indicating that for effective learning, an effective LE must be activity-oriented (Adeyemo, Adegbola&Oke, 2009) and interactive. These prove the value of an additional means of teaching apart from audio only, capable of not only facilitating perception, but can also be carefully organized, and can require the student to use more than one modality.

ICT-supported Education and Teaching Approaches

Teaching approaches should change from teacher-based instruction to learner-based learning where teachers facilitate learning; this is largely achievable with ICT tools. However, in spite of various research findings which lend their support to the effectiveness of ICT tools in science education, most Nigerian schools, especially government-owned schools have not shown any serious positive response to the use of ICT tools in science education and an average science teacher is still without basic knowledge of the operations and use of most ICT tools (Aladejana, 2007).

The reason for this lack of knowledge may be viewed from different angles. The use of ICT tools focuses on the modern perspective of education, which views the teacher as a facilitator of knowledge rather than the custodian of it (Azer, 2005.). This might be a threat to the traditional position of the teacher who may therefore show a tendency not to favour the integration of the use of ICT tools in education and this may in turn provide no motivation for acquiring any form of literacy; this may be much more applicable to experienced teachers who have spent a considerable amount of time in teaching and therefore see nothing wrong in the old methods.

Current globalization puts a demand on teaching and learning in Nigeria to adapt to changes in classroom practices across the world in order to bridge the digital divide in the educational process between developed and the developing nations. This will only be possible through positive response on the part of teachers. This study is a diagnostic one whose result will assist in finding a solution to the problem of poor performance in science subjects. This will be

possible through the use of the findings to plan for the proper training and possibly re-orientation of teachers to achieve more effective teaching in Nigerian schools through the use of ICT tools.

Constructivist Learning Theory

The study assumes that the use of ICT tools has a positive influence on learning of science and that appropriate use of the computers, multimedia packages etc. can bring tremendous improvement to the learning of science based on the theory of constructivism, a philosophy that perceives learning as a process of adjusting mental models to accommodate new experiences (Aladejana, 2006). It suggests that learners construct knowledge out of their experiences. According to Jean Piaget in Encarta (2005), this is done through processes of accommodation and assimilation. Social constructivism suggests that the background and culture of the learner must be taken into consideration throughout the learning process (Aladejana&Odejobi, 2006).

According to von Glaserfeld (1989), learners look for meaning and will try to find regularity and order in the events of the world even in the absence of full or complete information. Furthermore, in social constructivism, the instructor takes the role of a facilitator rather than that of a teacher in which case 'he asks rather than tell, gives support from the back rather than lecturing from the front, provide guidelines to assist the learners arrive at his or her own conclusions rather than giving answers according to a set curriculum, and maintains continuous dialogue with the learners rather than give a monologue; the critical goal being to support the learner in becoming an effective thinker' (Aladejana&Odejobi, 2006).

Objectives

This study is intended to find answers to the following questions:

- Is the science learning environments in Nigerian schools sufficiently constructivist in approach to engender the use of ICT tools?
- Is there a difference in the level of constructivism of the science classrooms of beginner and experienced teachers?
- Is the full integration of ICT tools in Nigerian science education a realizable dream in the nearest future?

ICT in Nigerian Education

Computer technology is still struggling find a strong foothold in most Nigerian public schools at a time when in many parts of the world, teaching and learning has moved on to the ICT-based delivery mode. Many teachers are yet to know how to make proper use of the computer to aid teaching. According to Ajewole (1998) these are the same teachers who must be prepared to write computer programmes, send e-mails, and use technology to stimulate biology, physics and chemistry experiments. Jimoh (2005) reported use of less than 60% of communication media by lecturers in the colleges of education and polytechnics, indicating there is still a long way to go.

Methodology

Sample and Data Collection

The population for this study consists of science teachers in Nigerian secondary schools. A sample of seventy-one (71) science teachers was drawn from among science teachers from twelve (12) secondary schools in Osogbo Local Government Area. The science teachers are those who teach traditional science subjects (physics, chemistry, biology, and agricultural science), mathematics, additional mathematics, integrated science, computer education and introductory technology. A total of one hundred (100) CLES were administered out of which ninety-six (96) were returned. The questionnaires were administered to all the science teachers in all the sampled schools. Stratified random sampling was employed for sample selection. All teachers with teaching experience between 0-5 years and those with teaching experience of 10 years and above were drawn from among all the science teachers sampled. A total of seventy-four (71) teachers were in this category.

