RE–ENGINEERING CHEMISTRY EDUCATION FOR NATIONAL DEVELOPMENT THROUGH DEVELOPMENT OF CREATIVITY SKILLS IN SECONDARY SCHOOL STUDENTS IN ANAMBRA STATE

[1]Evelyn Obianuju Egolum (*Ph.D*)
Department of Science Education, Nnamdi Azikiwe University Awka
eo.Egolum@Unizik.Edu.Gn

&

[2]Benson Ikechukwu Igboanugo (*Ph.D*)
Department of Science Education,Alex Ekwueme Federal University, Ndufu-Alike, 2Ebonyi State
bensonigboanugo@funai.edu.ng

Abstract

The purpose of this study was to find out how chemistry education can be re-engineered for national development through development of creativity skills in secondary school students. Four research questions guided the study. A survey research design was used for the study. The population was all the chemistry teachers in public secondary schools in the six education zones of Anambra State. The sample used for the study was ninety four (94) chemistry teachers selected from the fifty four (54) secondary schools used for the study. A structured questionnaire was used as an instrument to collect data for the study. The instrument was validated by experts and it has a reliability coefficient of 0.83 using Cronbach Alpha technique. The data collected was analyzed using arithmetic mean. The findings of the study among others indicated that the chemistry teachers used for the study were aware of most of the creativity skills that can be used to re-engineer chemistry education for national development but t2hey only teach to develop those skills in their students to a moderate or low extent. Only few of the teachers teach to develop those skills to a high extent. It was recommended among others that practical activities should be introduced and enforced in the teaching and learning of chemistry to develop skills in students.

Key words: Re-engineering, National development, Creativity skills, Chemistry education

Introduction

National Development is a process of reconstruction and development in various dimensions of a nation and development of individuals. It includes full growth and expansion of our industries, agriculture, and education, social, religious and cultural institution. National development includes all aspects of life of an individual and the nation (Bawa, 2022). It is the ability of a country to improve the social welfare of its citizens that is the capacity of a country to raise the standard of living of its residents. Dimensions of national development include educational, health, cultural, social and technological. We can improve national development by promoting education in general and science education in particular.

Science education is a veritable instrument for national development. Chemistry is an important science subject due to its nature and there is no controversy in understanding that chemistry due to its nature is of paramount importance for national development. Chemistry affects the people of our planets, protect and preserve our health, ecology, culture and wealth. Its principles, theories, technique and effective applications are the pedals for many industrial processes (Nleonu and Ezeibe, 2020) .Chemistry addresses the needs of majority through its relevance and functionality in content , practice and application (Egolum and Njelita,2015).

Chemistry education has been indentified to be one of the major bedrock for the transformation of our national economy (Udofia and Ekong, 2017). It is considered as a key agent of development either as a way of developing human capacity, increasing the skilled workforce or modernization or as a matter of personal freedom, developing capability and empowerment (Ayodele, 2018). Chemistry teaching should therefore enable young people have access to new knowledge and to expect change. For the change to be scientifically reasonable and meaningful, chemistry teachers must try to re-engineer chemistry education so as to impact creativity skills in their students and thus make them creative. When one is creative, it means that person has productive learning and can find new solutions to problems.

Creativity is all about originality, imagination, inspiration, ingenuity, inventiveness, resourcefulness and vision (Ibiri, 2014). Creativity is a mental activity performed where there is no prior correct solution or answer (Egolum, Igboegwu & Okonkwo, 2015). Creativity is the act of training new and imaginative ideas into reality (Naiman, 2010). It is involves two processes thinking and then producing. It is an experience of thinking characterized by a high d2egree of innovation, originality, divergent thinking and risk- taking. It requires passion and commitment. Creativity involves different kinds of intelligent working together. It is a universal concept and can be developed through training and practices (Ugwuda and Odo, 2014). According to Rees (2020), if we wish to encourage more students to do chemistry, we need to do more to emphasize the creativity that lies at the heart of scientific endeavor. According to Otuka (2004), creativity is something everyone e possesses in varying degree; everyone is born with some creative potentials. Creativity occurs at almost all ages and in all fields of human endeavor

