

Reviewing Science Education Curriculum through the Integration of ICT Practices: Implication for Scientific Literacy

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Abstract

The paper was a descriptive survey research, which sought to ascertain among others whether the revision of science education curriculum through the integration of ICT practices would produce individuals who would be knowledgeable and have understanding of natural phenomena. The sample size comprised of 32 principals, 18 curriculum experts and 350 teachers. Four research questions and one null hypothesis guided the study. The instrument used for data collection was structured questionnaire titled; "Structured Education Curriculum and ICT" (SEC – ICT) developed by the researchers. The reliability alpha coefficient of 0.84 was established when Spearman Brown prophecy formula technique was applied on the instrument. The data collected were analyzed using mean statistics to answer the research questions and ANOVA in testing the null hypothesis at 0.05 level of significance. The findings among others indicated that the revisioning of science education curriculum through integrating ICT has the potentials to produce individuals who are scientific literate. Based on the findings, recommendations were made among which was that staff professional development in ICT should be given priority attention for successful integration of ICT into science education curriculum.

Keywords: science education curriculum, ICT, curriculum experts, ANOVA

INTRODUCTION

The fact that science education curriculum has to be reviewed with the current technology trends in Nigeria suggests that the existing one is deficient. Review of curriculum connotes; renovation, renewal, revision, restructure, reform or change for improvement in order to achieve the national objectives of education (Anekwe and Obi, 2009). The idea of adding or removing items in the curriculum implies revision or renewal. To renew a curriculum is to revise or modify an existing one with the hope of providing a better programme. According to Tanner and Tanner (1975) curriculum is a "planned and guided learning experiences and intended learning outcomes, formulated through the systematic reconstruction of knowledge and experiences and intended learning outcomes, under the auspices of the school, for the learners' continuous and willful growth in social competence". The primary aim of education is to prepare learners for effective life in the society. This aim is not achievable without curriculum. In a functional curriculum the programme objectives should be derived from the needs and aspirations of the society (Nkpa 1987).

The objectives of the school should be one that must meet the needs and aspirations of the society since the school is established to serve the society. According to Anekwe and Obi (2009), a worthwhile curriculum is never static. It is dynamic, when analyzed, the intended objectives, the learning experiences, the methods of evaluation, all parts of or

steps in curriculum development would have continued to change. Some of the factors that influence curriculum change according to Okeke (1996) include;

- Change in the objectives of education emanating from change in the social values, beliefs, traditions etc.
- Change in what is known about learning process.
- Change necessitated by feedback from curriculum evaluation.

Akudolu (1996) pointed out that the wake of the millennium has witnessed a mismatch between the education the learners received in Nigerian schools and the life activities they are expected to engage in. The need to integrate Information and Communication Technology (ICT) to science education curriculum should not be over emphasized. The world today is becoming a global village due to this new trend of innovation of ICT. The National Policy on Education (2004) states that science education shall emphasis the teaching and learning of science process and principles. This will lead to fundamental and applied research in the sciences at all levels of education. The policy further states that the foals of science education shall be to:

- Cultivate inquiring, knowing and rational mind for the conduct of a good life and democracy
- Produce scientists for national development

- Service studies in technology and the cause of technological development and
- Provide knowledge and understanding of the complexity of physical world, the forms and the conduct of life.

The only vehicle that could be used to achieve and sustain this laudable goals is a worthwhile curriculum which would be ICT oriented. ICT deals with the handling of information using all kinds of electronic devices (NCET, 1995). These electronic systems can be used for broadcasting, telecommunications and all forms of computer-mediated communication. ICT centered education covers the use of computers, online self-learning packages, interactive CDS, satellites, telepresence systems and all types of Information Technology (IT); hardware and software (Akudolu, 2002, Adebay 2002). Reviewing science education curriculum would demand the integration of such technology as, e-classroom, computer tutorial lessons so as to enable students learn at their own pace, virtual fieldtrip, Cu-SeeMe ie video conferencing system, e-laboratory, television programme and Internet Relay Chat (IRC).

