Global Journal of Human-Social Science: G
Linguistics & Education
Volume 15 Issue 1 Version 1.0 Year 2015
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-460X & Print ISSN: 0975-587X

Evaluating Science Laboratory Classroom Learning Environment in Osun State of Nigeria for National Development

By Akinbobola, Akinyemi Olufunminiyi
Adeyemi College of Education, Nigeria

Abstract- The study evaluates the science classroom learning environment in Osun State of Nigeria. Stratified random sampling technique was used to select students from the eight (8) educational zone in Osun State. A total of 24 science teachers and 200 science students were used for the study. Ex-post facto design was adopted for the study. Science Achievement Test (SAT) with reliability coefficient of 0.84 using Kuder Richardson-21 and Science Laboratory Environment Inventory (SLEI) with a reliability coefficient of 0.87 using Cronbach alpha were the two instruments used for gathering data. Pearson Product Moment Correlation (PPMC) and t-test were used to analyze the data. The results showed that the science laboratory environment has a significant effect on students' academic achievement in science. Also, there is a significant difference between students' preferred and actual laboratory environments in terms of students' cohesiveness, open-endedness, integration, rule clarity and material environments. The results also indicated that there is no significant difference in the way students and teachers perceived the same laboratory environment. It is recommended that students should be given the opportunity to work cooperatively, provided with frequent laboratory activities which are integrated with the regular science class sessions and be encouraged to be creative by allowing occasionally to pursue their own science interests and design their own experiments. Also, standard laboratory spaces should be provided in schools with materials and equipment needed for the laboratory activities.

Keywords: science laboratory, learning environment, students' achievement.

GJHSS-G Classification : FOR Code: 139999

EVALUATINGSCIENCELABORATORYCLASSROOMLEARNINGENVIRONMENTINOSUNSTATEOFNIGERIAFORNATIONALDEVELOPMENT

Strictly as per the compliance and regulations of:

Evaluating Science Laboratory Classroom Learning Environment in Osun State of Nigeria for National Development

Akinbobola, Akinyemi Olufunminiyi

Abstract- The study evaluates the science classroom learning environment in Osun State of Nigeria. Stratified random sampling technique was used to select students from the eight (8) educational zone in Osun State. A total of 24 science teachers and 200 science students were used for the study. Ex-post facto design was adopted for the study. Science Achievement Test (SAT) with reliability coefficient of 0.84 using Kuder Richardson-21 and Science Laboratory Environment Inventory (SLEI) with a reliability coefficient of 0.87 using Cronbach alpha were the two instruments used for gathering data. Pearson Product Moment Correlation (PPMC) and t-test were used to analyze the data. The results showed that the science laboratory environment has a significant effect on students' academic achievement in science. Also, there is a significant difference between students' preferred and actual laboratory environments in terms of students' cohesiveness, open-endedness, integration, rule clarity and material environments. The results also indicated that there is no significant difference in the way students and teachers perceived the same laboratory environment. It is recommended that students should be given the opportunity to work cooperatively, provided with frequent laboratory activities which are integrated with the regular science class sessions and be encouraged to be creative by allowing occasionally to pursue their own science interests and design their own experiments. Also, standard laboratory spaces should be provided in schools with materials and equipment needed for the laboratory activities.

Keywords: science laboratory, learning environment, students' achievement.

I. Introduction

Laboratory work is an integral part of most science courses and offers an environment different in many ways from that of traditional classroom setting. A good laboratory environment promotes students' curiosity, rewards creativity, encourages a spirit of healthy questioning, avoids dogmatism, and promotes meaningful understanding, where wait-time is essential in promoting thoughtful responses and dialog.

A good science classroom welcomes all students and strives to enable all motivated students to be successful.

According to Akinbobola and Afolabi (2010), a productive laboratory environment is a student-centered classroom, which is interactive, comfortable, and collaborative learning is encouraged. NABT (1994) sees a laboratory learning environment as a place where students work individually, or in a small group to solve a problem. The students make use of scientific processes and materials to construct their own explanation of scientific phenomena. They make use of science process skills such as observation, collection and interpretation of data during scientific process. The distinction between laboratory learning and traditional classroom learning according to NABT (1994), is that in laboratory learning, activities are learner-centred, with students actively engaged in a hands-on and minds-on activities using laboratory materials and techniques.

