



Effect of Creative Teaching on Creative Thinking Among Different-Ability Upper-Basic Science Students in Gboko-Town

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Abstract

Effect of creative teaching on creative thinking among different-ability upper-basic science students in Gboko-town was studied using quasi-experimental design. Two research questions and two null hypotheses guided the study. Out of 674 Upper-basic II students in 7 Government Grant Aided schools in Gboko-town, a multistage sample of 70 students was drawn. Torrance Test of Creative Thinking with reliability coefficient of 0.83 determined using a test-retest method through Pearson Product Moment Correlation was used for data collection. Data were analysed using mean and ANCOVA. Findings showed no significant difference in the creative thinking level among different-ability students taught Basic Science using Lecture Method and those taught using Creative Teaching $F_{(2, 63)} = 0.343, p = 0.711 > 0.05$. Although, there existed a significant difference in creative thinking level in favour of those taught using creative teaching $F_{(1, 63)} = 73.813, p = 0.00 < 0.05$, no significant difference existed in the students' creative thinking level based on gender $F_{(2, 28)} = 2.920, p = 0.070 > 0.05$. Thus, Creative Teaching approach was recommended for teaching science in basic schools.

Keywords: Creativity, Basic Science, Creative Teaching, Creative Thinking, Different-Ability and Gender.

Introduction

Creativity has been viewed as one of the major competencies an individual can use to cope with our rapidly-changing. This could be why Sternberg (2010); Rosenstock and Riordan (2017) emphasises creativity as one of the dispositions necessary in the modern innovation economy. In the United Kingdom, creativity has become the core agenda for educational reform, expanding from the policy level to everyday life as a response to global economic competition and a rapidly changing technological and social milieu (Hall, 2010). Policy documents in many countries, such as Australia, Canada, the United Kingdom, China, Singapore and Nigeria have demonstrated the need to nurture students' creativity through science education (Shaheen, 2010) hence the need for creativity in Basic Science schools in Nigeria.

Basic Science is a core subject offered at the basic education level in Nigeria, which encompasses the process of creative thinking. The subject gives students the opportunity to integrate its concepts and processes in the real word (Ndinechi & Okafor, 2016). That is why the National Policy on Education (2013:12) spelt out its objectives as to acquire basic science and technology skills, apply scientific and technological knowledge and skills to meet individual and societal needs, take advantage of the career opportunities offered by science and technology and

become equipped for future studies and survival". This implies that Basic Science should be taught in a way that would enhance students' creative thinking abilities for functional living in the 21st century world. That is why the Federal Ministry of Education – FME (2014) posits that Basic Science is an activity-based course. However, these objectives are still difficult to achieve due to poor teaching method (Sagiru, 2015). Ode, Ayua and Alabi (2019) stated that if Basic Science is taught using appropriate methods, students' acquisition of creative thinking for self-reliance in adulthood would be assured. It is against this background that the study bids to investigate the effect of creative teaching on creative thinking among upper-basic science students with different-ability.

Creative Teaching as an aspect of creative science education according to Ayua (2019) involves teaching creatively and teaching for creativity, which goes hand in hand to enhance creative thinking in students with different-ability. Thus, teaching creatively entails demonstrating how to think creatively and the ability to use diverse methodological approaches and resources. While teaching for creativity involves inspiring students to think creatively, exposing them to creative thinking instances for generating ideas, encouraging creative learning and identifying learners' creative strengths as well as fostering them. Paul E. Torrance is one of the prominent scholars of creativity who severally



explored the teaching and learning of creativity (Worwood, 2011). Torrance identified particular skills related to creativity and showed success in creativity teaching using Torrance Incubation Model (TIM) of Creative Teaching and learning. The model was designed to “make teaching more effective in any subject, at any age level with any method of instruction” (Ayua, 2019). Torrance and Safter (1990) submitted that creative teaching and learning can be applied to a lesson, unit or project in any subject including Basic Science education at any school level to cultivate creative thinking in students with different abilities. This makes Basic Science meaningful to the students who are at formal operational stage (Piaget, 1957), the peak of mental development maturity where they understand science in abstraction by thinking creatively.

