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REVIEW OF RESEARCH IN EDUCATION
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Chapter Sixteen

HIGHER DEGREE RESEARCH IN SCIENCE EDUCATION IN NIGERIAN UNIVERSITIES

Uchenna Nzewi

INTRODUCTION

The place and role of research in education has been the subject of many academic write-ups. Research in science education dates back to the early sixties in Nigeria and has continued till the present (Jegede and Nzewi 1988, Omolewa 1977). Many advantages have been derived from science education research and these include (a) helping science teachers and educators gain insights into what has been (b) describing what exists now in terms of theory and practice and (c) describing where it is possible to go in science teaching in terms of improvement of science curriculum (Abdullahi 1983).

The explosion of scientific knowledge and the internal activities which result in scientific revolution have led to the diversity of topics of research and large numbers of articles produced. Even the most alert science educators and researchers are finding it increasingly difficult to keep up with the field. This has led many Nigerian researchers to now concentrate their efforts at collating the studies that have been done in science education (Balogun 1985, Bsaari 1986, Soyibo 1988, Jegede and Nzewi 1988, Odunusi 1989, etc).

In all these reviews, a large percentage of research work done in science education do not get mentioned. This is because such works were not published and are not usually easily available and within the reach of any and everybody. These are mainly the research studies embodied in doctoral dissertations.

It is, therefore, the intention in the present write up to collate the science education research that were undertaken as part of doctoral degree programmes in Nigerian Universities.

METHOD

Abstracts of Doctor of Philosophy (Ph.D) theses in science education were obtained from all the conventional Federal Nigerian Universities. This was done as part of a larger study which took the writer and two other colleagues to all these universities. (Ohuché, Nzewi and Nnochiri 1998). No information was however obtained from the University of Sokoto.
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In some cases, the writer had to read relevant portions of the dissertation whenever enough information could not be got from the abstract. The review was based on the Jegede-Kewi (1988) categorisational model which has the following 7 divisions.

- Learning and learner characteristics
- Variables in teaching
- Attitudinal studies and learning outcomes
- Teacher factor
- Curriculum development and evaluation
- Classroom and learning environment
- Research methodologies and paradigms.

(A full copy of the categorisational model is included in the appendix).

A summary of the categories under which the doctoral dissertations reviewed fall is presented in Table 1.

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THE REVIEW

Some of the studies in the review dates back to the period before 1994 but for the sake of continuity, they were briefly reviewed with emphasis placed on the studies done between 1994 and 1997.
1. LEARNING AND LEARNER CHARACTERISTICS

The first study under this category was that of Onyejiaku (1980). He investigated the effects of two cognitive styles and relative effectiveness of two teaching methods on the learning of some mathematics tasks. He also investigated sex performance differentials and the issue of interactions among the critical variables. His findings revealed that there was a significant main effect for the sexes combined but under the expository method, the tests of significance showed that analytic students scored significantly higher than the non-analytic students.

Following this, Ofoghui (1984) investigated the acquisition of science process skills among primary school pupils in some northern states of Nigeria. The sample for the study consisted of 310 primary six pupils. A self-designed Science Skill Evaluation Profile (SSEP) was used to monitor subjects' application of science process skills. The results indicated that the Primary Education Improvement Programme (PEIP) science programme improved the process skills of pupils generally.

Algoman (1985) studied the relationship between understanding of physics concepts and achievement in the West African School Certificate Physics examinations. Five hundred and one subjects randomly drawn from 34 secondary schools in Bendel State took the Test of Understanding Physics Concepts (TOUP). The study revealed that performance in the TOUP is a reliable predictor in the West African School Certificate Physics examinations and also that class five students in Bendel State do not understand physics concepts to the extent of applying them.

