

EFFECT OF SCIENCE EDUCATION ON RESEARCH AND INNOVATION

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Abstract

This study investigates the effect of science education on research and innovation in the technological advancement of the society. It is well known that education quality is far behind that of many countries. To learn from the example of Malaysia and Singapore there is need to have an in-depth study of the effect of science education on research and innovation. The study employed survey type of research design and two research questions were addressed. The sample consisted of 400 science teachers which were randomly selected from 50 secondary schools from the 5 Local Government Areas in the central senatorial district of Kogi state. Data was collected using two research instruments namely: Science Teachers Assessment Questionnaire (STAQ) and Public Assessment Interview (PAI). STAQ contained 30 items in Likert format and PAI contained check list of various facilities. The data collected were analyzed using mean of respondents to answer the research questions. The study revealed that science teachers' efforts were creative and thereby influenced the learners to be creatively inventive for societal development. It was observed that those students taught by selectively creative trained teachers performed far better than those taught by untrained teachers. It was therefore recommended that government should provide affordable equipment in science laboratories and workshops to promote inventive thinking in the learners.

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Education is mostly used to shape society in the classroom base on scientific research and innovation. This is believed by many advanced countries and it is not a mere rhetoric. The difference between developed and developing nation is based on the quality of life of the people which is determined by the level of development in science and technology. Education generally is meant to produce qualitative individuals for the eventual development of the society. This implies that education is a process used in transmitting culture and worthwhile values in terms of continuity and growth, and disseminating knowledge either to ensure social, economic or political control or to guarantee national progressive developmental stride in science and technology. Aibongbe (2010) in Omiko A. and Ocho (2005) observed that education is one of the greatest instruments for economic, social, political and overall human resource development of any nation. Also, according to Fafunwa (1974), this it does through the process of developing in a child or adult the abilities, attitudes and other forms of behavior which are of positive value to the society in which he lives.

Then, according to Kattari (2014), in a world base on science and technology, it is science education that determines the level of prosperity, welfare and security of the people. According to Uzoechi (2014), programmes of science education should be able to produce citizens who can apply their knowledge, skills and experiences to solve real life problems by harnessing the resources from their environment for the

betterment of the society. The quality and number of persons coming out of our schools and colleges will depend on our success in the great enterprise on national reconstruction to raise the standard of living of the people.

Research is defined in Oxford dictionary as a careful study of a subject, especially in order to discover new facts or information about it. Insights from several researches from different field on how people learn to become experts can help to dramatically enhance the effectiveness of science, technology, engineering and mathematics education. STEM education is critical to the advanced nations particularly the United States of America. Science is very critical to the future of World-powers because it is very relevant to the economy and the need for a citizenry to be able to make wise decisions on issues faced by modern society.

Several awareness have been created by nations that need technological advancement for improvement and have become increasingly widespread and desperate. There have been countless national, local and private programmes aimed at improving STEM education, but there continues to be very little discernible change in either students' achievement or interest in STEM.

Innovation has been numerously defined by different researchers but in science education, innovation is defined as introduction of novelties, the alteration of what is established, novel practice and change in established method. However, in the field of education innovation means

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creating something new which markedly deviates from traditional practices that have been in existence for a long time in order to impart education at different levels (Chauhau, 1979). Innovation refers to creative selection, organization and evaluation of human and material resources in new and unique ways which will result in the attainment of a higher level of achievement for defined goals and objectives (Ibraheem, 2014). A nation like Nigeria with positive role that necessarily have to be engaged with series of researches that bring about innovation that promotes the image of our nation. It will enable her to compete favorably well in this era of globalization.

According to the National Research Council (2007), the vitality of the nation is derived in large part from productivity of well-trained people and the steady stream of scientific and technical innovation they produce. In order to achieve this, our science teachers should include programmes that must be geared towards engaging learners in the excitement of science, helping them discover the value of evidence-based reasoning and higher order cognitive skills; this will enable the citizens utilize learning experiences to induce and manage positive change that could improve the standard of living in the society.

This paper discusses the importance of science teachers in guiding students to develop quality of creativity on research work that could bring about a sense of innovation during practical science, in collaboration with well-

equipped laboratories with modern equipments that initiate and promote research finding that are inventive in nature.

This paper is out to investigate the effectiveness of science education in research and innovation towards technological development of the society. This therefore, becomes the focus of this investigation.

Purpose of the Study

The major purpose of this study is to appraise the extent to which science education plays a vital role in research and innovation towards the technological development of the society. The study also specifically intends to:

- a. Find out the efficacy of science teachers strategies in imparting creativity in the learners to promote inventive thinking in them towards making the society technologically advanced.
- b. Find out whether science education will develop positive impact in the learners and also human capital development.

