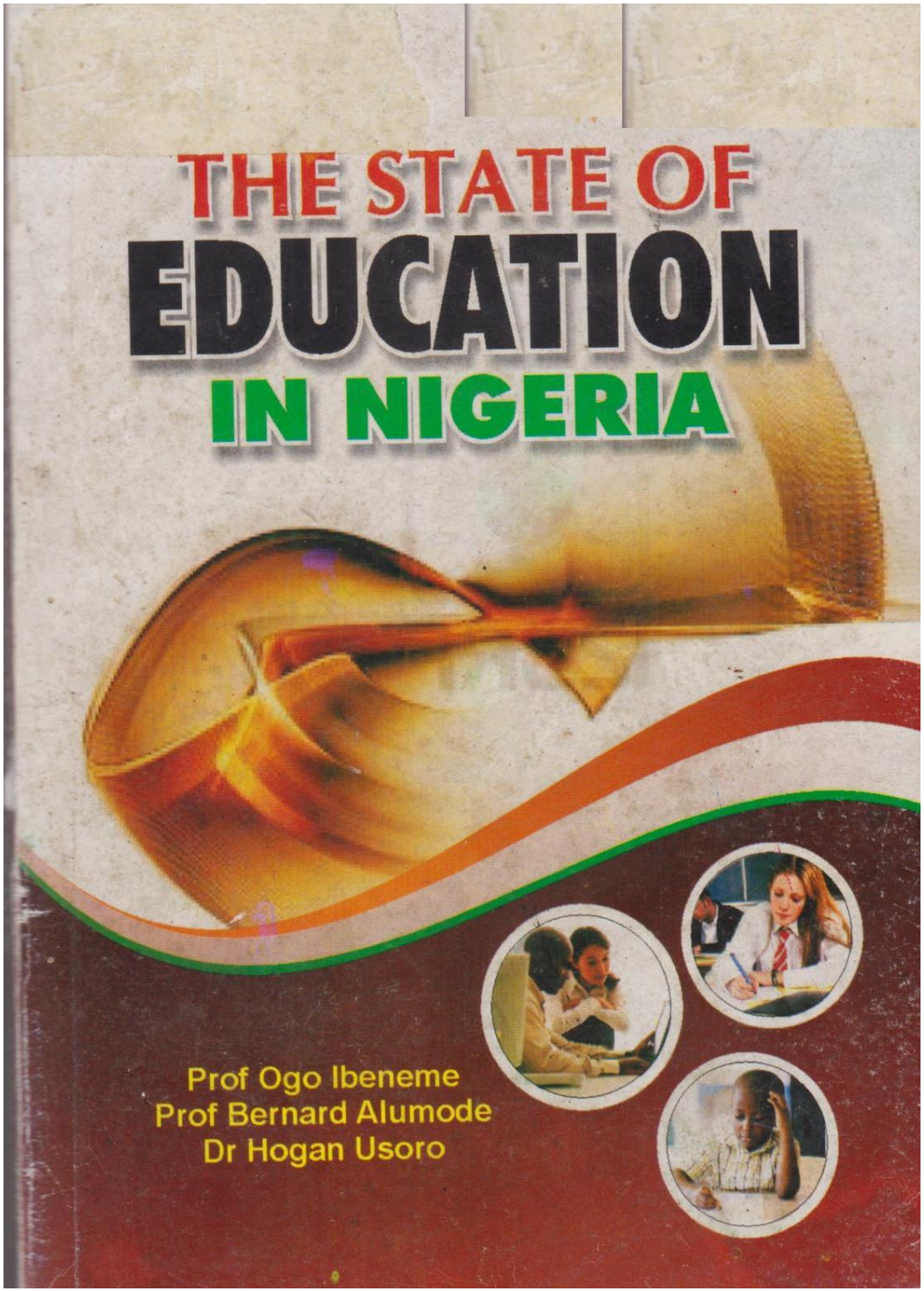

Chapter Fifteen

SCIENCE CURRICULUM INNOVATION IN NIGERIA: CHALLENGES AND PROSPECTS IN THE 21ST CENTURY

REBECCA U. ETIUBON
Department of Science Education,
University of Uyo,
Uyo.