Creative thinking involves students learning to generate and apply new ideas in specific contexts, seeing existing situations in a new way, identifying alternative explanations, and seeing or making new links that generate a positive novel outcome. This includes combining parts to form something original, sifting and refining ideas to discover possibilities, constructing theories and objects, and acting on intuition (Ton, Loc, Uyen & Son, 2020). Creative thinking is the process of seeking to perceive, discover the laws of things, consciously find new things to better understand the nature of things and phenomena as well as find the cause and prevent them, eliminate the unsuitable and develop the good (Ton, Loc, Uyen & Son, 2020). It is a process of thinking geared towards developing creative thinking capacity in learners of different-ability.

Generally, students vary in their academic performances due to one reason or the other. Different-ability levels refer to students’ high, average and low educational performance based on past academic scores in Basic Science (Ayua, 2021). Hostetter (2013) explained that different academic ability grouping is placing students of differing ability levels in the same class or group. Maikano (2016) also held that ability grouping is based on educators’ judgments of students’ abilities; and that when assigning students’ to tracks, prior test scores or other performance measures provided from other grades or schools are used to determine the ability levels. Avwiri (2017) found that there was no significant difference in the interaction of the teaching strategies on the students of high, average and low creative abilities in their acquisition of

creativity status in the construction of potentiometer. However, the main effect of the teaching strategy was significant. Relatedly, Wakili (2014) found that, the use of guided discovery in teaching Basic Science improved students’ creative trait among upper-basic science students with different-ability without consideration to gender difference.

Gender difference is as old as the creation and has featured severally in academic discourse. It is the character of being male or female, man or woman, boy or girl (Ayua, 2021). Gender disparity according to Danjuma (2015) globally militates against equitable participation of boys and girls in Science Education especially in Africa. Hamdallah, Ozovehe and Dyaji (2014) submitted that females face a number of inequitable difficulties that limit their potentials in participation in the Sciences. This implies that gender peculiarities affect teaching, learning and creativity of students in Basic Science. Ulger and Morsunbul (2017); Steinbüchel, Meeuwesen, Poinstingl, and Kiese-Himmel, (2018) and Zhang, Ren and Deng (2020) found significant difference between females and males upon creative thinking in favour of females. However, none of the studies were concerned with creative thinking as an aspect of creativity in relation to creative teaching.

The need to be creative and become productive is sort for as a substitute to redressing the issues of unemployment. That is why FRN (2014) opined that, educational activities should be learner centred for maximum self-development and self-fulfilment and teaching should be practical, activity based, experiential and industrial training (IT) supported, hence need for creative thinking in Basic Science learners. However, teachers basically impact knowledge of Basic Science concepts to enable the students excel in the internal and external examinations and not considering the creativity among different-ability students. Recent studies of Naz and Murad (2017), Avwiri (2017) and Peng (2019) indicates that Basic Science learners are typically considered to be passive and lacking creativity, as a result of poor teaching methods as one of the key factors causing students low creativity. Avwiri (2017) further asserts that poor methods of lesson delivery, leads students to low creativity with unpreparedness towards attaining the creativity status. The question here is: How can the creative thinking of different-ability students be developed and are there any teaching methods that could help improve the creative thinking of Basic Science students to



enable them become productive, self-reliant and cope with the challenging economy of the 21st century? It is against these backdrops that the study seeks to investigate the effect of creative teaching on creative thinking among different-ability upper-basic science students with following objectives:

1. To determine the creative thinking level among different-ability students taught Basic Science using Creative Teaching and those taught using Lecture Method.
2. To examine the creative thinking level between male and female students with different- ability taught Basic Science using Creative Teaching.

In line with the purpose, the following research questions were posed:

1. What is the mean difference in the creative thinking level among different-ability students taught Basic Science using Creative Teaching and those taught using Lecture Method?
2. What is the mean difference in the creative thinking level between male and female students with different-ability taught Basic Science using Creative Teaching?