The above technologies if integrated into science education curriculum have the potentials and promises to motivate students to learn, arouse and sustain their interest in learning. Gbamanja (1991) revealed that “today’s science teaching and learning have become more activity oriented and more student centered”. Problem solving is a primary characteristic and the learner does not just read about science but he does science. Science has become a basic required subject for all students. It has become interdisciplinary aiming at achieving scientific literacy among communities. Scientific literacy according to Gbamanja (1991) refers to the knowledge of and understanding of events and happenings in the environment. It refers to being literate about natural phenomena. Given to this revelation, integration of ICT to science education curriculum becomes eminent. In support of this, World Bank (1998) opined that ICT greatly facilitate the acquisition and absorption of knowledge, offering developing nations unprecedented opportunities for business and quality education. Urama (2008) pointed out that one of the reasons for integrating ICT into school curriculum is to prepare the current generation of learners for a workplace where ICT, particularly computers, internet and related technologies are becoming more and more ubiquitous. Enhancing science teacher’s competencies in teaching ICT influences the roles of teachers in the modern classroom. Teachers are no longer the custodians of knowledge but facilitators and guides thereby promoting child-centered method of teaching. Anekwe and Obi (2009) pointed out the following key strategies for successful integration of ICT into school curriculum;

- **Agreement:** Any attempt to integrate ICT must start with the curriculum planners and other stakeholders agreeing that the idea is laudable. Their acceptance and commitment are very vital to the successful integration of ICT.
- **Needs Analysis:** This is a process of defining the desired end of a given sequence of curriculum development. It will provide a set of criteria by which curricula may be developed and compared. This analysis will therefore try to ascertain if a gap really exists between the state of ICT, that is the statuesque at current and why? (William 2005 in Anekwe and Obi, 2007). What would be the ideal and how will it be achieved.
- The specification of educational goals and training levels as well as modalities of the use of ICT that can best employed in the pursuit of these goals.
- Provision of adequate technological facilities and equipment in all the secondary schools and related capacity building in the use of those ICT.
- Provision of infrastructure. A country’s education technology infrastructure depends on the national telecommunications and information structure. Therefore, these have to be adequately provided for successful integration.
- Teacher Development. There is need for teachers to be developed where-withal of ICT-skills with particular application, integration into existing curricular; changes in the teachers role, underpinning educational theories and curricular changes related to the use of IT (including changes in instructional design).

If science education curriculum is restructured through integration of ICT practices, no doubt, scientific literate individuals who will be knowledgeable of and understanding of events and happening in their environment will emerge.

The problem of the study pose a question: would the restructuring of science education curriculum through the integration of ICT practices produce scientific literate individuals.

Purpose of the Study

In general term, the purpose of the study is to ascertain whether the revision of science education curriculum through the integration of ICT practices could produce scientific literate individuals. Specifically, the study sought to:

1. Determine the factors that necessitate science education curriculum revision.
2. Determine the ICT practices to be integrated into science education curriculum.
3. Determine the potentials of ICT practices in producing scientific literate individuals.

4. Ascertain the strategies to be adopted for successful integration of ICT practices into science education curriculum.

Research Questions

The following research questions guided the study:

1. What are the factors that necessitate science education curriculum revisions?
2. What are the ICT practices to be integrated into the science education curriculum?
3. What are the potentials of ICT practices in producing scientific literate individuals?
4. What are the strategies to be adopted for successful integration of ICT practices into science education curriculum?

Null Hypothesis

There is no significant difference in the mean ratings of curriculum experts, principal and teachers on the potentials of ICT practices in producing scientific literate individuals.

RESEARCH METHODOLOGY

Research Design

The study was a descriptive survey research which sought to ascertain the mean responses of curriculum experts, principals and students on whether the renewal of science education curriculum through the integration of ICT practices would produce scientific literate individuals.

Area of the Study

The study was carried out in Phalga and Obio/Akpor Local Government Areas of Rivers State.