In its broad sense, the science laboratory has no boundaries. It encompasses every environment in which nature may be observed and investigated whether in the field or within the equipped classroom. The focal point for teaching science as investigative or inquiry is found in the laboratory. Through experiences in the laboratory, the student can find opportunities to verify basic scientific concepts for himself. These experiences can lead to a greater insight into the meaning of science and the nature and procedure of science in general.

The teaching laboratory involves both an illustrative and investigative function (Akinbobola, 2011a). The illustrative function has been emphasized in past science curriculum. Today, it is recognized that a static laboratory programme in which the student is told the answers to a series of recipe-type activities is not conducive and stimulating to the spirit of inquiry. Rather, if the student is to gain an understanding of the nature of science as a process of inquiry, he must actively participate in investigations of problems to which he knows no answers. The investigations may or may not lead the learner to correct answers, but in learning to ask relevant questions to seek reliable information, design effective experiences and to interpret data efficiently and honestly, the student will gain an insight into the nature of science. With problems or questions posed as the basis for an investigation, and with no answers given the student is faced with an unknown, and the path is open for a personal discovery (Akinbobola & Afolabi, 2009).

Methods found reliable and successful by scientists of historical importance may be studied and

Author: Department of Special Education and Curriculum Studies, Adeyemi College of Education, Ondo, Nigeria.
e-mail: akinbobola2006@yahoo.com

followed, or the student may follow his own creative imagination and strike out on an entirely new original approach to a problem-solving situation (Akinbobola & Ikitde 2011). According to Afolabi and Akinbobola (2012), conducting scientific discovery requires that students have easy equitable and frequent opportunities to use a wider range of materials, equipment, supplies and other resources for experimentation and direct investigation of phenomena. Therefore, schools must make every attempt to ensure that facilities are well equipped and maintained to ensure safe and effective learning environment.

Science classroom/laboratories should therefore be designed with the following goals in mind.

- Technology is integrated into the space for use by teachers and students.
- Furniture and utilities promote access by all.
- Adequate supplies, instruments, equipment and secure space to store these items is available in science laboratories.
- Facilities, support team teaching and integrated curricular activities.
- Laboratory and outdoor space is available for investigations, demonstrations and research.
- Facilities, materials and equipment provide a wide selection of experiences and opportunities for varied interests, capabilities, and learning styles of all students.
- Capable of supporting all of the objectives of the science program (Akinbobola, 2011b).

The proper teaching of science in particular calls for theoretical explanation and demonstrations by the teacher, enriched by questions and answers, as well as practical work by students. This in turns call for a space modification to accommodate all these activities (Ikitde, 2011). At the senior secondary level in Nigeria, two different spaces are provided; one for theoretical presentation and the second one for demonstration and students' practical work. Akinbobola (2007) suggests that the same space can be used for lectures and for practical work. In the case of rural locations, where services such as water, electricity and source of heat are not readily available, they can improvised by bringing water in buckets, electricity can be supplied from batteries or portable generators, while heat can be obtained from spirit-lamps or small stoves. Apart from being cheap and cost saving, it helps the conceptual unification of theoretical explanations and practical works.

The propositions are more advantageous at the junior secondary school level in Nigeria for teaching integrated science. However, the suggestion raises a major problem in the teaching of science subjects in senior secondary school level. For example; how easy is it for a classroom to be arranged and re-arranged for theoretical lessons and practical work which are often two separate activities? The central problem raises many other difficulties connected with time-saving, convenience of staff and students, as well as the safety of human and material resources.

Setting up a laboratory that utilizes the maximum of students' participation in the inquiry process holds the greatest impact of modern science teaching (Adesoji & Ibrahim, 2009). Science is accumulating a vest quantify of knowledge that grows at an alarming rate. All of science cannot be taught in a year. The inquiry approach necessitates less diversification of subject matter and more depth in investigation of specific scientific problems (Adesoji, 2008). The investigatory laboratory provides the modern science teacher with an opportunity to stimulate and guide the students into patterns that a scientist might employ in making a similar investigation. While some of the planning, organization, techniques and equipment may differ from the methods followed by a working scientist, the teacher can find in the investigatory laboratory a dynamic setting for teaching science as inquiry (Green, Elliot & Cummins, 2004).