Based on the purpose, the following hypotheses become important

1. There is no significant mean difference in the creative thinking level among different-ability students taught Basic Science using Creative Teaching and those taught using Lecture Method.
2. There is no significant difference in the creative thinking level between male and female students with

different-ability taught Basic Science using Creative Teaching.

Method

A pre-test post-test quasi-experimental design was used for the study. After pre-test, the experimental group was taught concept of chemicals using Creative Teaching; while the control group was taught the same concept using Lecture Method for six weeks before post-test. A multistage sample of 70 Upper-Basic II students in two schools drawn from the population of 674 (356 males and 318 females) in all the 7 government grant aided schools in Gboko-town was used for the study. Torrance Test of Creative Thinking (TTCT-Figural B) was used for data collection. Its section “A” collected students’ bio data; while section ‘B’ had 3 activities each lasting for 10 minutes with opportunity for multiple responses of fluency, originality, elaboration, abstractness of titles, and resistance to premature closure to test students’ creative thinking in Basic Science. Students’ ability levels were based on previous term’s performance grades (high = A/B; average = C/D; low = E/F). TTCT-Figural B was validated and pilot-tested with reliability coefficient of 0.83 determined by a test-retest method with Pearson Product Moment Correlation. Extraneous variables like group initial difference, group interaction effect and priming were controlled by homogeneity test, distant locations and impromptu tests respectively. Both pre-test and post-test were administered under standard examination conditions. The research questions were answered using mean and standard deviation. The hypotheses were tested at 0.05 alpha level using two-way Analysis of covariance.

Results

Table 1: Mean and Standard Deviation of Creative Thinking Scores of students taught Basic Science using Lecture Method and those taught using Creative Teaching.

Ability Level	Sample (n)	Teaching Method	Pre-TTCT		Post-TTCT		\bar{x} Gain	\bar{x} Gain Difference
			\bar{x}	SD	\bar{x}	SD		
High	14	LM	19.79	6.015	22.21	5.250	2.42	9.43
	14	CT	19.29	3.197	31.14	3.634	11.85	
Average	9	LM	19.44	4.693	22.33	5.701	2.89	8.74
	11	CT	19.73	3.228	31.36	4.610	11.63	
Low	12	LM	18.42	4.010	22.50	5.214	4.08	11.32
	10	CT	18.00	3.091	33.40	3.658	15.4	
Cluster		LM	19.22		22.35		3.13	9.83
		CT	19.01		31.97		12.96	

The result in Table 1 shows homogeneity in the pre-test mean scores among students of different-ability levels between experimental and control groups with cluster means of 19.22 and 19.01. The Table also shows that all the creative thinking level mean scores

among students of different-ability levels in the experimental group were higher than those in the control group with cluster mean gain difference of 9.83.

Table 2: Mean and Standard Deviation of Torrance Test of Creative Thinking Scores of male and female students taught Basic Science using Creative Teaching.

Ability Level	Gender	Sample (n)	Pre-TTCT		Post-TTCT		\bar{x} Gain	\bar{x} Gain Difference
			\bar{x}	SD	\bar{x}	SD		
High	Male	5	18.20	2.775	32.40	3.578	14.2	3.65
	Female	9	19.89	3.408	30.44	3.678	10.55	
Average	Male	7	20.29	2.215	29.86	4.776	9.57	7.18
	Female	4	17.25	5.188	34.00	3.266	16.75	
Low	Male	5	17.60	3.050	34.80	3.033	17.2	3.6
	Female	5	18.40	3.435	32.00	4.000	13.6	
Cluster	Male		18.70		32.35		13.66	0.03
	Female		18.51		32.15		13.63	

The result in Table 2 shows homogeneity in the pre-test mean scores among different-ability levels between male and female students with cluster means of 18.70 and 18.51. The table also shows that the

creative thinking mean scores in the post test was homogeneous between male and female with cluster mean gains of 13.66 and 13.63 respectively.

Table 3: Summary of Two-Way ANCOVA Analysis on creative thinking Among Different-ability Levels based on Teaching Methods.