Carmichael (1986) investigated the acquisition of seventeen mathematical concepts and skills among unschooled Npe children of Niger State of Nigeria. Three hundred and thirty-six children from that area constituted the sample for the study; while 40 primary school teachers were trained to use various kits and 52 questions to conduct the interview. Age was found to be highly significant in all question groups, except in individual concepts of transitivity and conservation of length. Most learning took place before age (nine) 9, but it continued past age 15 in all question groups. In transitivity, erratic swings in responses showed uncertainty. In conservation of length, the learning curve was flat until age 13, when there was a steep 20 percentage point increase to age 15. The sex of the subject was not significant except in the individual concepts of serialisation and the recognition of symbols, where males outscored females.
Otuka (1986) determined the relationships between eleven selected variables and physics concept attainment. Three hundred (300) form five students from 16 secondary schools in Kaduna State were used for the study. Pearson-Product Moment Correlation Coefficients revealed significant relationship between some of the variables and physics concept attainment. The data were further explored using the step-wise multiple regression analysis and the following factors were found to be significantly related to physics concept attainment: reading comprehension, reasoning ability, and attitude toward physics. Based on the findings the researcher concluded that for effective physics concept learning, the most helpful learning conditions are those previously learned abilities of the student...

Adyami (1997) investigated the differential effects of the field dependent-independent cognitive styles and the guided inquiry versus conventional expository modes of instruction on students' achievement in biology. Two hundred and fifty-eight (758) class four students from six selected secondary schools in Benin City, Bendel State were used for the study. Five instruments were administered on the subjects who took part in the study. Results of the study indicated that there was significant differences between the guided inquiry instructional group and the conventional expository instructional group in favour of the former. It was suggested that cognitive style information can be used to bring about significant and beneficial changes in students achievement in biology.

Akpah (1987) investigated the profile of students' performance in mathematics problem solving and examined the mathematics achievement levels with regards to the understanding of mathematical language, problem characteristics and other cognitive variables. Eight hundred and twenty (820) form three students drawn from 20 schools in Cross River State of Nigeria participated in the study. Twelve research instruments; eight achievement tests and four questionnaires were used in data collection. The findings indicated that at the end of the junior secondary school, students' ability to solve problems in mathematics is below average and that several cognitive and non-cognitive factors are correlates of students' mathematical problem-solving ability.

Bomide (1987) had as his primary objective to examine the relationships between the level of cognitive development in junior secondary school children and the conceptual demands of the Nigerian Integrated Science Project (NISP). Some factors influencing cognitive development were also examined.
Results of the study showed that a high proportion of the children studied were functioning at the concrete level of thought development. Approximately 70% of the NISEP curriculum seems to demand abstract thinking. Age, sex, mental ability and school location were found to exert significant influence on concept development.

Paparui (1987) undertook his own study to investigate mathematics. The study also aimed at formalising a monitoring system for the management of education. The findings of the study revealed that students' achievement in the JSS mathematics is significantly related to the family background of students, also there are some significant differences between boys and girls in their cognitive and effective achievements, and teacher characteristics have significant effect on students' achievement.

The studies done in this category have all concentrated on either finding out factors affecting cognitive styles or influences on acquisition of process skills or cognitive preferences. They are more concerned with finding the state of the art and offering recommendations. It appears that more work is needed in the area of identifying some of the strategies recommended to find out their efficacy in improving cognitive styles or in the acquisition of process skills or understanding of concepts. Another important point is that most of the studies were in the area of mathematics. Only one study each had been done in the area of primary science, integrated science and biology, and none in the area of chemistry. Further researchers might therefore be interested in doing their work in the area of chemistry and other sciences.

**VARIABLES IN TEACHING**

The studies in this category are diverse as can be discerned from Appendix A. These studies will now be discussed. Isegbuelan (1980) investigated the effects of some advance organizers, post organizers and behavioural objectives on the learning of some concepts of genetics. The subjects were three hundred and sixty (360) form four pupils with an age range of 14-16 years from eleven arms of class four in three types of secondary grammar schools in Benin City, Bendel State. Results of the investigation showed that the orienting stimuli did not affect performance on the criterion measures significantly.

Nwanaka (1981) examined the effect of the application of Ausubel's theoretical model of meaningful verbal learning to an experimental sequence of a unit in biology. He also investigated the effect of such an application on learning and retention in form III classes in secondary schools in Ille-Ife.
Data were collected using an instrument that measured high cognitive skills on Bloom's taxonomic hierarchies. Results indicated that there was no significant difference in the achievement and retention of students in the treatment group, there was also no significant difference between the achievement and retention scores of the students.

