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The effect of the Availability and Utilization of Laboratory Apparatus in the Teaching of Physics: A Case Study of Secondary Schools in Karu LGA, Nigeria

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ABSTRACT

The study examined the impact of the availability and effective utilization of instructional materials such as basic laboratory apparatus on the attitude of learners towards Physics and their sustained interest while offering the subject. Five students and one Teacher from each of the ten randomly selected senior secondary schools in Karu Local Government Area of Nasarawa State were used for the study. Data collected through the use of questionnaires from both the Teachers and the Students were analysed using percentages. The results show that the greatest hindrance to the effective teaching of Physics in these schools is not lack of the necessary laboratory apparatus and equipment but rather lack of their usage. It was also established that effective utilization of these materials have positive influence on the students' attitude towards Physics which could indirectly affect their academic achievement in the subject.

Key words: Utilization, Apparatus, Effectiveness, Instructional Materials, Laboratory, Physics.

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INTRODUCTION

Investigations have shown that Secondary School students have been exhibiting dwindling interest in Science generally over the past few years (Esiobu, 2005). This among other reasons explains the reported low enrolment and consistent poor performance in Physics (Akanbi, 1983; Omosewo, 1999) The reason for the negative attitude of the students towards the subject which impacts their performance may not be unconnected with the teaching style adopted by the Teachers which often times is rote learning and memorization of formulas as opposed to the more effective practical, hands-on approach. This ineffective approach is often blamed on the paucity of instructional materials.

The negative trend spells doom for our National Development as Science is said to be the bedrock of Scientific and Technological development of any Nation. To further compound the problem, Physics as one of the Science Subjects remains one of the most difficult subjects in the school curriculum according to the Nigeria Educational Research and Development Council (NERDC) (Isola, 2010). And its effective teaching and learning as well as students' poor performance have become a concern to all stakeholders in the educational sector. The only remedy to this National embarrassment and way out of this predicament may be for Teachers to embrace the guided discovery method as advocated by the National Teachers' Institute and Bruner, a renowned Cognitive Theorist of learning and Teaching. The most effective approach to Physics teaching is to support theoretical explanations with actual practices in the laboratory (Ojediran et al., 2014). Unfortunately, this method is resource-based and so cannot be implemented without basic instructional materials such as laboratory

Table 1. Status of the laboratory and equipment.

QUESTION	Actual numbers			In percentages (%)		
	Yes	No	Total	Yes	No	Total
Existence of laboratory	50	0	50	100	0	100
Lab Dedicated to Physics not shared	30	20	50	60	40	100
Lab Adequately equipped	27	23	50	54	46	100
Apparatuses in good working condition	8	2	10	80	20	100
Most apparatuses are standard not improvised	8	2	10	80	20	100
Availability of Technologist(s)	5	5	10	50	50	100

apparatus (NTI, 2007a, 2007b).

The poor academic success in Physics could be attributed to many factors among which the Teacher's strategy is considered very important. Teaching of Physics without adequate and functional instructional materials especially laboratory apparatus may certainly result in poor academic achievement according to Frazer et al. (1992). A study conducted by Bello (2012) on the effect of availability and utilization of Physics laboratory equipment on Students' Academic Achievement in Senior Secondary School Physics showed that the use of appropriate teaching equipment and teaching method is critical to the successful teaching and learning of Physics. Taale and Antwi (2012) also discovered that inadequate exposure to science laboratory work at the secondary school level has been a major cause of first year University students' inability to comprehend and apply scientific knowledge.

A professionally qualified Science Teacher no matter how well trained, would be unable to put his ideas into practice if the school lacks the equipment and laboratory apparatus necessary for him or her to translate his competence into reality in the classroom. So to attract and retain good students in Physics classes, the learning environment must be made more student-friendly and this can only be achieved by investing in relevant instructional materials especially laboratory apparatus and encouraging Teachers to utilize them for enhanced instructional effectiveness (Akuezillo, 1995). One major hindrance is the resource intensive nature of Science compounded by the economic recession which makes the standard laboratory apparatus unaffordable to most schools (Bassey, 2002). This leaves the dedicated Teacher with no other alternative than improvisation which research has shown demands professional commitment, resourcefulness, initiative, adventure, creativity, curiosity and perseverance on the part of the Teacher. Akinyemi and Orukota (1995) noted that whether the improvised apparatus cost less than the standard manufactured ones or not, they still cost money and this money is usually not readily available to the Teacher. Of the five factors investigated as possible predictors of performance in secondary school physics in Ebonyi north educational zone of Ebonyi State, Nigeria, Onah and Ugwu (2010) found out that School location and interests of students have no significant effects while gender, teacher qualification and laboratory facilities have very significant effects on performance of students in Physics at secondary school level.