Creativity is inherent in every person, but most people lose it as a result of influence of various factors (Maslow, 1999). The development of student's creativity should be one of the main goals of the activities of secondary school teachers. The nature and degree of development of student's creativity depends on their skill, personal competence as well as the application of innovative methods in teaching (Egolum, Igboegwu & Okonkwo, 2015) and forms of conducing classes. Creativity requires a safe environment in which to play, exercise autonomy and take risks. Creativity is a cluster of skills that are needed to produce ideas that are both original and valuable (Sternberg in Pugliese, 2020). Skills are expertness, practical

ability, dexterity and facility for doing something such as observing, cutting, manipulating, assembling, classifying, repairing, generalization and so on. Creativity skills is learned abilities related to bring forward more novel and useful outcomes and products which can be developed deliberately and enhances through practice, feedback and diverse applications. When students creativity skills are developed when teaching chemistry, they will graduate and be self reliant instead of looking only for white collar jobs which are non-existence.

One of the goals of education is to foster and encourage creativity and critical thinking (Ugwu, 2008). But in Nigeria, more emphasis is placed on measuring student's performance and knowledge acquisition with total neglect to skill acquisition and creativity, also in almost all the developed countries in the world, one time or the other involved re-engineering science education with different methods for different purposes (Ibraheem, 2012). Nigeria as one of the developing countries in the world will not be an exception in the area of re-engineering its science education generally and chemistry in particulars.

To re-engineer chemistry education is to meet the emerging needs of population and the nation as a whole so that our nation will be lifted to higher realm economically, socially and technologically. To re-engineering chemistry education for creativity, the curriculum should be carefully designed to encourage inculcation of skills and adaptations in the use of innovative 82teaching approaches. Teachers need to have a clear understanding of what creativities skills are so that they can recognize them and develop them. Therefore the researchers want to find out if chemistry teachers are aware of creativity skills and if they use them and also how chemistry education can be re-engineered for national development through development of creativity skills in secondary school chemistry students

Purpose of the Study

The purpose of this study is to find out how chemistry educa2tion can be re-engineered for national development through development of creativity skills in secondary school students.

Specifically, the study sought to;

1. Find out the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development
2. Determine the extent secondary school chemistry teachers teach to develop creativity skills needed for re-engineering chemistry education.
3. Ascertain the factors that hinder chemistry teachers in secondary schools from developing in their students creativity skills needed for re-engineering chemistry education.
4. Suggest strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students.

Research Questions

The following research questions guided the study;

1. What are the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development?

2. To that extent do secondary school chemistry teachers teach to develop creativity skills needed for re-engineering chemistry education for national development?

3. What are the factors that hinder chemistry teachers in secondary schools from developing creativity skills needed for re-engineering chemistry education in their students?

4. What are the strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students?

Methods

The study adopted a survey research design because it is the best technique for obtaining the necessary data from a group and involves the use of questionnaire to determine the options, preferences, attitudes or perceptions of people about a particular situation. The study was conducted in the six (6) education zones of Anambra state of Nigeria. The population of the study was all the chemistry teachers in public secondary schools in the 6 zones. Purposive sampling technique was used to select nine schools from each of the 6 zones making it a total of fifty four (54) schools. The schools selected were those that have more than one or at least one chemistry teachers. All the chemistry teachers in the fifty four schools selected were used for the study so the sample size was ninety four (94) chemistry teachers.