The various dimensions of science laboratory environment as perceived by the students and the actual laboratory environment include student cohesiveness, open-endedness, integration, rule clarity and material environment (Fisher & Fraser, 1983). Student cohesiveness is the extent to which students know, help and are supportive of one another. Open-endedness is the extent to which the laboratory activities emphasize an open-ended, divergent approach to experimentation. Integration is the extent to which the laboratory activities are integrated with non-laboratory and theory classes. Rule clarity is the extent to which behaviour in the laboratory is guided by formal rules while material environment is the extent to which the laboratory equipment and materials are adequate (Fraser, Giddings & McRobbie, 1993).

II. Statement of the Problem

In spite of all the advantages and the recognition given to science subjects as the pivot for technological and economic development of a nation, the laboratory learning environment in which the science subjects suppose to be learnt seems not to be conductive for effective teaching and learning process. This has led to the perception of students that science is a difficult subject. This perception of students has affected learners' interest and led to declining rate of students' achievement in science subjects in Senior Secondary School Certificate Examinations (SSSCE) conducted by West African Examinations Council (WAEC) and National Examinations Council (NECO) in Nigeria (Akinbobola, 2011b). Hence, does the science laboratory learning environment affect students' achievement in science? What difference exists between the preferred and actual science laboratory environment as perceived by students? Do the perception of students and teachers about science laboratory environment similar? These are the questions that seek answers in this study.

III. Purpose of the Study

The purpose of the study is to evaluate science classroom learning environment in Osun State of Nigeria for national development. Specifically, the study is designed to achievement the following objectives:

1. To examine the effect of science laboratory environment on students' achievement in science.
2. To ascertain the difference between preferred and actual science laboratory environment as perceived by students.
3. To find out the perception of students and teachers in the same laboratory environment.

IV. Hypotheses

Ho1: Science laboratory environment has no significant effect on students' academic achievement in science subject.

Ho2: There is no significant difference between students' perceived and actual science laboratory environment in terms of student cohesiveness, open-endedness, integration, rule clarity and material environment.

Ho3: There is no significant difference between the perception of students and teachers about the same science laboratory environment.

V. Research Method

Ex-post facto design was adopted for the study. The population for the study comprised of all the 650 senior secondary two (SS2) science students in the selected schools in the eight (8) educational zones in Osun State of Nigeria. Stratified random sampling technique was used to select schools from educational zone. Twenty-five (25) students and three (3) teachers were randomly selected from each school. A total of 24 science teachers and 200 science students were used for the study. Science Achievement Test (SAT) and Science Laboratory environment Inventory (SLEI) were the instruments used to gather data for this study. The SLEI was adopted from Fraser, Giddings and Mc Robbie (1993) and consisted of 35 structured items with five (5) options namely very often, often, sometimes, seldom and never with a rating scale ranging from 5 to 1. The items measured five different dimensions of laboratory environment namely student cohesiveness, open-endedness, integration, rule clarity and material environment.

The three types of SLEI that were used in the study include SLEI-A, SLEI-P and SLIE-T. SLIE-A is designed to measure the actual environment. SLEI-P is designed to measure preferred environment while SLEI-T is designed to measure the teachers' assessment of the laboratory environment. Although, the wording of the item is similar for the three types, but the statement clearly instruct students what the laboratory is actually like or what they would like it to be. For example, an item such as "I interact very well with other students during practical activities in the laboratory" in the actual form is changed to "I would interact very well with other students during practical activities in the laboratory" in the preferred form.