Instrumentation

The instrument for data collection is the "Classroom Learning Environment Survey" (CLES-Teachers Actual). The CLES was used to assess how constructivist the science classrooms in the schools were. The original CLES was a standard instrument developed by Taylor & Fraser (1991) to provide teachers with an efficient means of learning more about their students' perceptions of the extent to which the classroom learning environment enabled them to reflect on their prior knowledge, develop as autonomous learners, and negotiate their understandings with other students. The need for an instrument that addresses the socio-cultural restraints of the

original CLES gave rise to the revised version which incorporated a *critical theory* perspective on the socio-cultural framework of the classroom learning environment (Taylor, Fraser & White; 1994). The CLES consists of two forms, Actual and Preferred, which can be administered to students and teachers.

The Actual form assesses participants' perceptions of their "actual" or “real” classroom learning environment while the preferred form allows participants to record elements of their "preferred" classroom learning environment. This research made use of an instrument adapted from the first part of the Teachers’ Actual form and the original CLES. The items reflect a constructivist-oriented approach to teaching and learning which encourages the construction of knowledge through negotiation and collaboration with both students and teachers, and teachers' reflections on their students learning and understanding and on other students' ideas and explanations. The second part of the CLES, the CMLES measures students' reactions to the interactive multimedia program; it is not used in this study.

The CLES adapted for use in this study is a two-section instrument. The first section is the personal information section which provides demographic information including type of school (public/private) and length of teaching experience of the teacher. Section two consists of six (6) scales including a total of 30 questions. Each scale consists of five (5) items. The section examines the different learning opportunities available to the students based on the nature of the classroom environment createdas shown in Table 1.

TABLE 1: Descriptive Information for each scale of the CLES used in this study (Taylor, Fraser and White, 1994, Maor, 1999)

CLES Scale Type	Scale name	Description
Student Negotiation	Learning to Communicate	Extent to which students have opportunities to discuss their questions and their solutions to questions.
Personal Relevance	Learning About the World	Extent to which students perceive the relevance of school science to their out-of-school experiences
Reflective Thinking	Learning to Think	Extent to which students have opportunities to reflect on their own learning and thinking.
Inquiry Learning	Learning to Investigate	Extent to which students are encouraged to engage in inquiry learning.

Shared Control	Learning to Learn	Extent to which students are invited to share control with the teacher of the total learning environment, including the design and management of learning activities, determining and applying assessment criteria, and participating in the negotiation of the social norms of the classroom
Critical Voice	Learning to Speak Out	Extent to which a social climate has been established in which students feel that it is legitimate and beneficial to question the teacher's pedagogical plans and methods, and to express concerns about any impediments to their learning

Validity and Reliability of Instrument

The original CLES was reported to have a discriminant validity of 0.44 and reliability of 0.88. This is exactly the same value as calculated for the adapted instrument used in this study which gives Cronbach's alpha 0.878 indicating highly correlated and therefore reliable items.

Findings& Discussion

Data analysis

The data analysis procedure involved the selection of the two groups of teachers concerned in this study: beginner teachers and experienced teachers. Beginner teachers are teachers with 0-5years teaching experience while experienced teachers are teachers with teaching experiences of 10 years and above. The intermediate group of teachers (6-9 years experience) are excluded from the study. Data analysis was done using percentages and frequency tables.

Results and Discussion

Each of the response options Almost Never, Seldom, Sometimes, Often and Almost Always are assigned values 1, 2, 3, 4, and 5 respectively. The highest mark possible for any question is therefore 5 (Almost Always), making the highest possible mark for all questions per respondent a total of 150 and the highest possible mark for all the beginner teachers 5,850 (i.e. 150x39) and 4800 (150x32) for experienced teachers.

For the purpose of this study, the assumptions are as shown in Table 2.