Population of the Study

The target population consisted of all the principals and science teachers in all the secondary schools in Phalga and Obio/Akpor Local Government Areas and all the curriculum experts in University of Port Harcourt and Rivers State University of Education, Rivers State, Nigeria.

Table 1: Population Projection of Target Audience

Target Audience	Population	Sample
Science Teachers in Phalga	1052	354
Science teachers in Obio/Akpor	1049	146
Principals of secondary schools in Phalga	96	32
Principals of Secondary schools in Obio/Akpor	90	30
Curriculum experts in University of Port Harcourt	30	10
Curriculum experts in Rivers State University of Education	24	8
Total	2321	580

Sample and Sampling Techniques

The sample comprised of a total of 500 science teachers, 62 principals and 18 curriculum experts. The total number of respondents selected was 580 using stratified random sampling.

Instrument for Data Collection

The instrument for data collection was a 48-item Likert scale questionnaire titled; Science Education Curriculum and ICT (SEC-ICT) developed by the researchers. The weightings of the responses were; Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, Strongly Disagree (SD) = 1. The average of these points is $2.50 (4+3+2+1) = 10/4 = 2.50$

Validation of the Instrument

Four experts from the department of curriculum studies and educational technology in University of Port Harcourt and Rivers State University of Education, Nigeria validated the instrument. The experts after examining the instrument made some corrections in precision of items and ambiguity of statement. These corrections were affected in the final draft of the instrument.

Reliability of the Instrument

The split-half method for testing reliability was applied. The researchers administered copies of the instrument to a sample of 5 curriculum experts, 5 principals and 10 teachers in the secondary schools which were not part of the sample schools. Their mean ratings were separated into odd and even numbered items. The two halves were correlated using the Pearson Product Moment Correlation analysis. To obtain the coefficient for the whole questionnaire. Spearman Brown Prophecy Formula was used to get the reliability coefficient to be 0.84 which was satisfactorily used for the study.

Method of Data Collection

The researchers were helped by six research assistants to distribute and retrieve the questionnaires.

Method of Data Analysis

Mean scores were used in answering the research questions. The acceptable level of mean score was 2.50 and above. The null hypothesis of variance (ANOVA). This was deemed appropriate because data were interval and more than two mean groups were compared.

RESULTS

The results were presented according to tables 1, 2, 3, 4 while the null hypothesis was presented in table 5.

Table 2: Mean Ratings on the Factors that Necessitated Science Education Curriculum

S/N	Items on the factors that necessitated curriculum reform	Curriculum experts mean	Principals mean	Science Teachers Mean	Decision
1.	The present system of education produces mostly job seekers instead of job generators	2.52	3.00	2.96	A
2.	Science education ought to prepare learners to be literate about natural phenomena	2.50	2.72	2.55	A
3.	The present science education curriculum ought to embrace inquiry/discovering activities which lead to acquisition of knowledge and understanding about natural world.	2.50	2.55	2.60	A
4.	The present science education curriculum lacks technological application	2.50	3.11	2.95	A
5.	One expects science education curriculum revision because of change in the system of education	3.00	3.15	2.70	A
6.	Curriculum has to change because of new methods of teaching for instance, the use of instructional media technologies	2.50	2.61	2.70	A
7.	There is now change in teachers role; from custodian of knowledge to facilitators of learning	2.51	3.20	3.12	A
8.	Science curriculum has to be reformed because of new ways of organizing learning experiences such as Computer-Based learning.	3.00	3.18	3.20	A

Table 2 revealed that all the items in 1-11 scored up to 2.50 and above which are acceptable means. This is an indication that all those items necessitated science curriculum revision in Rivers State secondary schools.