The SAT consisted of 45 multiple-choice items. Fifteen (15) questions were drawn from each of physics, chemistry and biology by the researchers using the curriculum meant for the current term. Each item had four options with only one correct answer and the correct answer was scored 2 marks. The validation of the instruments were ascertained by six science educators, two from each subject and the instruments were trial tested with 40 students in a school that was not used for the main study. The data obtained from SAT were subjected to Kuder Richardson formular-21 and the result showed a reliability coefficient of 0.84. The data collected from SLEI were subjected to Cronbach alpha and the result showed reliability coefficient of 0.87. The SAT and SLEI were administered to all the subjects. The data collected were analyzed using Pearson Product Moment Correlation (PPMC) and t-test. All the hypotheses were tested at. 05 level of significance.

VI. Results

a) Hypothesis One

Science laboratory environment has no significant effect on students' academic achievement in science subjects.

The analysis is as shown in Table 1.

Table 1: Analysis of the effect of laboratory environment in student' Academic achievement

Variable	N	ΣX, ΣY	ΣX^2, ΣY^2	ΣXY	r	DF	t-cal.	t-crit.	Decision
Laboratory Environment(x)	200	13986	1009492	1039861	0.96	198	48.25	1.96	*
Academic Achievement (Y)	200	14424	1073960						

** = Significant at p<.05*

The analysis in Table 1 shows that the calculated t-value of 48.25 is greater than the critical t-value of 1.96 at $p<.05$ alpha level. Therefore, the null hypothesis which stated that science laboratory environment has no significant effect on students' academic achievement in science subject is rejected. This implies that science laboratory environment has significant effect on students' academic achievement in science subjects.

b) Hypothesis Two

There is no significant difference between students' preferred and actual science laboratory environment in terms of student cohesiveness, open-endedness, integration, rule clarity and material environment. The analysis is as shown in Table 2.

Table 2 : T-test analysis of students' preferred and actual science laboratory environment

Laboratory Environment	N	$\overline{X}$	SD	DF	t-cal	t-critical	Decision
Student Cohesiveness							
Actual							
Preferred	200	26.52	6.84	398	8.11	1.96	*
	200	32.20	7.24				
Open-endedness							
Actual							
Preferred	200	25.17	6.25	398	8.91	1.96	*
	200	30.98	6.78				
Integration							
Actual	200	24.25	7.59	398	7.39	1.96	
Preferred	200	29.72	7.14				*
Rule Clarity							
Actual	200	23.88	8.20	398	6.23	1.96	
Preferred	200	29.24	8.96				*
Material Environment							
Actual	200	25.92	7.42	398	7.43	1.96	*
Preferred	200	31.64	7.93				

** = Significant at $p<.05$*

The analysis in Table 2 shows that the calculated t-value of 8.91, 8.11, 7.43, 7.39 and 6.23 for open-endedness, student cohesiveness material environment, integration and rule clarity respectively in order to magnitude is greater than the critical t-value of 1.96. Thus, the hypothesis which stated that there is no significant difference between students' preferred and actual science laboratory environment in terms of student cohesiveness, open-endedness, integration, rule clarity and materials environment is rejected. This implies that student preferred science laboratory environment is different from the actual science laboratory environment.

c) Hypothesis Three

There is no significant difference between the perception of students and teachers about the same science laboratory environment. The analysis is as shown in Table 3.

Table 3 : t-test analysis of the perception of students and teachers about the same science laboratory environment

Perception	N	$\overline{X}$	SD	DF	t-cal.	t-critical	Decision
Teachers	24	32.71	8.35	222	0.54	1.96	NS
Students	200	31.65	8.92				

NS= Not significant at $P<.05$ alpha level.

The analysis in Table 3 shows that the calculated t- value of 0.54 is less than the critical t-value of 1.96. Therefore, the null hypothesis which stated that there is no significant different between the perception of students and teachers about the same science laboratory environment is retained. This implies that both the teachers and students perceived the status of science laboratory environment in the same way.

VII. Discussion of Results

The results of hypothesis one showed that science laboratory environment has significant effect on students' academic achievement in science subjects. This might be due to the fact that the most effective vehicle by which the process of inquiry can be learned appears to be a laboratory setting which the students experience firsthand process. Laboratory settings have also been demonstrated to be effective means for comprehension, understanding and application of scientific knowledge. Inquiry method and varieties of activities in a good science laboratory environment provide students which opportunities to observe, sample, experience and explain with scientific phenomena in their quest for knowledge of nature. This is in line with the findings of Mc Robbie and Fraser (1993), Wong and Fraser (1997) and Akinbobola (2007) that there is a positive relationship between the nature of laboratory environment and students' achievement in science.