METHODOLOGY

The main instruments used for this study were two separate questionnaires constructed by the investigators and administered to both the Physics Teachers and Students in ten schools. Physical visits was also conducted to these Schools in order to get independent information about the availability, adequacies, and functionality or otherwise of the laboratory facilities in the schools. The data from the questionnaires was relied upon absolutely for information on the utilization of these equipment using the students' response to crosscheck and verify the information received from their Tutors. There were 60 respondents sampled for the study and the data collected were analysed. Schools selected include one Federal Government College, four State Government owned schools and five private schools. All the schools are situated within the Karu Local Government Area of Nasarawa State, Nigeria, except the Federal Government College which is located just outside this Local Government. All the respondents were either Physics Teachers or Students who have been taking Physics for at least one year and are therefore considered competent enough to answer the questions posed in the questionnaires.

RESULTS, ANALYSIS AND DISCUSSION

The following collated results serve as the basis for the conclusions and recommendations.

Summary of Data from Respondents

Table 1 and 2 shows poor utilization of these laboratory apparatuses and equipment because of infrequent class demonstrations and even fewer scheduled practical

Table 2. Utilization of laboratory apparatuses and equipment.

	Always	Often	Occasionally	Rarely	Total
Frequency of class demonstration	5 (10%)	15 (30%)	16 (32%)	14 (28%)	50 (100%)
Evaluation of students' practical skills	3 (30%)	2 (20%)	4 (40%)	1 (10%)	10 (100%)
	Weekly	Forth nightly	Monthly	Termly	Total
Frequency of scheduled practical sessions	10 (20%)	5 (10%)	14 (28%)	21 (42%)	50 (100%)
	Yes		No		Total
Grading of practical reports as part of assessments	27 (54%)		23 (46%)		50 (100%)

Table 3. Potential impact of optimum utilization of apparatuses on student learning.

Question	Actual numbers			In percentages (%)		
	Yes	No	Total	Yes	No	Total
Enhanced understanding of concepts taught	43	7	50	86	14	100
Possible better performance	47	3	50	94	6	100
Increased love for the subject	40	10	50	80	20	100

Table 4. Teachers' predominant method of teaching.

Method	Actual numbers	In percentages (%)
Demonstration	7	70
Problem-solving	4	40
Guided discovery	1	10
Chalk-talk	1	10
Total	13	130

Table 5. Students' preferred learning style.

Learning style	Actual numbers	In percentages (%)
Auditory	4	8
Visual	25	50
Kinesthetic	21	42
Total	50	100

sessions for the learners. Only few (20%) of the learners have practical weekly. Table 3 shows the conviction of the overwhelming majority of the students that their academic performance in the subject could be improved drastically with better utilization of the laboratory apparatuses during teaching and class experiments. The percentages add up to more than 100% because some Teachers choose more than one type of methods. Tables 4 and 5 show there is a strong correlation between the Teachers' predominant method of teaching (Demonstration) and the Students' preferred learning styles (Visual and Kinesthetic). Both demonstration and kinesthetic are activity-based and engaging (Figure 1)

Summary of Findings

The following are the major findings from this study: Majority of the Secondary Schools have dedicated and well-equipped Physics laboratory. All the schools have at least one qualified Physics Teacher who sometimes doubles as laboratory personnel. Only half of the schools have laboratory Technologist/Technicians. Practical reports written and turned in by the students are neither graded nor used as part of their continuous assessments in some of the schools and all the Teaching staff respondents agreed that learning through hands-on experience using laboratory apparatus could significantly enhance students' understanding of scientific concepts and subsequently influence their academic performance in the subject.