Research Question

The following two research questions were formulated to guide the study and tested at 0.05 level of significance:

1. What strategies can science teachers use to inspire research innovation in science students?
2. To what extent has research innovation made positive impact on the immediate society?

Science Teachers

Science teachers are the nerve centre for technology advancement in any society. Hence it is a must for any nation to rise above poverty and backwardness and this rest heavily on the shoulders of science teachers. According to Onu (2007), it is a well-known fact that no technologically advanced nation is poor and no poor nation is technologically advanced. This has a lot of implications for science education which is the centre of research innovation.

These implementers of national curriculum are very relevant in the development of skills among the learners. They equip the learners with attributes such as scientific enquiry, power of observation, mastery of manipulative skills, resourcefulness and mechanical comprehension (Iherechery, 1998). These qualities enable science learners to meaningfully engage in research work and reason inventively towards innovation.

It is the teacher that possesses that quality that leads the learners to think in a highly imaginative way that apply the knowledge rather relating it to the existing knowledge to foster creative thinking in the learners. This could lead them to inventive reasoning that promotes the society technologically. Teachers are capable of this being that they are motivators, facilitators, role model, and friends to the learners and as one who is actively involved in achieving the laid down educational objectives (Omadivi, 2011). They also impart knowledge with multiple ways of encouragement. They

teach with concepts that are known to the learners to explain things that are abstract.

According to Uzoechi (2014), a creative science teacher should be able to know when it will be most important or appropriate to use direct teaching, inquiry, discovery, project or group work. Teachers' field of adequate content knowledge and ability to create an appropriate learning environment also add to the creative way of imparting knowledge to the learners. The researcher also identified that the popular method of instruction in most institutions particularly in secondary school science (biology inclusive) is mainly expository (Okoli, 2006; Aniodo and Ebo, 2013). This method concerns mainly verbal presentation of subject matter which is mainly teacher centered. By this method, the teacher only presents lessons without any hand-on or practical activity to the students. According to Ezenduka, et al (2014), expository method lacks innovation and does not encourage learning conditions that foster creativity in science learning. So, based on this, most science teachers adopted an innovative teaching approach that enable students participate in the lesson, acquire skills, generate ideas and develop critical thinking to enhance creativity that bring about innovation.

Methodology**Research design**

The research was based on survey design meant to collect data from science teachers. A survey design according to Olaitan and Nwoke (1999) is one in which

the entire population or representative sample are studied by collecting and analyzing data from the group through the use of questionnaire, interview or field observation. The area of the study was Kogi state which comprised five local government areas in the central senatorial district of the state. The population for the study was 400 respondents made up of 250 Biology teachers, 60 Chemistry teachers, 50 Physics teachers and 40 Agricultural science teachers.

Instrumentation

Two research instruments were used for the collection of data. They are: Science Teachers Assessment Questionnaire (STAQ) and Public Assessment Interview (PAI). The STAQ contained 30 items and they were in the likert scale format; each having five response options with specific marks ranging from A indicating strongly agree = 5, B – agree = 4, C – undecided = 3, D – disagree = 2 and E – strongly disagree = 1. The second instrument known as Public Assessment Interview was a check list for various science, technological, vocational and ICT facilities. PAI was used to identify some facts that science teachers may hesitate to release which are vital information for the researcher. From a written record of responses; it was established that science teachers' efforts were creatively inventive for societal development. The instruments were validated by three experts in the area of science education, measurement and evaluation for face validity, all from Faculty of Education, Ahmadu Bello

University Zaria. The corrections were effected before the final questionnaire was constructed.

Data Collection Procedure

The instruments were administered on the science teachers in the respective schools with the help of five research assistants, one for each local government covered by the study. 400 copies of STAQ questionnaire were served to the science teachers. PAI interview check list was conducted to some sampled public servants.

Data Analysis

To analyze the data collected with the questionnaire, the two research questions were answered using mean and simple ranking. An acceptance criterion mean of 3.5 was used for the research questions. The questionnaire was meant to answer the two research questions formulated for the study using the five Likert points scale format. To ascertain the reliability of the STAQ and PAI, they were administered twice on the respondents at an interval of two weeks. Two schools, one public and one private school were used for test and retest reliability. The results of the separate exercise were correlated by applying the Pearson's Product Moment Correlation Statistics. The coefficient of $r = .82$ was obtained and this was considered adequate enough in ascertaining interval consistency of the items in the instrument.

Result

Research Question 1: What strategies can science teacher use to inspire research innovation in science students?