The result of hypothesis two showed that students' preferred science laboratory environment is different from the actual science laboratory environment in existence. The result also indicated that the significant difference exists between students' preferred and actual science laboratory environment in terms of open-endedness, student cohesiveness, material environment, integration and rule clarity respectively in order of magnitude in favour of preferred science laboratory environment.

The form of open-endedness that the students preferred is significantly different from the present status of science laboratories. The present situation in the laboratories is a stereotyped one which makes the teacher to decide the activities to be carried out by the students. However, the students prefer using activity curriculum in which students can pursue their own interest based on their needs and aspiration with the provision of variety of activities by the teachers. This will provide an open-ended divergent approach to experimentation. This is in agreement with the findings of Afolabi and Akinbobola (2009) that inquiry method through laboratory activities in open-ended form exposes the students to more realities of life and they tends to work as scientist and acquire knowledge by themselves in which the teacher serves as a guide and correct their misconceptions.

The form of student cohesiveness that the students preferred us significantly different from the present status in which students work alone. This might due to the fact that, working together cooperatively enhances appropriate behaviour in organizing work, asking questions, encouraging social interaction, demonstrating self management and facilitating better study habit and retention of knowledge. This is in line with the findings of Dilworth (1996) that working in small group enhances performance, promote learning and skills, and improvement of self-development through collaborative learning.

The form of material environment that the students preferred is significantly different from the actual material environment available in terms of materials and equipment. Most of the materials available are in short supply and this make the practical activities to be crowded. The students preferred form of material environment that make teaching to be real, provide first-hand experiences, develop creative ability of learners, and promote innovation and learning by doing. This is in line with the findings of Teh and Fraser (1995) that good laboratory environment enhances hands-on activities and enable the students to acquire basic science process skills in order to solve problems.

The form of integration that the students preferred is the type that the practical activities are integrated with theory. The actual situation is that the theory and the practical activities take place at different time. Most often, the practical activities are delayed until the final external examination is near. Integration of practical activities with theory enhances the development of science process skills and the ability of students to arrive at generalizations or concepts. This is in line with the findings of Ikitde (2011) that integrating practical work with theory enable students to develop the habit of critical thinking, innovation and creativity.

The form of rule clarity that the students preferred is the type that student's safety and proper handling and care of equipment is ensured. The teacher should prepare the rules and regulations guiding laboratory activities and make it known to the students.

The results of hypothesis three showed that both the teachers and students perceived the status of science laboratory environment in the same way. The might be due to the fact that both the students and the teachers recognize the problems facing the laboratory environment which include shortage of tools, materials and equipment and lack of maintenance culture. This in agreement with the findings of Akinbobola (2007) that the major problem facing laboratory environment is improper maintenance of materials and equipment.

VIII. Conclusion

From the findings of the study, there is clear indication that the science laboratory environment has significant effect on students' academic achievement in science subjects. There exists a significant difference between students' preferred and actual science laboratory environment in terms of open-endedness, student cohesiveness, material environment, integration and rule clarity respectively in order of magnitude in favour of preferred science laboratory environment. Also, both the teacher and students perceived the present status of science laboratory in the same way.

IX. Recommendations

In view of the implication of the findings from this study, the following recommendations are made:

Laboratory activities should be integrated with theory during regular class period.

1. Students should work collaboratively in a small group in the laboratory in order to enhance appropriate behaviour in organizing work and social interaction, and facilitating better study habit and retention of knowledge.
2. Adequate materials and equipment should be provided in the laboratory by the government in order to promote creativity, innovation and learning by doing.

Global Journal of Human-Social Science (G) Volume XV Issue I Version I Year 2015

3. Safety rules and regulations guiding laboratory activities and procedures should be made known to the students.
4. Adequate storage facilities should be provided in order to secure the materials and equipment available in the laboratory.
5. Maintenance culture should be enhanced through organizing regular seminars, workshops and conferences for teachers.