Table 3: Mean Ratings of ICT Practices to be Integrated in Reviewing Science Education Curriculum

S/N	Items on ICT Practices	Curriculum experts mean	Principals mean	Science Teachers Mean	Decision
	The following ICT practices should be integrated into the science curriculum for relevancy Computer-Assisted Instruction like:				
9.	Tutorial lessons	2.52	2.65	2.70	A
10.	Drill and practice exercises	2.50	2.71	2.60	A
11.	Simulations	3.00	2.56	2.72	A
12.	Games	2.65	2.72	3.00	A
13.	Computer managed instruction for: Keeping tracks of students records	3.00	2.56	2.96	A
14.	Personnel records	2.63	2.91	2.81	A
15.	Marking and scoring of test.	3.00	3.11	3.15	A
16.	Internet connectivity to allow access to: Browsing for information	2.70	2.56	2.52	A
17.	E-mail	2.56	2.96	2.72	A
18.	Virtual field trip	2.64	2.73	2.56	A
19.	e-classroom	2.60	2.72	2.80	A
20.	e-laboratory	2.76	2.96	2.64	A
21.	World Wide Web (WWW)	2.73	2.53	3.00	A
22.	Television programmes	2.90	2.62	2.96	A

Table 3 showed that all items 9-22 scored up to 2.50 and above, showing the acceptance of mean levels. This reveals that all the listed ICT practices are accepted to be integrated into the science education curriculum for renewal.

Table 4 below showed that all the mean ratings of the respondents from 23-33 items scored up to the acceptable mean of 2.50 and above except the item 33 which scored below the acceptable mean. This is an indication that ICT practices do not produce learners who will depend on others for survival.

Table 4: Mean Ratings on the ICT Practices for producing Scientific Literate Persons

S/N	Items on the potentials of ICT practices	Curriculum experts mean	Principals mean	Science Teachers Mean	Decision
	ICT Practices could do the following in producing scientific literate persons:				
23.	Motivate and sustain student's interest in learning.	2.71	2.62	2.80	A
24.	Facilitate the acquisition of basic science technology and mathematics.	2.65	2.56	2.72	A
25.	Facilitate the acquisition of higher-order thinking skills and problem solving	2.70	2.91	2.62	A
26.	Acquisition of competencies necessary for self-reliance.	2.91	2.64	2.52	A
27.	Provide life-long education which is the nations educational policy.	2.81	2.72	2.86	A
28.	Help in transferring in school experiences to out-of-school reality.	3.00	3.11	2.15	A
29.	Increase access to and improve the relevance and quality of education	2.86	2.72	2.80	A
30.	Enable learner access to a wider range of information resources	2.56	2.61	2.72	A
31.	Provide studies in technology and cause of technological development	2.72	2.81	2.60	A
32.	Equip learners with the skills of functional literacy in a digital age.	2.62	2.90	2.71	A
33.	Produce learners who will be dependent on others for survival	2.00	2.11	1.96	D

Table 5: Mean Ratings on Strategies for Successful Integration of ICT Practices into Science Education Curriculum

S/N	Items on Strategies for Successful Integration	Curriculum experts mean	Principals mean	Science Teachers Mean	Decision
	The following Strategies Should be put in place for Successful Integration of ICT Practices into the Curriculum				
34.	There has to be agreement between the curriculum planners and other stake-holders that the integration is good.	3.20	3.10	3.11	A
35.	Needs assessment has to be conducted in order to provide basis for comparison between the standards and the status quo	2.80	2.72	2.62	A
36.	Statement of educational goals has to be stated in clear terms	2.71	2.65	2.52	A
37.	Specification of computer educational programmes for JS 1-3 and SS 1-3 have to be stated clearly	2.82	2.90	2.52	A
38.	There have to be provisions of infrastructural facilities like computer laboratories in all the secondary schools.	2.71	2.53	2.90	A
39.	Internet connectivity is needed	2.60	2.71	2.62	A
40.	Employment of computer specialists are needed for consultancy services.	2.52	2.60	2.52	A
41.	Staff development strategies are needed through: Series of ICT workshops	3.00	3.15	3.11	A
42.	International conferences	2.59	2.63	2.51	A
43.	In-school awareness seminars to stimulate the interest and appreciation of ICT potentials.	2.50	2.72	2.90	A
44.	Training in some specialized areas like; Database management	3.00	2.91	2.71	A
45.	Computer Assisted instruction	3.15	3.11	3.10	A
46.	Computer managed instruction	2.52	2.60	2.93	A
47.	Internet Browsing	2.64	2.71	2.65	A
48.	Evaluation of the educational programme	2.72	2.96	2.80	A

In table 5, all the respondents mean rating in items 34-48 scored up to 2.50 and above thus indicated that all the listed strategies were good for successful

integration of ICT practices in science education curriculum.