Introduction

Knowledge is expanding and changing the way ideas are being looked into. With dynamic evolutionary trends in modern-day teaching, there needs to be a paradigm shift in the way learning experiences are brought to the learners. For science, technology. Engineering and Mathematics (STEM) education to engender the magnitude of change that will ensure that modern-day challenges are effectively tackled, it is imperative that science curriculum undergo innovation.

Existing science curricula need to be broadened or narrowed lo include necessary contents or to exclude obsolete and outdated contents through innovation. How the necessary contents of STEM will be integrated and organized into meaningful learning outcomes and delivered is a challenge that

curriculum specialists need to lace.

The secondary school sector is presently lacing shortage of innovative instructional materials/facilities and personnel for implementation of the newly derived 2009 science curriculum by NERDC. Little or no innovative resources are embedded in the new science curriculum except for biology retaining its 'nature' status. Esu, Enukoha and Umoren (1998) observed that a ne\v curriculum will require additional resources which will include time, material resources, administrative support and expertise. There must be effective concern about seeking innovation and quality in the nation's secondary education.

According to Mintrom (2000) in Ajibola (2008) an innovation is an idea, practice or object that is perceived as new by an individual or other units of adoption. Innovation therefore include introducing new curriculum comeiit; specific curriculum materials, teaching aids, modes of organization and educational principles. There are various suggested sources for curriculum innovation that can L-nrich science teaching. These sources include research institutes, local environment such as fields, parks, industries, museum, archives, experienced community personnels in various fields of scientific knowledge, journal inputs, illustrative science books, ideas from magazines, research works, theses and Dissertations, conference proceedings, iconic models, advertising strategies, and modern technologies.

Innovation of the science curriculum is ideal to promote

and concretize learning needs and experiences that will provide skills and opportunities of furthering students creativity and productivity for lifelong use. Innovative resources have the following qualities: they improve learning visualization, enables access to concrete models and objects, enable learners to experiment on selecting and presenting, allow for more time to interact with objects and ideas to achieve higher level thinking through manipulation, use of modern equipment like virtual libraries, simulation and other ICT gadgets to actualize learning experiences. Previous research efforts have shown that the primary school is the stage for the introduction of innovative ideas and practices (Jalaluddin, 1990).

Sound scientific literacy skills and knowledge acquisition for competence on innovative application for science teaching is needed to achieve the objectives of science education in the National Policy of Education {NPE, 2004). For the demands on sustainability and national development to be met, an enduring environment with knowledgeable human resources, functional and available resources, and more importantly innovations on the science curriculum must be in place.

Some of the stated objectives of science education curriculum in the National Policy on education (NPE, 2004) are to; diversify secondary curriculum to cater for differences in talents, opportunities and roles possessed by or open to students after their secondary school course; equip students to live effectively in our modern age of science and technology; raise a generation of people who can think for themselves, inspire its students with a desire for achievement and self-improvement

both at school and later in life. Until these objectives are properly focused through innovation integration in the science curriculum, the demands of changing trends in science education adopted the world over will remain a mirage in Nigeria.

Osokoya (2003) noted that science teaching and learning can be meaningful and effective it" backed by the necessary resources to enrich instruction. This can occur by implementing and utilizing rich science innovative resources and sources of innovation to elucidate meaningful learning outcomes, Most teachers in secondary schools teaching science still view knowledge as existing only within the confines of the classroom environment. They implement a curriculum that ensure that students cover relevant science content and have opportunity to learn truths which are documented in books (Eshiet, 2008). These teachers do not have knowledge of applying innovative resource and sources that can improve their science content teaching and at the same time enhance students grasp of the subject/topic content. Ojesola (2001) linked adequate skill development in learners to their exposure to real situations. He posited that transfer of learning /training occurs when adequate experiences are provided.

Agbure (2006) noted that the only tools available to a learner are the senses. It is only through seeing, hearing, touching, smelling and lasting that an individual interacts with the environment. This is true of innovation which includes concrete objects and contributes effectively lo students creative skills and knowledge dissemination in all other areas.

