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EFFECT OF SCIENCE-TECHNOLOGY-SOCIETY STRATEGY ON ENTREPRENEURIAL CREATIVITY AMONG UPPER-BASIC SCHOOL STUDENTS

[1]Ayua G, A & [2]Agbidye A.

Corresponding Author: Ayuageoffrey@gmail.com,
Department of Science and Mathematics Education, Benue State University, Makurdi, Nigeria

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Abstract

This study investigated the effect of Science-Technology-Society (STS) strategy on Entrepreneurial Creativity among Basic Science students in Upper-Basic Schools. A pre-test post-test quasi-experimental-control group research design was used. The study was guided by two research questions and two hypotheses. A sample of 69 upper basic II students purposively drawn from two schools out of the population of 1753 students in the 27 UBE JSS in Makurdi were used for the study. Entrepreneurial Creativity Observation Checklist (ECOC) was validated, pilot-tested with a Cronbach Alpha reliability coefficient of 0.81 and used for data collection. Mean ranks and mean rank difference were used to answer the research questions. The null hypotheses were tested at 0.05 level of significance using Mann Whitney U-test. Findings showed that the level of Entrepreneurial Creativity between students taught Basic Science using STS was higher than those in the control group. Also, there was no significant mean difference in the level of Entrepreneurial Creativity between boys and girls taught Basic Science using STS. This implies that STS is effective and gender friendly. So, it was recommended among others to be used in teaching Basic Science for the development of entrepreneurial creativity among students across gender.

Keywords: Entrepreneurial Creativity, Entrepreneurship Education, Science-Technology-Society.

Introduction

One of the major challenges of science education is how to make it functional, which is believed to be the secret of its success and this seems to be the most daunting. As a result, the right atmosphere necessary for functional science education is imperative. Although several factors are needed to attain this desired paradigm shift, the need for effective teaching and learning strategies may hardly be exempted. Education as defined by Ortese, Yawe and Akume (2005); and Okeke (2007) is the process individuals undergo to acquire knowledge, skills, abilities and attitudes leading to a relatively permanent change in behaviour that is necessary for effective and functional living in the society. This implies that the goals of education include production of entrepreneurial scientists. Therefore, the high incidence of poverty in Nigeria especially among the youth may likely be as a result of lack of entrepreneurial creativity. In the face of the serious and growing threat of unemployment in Nigeria today, the need for Nigerians to seek avenues for self-employment and self-fulfillment seem compelling.

It is against these backdrops that Mohammed and Funtua (2009) opined that since basic school is the foundation upon which the whole of the education system rests, its curricula should include entrepreneurship. This is in line with the goals of Nigerian education as stated in the National Policy on Education; that science should be taught at basic school level for the development of scientific and reflective thinking, adapting to changing environment, acquisition of manipulative skills and preparation for further studies/life (Federal Republic of Nigeria-FRN, 2013). However, it is observed that the right atmosphere for meeting such sound goals for functional science education is lacking (Nwosu, 2004; Ezeudu, 2008; Asiriuwa, 2009; Ibe, 2011). Entrepreneurship education at all levels of Nigerian education system has a lot of benefits to offer. Bolarinwa (as cited in Ezeudu, 2008) submitted that it brings about entrepreneurial skills acquisition leading to reduction of unemployment among youths and will play a complementary role in developing the occupational knowledge, job skills and work experience among teachers and students. To Jongur, Kabutu and Abba (2009) other advantages include: effective utilization of local resources, decentralization and diversification of business, promotion of science and technology, capital formation and promotion of the spirit and culture of entrepreneurship among Nigerian Youths. Although creativity and entrepreneurship were considered as separate concepts, Fillies and Rentschler (2010) reported that they have become increasingly interconnected in relevant literature in the 21st century because of the ties between them. Creativity is the heart/spirit of enterprise, key to innovation and gateway to successful entrepreneurship. Thus, entrepreneurial creativity deals with the relationship between creativity and entrepreneurship. It is about coming up with innovative ideas and turning them into value creating and profitable business activities.