The instrument used to collect data relevant for answering the research questions was a structured questionnaire termed chemistry teachers response on the creativity skills needed to re-engineer chemistry education for national development. The questionnaire had two sections (A and B). A contained the respondents biodata. Section B consisted of fifty one (51) items and was made up of four sections (i, ii, iii and iv). Items on sections (B) (I, iii and iv) was built on a four point rating scales of Likert type of Strongly Agree (SA) – 4 points, Agree (A)-3 points, Disagree (D)-2 points and Strongly Disagree (SD) – I point. Items on B11 was built on a four point rating scale of Likert type of Very High Extent (VHE) – 4 points, High Extent (HE)-3points, Moderate Extent (ME) -2 points and Low Extent (LE) – 1 point. The face and content validity of the instrument was determined by giving the questionnaire to 3 experts, two from science education department and one from the department of measurement and evaluation all from Nnamdi Azikiwe University Awka. The reliability of the instrument was done using Cronbach Alpha technique and the reliability coefficient was 0.83. Thus the instrument was considered reliable for the study. The instrument was administered to the respondents by the help of research attendants and a total of ninety four (94) questionnaires were returned. The data collected was analyzed using arithmetic mean with decision point 2.50. Items with means of 2.50 and above were accepted while items with means less than 2.50 were rejected.

Results

Research Question One: What are the creativity skills needed to be developed in secondary school chemistry students to re-engineer chemistry education for national development?

Table 1: Mean responses of chemistry teachers on the creativity skills needed to re-engineer chemistry education for national development

S/N	ITEMS	SD	A	D	SD	X	DECISION
1	Making observation	32	54	2	6	3.52	A
2	Imagination	18	33	24	19	2.53	A
3	Curiosity	27	30	28	9	2.80	A
4	Asking questions	40	42	4	8	3.21	A
5	Collaboration	31	26	20	17	2.76	A
6	Effective communication skills	50	25	11	8	3.21	A
7	Self motivation	42	32	19	2	3.23	A
8	Problem solving	42	40	9	5	32.31	A
9	Experiment	31	53	6	4	3.18	A
10	Developing own project	30	27	22	15	2.77	A
181	Effective data analysis	26	31	29	8	2.80	A
12	Net working	16	19	42	17	2.36	A
13	Open mindedness	26	39	24	5	2.91	A
8	**GRAND MEAN**					**2.97**	

Results on table 1 showed that all the items except networking were regarded as the creativity skills needed to re-engineer chemistry education for national development. They all had mean score above 2.50 except item 12 hence their grand mean was 2.9.

Research Question Two: To what extent do secondary school chemistry teachers teach to develop creativity skills needed for re- engineering chemistry education?

Table 2: Mean responses of chemistry teachers on the extent they teach to develop creativity skills in their students.

S/N	ITEMS	VHE	HE	ME	LE	X	DECISION
1	Marking observation	20	18	8	48	2.10	ME
2	Imagination	9	11	30	44	1.84	LE
3	Curiosity	7	19	50	18	2.16	ME
4	Asking questions	21	48	16	9	2.86	HE
5	Collaboration	15	20	41	18	2.34	ME
6	Effective communication skills	13	22	40	19	2.318	ME
7	Self motivation	15	9	46	24	2.16	ME
8	Problem solving	21	18	12	43	2.18	ME

9	Experiment	25	32	22	15	2.71	HE
10	Developing own project	11	43	17	25	2.47	ME
11	Effective data analysis	6	15	53	20	2.07	ME
12	Net working	6	20	23	45	1.86	LE
13	Open mindedness	8	22	20	44	1.94	LE
	GRAND MEAN					**2.23**	

Table 2 revealed that chemistry teachers used for the study use only items 4 and 9 to a high extent, items 3, 5, 6, 7, 8, 10 and 11 were used to a moderate extent while other items were used to a low extent. The grand mean of 2.23 indicated that the chemistry teachers used for the study teach to develop those creativity skills to a moderate extent.

Research Question Three: What are the factors that hinder chemistry teachers in secondary schools from developing creativity skills in their students?

Table 3: Means responses of chemistry teachers on the factors that hinder their development of creativity skills in secondary school chemistry students.