Science Curriculum Innovation and the Teacher

All secondary school science curricula are developed by accredited bodies comprising experienced science teachers, and school administrators accredited with reasonable records of experience and sound scholarship. These curriculum developers arc guided by the manpower needs of the society as prescribed by government to groom the younger citizens for higher education in identified fields (Eshiet, 2007). Teaching requires knowing how to teach, and teachers are required to undergo further training in teaching methodologies. This will improve teachers' competence on innovating instructional materials that will enhance classroom science teaching. As teachers employ innovation in science teaching, a measure of innovative skill is being inculcated in the learners. Teachers are intellectually equipped to source for and innovate indigenous resources that can play active roles in the transfer of knowledge and in the provision of different types of motivation to learners According to (Ekpo, 2009) the burden of transferring knowledge to the learner his switched from the teacher to the myriad of resources available in the market. To this end, the teacher's prime role is to provide the learners with a wide variety of innovative resources to enhance learning experiences and nurture innovative creative responses in them, Preparation of teachers for quality and knowledge innovation technique is a panacea for teaching science.

Innovative Curriculum Resource Materials

One cannot solve problems by bringing ideas from various topics a fields together unless one has some ideas. Therefore, the teacher should bring to mind some relevant concepts and

principles, compile them as paper-base, computer-base and audiovisual resources and provide for students use. Innovative curriculum will improve learners virtual senses manipulative skills. Innovative curriculum simplify facts and ideas. They are activity-oriented and increase students creativity.

ICT Modeled Innovative Resources

There is an upsurge in the use of (CT tor teaching and learning sciences. If these technologies are available in schools, teachers utilization of them through innovation will enhance learning efficiency. When they do U.SL them, diverse teaching and learning approaches and learners confidence will be built, in reality, ICT innovative sources arc often not available and accessible. With the development of virtual reality and library more teaching and learning resources arc made available for teachers' and students' use if they arc computer literate and have the enabling facilities within reach (Ekpo, 2009). With ICT innovative packages teaching strategics will be easier to design and handle.

Challenges of Science Curriculum Innovation in Secondary Schools

Inadequate innovative resource materials are a bane in the Nigerian science teaching curriculum. Curriculum innovation is one of the vital elements required in a teaching situation for students meaningful learning experiences and outcome to be actualized. Curriculum is dynamic in nature. It responds to dynamic changes in the society. To respond effectively to the nation's educational needs, there must be high concern of seeking innovation and quality in the science curriculum.

While attempts arc being made towards progress in reviewing and propounding new science curricula, new devices and instructional materials for teaching science, and debates and reforms are being made for science education curriculum, attempts should be made in finding ways for innovation implementation and techniques in science instruction.

A look at the science curriculum indicates that there are inherent problems as regards innovation particularly on topics considered difficult by both teachers and students on concepts such as stereochemistry, thermochemistry, electrochemistry and quantum chemistry, in physics, quantum mechanics and particle physics present problems. In Biology, genetics and molecular biology are not easily understood. In Mathematics, trigonometry and further mathematics covering matrix and calculus present problems. These science concepts require urgent refocusing for innovations in teaching to inculcate creativity, skill application for learning interest and motivation.

There are myriads of challenges militating against science curriculum innovation; these include, students workload, large class size, foreign lesson contents, time allocation for science teaching, dearth of innovation resources, the teaching process itself, lack of standards for the resource-content introduced among others. Innovating science curriculum may involve recruiting qualified, knowledgeable and experienced teachers who can innovate indigenous resources. How, when and where to implement innovative curriculum resources will include the following: innovative competence of teachers, topics for innovation, provision of

funds for producing innovative materials, curriculum design for adoption for innovation, sources of innovation for utilization, classroom sizes to suit innovation, research institutes to model innovations, teacher training centres to teach innovation, providing ICT modeled innovative resource packages and programmes

Curriculum innovation in secondary school science curriculum is very low and obsolete. What is offered in the classroom for the Nigerian learner can neither adequately develop the potential of the learners nor prepare them for a productive life in society (NTI, 2007), they are hopelessly inadequate to match the needs of our society, the individual student, or meeting the challenges of a dynamic changing world of science and technology. Inspite of researches made for improvement in integrating innovative resources in leaching science in secondary schools, little effort has made by most Nigeria science teachers and curriculum planners in effecting the use of innovative resource materials in enhancing classroom. Science leaving outcomes. The curriculum planners themselves have not helped matters in achieving this goal. While attempts have been made at reviewing and re focusing the science curriculum, little attempt has been made at including and integrating innovative science resources in the science curriculum for science teaching. This hampers learning experiences to outcomes

The depth and scope of science curriculum content are revealed in actual teaching as the teacher is guided, not only by the cognitive level of the learners but also by the require men Is of the curriculum which he is to implement (Eshiet, 2008).