According to Kotelnikov (2017) creative thinking skills, cross-functional expertise, motivation and entrepreneurial actions are the key elements of entrepreneurial creativity. Creative thinking skills include: inventive thinking, thinking outside the box, lateral thinking, asking searching questions, creative problem solving and radical thinking. Cross-functional expertise has to do with: systemic thinking, entrepreneurial mind-set and skills, master of business synergy and systemic innovation. Motivation on one hand it refers to internal motivation like love, burning desire to make a difference, creative dissatisfaction with the status and fun-driven creativity. On the other hand motivation means external motivation like creativity under the gun, problems, enemies and competitors. Entrepreneurial actions: deals with stretching oneself, being prepared to win, adopting a can-do attitude and jumping in, experimenting with new ideas, working smart and hard to conquer different enemies of innovation, attaining the seemingly impossible and turning your dreams into reality. Entrepreneurship education may be important to the survival and future of Nigeria's economy if teaching methods are such that would aid development of entrepreneurial creativity among students right from basic education level. This is because in the education system, it is common that the classroom teacher in most cases determines to a large extent, the quality of students' learning experiences (Ayua & Jato, 2012).

That is why Science-Technology-Society (STS) teaching method, which is based on constructivist's theory was studied. STS is students' centred allows them generate questions on identified problems or phenomena, define them and think out potential solutions; and by so doing they see the problems as important and personally relevant. They also feel their actions are valuable and not just exercises and have decision making responsibility. When students take ownership of the situation and their own learning, they develop deeper and richer knowledge structures leading to a higher likelihood of transferring to novel situation

(Akcay & Akcay, 2015).

STS is an interdisciplinary approach that seeks to explore and understand the many ways that modern science and technology shape modern culture, values, and institutions on the one hand, and on the other how modern values shape science and technology (Mansour, 2009). STS may be defined as an integrated approach to science teaching, which means dealing with students in their own environments and with their own frames of reference (Yager & Akcay, 2010). It is the teaching and learning of science in the context of human experience. It also means determining and experiencing ways that Basic science and Technology concepts and processes are handled in society. In other words, it means starting from the real-world problems included in the students' perspectives, instead of starting with the basic concepts and processes [National Science Teachers' Association (NSTA), 2007]. Therefore, STS means focusing upon current issues and attempts at their resolution as the best way of preparing students for current and future citizenship roles. This means identifying local, regional, national, and international problems involving students in planning for individual and group activities which address problems, and moving to actions designed to resolve the issues identified and investigated (Akcay & Yager, 2010). STS is geared towards entrepreneurial creativity via entrepreneurship education enshrined in science subjects.

Empirically, Avwiri (2017) studied "creativity of secondary school students and entrepreneurial skills acquisition in the construction of potentiometer in Physics students and discovered no significant difference among Demonstration, Guided-inquiry and Cooperative teachings among high, average and low creative ability students' acquisition of entrepreneurial creativity skills. Thus, use of innovative teaching strategies for students' entrepreneurial creativity/skills acquisition was recommended. Wakili (2014) also investigated "influence of guided discovery approach on creative attainment among Basic Science students at upper basic education level and found that use of guided discovery in teaching Basic Science improved students' creativity trait of flexibility. In another experimental study " impact of STS teaching approach on students' learning in five domains", Akcay and Yager (2010) examined the effectiveness of the Chautauqua Professional Development Program in terms of the mastery of Basic Science concepts, understanding major science processes, creativity skills usage, improving students' attitudes toward science and ability to apply science concepts and processes in new situations. It was found that students in the student-centred STS sections achieved significantly better than students in the teacher-directed STS sections in terms of understanding and use of process and creativity skills without gender difference.