Table 1: Mean Responses of Science Teachers on the Strategies they use to Inspire Creative-Innovation in Science Students.

S/N	Items	Responses						Remark
		A		N	A	D	ean	
1.	Research work arouses interest in the learners.	96	22	24	48		3.88	Accepted
2.	It encourages students to become independent in their learning and thinking.	80	20	40	32	40	3.64	Accepted
3.	Gives room for research experiment for inventiveness.	96	19	16	32	64	3.56	Accepted
4.	It makes hard working students to be recognized and be regularly rewarded.	12	22	8	16	32	3.96	Accepted
5.	It allows students to further their thinking.	11	23	8	16	32	3.96	Accepted
6.	It supports students led discovery.	96	18	16	32	8	3.50	Accepted
7.	Practical activities lead students' ability to apply their knowledge in further research.	96	22	24	48	8	3.88	Accepted

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8.	Promotes research activities for inventive innovation.	12	20	8	32	40	3.85	Accepted
9.	It prepares learners to acquire scientific facts and theories.	12	20	8	32	48	3.76	Accepted
10.	It helps students to build their self-efficacy.	96	22	8	48	24	3.88	Accepted
11.	It inspires creative skills.	96	18					
12.	It enables students to apply skills in solving problem in real life situation.	96	19	16	32	64	3.56	Accepted
13.	It provides skills for healthy life style.	12	19	8	32	48	3.76	Accepted
14.	Helps to ensure students acquire knowledge and skills necessary for innovation.	14	16	8	32	48	3.82	Accepted
15.	Provides a stimulating environment for creative learning.	11	17	48	24	40	3.74	Accepted
16.	Gives students the opportunities to work on project that build their	80	20	40	32	40	3.64	Accepted

	creative potentials.							
17.	Allows students to reflect upon ideas and concepts from different points of view.	16	16	24	24	16	4.14	Accepted
18.	It helps students to connect their ideas to their own experiences and emotions.	11	23	8	16	32	3.94	Accepted
19.	Encourages the learners to set time for creative activities.	80	19	40	32	56	3.52	Accepted
20.	Encourages students to analyze and work through mistakes.	96	18	16	32	72	3.50	Accepted

All the items in Table 1 were accepted by science teachers as the strategies science teachers possibly inspire for creative innovation in the learners to promote technological advancement in the society.

Research Question 2: To what extent has research innovation made positive impact on its immediate society?

Table 2: Mean Responses of Science Teachers on the Positive Impact that Research and Innovation have on its Immediate Society.

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/N	Items	Responses						Remark
		A		N	A	D	ean	
1.	It provides more scientists for technology advancement in a society.	176	160	24	32	8	4.16	Accepted
2.	It promotes invention for national development.	176	160	24	24	16	4.14	Accepted
3.	It promotes more scientists that engage in invention.	160	160	32	32	16	4.04	Accepted
4.	It prepares individuals to be resourceful technologically.	160	192	—	64	16	4.12	Accepted
5.	It equips individuals qualitatively for the eventual development of the society.	144	192	—	32	32	3.96	Accepted
6.	It promotes skill for the society development.	112	232	8	16	32	3.94	Accepted
7.	It provides self-employed individuals in the society.	200	184	16	—	—	4.46	Accepted
8.	It reduces the rate of mortality in the society.	192	192	16	—	—	4.44	Accepted
9.	It promotes skills for healthy life style, socio-economic survival, self-reliance and self-sustenance.	192	184	24	—	—	4.42	Accepted
0.	It improves standard of living in the society.	176	160	24	24	16	4.14	Accepted

The data in the table 2 above, indicated that all the items there-in were accepted by the respondents as the impact that the research, innovation and science education have on the society.

Discussion

The first result on the study is from Public Assessment Interview that revealed the fact that, in a situation where science by doing is a usual habit of an

institution, laboratory activity is always encouraged. Here the learners are always encouraged to work in productive and supportive groups where questions are made part of the daily activities that help to build their self-efficacy. During laboratory activities, science students' ideas are connected to their own experiences and emotions that made them to be creative in thinking that assist them

well in research and innovative work that support students' led discovery.

Then, the result of the analysis from table I revealed that science teachers agreed with all the items. The mean realized from the respondents were used for data analysis. It revealed that science teachers' efforts were creative and that usually gives students opportunity to create and try something new; thereby influencing the learners to be creatively inventive for the societal development. This finding is in agreement with the statement of Ahmed M.M. (2011) that teachers can promote active learning through laboratory activities that allows students to further their thinking by brainstorming, modeling, creative thinking, and inventiveness. Supporting this, Nonye B.E, (2014) stated that when implementing creativity into the classroom, teachers should allow students to reflect upon ideas and concepts from different points of view. Also they should repeatedly encourage idea generation that consequently results to inventiveness towards making the society technologically advanced.