Table 2: Assumptions for Constructivism

Scores	Degree of Constructivism	Notation
<60%	Nil	n
60-69%	Low	l
70-79	Medium	M
80-89	High	H
90% and above	Very High	Vh

Table 3: Summary of Teachers' Responses to the CLES

QUESTION CATEGORY IN CLES			BEGINNER TEACHERS % Score	EXPERIENCED TEACHERS % Score
Learning to communicate	Student Negotiation	Q1-5	70.1 (m)	67.1 (l)
Learning about the World	Personal Relevance	Q6-10	69.6 (l)	60.0 (l)
Learning to Think	Reflective Thinking	Q11-15	67.2 (l)	58.6 (n)
Learning to Investigate	Inquiry Learning	Q16-20	53.9 (n)	53.0 (n)
Learning to Learn	Shared Control	Q21-25	43.6 (n)	38.9 (n)
Learning to speak Out	Critical Voice	Q26-30	60.3 (l)	60.1 (l)
General		**Q1-30**	**63.1 (l)**	**56.3 (n)**

Research Question 1: Is the science learning environments in Nigerian schools sufficiently constructivist in approach to engender the use of ICT tools?

The observations made from the responses of both groups of teachers are summarized in Table 3 and explained below; these are to provide a picture of the environment in terms of the various factors being assessed in each category.

- Neither the classroom of the beginners nor experienced teachers is generally highly constructivist in approach.

- The Nigerian science classroom is therefore, in general, insufficiently constructivist in approach to engender the use of ICT. It is also worthy of note that students' participation in the determination of the classroom atmosphere, and hence their own learning is the poorest as shown in the responses of both groups of teachers to questions 21-25 where percentage scores are below 50% for both groups of teachers.

In addition to the above general observations, the following can also be noted:

1 There is a reasonable level of communication in the science classrooms and the level of student-student interaction is appropriate as observed with the scores of both groups on the learning to communicate scale which is the highest for both groups.

2 With reference to the Personal Relevance scale, the study shows that while the level is low for both groups of teachers, though beginner teachers are at a much upper part of the low scale. This is one of the critical issues in science learning connoting abstractness due to inability on the part of the students to translateclassroom learning to an experience relevant to their out-of-school life.

3 The result also shows that it is not often that the learner is presented with the opportunity to reflect on personal learning. However, this is still better on the part of beginners than experienced teachers.

4 Opportunities for inquiry learning were also found to be low. Results are low for both groups of teachers. This is not surprising considering the state of the science learning environment especially the science laboratories, in most schools. With materials and equipment not available, very little can be done in terms of investigation by science students.

5 The result based on the Shared Control scaleis the poorest. It is concerned with students being invited to share control with the teacher of the total learning environment, including the design and management of learning activities, determining and applying assessment criteria, and participating in the negotiation of the social norms of the classroom**.** The result shows this to be very poor for both groups of teachers which is indicative of the fact that teachers still exercise absolute control over their classroom while the other major stakeholders, the learners, are denied the opportunity to participate in determining how and what they learn. This situation does not produce a good learning environment required for effective learning.

6 The Critical Voice scale assesses the extent to which a social climate has been established in which students feel that it is legitimate and beneficial to question the teacher's pedagogical plans and methods, and to express concerns about any impediments to their learning. The scale is named Learning to Speak Out**.** The results are low for both groups of teachers, though as with the observed trend, it is much better for beginner teachers than their senior counterparts. A good learning environment should be one in which students are actively involved in the learning process (Ibrahim &Oludipe, 2008).

Based on the result of this study, it can be concluded that the Nigerian science classroom is still far from what it should be. The traditional view of the teacher as all-in-all still holds a strong place in education. There is the need to intensify efforts at all levels to train and retrain teachers to adjust teaching pedagogies in a way to ensure that learners are brought to a central place in the entire learning process.

Research Question 2: Is there a difference in the level of constructivism of the science classrooms of beginner and experienced teachers?

The results based on teachers' responses are shown in Table 2 and Figure 1. The following can be observed:

- The science classrooms of beginner teachers are generally more constructivist in approach than those of experienced teachers.
- The difference in the level of constructivism for both groups of teachers is only slightly different as can be observed from the clustered charts.
- In terms of the critical voice, both classrooms are almost equally poorly constructivist.