Reference Références Referencias

1. Adesoji, F.A. (2008). Students, teacher and school environment factors as determinants of achievement in senior secondary school chemistry in Oyo State, Nigeria. *The Journal of International Social Research*, 1(2), 13-34.
2. Adesoji, F.A. & Ibrahim, T.L. (2009). Effects of student team-achievement divisions strategy and mathematics knowledge on learning outcomes in chemical kinetics. *The Journal of International Social Research*, 2(6), 15-25.
3. Afolabi, F. & Akinbobola, A.O. (2009). Constructivist problem based learning technique and the academic achievement of physics students with low ability level in Nigerian secondary schools. *Eurasian Journal of Physics and Chemistry Education*, 1(1), 140-146.
4. Afolabi, F. & Akinbobola, A.O. (2012). Creating and sustaining action learning in physics classroom. *European Journal of Business and Social Sciences*, 1(2), 11-24.
5. Akinbobola, A.O. (2007). Comparative effects of improvised and standard equipment on students' achievement in senior secondary schools physics. IN E.N. Etuk, I.M. Udofot, & A.E. Udosen(Eds.), *Education in Nigeria in the 21st century: Focus and imperatives.* Uyo: Abaam Publishing Co. pp 205-216.
6. Akinbobola, A.O. (2011a). Visual, auditory and kinesthetic learning styles and students' achievement in Nigerian senior secondary school physics. *IRCAB Journal of Arts and Education*, 1(1), 140-146.
7. Akinbobola, A.O. (2011b). Teaching methods, study habits, school location and gender factors as determinants of retention ability of physics students in Nigeria senior secondary schools.
8. *IRCAB Journal of Arts and Education*, 1(1), 152-158.
9. Akinbobola, A.O. & Afolabi, F. (2009). Constructivist practices through guided discovery approach: The effect on students' cognitive achievement in Nigeria senior secondary school physics. *Bulgarian Journal of Science and Educational Policy*, 3(2), 233-252.
10. Akinbobola, A.O. & Afolabi, F. (2010). Analysis of science process skills in West African senior secondary school certificate physics practical examinations in Nigeria. Bulgarian Journal of Science and Education Policy, 4(1), 32-47.
11. Akinbobola, A.O. & Ikitde, G.A. (2011). Strategies for teaching mineral resources to Nigerian secondary school science students. *African Journal of Social Research and Development*, 3(2), 130-138.
12. Dilworth, R.L. (1996). Action learning: Bridging academic and workplace domains. *The Journal of Workplace Learning,* 8(6), 48-56.
13. Fisher, D.L. & Fraser, B.J. (1983). A comparison of actual and preferred classroom environment as perceived by science teachers and students. *Journal of Research in Science Teaching,* 20, 55-61.
14. Fraser, B.J., Giddings, G.J. & Mc Robbie, C.R. (1993). Development and cross-nation validation of a laboratory classroom environment instruction for senior high school science. *Science Education*, 77, 1-24.
15. Green, W.J., Elliot, C. & Cummins, R.H. (2004). Promoted inquiry-based learning in the introductory chemistry laboratory. *Journal of Chemical Education,* 81, 239-241.
16. Ikitde, G.A. (2011). Effect of integrating fieldwork with theory on students' performance in senior secondary school biology. *African Journal of Social Research and Development*, 3(1), 252-258.
17. McRobbie, C.J. & Fraser, B.J. (1993). Associations between students' outcomes and psychosocial science environment. *Journal of Educational Research*, 87, 78-85.
18. NABT (2004). *Role of laboratory and field instruction in biology education*. Available http//www.nabt.org
19. Teh. G. & Fraser, B.J. (1994). An evaluation of computer-assisted learning in terms of achievement, attitudes and classroom environment. *Evaluation and Research in Education*, 8,147-161.
20. Wong, A.F.L. & Fraser, B.J. (1994). *Science laboratory classroom environment and students' attitudes in chemistry classes in Singapore*. A paper presented at the annual meeting of American Educational Research Association (AERA), New Orleans, L.A.