DISCUSSION

The data did not show that availability of Physics laboratory equipment vary with type of school in line with the ownership of the school but the Federal school has

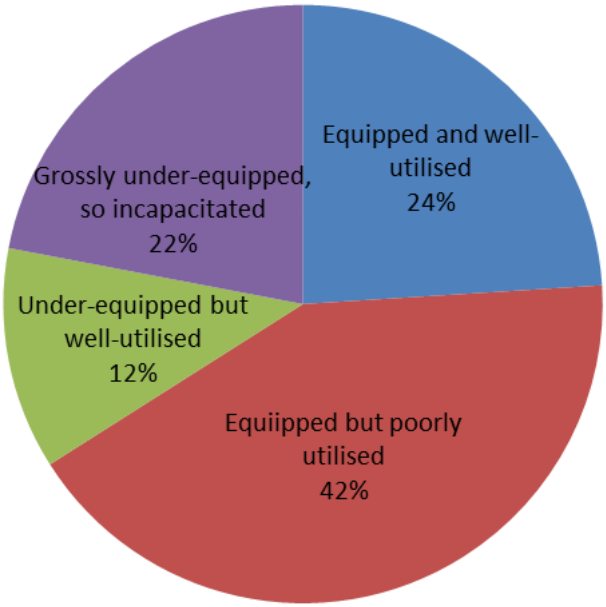

Figure 1. Pie-chart showing overall appraisal of the availability and utilization of laboratory apparatuses in these schools. Utilization is considered poor if frequency of class demonstration is very low or scheduled practical sessions is only once in a month or fewer.

highest annual budgetary allocation for Physics laboratory supplies compared with the average for the private owned schools, while the state owned schools had the least average allocation. This is due to the fact that Federal Government has higher financial resources than State Governments and Proprietors of private schools usually accept personal responsibility to equip their schools to keep a good standard in order to remain competitive. Besides, the Ministry of Education also enforces strict regulations in licensing new private schools, this ensure private schools acquire most necessary laboratory equipment before getting Government approval (Bello, 2012). On the other hand, on the average private schools have the highest utilization, followed by the Federal Government School and state owned schools the least utilization of the acquired equipment.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The survey shows that the greatest hindrance to the effective teaching of Physics in these schools is not lack of the necessary laboratory apparatus but rather lack of their effective utilization. This poor utilization of the laboratory apparatus and equipment may not be unconnected with the lack of laboratory personnel to assist the Teachers in preparing for class demonstrations and practical in many of the schools. Finally, the need for utilization of laboratory apparatus and equipment in the teaching of science cannot be overemphasized. Introductory Physics can be among the most enjoyable educational experiences for students if only because there is so much hands-on activity in the laboratory. This necessitated the recent paradigm shift from Teachers over-dependence on excessive use of words to express or convey ideas in the teaching-learning process to the use of instructional materials such as laboratory apparatus, equipment, computer simulations and video clips that minimize the Teacher's talking and at the same time make the message clearer, more interesting and easier for the learners to assimilate. Such materials also help in simplification and concretization of complex phenomena (Adeleye et al., 2012).

There are several advantages of complementary and synergistic uses of different resources and deployment of variety of teaching strategies including:

1. Changing learners' attitude from boredom, sheer drudgery, apathy and indifference to enthusiasm and excitement just by avoiding monotony of teaching style.
2. Increased student engagement and more effective learning during lessons. (Taale and Antwi, 2012).
3. Increased conceptual understanding of scientific phenomena and ultimately better student mastery of the subject matter.
4. Diversification of teaching methods incorporates all the three learning domains, namely cognitive, affective and psychomotor for optimal educational experience.

5. Building of students' capacity for critical thinking and analysis as they carry out independent research and scientific investigations. (Bello, 2012).
6. Students' skill acquisition and subsequent boosting of confidence. (Bello, 2012).
7. Immediate feedback received by Teachers through guided class activities and evaluation of laboratory reports (Ojediran et al., 2014).
8. Sustained motivation since student feels a sense of accomplishment with each little success (Finkelstein et al., 2006).
9. Engenders spirit of inquiry and exploration which is fundamental in science.
10. Broader assessment of student academic achievement.
11. Encourages development of social skills as students interact during class activities.

Perhaps the only downside to the increased utilization of these laboratory resources and deployment of variety of teaching strategies is that it is time-consuming and demands guidance from the Teacher to prevent the class from becoming noisy and rowdy.

Recommendations

The following recommendations are made to improve the utilization of laboratory apparatus in the teaching of Physics in Nigerian Secondary Schools.

1. Recruitment of qualified, dedicated laboratory personnel (Technologists/Technicians) to work in schools to address the problem of shortage of trained manpower in order to lessen the burden of the Teachers and make them more effective on their job.
2. Re-orientation of Science Teachers on the need to increase students' exposure to hands-on experience.
3. Increased professional commitment and dedication on the part of Science Teachers to incorporate class demonstrations into their teaching.
4. The frequency of scheduled practical sessions needs to be increased especially for schools with enough qualified personnel.
5. Improved funding for laboratory supplies to schools with inadequate facilities.

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