Table 2 answered the research question 2 which is on the positive impact of research and innovation on the immediate society. This agreed with the findings of Omadivi O.A. (2011) who stated that the impact research and innovation have is to make the society economically balanced. It also inspires creativeness and skills to improve the standard of living of individuals in a nation that is technologically advanced.

Furthermore, report on teaching under observation, established that, there was a significant difference between the performances of students taught by creatively trained teachers and those taught by untrained teachers. This is in line with the result of Obori (2015) which was established on science teachers' competence; which revealed that students taught by well trained teachers performed far better than those taught by untrained teachers.

Conclusion

The results of this research work have further established that, science education has a great effect on research and innovation that develops a nation to compete favorably well globally. The most effective strategy for sustaining peace and national development is to stimulate interest of younger generation towards science education on research and innovation by emphasizing on more dynamic and functional science practical activities where their mind could be easily lured into serious research work by creative and innovative methods of teaching. This promotes the nation technologically which in turn enhances economic productivity, protective educational and individual well-being that fosters the needed growth of the nation.

Recommendations

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

1. Federal government should try to buy science equipments like

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the mass consignments of 1981 to all the secondary schools in the country so as to make the nation a technologically advanced one.

2. Federal government should make the condition of service of teachers to be reasonably comparable with those teachers in the advanced nations

3. In-service training should be given to science teachers on educational technology particularly on the production and use of computerized instructional materials.

4. Government should embark on massive recruitment of teachers offering them lucrative salaries.

5. Class size should be stream lined to correspond with the provision in the National Policy on Education for effective teaching and learning exercises.

6. Government should provide infrastructural facilities in public schools for science teachers to promote creative teaching for research and inventive thinking of the students.

References

- Ahmed, Modibbo Mohammed (2011). Teachers Education as it Affects Wealth Creation and Empowerment: *Nigerian Journal of Professional Teachers: An International Journal of the Teachers Registration Council of Nigeria*. (2), 94-102.
- Aniodo, H.C.O. and Egbo, J.J. (2013). Effect of Inquiry Role Approach on Students Achievement in chemistry. *Proceedings of the 54th Annual Conference of STAN, Awka Zone*.
- Fafunwa, A.B. (1983). *Development of Education, Trends and Issues in Nigeria Education*. Ife, University of Ife Press limited.
- Federal Republic of Nigeria (FRN, 2004). *National Policy on Education*. Yaba, Lagos NERDC press.
- Ibraheem A.O. Obori (2015). Influence of Science Teachers' Competence on the Students' performance in secondary School Biology. *Academic scholarship Journal*. 10(1), 177 – 186.
- Kattari, D.S. (2012). Re-Engineering Education for Employment and Self Productivity in Nigeria. *A Paper Presented at the 14th Annual National Conference of National Association for Advancement of Knowledge (NAFAK)*. Auchi Polytechnic, Auchi. 4(1), August, 119-128.
- Nnaka, C.V. (2006). Innovative strategies for Effective Teaching and Learning of Science, Technology and Mathematics (STM) in Schools. *A Key Role Address Presented at the Workshop of STAN, Awka Zone*.

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- Nonye Blessing Emmadiole and Uzoечи, Benneth Colman (2014). Clementina Ukamaka Okafor, Enhancing Students' Creativity (2014). Strategies Teachers can Through Innovation Science, use to Inspire Creativity in Senior Technology and Mathematics Secondary Biology Students. Teaching. STEM Education and *Science Teachers Association of Nigeria Journal*. Creativity. *Science Teachers Association of Nigeria*.
- Okoli, J.N. (2006). Effect of Investigative Laboratory Approach and Expository method on Acquisition of Science Process Skills by Biology Students of Different Level of Scientific Literacy. *Journal of Science Teachers Association of Nigerian*
- Omadiyi, A.O. (2011). Critical Thinking Skills Approach to improving Science Education in Nigeria: The Role of Science Teachers. *Journal of Science and vocational Education (JSVE)*. 5, 54-59.
- Omiko Akani (2014). Creativity-Oriented Science and Technology Curriculum for Secondary Schools in Nigeria: *Implication for Science Teachers Association of Nigeria*.
- Oni, C.S. (2007). Developing Vocational Education through Computer Literacy in Nigerian Junior Secondary School. Retrieved 14 September, 2009 from <http://nesu.edu/meridian/simmer2007/Oni/index.htm>.