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared
Corrected Model	1681.550 ^a	6	280.258	12.995	0.000	0.553
Intercept	1542.446	1	1542.446	71.517	0.000	0.532
TTCT Pre-test	63.267	1	63.267	2.933	0.092	0.044
Teaching Method	1591.965	1	1591.965	73.813	0.000	0.540
Ability Level	34.002	2	17.001	0.788	0.459	0.024
Teaching Method* Ability Level	14.786	2	7.393	0.343	0.711	0.011
Error	1358.750	63	21.567			
Total	54449.000	70				
Corrected Total	3040.300	69				

a. R Squared = .553 (Adjusted R Squared = .511)

Table 3 shows no significance difference in the level of creative thinking among different-ability students taught Basic Science using creative teaching and those taught using lecture method since, $F_{(2, 63)} = 0.343$, $p (0.711) > 0.05$. Therefore, the null hypothesis was not rejected. However, the table also indicated that student's level of creative thinking in the experimental group was better than those in the

control group since, $F_{(1, 63)} = 73.813$, $p (0.000) < 0.05$. The implication of the result is that although creative teaching enhances creative thinking, it is not dependent on students' academic abilities.

Hypothesis 2: There is no significant difference in the creative thinking level between male and female students with different-ability taught Basic Science using Creative Teaching.

Table 4: Summary of Two-Way ANCOVA Analysis on Creative Thinking among Different-ability Levels based on Gender.

Source	Type III Sum of		Mean Square	F	P	Partial Eta Squared
	Squares	Df				
Corrected Model	122.048 ^a	6	20.341	1.368	.262	.227
Intercept	727.096	1	727.096	48.911	.000	.636
TTCT Pre-test	12.842	1	12.842	.864	.361	.030
Gender	.229	1	.229	.015	.902	.001
Ability Level	27.469	2	13.734	.924	.409	.062
Gender * Ability Level	86.822	2	43.411	2.920	.070	.173
Error	416.238	28	14.866			
Total	36059.000	35				
Corrected Total	538.286	34				

a. R Squared = .227 (Adjusted R Squared = .061)

Table 4 reveals that no significant difference existed in the creative thinking level between male and female students with different-ability levels taught Basic Science using Creative Teaching since, $F_{(2, 28)} = 2.920$, $p(0.070) > 0.05$. The null hypothesis was therefore not rejected. This implies that, creative thinking is without gender difference, hence it enhances creative thinking level in both male and female students with different-ability in Basic Science.

Discussion

On students' creative thinking based on teaching methods, it showed no significant difference in the creative thinking among different academic ability students taught Basic Science using Lecture Method and those taught using Creative Teaching. However, students' level of creative thinking in creative teaching was higher than those in the Lecture Method. Based on field experience, the finding is not odd because students in the creative teaching heighten anticipation for deepening expectation and keeping it going, hence creative thinking was fully developed for hard work, finding and using resources for future visions and the curiosity, motivation aroused gave students attention to use the resources in line with the creative thinking heightened and produce a novel product. This shows that engagement of students in the creative teaching drive their creative thinking. Thus, the finding agrees with that of Avwiri (2017) who found that there was no significant difference in the interaction of the teaching strategies on the students of high, average and low creative abilities in their acquisition of creativity status in the construction of potentiometer. However, the main effect of the teaching strategy was significant. Also, Wakili (2014) who found that, the use of guided discovery in teaching Basic Science

improved students' creative thinking level among Upper-basic science students with different-ability.

As to students' creative thinking based on gender, no significant difference existed in the creative thinking between male and female students of different academic ability taught Basic Science using Creative Teaching. Thus, Creative Teaching is without gender difference across high, average and low ability students. Following field experience, the finding is not strange because both boys and girls were excited, thoughtful and actively involved in the creative teaching and learning processes. This finding differs from Ulger and Morsunbul (2017); Steinbüchel, Meeuwssen, Poinstingl and Kiese-Himmel (2018) and Ren and Deng (2020) who found significant difference between females and males upon creative thinking level. This difference might occur due to time, space and maybe event.