Table 6: ANOVA Summary for the Mean Ratings of Curriculum Experts, Principals, and Teachers on the Potentials of ICT Practices in Producing Scientific Literate Individuals ($P < 0.05$ level of significance).

Source of Variation	Sum of Squares	DF	Mean Square	F-Cal	F-crit	P
Between Groups	0.003	2	0.005	0.00414	3.11	$H_1 > 0.05$
Within Groups	56.927	157	0.362	0.005		
Total	56.930	159				

Table 6 revealed that F-calculated is 0.00414 while F-critical is 3.11. The F-calculated is less than the F-critical. Thus, we fail to accept the null hypothesis of no significant difference.

DISCUSSION OF THE FINDINGS

The findings in table 2 showed that all the respondents, curriculum experts, principals and teachers were of the consensus that all the listed items were reasons that necessitate curriculum revision. This findings is in line with the views of Ugwu (2003) who observed that traditionally, school curriculum has been highly and primarily intellectual, bookish, abstract and theoretical. The best and often most highly acclaimed students have been those who are able to re-cogitate facts, equations, formal logic, citing chapters and verses, as well as accurately manipulating verbal symbols. Therefore, there is need that the science education curriculum be restructured to integrate ICT practices in order to effectively produce learners who will be scientific literate.

Table 3 revealed that all respondents accepted that all the ICT practices listed should be integrated in reviewing the science education curriculum. This fact was admitted by Ivowi (2000) in Anaekwe and Obi (2002) who stated that the education system should be effectively modeled towards science and technology with a focus on the creation of science and technology awareness at the primary level, absorption of science and technology knowledge and thinking at the secondary level and actualization of science and technology through design, construction and production at the tertiary level.

The study revealed in table 4 that the respondents agreed with all the items but one that the ICT practices have the potentials for producing scientific literate individuals. The Anova test for null hypothesis I showed no significant difference in the mean ratings of curriculum experts, principals and teachers. This findings is in line with Asogwa (2008) who stated that one of the benefits of ICT is to make students become independent learners and good beginners. The study also revealed in table 5 that all the listed items should be adopted for successful integration of ICT practices into the science

education curriculum. This is an indication that all the strategies listed were good for successful integration. The respondents agreed that the first strategy in science education curriculum revision is agreement. There has to be agreement between the policy makers and other stakeholders that the curriculum needs renewal. This is in line with the view of Okeke (1996) who opined that, worthwhile curriculum revision process must begin with agreement on what needs to be changed.

CONCLUSION

The paper looked at the factors which necessitated curriculum change among which was, that the products of secondary schools generally are not productive in this digital age. The researchers therefore advocated that the restructuring of the science education curriculum be made by integrating ICT practices. It was affirmed that ICT practices have the potentials for producing scientific literate individuals who would be self-reliant, critical thinkers, problem solver, independent learner, competent and fully equipped with the skills of functional literacy in information age. They will be knowledgeable and have an understanding about natural phenomena, to be able to contribute to their immediate society and to the sustainability of the entire nation. The strategies through which this curriculum review would be adopted were highlighted among which were that there have to be agreement that the idea is laudable and that there would be staff professional development in the where-withal of ICT practices.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. The science education curriculum should be revised to accommodate ICT practices.
2. The curriculum planners should come up in clear terms with the activities or programme of studies in the recommended computer education in the National Policy on Education.
3. This programme of activities should be sent to all the secondary schools for immediate take-off of computer course.

4. Adequate infrastructural facilities and technological equipment should be provided by state and federal government.
5. Priority should be given to staff and professional development in ICT.

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