In another study by Agboola (1983), the Diagnostic-Prescriptive Teaching method (DPT) was compared with the lecture method using the pretest-posttest control group design and employing four methods: an achievement test, an attitude scale, a social distance scale, and a scale for the analysis of classroom interaction. Results confirmed that the DPT learners performed better in an achievement test and developed more positive attitude towards mathematics than those in the lecture method class.

Eghugwu (1983) investigated whether some physics concepts would serve as advance organizers for other physics concepts. The selected organizers were presented in three forms: the verbal organizer, graphic organizer, and a combination of the verbal and graphic organizers. Students' achievement scores in the posttest and retention scores were analyzed. The results showed that boys' schools gained significantly in the use of the verbal and graphic organizers, and that these two modes were less facilitative in girls' schools. There was evidence that combining the verbal and graphic organizers would be more facilitative to the generality of students.

The study by Fonche (1982) looked at the methodology of teaching organic chemistry practically at the tertiary level. It was carried out in five African universities using a questionnaire that was developed in 1973. A semi-structured approach for the purpose of learning/teaching practical chemistry was developed. Then comparisons of this approach with the traditional structured approach indicated that students preferred the semi-structured technique.

Orihifu (1983) investigated the effectiveness of an individualized instructional package in secondary school chemistry. Three research instruments were administered to 280 randomly selected class four students from eight coeducational secondary schools in Bendel State. The findings show that the schools were equivalent with regard to their pre-entry knowledge of basis concepts in chemistry. Students using the individualized instructional package demonstrated higher academic achievement, better retention capacity than those using regular classroom instructional materials.

Olarewaju (1984) investigated the effects of instructional objectives and hierarchically organized learning tasks on students' attitude, cognitive achievement and problem-solving skills in integrated science. Data was gathered through the use of students' attitude questionnaire, integrated science achievement test and test of problem solving skills.
Results indicated among others that the treatment groups performed significantly better than the control group. The hierarchy plus objective group had more favourable attitude than the non-hierarchy plus objective group, the non-hierarchy plus objective had higher mean scores than the hierarchy plus objective and hierarchy plus non-objective groups on cognitive achievement scores.

In this study by Akindehin (1985), an instructional package, introductory science teacher education (ISTE) was designed to incite in pre-service science teachers the acquisition of scientific literacy. One hundred and twenty (120) first year students from Adeyemi College of Education, Ondo and College of Education, Ibadan, were used as experimental and control groups. Students in the experimental groups were exposed to ISTE throughout the first semester of the 1984/85 academic year. The major findings of the study were that students accepted ISTE as part of the science teacher education programme of the college and when compared with the equivalent group that did not have the experience, pre-service science teachers exposed to ISTE were found to have acquired better understanding of the nature of science and hence developed a more realistic view of science related attitudes.

Bello (1985) investigated problem solving instructional strategies and students' learning outcomes in secondary school chemistry. A three stage sampling method was employed to select hundred and thirty eight students from two secondary schools in two local government areas. Data were gathered with problem solving attitude scale, chemistry achievement test and test of logical thinking and analyzed using ANCOVA and t-test. The findings of the study revealed that the problem solving strategies supplemented with practice, verbal feedback and teacher directed remedial instruction is the most effective instructional approach to facilitate substantially students' achievement in chemistry.

In this study, Okelana (1986), attempted to identify desirable communication strategies expected in a biology textbook. Effort was also made to determine the relative effects of selected strategies upon secondary school students' learning. One hundred and fifty four (154) form four secondary school students drawn from three selected schools in Oyo State of Nigeria were involved in the study. The study revealed that there were significant differences in the number of evolutionary, ecological, economic importance, historical and knowledge themes in the four biology textbooks.

By Duham (1986) in his study compared the effectiveness of three methods - the laboratory, the lecture and programmed instruction of teaching chemistry in secondary schools in Bendel State of Nigeria.
The sample consisted of one hundred and sixty class three students in four mixed schools located in the delta part of the State. Three separate teaching instruments based on the philosophy of each method but with the same subject matter and behavioural objectives were administered to the respective methods groups by professional teachers in the presence of observers.