These contents cannot be adequately taught when the teacher cannot model innovations and innovative materials that students could adapt for learning.

Objectives of the Study

1. To determine the extent of implementation of innovation sources in science curriculum.
2. To examine the extent of teacher preparation on innovation development in science curriculum.
3. To assess the effectiveness of innovative software programmes/packages dissemination in science curriculum.
4. To determine the extent of implementation of innovation materials in science curriculum

Research Questions

1. What is the extent of implementation of innovation sources in science curriculum?
2. To what extent does teacher preparation affect innovation development in science curriculum?
3. How effective is the dissemination of innovative software programmes/packages in science curriculum?
4. What is the extent of implementation of innovation materials in science curriculum?

Research Procedure

Design, Population and Sample

The Study adopted a descriptive survey design. The population comprised all science teachers from the 31 Local Government Areas of Akwa Ibom State and the South-South, and South- East Zones of Nigeria who attended the Education

Summit in Akwa Ibom Slate. Six hundred and ten (610) science teachers were randomly selected from a population of one thousand two hundred and thirteen (1213) science teachers and they formed the sample for the study.

Instrumentation

The instrument was a 35-item questionnaire, which was face validated by two lecturers of test-measurement and evaluation of the science Education Department of University of Uyo and two experienced secondary classroom chemistry teacher who modified the instrument to 28-items. The instrument titled Science Curriculum Innovation Questionnaire (SCIQ) was administered to the six hundred and ten (610) science teachers during the education summit meeting that lasted for 4 days and retrieved the same day the were given. The questionnaire consisted sections A and B. Section A of the questionnaire dealt with the demography of the participants and section B dealt with the participants opinions on science curriculum innovation. Section B used a four-type rating scale of Strongly Agree (4), Agree (3), Disagree (2) and Strongly Disagree (1) to determine the science teachers opinions. The reliability of the instrument was determined using Kuder-Richardson-Formula - 21 to give a reliability coefficient of 0.82. Research Question 1 was analyzed using percentage count (%) and Research Questions 2 to 4 were analyzed using mean (X) and standard deviation (SD). A Mean of 2.50 and above indicated a positive opinion and below 2.50 was an indication of negative opinion.

Result Presentation

The participants responses were analyzed in line with the

research questions and presented on the Table as shown below.

Table 1: Extent of Implementation of Innovation Sources in Science Curriculum Using Percentage (%) Count

S/N	Innovative Sources	Great Extent (%)	Average Extent (%)	No Extent (%)
1	Research Institutes	7.5	18.9	73.6
2	Conference Proceedings	15.7	.14.4	49.9
3	Journals	21.2	.17.5	41.3
4	Textbooks	40.4	.116	16.0
5	These and Dissertations	21.8	26.3	51.9
6.	Magazines Idea source	-	-	-
7.	Local Environmental Recourses	4 9	6.4	88.7
8	Iconic models	-	-	-
9.	Advertising brand model	-		-
10	Modern Ice html (ink	-	11.5	88.5
11	Community Resources		1.2	98.8
12	Researches	11.8	17.7	70.5
13	Scientific Kits	-	3.3	96.7

Table I shows the extent to which science curriculum has implemented innovative sources as inputs for science teaching, While textbooks and ^inference proceedings which arc in themselves consulted from textbooks emerged the most used sources for science teaching; iconic models, ideas from magazines, advertising brand models, modern technologies, community resources which involves experienced personnel with wealth of knowledge are not at all featured in the science

curriculum. The extent of implementation of innovation sources for research institutes, researches conducted and scientific kits in science curriculum teaching is very low.