S/N	ITEMS	SA	A	D	SD	X	DECISION
1	Teaching method and techniques	41	39	5	9	3.19	A
2	Teachers insufficient practical skills	54	31	6	3	3.45	A
3	Learning environment the teacher teaches	19	50	17	8	2.85	A
4	Fear of taking risks	29	41	22	2	3.03	A
5	Educational qualification and experience possessed by the teachers	45	22	16	11	3.07	A
6	Teachers inability to instill problems solving skills in their student	33	48	10	3	3.80	A
7	Lack of collaboration between teachers	8	27	50	14	2.26	D
8	Insufficient application areas	27	41	23	3	2.98	A
9	Insufficient instructional facilities	43	36	11	4	3.26	A
10	Intensive curriculum	30	42	18	4	3.04	A

11	Expectation of the child's community	8	15	45	26	2.39	D
12	Lack of teachers self confidence	10	42	15	2.7	2.37	D
13	Methods for evaluating pupils progress	45	30		181	3.27	A
	GRAND MEAN					**3.00**	

Table 3 revealed that chemistry teachers used for the study agreed that all the items in the table except items 7, 11 and 12 were among the factors that hinder chemistry teachers from developing creativity skills in their students.

Research Question Four: What are the strategies that can be used by secondary school chemistry teachers to re-engineer chemistry education through development of creativity skills in their students?

Table 4: Mean responses of chemistry teachers on the strategies they can use to re-engineer chemistry through development of creativity skills in secondary school chemistry students

S/N	ITEMS	SA	A	D	SD	X	DECISION
1	Build basic problem solving skills	33	53	4	4	3.22	A
2	Provide opportunity for discovery	39	28	17	10	3.02	A
3	Stimulate curiosity & explanation	29	28	21	16	2.74	A
4	Build intrinsic motivation	18	39	20	17	2.62	A
5	Encourage confidence & willingness to take risks	16	27	42	9	2.53	A
6	Teach chemistry using creative approach	51	26	10	7	3.29	A
7	Experiment with activities where students can practice creative thinking	30	45	18	1	3.11	A
8	Explore different creative theories	31	40	21	2	3.06	A
9	Teach techniques and strategies for facilitating creative performance	35	40	14	5	3.12	A
10	Be present with students ideas	29	43	17	5	3.02	A

11	Create enabling environment	40	34	20	0	3.21	A
Grand mean					**2.99**		

Table 4 revealed that all the items on the table were among the strategies that can be used to re-engineer chemistry education through development of creativity skills as indicated by the chemistry teachers.

Discussion

The findings of the study on the creativity skills needed to re-engineer chemistry education for national development revealed that except networking, making observations, problem solving, experimenting, open mindedness, effective data analysis, curiosity among others were the creativity skills needed to re-engineer chemistry education for national development. This study is in agreement with the work of Abubakar (2012) who in his work opined that for students to engage in laboratory work, identity problem, develop hypothesis, plan experiments, conductor experiment, gather data and do effective data analysis, it needs creativity thinking and skills.

Findings in table 2 revealed that teachers used for the study teach to develop skills of asking questions and performing experiments to a high extent when teaching chemistry. They also agreed they teach to develop skills of curiosity, observation, self collaboration, effective communication, self motivation, problem solving, making students develop their own projects and effective data analysis to a moderate extents but teach to develop the skills of imagination, networking and open – mindedness to a low extent.

Responses of teachers used for the study showed in table 3 that teaching methods and techniques, intensive curriculum, expectations of the child's community, fear of taking risk, and insufficient instructional materials among others are factors that hinder chemistry teachers from development of creativity skills in their students. This is in agreement with the work of Akkanat and Murat (2015) who found out that chemistry teachers do not have enough knowledge about teaching methods and techniques that were efficient in developing creativity ability of their students. They also found out that the allowed weekly lesson hours and curriculum was not effective for developing creativity. This is because chemistry education programme is too intense and weekly lesson hours for chemistry classes do not allow implementing any activities to develop creativity. But the study disagrees with the study of Akkanat and Murat (2015) in the area of risk taking is one of the factors that prevent them from developing skills in their students.