The gap between policy and practice occasioned by poor teaching resulting in unemployment due to lack of entrepreneurial creativity for self-reliance after school gave rise to this study. Looking at the philosophy and goals of Nigerian education as stated in the National Policy on Education (FRN, 2013), one would expect this nation to have developed far beyond mental and economic neo-colonialism. Education ought to be the health and wealth of any individual or nation (Ayua, 2012). Ideally, an educated person should fit into the society and be self-reliant. However, lack of entrepreneurial creativity predisposes over 60% and 70% Nigerian students to joblessness and poverty after graduation (Olorukooba, Usman and Yero, 2009; Eriba, 2011). Ayua and Eriba (2015) stated that many graduates wonder why their education cannot earn them a living. This is because they were not armed with entrepreneurial skills while schooling to cope in the absence of white collar jobs. As a result, Olajide and James (2009) and Anaele (2010) reported that government made unsuccessful post-school efforts to train graduates/retirees on trades to do after NYSC/retirement. Ayua and Eriba (2015) lamented that sometimes about to retire workers do not want to do so because of

lack of entrepreneurial creativity to fall on. So, they either change their age or take contract appointments after retirement. While those who cannot do otherwise, go languishing/waiting for gratuity/monthly pension, which hardly comes.

These problems may worsen if students are not armed with entrepreneurial creativity while young and schooling; especially at basic education level. It is against this backdrop that "effect of science-technology-society strategy on entrepreneurial creativity among upper-basic school students" was studied with the following objectives:

1. Find out the difference in level of entrepreneurial creativity between students taught Basic Science using STS and LM.
2. Determine the difference in level of entrepreneurial creativity between boys and girls taught basic science using STS.

Research Questions

1. What is the mean difference in level of entrepreneurial creativity between students taught Basic Science using STS and LM?
2. What is the mean difference in level of entrepreneurial creativity between boys and girls taught basic science using the STS?

Hypotheses

1. There is no significant mean difference in the level of entrepreneurial creativity between students taught Basic Science using STS and LM.
2. There is no significant mean difference in the level of entrepreneurial creativity between boys and girls taught basic science using STS.

Method

A pre-test post-test quasi-experimental-control group research design was adopted for the study. Experimental Group were taught concepts of work, energy, power and Simple machines using Science-Technology-Society; while the Control Group were taught the same concepts using Lecture Method. This treatment lasted for six weeks and thereafter, students in all the groups were post-tested. A purposively sample of 69 students in two schools drawn from the population of 1753 Upper-Basic II students in all the 27 UBE JSS in Makurdi was used for the study. As regards sampling, two UBE JSS with standard intact classes of teacher-student ratio of 1:35 as stated in the National Police on Education (FRN, 2013). Entrepreneurial Creativity Observation Checklist (ECOC) used for the study was researcher-made. ECOC had two sections. Section 'A' items dealt with students' bio data. Section 'B' items were designed to observe and assess students' level of entrepreneurial creativity using a 5-point Likert scale with **VH** (Very High) = 5, **H** (High) =4, **M** (Moderate) =3, **L** (Low) =2 and **VL** (Very Low) = 1. ECOC was validated by three experts: two in science education and one in test and measurement from Benue State University, Makurdi. Their inputs were used to improve the quality of ECOC. It was pilot tested on 15 Upper-Basic II students in a UBE JSS other than the study's actual sample but possessed similar characteristics of the sample for the actual study. The reliability coefficient of ECOC was tested using the Cronbach Alpha method to determine the internal consistency strength of a set of scale on a continuum or multiple-scored test items, which yielded 0.84. Both pre-test and post-test were administered under standard examination conditions using ECOC. Research questions were answered using mean and standard deviation and Mann Whitney U-test was used to test the null hypotheses at 0.05 level of significance. Mann Whitney U-test was deemed best here because the independent or factor variable (STS) is one against two groups (experimental against control and male against female) dependent or test variable (entrepreneurial creativity), which is ordinal or continuous but not normally distributed.

Results

The results are presented in order of research questions and hypotheses.

Research Question 1: What is the mean difference in level of entrepreneurial creativity between students taught Basic Science using STS and LM?

Table 1: Mean Difference in Level of Entrepreneurial Creativity between Students taught Basic Science using STS and LM

Group	**N**	**Pre-test**		**Post-test**		**Mean gain**
		Mean	Standard deviation	Mean	Standard deviation	
STS	41	19.17	0.43	27.44	0.38	8.27
LM	28	18.76	1.78	20.22	1.66	2.46
Mean Difference		**00.41**		**07.22**		**5.81**
Total	69					

Table 1 shows equivalence between the experimental and the control groups with a negligible pre-test mean difference of 00.41. After post-test, the mean gain difference between students taught Basic Science using STS and LM was 5.81 in favour of STS.