		Responses						
	Teacher Preparation for Innovation	SA	A	D	SD	X	SD	DECISION
1	Teacher Preparation for innovation 1. Teachers lack knowledge for innovation	200	176	89	145	2.70	0.88	Accepted
2	Teachers are not to adequately trained	187	213	137	73	2.84	0.82	Accepted
3	Ideas from teachers are not considered	263	102	154	91	2.38	0.83	Accepted
4	Most teachers are not resourceful	371	104	46	89	3.24	0.90	Accepted
5	Teachers find it difficult to make change	122	313	126	49	2.83	0.81	Acceptable
	Dissemination of innovative software programmes and packages							
1	Research institutes give information on innovative software programmes and packages to schools	141	FM	140	143	2.53	1.02	Accepted
2	Curriculum planners of Ministry of Education do not provide software programmes and packages	174	161	110	165	2.56	1.00	Accepted
3	Introductory technology units in schools do not innovate software programmes and packages	138	197	184	91	2.62	1.02	Acceptable
4	School administrators buy software programmes and packages for innovation	131	159	139	181	2.46	0.80	Not Accepted
5	Technology resource centres produce innovative software programmes and packages	163	108	163	71	2.44	0.80	No. Accepted
	Implementing Innovative Materials							
1	Special science kits are not integrated in curriculum	181	213	105	11.1	2.76	0.89	Accepted
2	Inadequate materials for innovation	316	102	88	104	3.03	0.90	Accepted
3	Teachers do not improvise innovative materials	191	153	119	147	2.65	1.01	accepted
4	Innovative models are not created by teachers	213	133	101	163	2.65		
5	Students do not create	159	146	212	93	2.61	1.00	Accepted

Analysis of Results

Table 2 shows the result of analysis response on item I on teacher preparation for innovation with a mean of 2.70 (X =2.70 SD - 0.88). It was agreed that teachers lack knowledge for innovation on science curriculum. Hems 2 in 5 shows high Mean (X) responses of (X = 2.84 SD =0.82) {X = 2.88, SD = 0.83) (X - 3.24, SD 0.90) and (X = 2.83 SD =0.81) respectively. The participants agreed on these items that teachers are not adequately trained, their ideas are not usually considered as inputs for the science curriculum as they are not consulted during curriculum planning; and (heir most teachers are not resourceful and teachers find it difficult to make change.

On the dissemination of innovative software programmes/packages, Items I to 3 have mean (X) responses of (X = 2.53, SD - 1.02), (X = 2 56, SD - 1.00) and (X = 2.62, SD = 1.02) respectively, The participants agreed that research institutes only give out information on innovative software programmes/packages but do not participate in the implementation of such packages in the science curriculum. It also shows that curriculum planners of Ministries of Education do not provide software programmes and packages; and introductory technology units of schools do not innovate software programmes/packages. Items 4 and 5 gave negative responses with Means (X) of (X - 2.46, SD = 0.80) and (X = 2.44, SD - 0.80). The participants disagreed that school administrators buy software packages/programmes and technology resources centres produce innovative software programmes/packages.

Items on implementation of innovative materials in science curriculum gave mean (X) responses of (X =2.76, SD = 0.89 {X = 3.03, SD « 0.9.0) (X - 2.63, SD = 1.01) (X=2.65, SD = 1.02) and (X = 2.61, SD = 1.00) respectively. These items revealed that special science kits are not integrated in science curriculum, there is dearth of materials for innovation, teachers do not improvise innovative materials, innovative models are not created by teachers and students do not create innovative diagrams/illustration for science classroom interactions.

Table 3: Summary Results on Average Means (X) of Items

Item	1	2	3	4	5	Ave. X	SD	Decision
Teacher preparation of innovative	2.7	2.8	2.88	3.24	2.83	2.89	1.06	Accepted
Dissemination of innovative software programmes and packages	2.53	2.56	2.62	2.46	2.44	2.52	1.02	Accepted
Implementing innovative materials in science curriculum	2.76	3.03	2.63	2.65	2.61	2.73	1.1	Accepted

mmary of Findings

Results presented in Tables 2 and 3, show the mmary of findings as follows:

Teacher preparation is very low as to map out innovation in the new science curriculum to prepare students effectively for science activities.

Dissemination of innovative software programmes/package, is grossly inadequate to meet the challenge of science education for knowledge

acquisition and learners lifelong productivity/

iii Lack of implementation of innovative materials in sciences curriculum hampers teachers since teaching and students scientific efficiency and effectiveness in the sciences.

Discussion of Findings

Research question 1 investigated the extent of implementation of innovative sources in the science curriculum. It revealed that innovative curriculum sources are ardly consulted nor integrated into science curriculum for effective science teaching. Even with the newly introduced and reviewed 2009 science curriculum, innovative sources are hardly indicated lo be used on any of the reviewed concepts. This is in agreement with ESU, Emkoha and Umoren (1998) who observed, that a new curriculum will require additional resources that will include time, material resources, administrative support and expertise. The observed low implementation o these sources indicate that science leaching will not be effective without these appropriate innovative sources.