Table 4 revealed that creating enabling environment, teaching chemistry using creative approach, building basic problem - solving skills in students, developing motivation and willingness to take risks among others were among the strategies that can be used to re-engineer chemistry education through development if creativity skills in students.

Conclusion

Creativity is a trait that fuels the future. It serves to inspire students and should be integrated into every part of learning when planning and designing learning. When designing learning experiences, teachers can plan and frame curriculum and provide instructional recourses that give student options, voice and choice in order to enable them to be creative. Chemistry education can be re-engineered for national development when students are allowed to explore their creativity in relevant interesting and worthwhile ways. Also all possible techniques of teaching chemistry in our schools should be applied so as to produce creative citizens that will be self- dependent and self – productive for national development.

Recommendations

To re-engineer chemistry education for creativity

1. Improvised and use of locally available materials for practical experiments should be encouraged in our educational system to equip our students for self reliance
2. Practical activities should be introduced and enforced in the teaching of most chemistry topics to remove the abstract nature of chemistry concepts and replaced them with concrete experiences for creativity.
3. Chemistry curriculum should be re-structured to enable students relate chemistry to nature and society to equip them in the adequate practical skills for industrial technicians or chemical artisans
4. Seminars, Conference and workshops on ICT and practical activities should be encouraged among chemistry teachers to help them have confidence and develop creativity skills they will impact in their students.
5. Undergraduate education should be made to foster creativities by making changes in the university teaching and academic human resource policies using research and connecting resources that have sustainable benefits.

REFERENCES

Abubakar, T.(2012). Re-engineering creativity in science education: Implication for employment and self productivity. *Knowledge Review 25 (1) 61-64.*

Akkanat, G. and Murat, E. (2015). Chemistry teachers views of creativity. Asian Pacific Forum on Science Learning & Teaching, 16 (1) 5, 1-21

Ayodele, O.D. (2018). Restructuring secondary school chemistry education for sustainable development in Nigerian developing economy. *African Journal of ChemicalEducation, 8 (2), 93- 111.*

Bawa, B. (2022). National development: Meaning and problems. Scopus Indexed Conference. *International Conference on Applied Science, Engineering, Technologyand Management.*

Egolum, E.O. Igboegwu, E.N. & Okonkwo, C.O.(2015).Enhancing the creativity skills of chemistry students through innovative instructionaltechniques. *Journal of Resourcefulness and Distinction 10 (1), 157-165*

Egolum, E.O. and Njelita, C.B. (2015). Teaching chemistry for relerance through active-learning instructional strategies. *Journal of Science Education. 12 (1), 34-44.*

Ibiri, B.P. (2014). Pico stem sheeps network dimension of creativity, A panacea for educational challenges, poverty reduction and diseases control in the 21s century.

Ibraheem, A.O. (2012). Re-engineering science education for employment and self productivity in Nigeria. African Education Indices, 4(1), 119-128.

Maslow, A.H. (1999). The far units of the human psyche. St petersburg, 432

Naiman, E.C. & Ezeibe, A. (2020). The role of chemistry education in development of entrepreneurship program in Nigeria science. *View Journal, 1 (1), 24-27*

Pugliese C. (2020). Teaching creativity: What is creativity? Macmiccian Education Ltd.

Otuka, J.O. (2014). Foundation of science education. Macmillian Nigeria Publisher Limited for National Open University of Nigeria.

Rees, S.S. (2020). Why we need to teach chemistry creatively. Royal Society of Chemistry.

Udofia, T.M & Ekong, A.O. (2017). Chemistry education and enhancement of agricultural production. Implications for food security in Nigeria. *British Journal of Education, 5 (2), 94-103*

Ugwu, A.N. (2008). Current issues in implementation of senior school science curriculum in Nigeria. *Proceedings of the 49th Science Teachers Association of Nigeria Annual Conference. 19-25.*

Ugwuda, A.O. & Odo, J.A. (2014). Re-engineering science, technology, engineering and mathematics (STEM) education for creativity development in Nigeira. *55th Annual STAN Conference Proceedings, 55-60.*