Research Question 2: What is the mean difference in level of entrepreneurial creativity between boys and girls taught basic science using the STS?

Table 2: Mean Difference in Level of Entrepreneurial Creativity between Boys and Girls taught Basic Science using the STS.

Group	**N**	**Pre-test**		**Post-test**		**Mean gain**
		Mean	Standard deviation	Mean	Standard deviation	
Boys	22	18.12	1.344	26.36	1.681	8.24
Girls	19	17.51	1.014	25.44	1.311	7.93
Mean Difference		**00.61**		**1.92**		**0.31**
Total	41					

Table 2 indicates no equivalence between boys and girls with pre-test mean difference of 00.61. After post-test, the mean gain difference between boys and girls taught Basic Science using STS was negligibly 0.31.

Hypotheses 1: There is no significant mean difference in the level of entrepreneurial creativity between students taught Basic Science using STS and LM.

Table 3: U-test Summary Analysis on Level of Entrepreneurial Creativity between Students taught Basic Science using STS and LM.

Group	N	Mean Rank	Sum of Rank	df	U-value	P-value	A	Decision
STS	41	48.94	2006.50					
LM	28	14.59	408.50	67	2.500	.000	0.05	Significant
TOTAL	69							

P<0.05

Table 3 shows that $U_{(67\ df)} = 2.500$, P = 0.000 < 0.05. Thus, the two-tailed test is statistically significant since p-value is less than 0.05 level of significance. Therefore, the null hypothesis is rejected.

Hypothesis 2: There is no significant mean difference in the level of entrepreneurial creativity between boys and girls taught basic science using STS.

Table 4: U-test Summary Analysis on Level of Entrepreneurial Creativity between Boys and Girls taught Basic Science using STS.

Group	N	Mean Rank	Sum of Rank	df	U-value	P-value	A	Decision
Boys	22	18.14	399.00					
Girls	19	24.32	462.00	39	146.00	.098	0.05	Insignificant
TOTAL	41							

P>0.05

Table 4 shows that $U_{(39\ df)} = 146.00$, P = 0.098 > 0.05. Thus, the two-tailed test is not statistically significant since p-value is greater than 0.05 level of significance. Therefore, the null hypothesis is retained.

Discussion of Finding

The findings this study were discussed in order of the study's objectives from which the answered questions and the tested hypotheses were drawn. Thus: As regards the level of entrepreneurial creativity between students taught Basic Science using STS and LM, a significant mean difference in the level of entrepreneurial creativity between students taught Basic Science using STS and LM was found. Thus, the mean gain difference after post-test was 5.81 in favour of STS. This means STS enhances students' entrepreneurial creativity and aids self-reliance. This finding is similar to that of Wakili (1014) who established that guided discovery subsumed in STS improves students' creativity trait of flexibility. However, this finding differ from Avwiri (2017) who

discovered no significant difference among Demonstration, Guided-inquiry and Cooperative teachings among high, average and low creative ability students' acquisition of entrepreneurial creativity skills.

In respect of the level of entrepreneurial creativity between boys and girls taught Basic Science using STS, there was no significant mean difference in the level of entrepreneurial creativity between boys and girls taught Basic Science using STS. Thus, both boys and girls had mean gains of 8.24 and 7.83, which are approximately same as 8.00. This implies that STS, which is student-centred and allows learners to think outside the box in their bid to link science, technology and society engenders entrepreneurial creativity successfully across gender. The finding is similar to those of Akcay & Yager (2010) who found that students in the student-centred STS sections achieved significantly better than students in the teacher-directed STS sections in terms of understanding and use of process and creativity skills without gender difference.

Conclusion

Sequel to the findings of the study that Science-Technology-Society teaching strategy is gender friendly and has a positive effect on development of entrepreneurial creativity among upper-basic school students, the workability of Science-Technology-Society teaching strategy was established.

Recommendations

Based on the study's findings that Science-Technology-Society teaching strategy is gender friendly and has a positive effect on development of entrepreneurial creativity among upper-basic school students, it was recommended that Science-Technology-Society teaching strategy should be used for Basic Science teaching to both boys and girls at upper basic education level

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