Research Question *2* revealed that teacher preparation is too low and that teachers are slow to embrace change as to meet the demands of a newly reviewed science **curriculum** to implement various innovations in the curriculum. This finding corroborates Osokoya (2003) who opined that without adequate teacher preparation science teaching by teachers and science learning by students cannot be effective without meaningful and necessary resources that enrich instruction. Teacher preparation must be of serious concern to curriculum planners

to make students enhance their knowledge of scientific concepts.

Research Question 3 revealed that there is hardly any form of dissemination of innovative software programmes and packages from the different available educational agencies and that even few agencies having these hardly make them available to schools as these are grossly inadequate to meet the challenges of science education and scientific literacy appreciation for life-long productivity. This in agreement with (Ekpo, 2009) who opined that the burden of transferring knowledge to the learner with the myriad of resources available now, will provide a wide range of innovative resources will enhance and nurture learners experiences and prompt creative responses in them. These software programmes/packages will boost students initiatives towards skill acquisition

The findings on Research Question 4 indicate lack of implementation of innovative materials and this hampers students effectiveness in the sciences. This is supported by Eshiet (2008) and (NTI, 2007) who report that what is offered in the classroom for the Nigerian learner can neither adequately de\--lop the potential of the learner nor prepare them for a productive life in society. This, invariably will affect students' performance iri the sciences. Appropriate innovative materials will enhance resource use by the students.

Prospects of Curriculum Innovation in the Sciences

Amalu (2010) staled that innovations are usually borne out of necessity and arc always for good intentions. Meaningful science leaching an learning can 1 here fore effectively occur

when individuals arc equipped with necessary innovation tools to think for themselves and face the challenges (if meeting social changing needs, the teacher is to make adequate preparation through training in reeling these needs and provide feedback lo curriculum planners to integrate innovative materials in science curriculum to provide essential learning outcomes. The teacher should employ variety of innovative materials during lesson delivery and interaction 10 foster learning skills and retention of scientific concepts.

Conclusion/ Recommendations

Effective teaching and learning can only take place when adequate innovative materials arc in place and teachers are well prepared through naming to innovate basic instructional materials that meet learning needs. School Administrators, Federal and State Governments should sensitize science teachers by organizing statewide workshops. Challenges such as short supply of innovative materials should be addressed through building of material innovation research institutes to provide kits, tools and other necessary devices for innovation.

A relevant innovative science curriculum will en-low its learners with appropriate knowledge and learning skills and attitudes that v. ill enable them harness available resources for lifelong productivity.

All agencies for education interested in moving the nation forward for sustainable development should come together to adequately provide for necessary innovative sources and materials for quality education.

Well-trained teachers that will produce knowledge-based

society with innovative skills for their learners should be a priority for school administrators, educational agencies and all tiers of government.

References

Agbure. F. O. (2006). Educational reform and national development in Nigeria, *Journal of Teacher Perspective.* 3(4), 38-43.

Amalu, O. G. (2010). Innovations and Issues in Primary Education. *Journal of Childhood and primary Education,* 7(1), 57-71.

Ekpo, C. M. (2009). Innovative Practices in the adaptation, improvisation and utilization of indigenous Resources to complement curriculum Resources for the attainment of Educational Goals. *Journal of the Nigeria Association for Educational media and Technology,* 1(1), 13-16.

Eshiet, I. T. (2008). *Teaching Difficult Concepts in a school curriculum The Concept of Scientific am! Technological Concepts.* Abaam publishers, Uyo, P. 61-64.

Federal Republic of Nigeria. *National policy on Education* (4th ed.) (2004). Yaba, Lagos, NERDC press. National Teachers"

Jalaluddin, A. K. (Educational computing at the secondary school level: Need for Renewal with vision. In A.

McDaugall and C. Dousing (Eds.) *Computer in Education*, B. V (North Holland), Elsvic - science publications.

Institute - (NTI, 2007). *Manual for the retraining of primary school teacher: school --based assessment.* Kaduna: NTI.

Ojesola , K. W. (2001). Central-policy on vocational Education: A hindrance to effective citizenship in Nigeria. *Journal of Educational Development,* 3, 35.

Osokoya, I. O. (2003). *6-3-3-4 Education in Nigeria; History, Strategies. Issues and Problems.* Ibadan: Computer Age Publication.