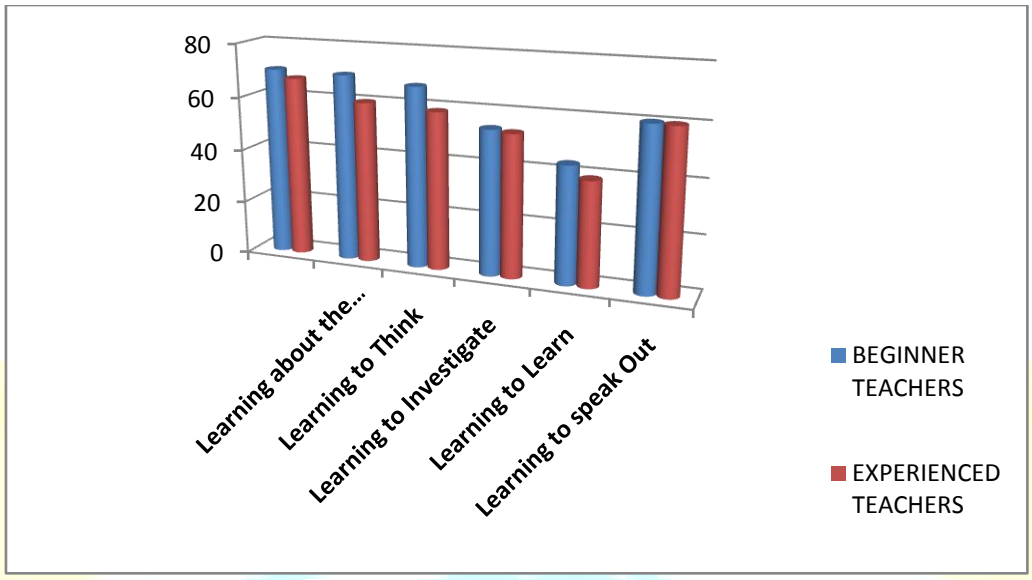

Figure 1: Clustered Chart of Beginner and Experienced Teachers' Responses

Research Question 3: Is the full integration of ICT tools in Nigerian science education a realizable dream in the nearest future?

The result shows that the perception of the teacher as the 'all-in-all' in the classroom still pervades the thinking of many teachers. Students still have no say in their learning and the science classrooms are quite poorly constructivist in approach and as such, based on the perception of an active, student-centered, highly interactive class as requirement for an ICT-based instruction, the use of ICT tools for teaching and learning may still be a challenge for some time. However, with the observation made with beginner teachers, there may be hope that with more effort put into policy implementations, a positive trend might be observed in not too distant future with particular reference to beginner teachers.

In this age of information, it is an impossible task for anyone to adopt the position of the custodian of any type of knowledge.

8. Conclusion and Recommendations

The following conclusions can be drawn from the results

- There is need for more effort to be put into the re-orientation of teachers to adopt the modern view of the teacher as a facilitator of learning. In this age of information, it is an

impossible task for anyone to adopt the position of the custodian of any type of knowledge.

- Teachers-in-training curriculum should incorporate ICT from the very beginning as this is the only way to ensure that teachers will be in the position to take their proper place in the classroom with regards to ICT.
- The study shows that the Nigerian science classroom is only slightly constructivist in approach; this is a challenge to the full integration of ICT in teaching and learning.
- It is also observed that beginner teachers' classrooms are more constructivist in approach than those of their older counterparts, hence there is hope that with more focus on teacher training and more training opportunities for beginner teachers, a lot can be achieved within a short time. Finally, going by the present state of things in the Nigerian science classroom, it will take some time before the full integration of ICT in science education can be achieved.

Based on the conclusions drawn from the study, it becomes imperative that:

- If ICT were going to play any meaningful part in Nigerian science classrooms, there is a need for further and continuing re-orientation of teachers on the need to adopt the modern view of education and thus work at making their classrooms more student-centered.
- Teacher education as well as primary and secondary school curricula should reflect the perceived importance of these tools and classroom practices should follow in the same direction.
- Influx of younger, easily adaptable teachers should be encouraged into the schools while lesser number of older, un-adaptable ones should be retained.
- There is need for recommendation of mandatory practical in-service courses in the use of ICT tools in the classroom with continuous reorientation of all teachers towards the adoption of the learner-centered instructional mode.
- Educational policies must also reveal this need and its importance. Then only, can ICT tools find a place in the Nigerian science classroom.

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