Sawoe (1986) investigated the comparative effectiveness of the inquiry-based or open classroom and the refined Traditional (R&T) approaches to science teaching. Five hundred and seventy (570) students were randomly assigned to treatment and control groups, and two instruments, the attitude scale and the achievement test were used. Data were analysed using ANCOVA, ANOVA and post hoc comparisons. The study revealed that both the inquiry-based and R&T instructional approaches could be employed as viable alternatives in science teaching; both the inquiry-based and the instructional approaches were decidedly superior to the traditional approach.

The effects of the use of electronic calculators on the outcomes of mathematics instruction was investigated by Abimbade (1987). He used a paradigm of 3 x 3 factorial design of three ability levels - high, average and low - by treatment groups - unrestricted calculator, and restricted calculator groups, and a control group - no-calculator group. Six null hypotheses were formulated and tested for the study. Results show that pupils within the same ability level who use calculators will perform better than those who do not use calculators. In addition, it was found that calculators have computational advantage and promote high achievement gains in mathematics.

Ajeowo (1987) specifically tried to find the effects of the discovery and expository instructional methods on the achievement of students in biology. The learning outcomes investigated included cognitive achievement, scientific attitude and scientific processes and practical skills achievement. The study involved 240 classes in six secondary schools in Illeosi, Oyo State. Test scores were analysed using ANCOVA and t-tests. The results showed that a significant difference occurred in the performance of students exposed to the discovery and expository methods; all the various ability groups in the discovery class outperformed their counterparts in the expository group in the process and practical skills. The study by Sawoe (1987) investigated the effects of Behavioural Objectives (BO), dynamic prescriptive teaching (DP) and a combination of the two strategies (BO+DP) on achievement in integrated science. Students achievement in integrated science was measured at four levels: immediate cognitive achievement, retention, attitude and achievement motivation, and six instruments were used for data collection. Data were analysed using t-test, ANCOVA, Multiple Classification Analysis (MCA) and Scheffe tests.
of these on students' achievement. The students were found to have a positive attitude towards science, with physics students being the most positively inclined. There was a low positive but significant relationship between attitude scores and achievement.

Odorou-Mensah (1987) investigated the effects of science related attitudes and the teaching strategy used by the teacher on students achievement. The teaching strategies investigated were the inquiry discovery and lecture-demonstration teaching strategies. The major findings were that students exposed to inquiry-discovery teaching strategy performed significantly better than their counterparts to lecture demonstration in the processes/skills of biology but not in the cognitive areas of biology; students with more favourable science-related attitudes performed better than their counterparts with less favourable science-related attitudes in both the processes/skills and cognitive area of biology. 

There appears to be a dearth of research in this area. This may be due to the fact that attitude studies usually require much rigours and much time. This reason may be enough to put off doctoral students in this area, but this should not be so. More research should be encouraged here as research has shown that attitude has a positive relationship with achievement.

4. TEACHER FACTOR

Among the studies done under teacher factor was that of Emia (1979), who studied the association between teacher participation in an in-service training programme and pupils achievement in science. From this study, it was apparent that in-service training programmes have a positive effect on teachers productivity and also on students' achievement. Shiwiru (1979) investigated the relationship between science teachers' methodology and objectives for science teaching. The study also sought relationships between teachers' preference for science teaching objectives, teachers claim for science teaching objectives attained in the classroom and observers' assessment of science teaching objectives attained in the classroom. Results indicated that teachers generally know the desired objectives for science teaching and probably desired to attain these objectives in their interaction with students. However teachers instructional behaviour in the classroom was not in consonance with these objectives.

The main objectives of the study by Attah (1981) were to determine teachers' perceptions of the important personal and professional characteristics required of teachers, desirable science teaching behaviours which contribute to successful
teaching, school conditions which enhance teaching and to compare teachers' perceptions' perceptions with their classroom behaviours. Statistical analyses indicated significant differences in teachers' responses to items on the Background Information Schedule and the Who Is an Effective Science Teacher questionnaires (WIESST) on the basis of professional qualification. On the other hand, there were no significant differences in teachers' responses to BIG items, while significances existed in responses to WIESST based on years of science teaching experience.

Chauki (1981) investigated the ways in which preface, process, and product variables related to student outcomes in mathematics interact with each other, and with student outcomes in mathematics itself. Teacher attitude and experience were found to contribute highly to student outcomes while teacher characteristics were found to have a strong effect on teacher roles. Teacher personality was also shown to have a strong effect on learning outcomes. The personality traits, nurturance, introversion, and abstemiation were positively related to student outcomes while affiliation change and heterosexuality are negatively related to student outcomes.

Sherley's (1984) study examined the effect of early part- icipation of classroom teachers in the development of mathematics curricula, and familiarisation of teachers with new mathematics curricula, on the teachers' attitudes toward the introduction of new curricula, and more generally, on the successful implementat- ion of new mathematics programmes. Significant positive correlations and significant differences in teachers' attitude toward accepting curriculum change and their previous participation in curriculum development and their knowledge of new programmes.

The study by Onakal (1995) sought to obtain evidence of attitudes of secondary school physics teachers toward physics instructional and assessment practices, and to ascertain the extent to which attitude explain learning outcomes in physics. The study found among others that the respective attitude profiles of the teachers towards physics instructional and assessment practices point more to the positive than the negative.

Ibeagha's (1996) study sought to obtain empirical evidence of instructional strategies of university trained physics teachers as correlates of learning outcomes in secondary school physics. The findings reveal among others that instructional strategies of university trained teachers when taken together could effectively predict students achievement in physics.

The study on teacher factor have pointed out the teacher as an important factor in the teaching-learning process. These studies are however no way near being conclusive. Further studies are therefore, indicated if those factors that affect teachers quality and productivity and consequently students' achievement are to be fully understood.
The studies reviewed under this section include those that deal with evaluation of programmes, evaluation of subject matter and achievement, and also evaluation of learning outcomes. The first study to be reviewed in this category is that of Nwana (1965). This incidentally is the first doctorate dissertation written in a Nigerian university.

The investigation by Nwana (1965) was to determine and evaluate the performance of secondary school pupils in the various levels of cognition with respect to school certificate Biology. Objective test items on school certificate biology were constructed to cover the major subject matter areas and to test both lower and higher cognitive behaviours. Analysis of variance showed significant differences amongst the five forms in both the biology variables and the aptitude variables. Mani (1981) investigated the congruence or the gap between the intended and practiced forms of the science Teachers' Association of Nigeria Integrated Science Curriculum. The teachers' perceptions about the curriculum ideology and the curriculum materials were used to describe what was taught and learned. The teachers' classroom activities in instruction were observed while the effects of instruction on the pupils were assessed. The study noted consensus among the teachers about the curriculum ideology. The classroom behaviours of the teachers during the instruction of the curriculum did not conform to those implied by the curriculum intentions. There was a gap between the intended and practiced forms of the STAN Integrated Science curriculum.

Telbo (1981) set out to construct and validate a criterion-referenced test involving some concepts in chemistry. The concepts are Mole concept, Modern Nomenclature, S.I. Units, Energetics and Kinetics. One hundred criterion-referenced items of the multiple-choice type were copied to be reviewed in this. These items were divided into two tests, batteries of 50 items each labelled Test I and Test II. These tests were administered on 511 subjects (255 boys and 256 girls) from 13 secondary schools in two states of the Federation. The mean scores of the subjects by school as well as the individual scores of the subjects in the five concepts were compared with the acceptable performance standards set for each of the concepts and also for the two tests. The results obtained showed that most of the subjects used for the study had difficulties in mastering these concepts.

The study by Russell (1982) was undertaken to accomplish three major objectives: to construct, validate and standardize an objective test using the mathematics syllabus of Liberia; to use the test scores to determine the extent to which students completing high school in Liberia master the mathematics curriculum prescribed by the Ministry of Education and to use
the test scores to compare performance of students relative to sex, school and geographical variables. A standardised mathematics achievement test (DMAT) of 80 items was constructed and used in this investigation. Findings of the study were that the reliability coefficients of DMAT ranges from 0.66 to 0.90; the concurrent validity coefficients also ranges from 0.39 to 0.53; and the performance of the sample fell below the minimum mastery levels set in the study. Maduwe (1984) investigated the effect of supplementing mastery learning strategy with preparatory review on the level of students' achievement in chemistry. The results show that supplementing mastery learning with increasing the level of students' achievement on mole concept in chemistry. 

Ogahenti (1984) undertook to investigate the factors which related significantly to students' outcome in mathematics at the terminal and of secondary education in Oyo State in a three-dimensional perspective namely; the mathematics curriculum as intended, implemented and realized. Correlational analysis was used to determine the contribution of certain selected variables to variation in cognitive achievement. The major findings of the study were that the background variables collected were generally predictive of students cognitive and effective achievements in mathematics; opportunity-to-learn measures showed that mathematics curriculum was more than 70% realised.

The major objective of the study by Afolabi (1988) was to find out the effect of formative testing with remediation on achievement, both cognitive and affective in mathematics. Results indicates that formative tests with remediation is most effective in improving student cognitive achievement and that the difference score on each of the effective variables was smallest for the formative with remediation treatment.

Obioma (1985) developed and validated a diagnostic mathematics test for junior secondary schools in Nigeria. He developed a 50-item Diagnostic Mathematics Test (DMAT). After two stages of item analysis, the final version of the DMAT and a Content/Cognitive Preference Questionnaire (COPED) were then administered to a stratified sample of 5,000 students from Anambra, Cross River, Imo and Rivers States. Major results indicated that the average test difficulty levels of the DMAT scales and its complexity dimensions are in the range of 0.27 - 0.50; three theoretical dimensions were identified for the DMAT content dimensions, while four theoretical dimensions were identified for the DMAT complexity dimensions based on four analytic results.

Obiomi (1985) assessed the quality of human input into a mathematics education programme under which prospective elementary teachers are being prepared for primary school mathematics teaching in terms of student participants educational background, interest in and motivation for the choice of teaching as a career, and perceptions of the objectives for the teaching and learning of mathematics.

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Assessment was also done in terms of mathematics tutors' academic professional qualifications, lengths of teaching experience, and perceptions of the content and objectives of the mathematics course for elementary teacher training. Findings show that ninety percent of elementary school teachers in the sample had secondary school educational background, at least 60% did not possess qualifications that would enable them seek admission into higher institutions.

The study by Ogundeyin (1985) was undertaken to identify the effectiveness of conceptual versus subject-based curriculum on students' achievement in general nursing preparation programmes. The study found that students whose learning was planned using the conceptual curriculum demonstrated a higher level of achievement than those whose course was planned using the traditional subject-based curriculum.

Olabodun (1986) focused on ways of using mastery learning to change students' cognitive and affective outcomes in mathematics. The method of inquiry was by means of direct teaching using conventional approach (control group), mastery learning approach (Exp. group A) and mastery learning with peer tutoring approach (Exp. group B). Diagnostic progress tests, feedback/ correctives and other learning resources and materials were used to bring 80% of mastery learning group to a mastery criterion standard of 70% on each of the unit tests before moving to the next topic. Results of the pretest, posttest and retention test were analysed and among other things, the result showed that mastery learning strategy enabled students to attain similar achievement to learn better and to retain more of what was learnt.

Jonath-Itelli (1990) examined the present situation of evaluation of primary school mathematics, identified attendance problem and studied the advantages of continuous assessment in primary school mathematical education in two States of Nigeria. Instruments to measure teachers' method of assessment, attitudes to mathematics and to tests and examinations in mathematics and pupils' classroom social adjustment were designed, validated and used. Tests to provide pupils achievement in the subject were also constructed, validated and used. The study found that teaching knowledge of some of the topics in the primary school mathematics syllabus and attitude to assessment of pupils performance in the subject were not good.

The purpose of this study by Inokoya (1986) was to provide instruments for the continuous assessment of pupil achievement in the cognitive domain in upper primary schools in Nigeria. The continuous assessment test UPSAT 6 was a 90-item instrument made up of knowledge, comprehension and application items. It was validated and pre and trial tested. It was later administered to 3,600 pupils drawn from Anambra, Benue and Benue States of Nigeria. The major findings were that UPSAT 6 was both reliable and valid; areas of
strengths and weaknesses for individual pupils and group of pupils cut across knowledge, comprehension and application levels of the cognitive domain.

Alorga (1987) investigated the effects of two probabilistic models of item analysis on students performance using achievement tests. Four tests of arithmetic, algebra, geometry, and statistics were administered to 900 subjects in four cities. Results indicated that there was a significant difference between students' performances by sex on each of the mathematics tests, it was also found that there was a significant difference between the performances of the study groups.

The final study under this category was carried out by Oyejide (1988). The study was aimed at developing and validating a learning hierarchy in some topics in secondary school mathematics and determining its effect on students learning outcome. The study was carried out in two stages, the process of validation and the use of the instructional material. Findings of the study indicate among others that there was a significant difference in performances, transfer of knowledge and retention of skills in favour of the learning hierarchy groups.

The researcher under this category have revealed that some instruments had been developed for measuring cognitive achievement and some efforts made at standardising them. If these instruments are collated, and standardised further if the need exists, they will be useful tools for classroom teachers who are beset with the problem of where to get at standardised tests to use. There has also been some attempts at evaluating some programmes but it appears that mathematics has received the greatest attention. There is, therefore, the need for future researchers to evaluate programmes that are connected with other subject areas.

The mode of assessment that is in use in Nigeria today is continuous assessment. There is a dearth of research efforts geared towards the successful implementation of continuous assessment at the doctoral level. Future researcher may therefore wish to gear their research efforts towards filling this gap.

6. CLASSROOM AND LEARNING ENVIRONMENT

The studies reviewed here ranged from classroom interaction pattern to learning environment like laboratories and their effects on learning outcomes.

The first study to be reviewed here is that of Odunuga (1983) whose study set out to find out the effect of two teaching strategies (laboratory and conventional methods) on the learning outcomes in integrated science.
The study showed that students exposed to the laboratory method in both cognitive and process skills and achievement; and developed more favourable attitude towards integrated science. Okebukola’s (1984) study examined interaction patterns occurring within the laboratory which assists the learner in acquiring and developing competencies basic for an understanding of science and the activities of scientists. The interaction patterns examined were the co-operative, competitive and individualistic laboratory interaction patterns. All the subjects (1,330 secondary class three biology students) were pretested, treated for six weeks, and post-tested on all dependent measures. The experimental sample performed significantly better than the control in attitudes and practical skills. Within the experimental group, the co-operative condition promoted the highest statistically significant gain in cognitive achievement and scientific attitude while the competitive resulted in the best performance in practical skills. The individualistic group exhibited the weakest performance on all the measures.

Onocha (1985) studied the patterns of relationships between home and school factors and pupils’ leaving outcomes in Bendel primary science project. Certain home and school factors were found to have a facilitative effect on learning outcomes.

Adeloye’s (1987) study was directed at finding the relationship between teacher classroom/laboratory questioning styles and students’ achievement and participation in Biology. The results of the study which involved 450 biology students show that there is evidence in favour of the higher-order questioning as a factor facilitating higher cognitive achievement, development of interest, acquisition of process skills and improved class participation of students in biology.

The last study in this category was that of Ogunleye (1987) who investigated school factors which may be associated with the achievement of students from 20 secondary schools. The specific factors investigated was the effect of laboratory teaching in physics on the achievement in physics. The findings of the study led the researcher to recommend the use of the guided expository laboratory technique.

The studies reviewed under this category had identified many classroom and environmental factors that influence and affect achievement in science. These studies are by no way comprehensive. Further studies are therefore needed in this area, particularly in the area of socio-cultural correlates of science achievement.
SUMMARY AND CONCLUSION

An attempt had been made to review doctoral dissertations written in the area of science education. It was the intention to do this under seven categories as listed in Table 1. Unfortunately no research has been done under the seventh category - Research Methodologies and Paradigms.

The studies reviewed have revealed an emerging pattern. More work has been done in the area of mathematics than in all other areas. Science educators with special interest in other subject areas are, therefore, called upon to carry out more work in their areas. This call is particularly pertinent to those who are interested in primary science because it appears as if the least work has been done in this area.
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