Conclusion and Recommendations

Based on the findings, it was concluded that: The level of creative and critical thinking among students with different-ability can be enhanced without gender difference if taught Basic Science using Creative Teaching. To do this effectively, the following were recommended:

1. Teachers should teach Basic Science using Creative Teaching.
2. Government through the Ministries of Education and teacher training institutions in Nigeria should ensure in-service training and retraining of teachers on Creative Teaching lesson delivery.
3. Teacher training institutions in Nigeria should include constructive teaching strategies such as creative teaching in the teacher training programmes.



- School proprietors, head and parents' teachers' association should provide materials/funds needed by the teachers for creative teaching of Basic Science.

References

- Avwiri, E. (2017). Creativity of secondary school students: Entrepreneurial skills acquisition in the construction of potentiometer in Physics. *International Journal of Science and Technology (STECH) Bahir Dar-Ethiopia* 6 (2), 61-75.
- Ayua, G. A. (2019). Creative teaching of science in the 21st century. In P. O. Agogo and E. E. Otor (Eds.), *Methods and Resources in Science Teaching in Nigeria* (PP 174-192). Makurdi: Optimism Academic Publishers.
- Ayua, G. A. (2021). *Impact of creative-teaching on interest, entrepreneurial skills acquisition and performance in basic science among varied ability upper-basic students*, Makurdi, Nigeria. PhD thesis Submitted to the School of Postgraduate Studies, Ahmadu Bello University, Zaria, Nigeria.
- Danjuma, G. S. (2015). *Effects of collaborative and competitive learning strategies on upper-basic two students' interest and achievement in basic science* (PhD thesis), Department of Science.
- Federal Ministry of Education - FME. (2014). *9-year basic education curriculum*. www.nerdc.org.ng
- Federal Republic of Nigeria - FRN. (2014). *National policy on education*. Yaba, Lagos: Nigeria Educational Research and Development Council (NERDC) Printing Press.
- Hall, C. (2010). Creativity in recent educational discourse in England. *World Englishes*, 29(4), 481-492.
- Hamdallah, A., Ozovehe, A. & Dyaji, L. (2014). Impact of creative teaching on science pupils' academic performance. *IOSR Journal of Research and Method in Education (IOSR-JRME)*, 4(6), 40-44. www.iosrjournals.org.
- Hostetter, D. P. (2013). *Does homogenous ability grouping for high school honours English instruction benefit the high achiever?* PhD thesis Seton Hall University, New Jersey, USA. <https://scholarship.shu.edu>.
- Maikano, S. (2016). *Impact of computer-assisted and science process instructions on retention and performance in biology among varied abilities secondary school students in Kaduna, Nigeria*. PhD Science Education thesis, Ahmadu Bello University, Zaria, Kaduna State, Nigeria.
- Naz, F. & Murad, H. S. (2017). Innovative teaching has a positive impact on the performance of diverse students. *Journals Sage Publications*, 7(4), 1-8. <http://journals.sagepub.com/doi/full/10.1177/2158244017734022>
- Ndinechi, M. C. & Okafor, K. C. (2016). STEM. Education: A Tool for Sustainable National Capacity Building in a Digital Economy. Available on NERDC Press. <https://www.researchgates.net/publication/303446505>.
- Ode, J. O., Ayua, G. A. & Alabi, A. O. (2019, August). *Towards enhancing the entrepreneurial skills of primary school pupils through creative teaching of basic science*. Paper presented at the 2019 Annual International Conference on Creativity, Innovation and Entrepreneurship Education: Harvesting from the Cradle, Organised by Faculty of Education, University of Nigeria Nsukka (UNN), Held at Princess Alexandria Auditorium (PAA), UNN.
- Peng, Y. (2019). Effects of creativity instruction in science on creative thinking and science achievement in Chinese students *UNLV Theses, Dissertations, Professional Papers, and Capstones*. 3743. <http://dx.doi.org/10.34917/16076284>
- Piaget, J. (1957). *Logic and psychology*. New York: Basic Books.
- Rosenstock, L., & Riordan, R. (2017). Changing the subject. In R. A. Beghetto, & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 3-5). New York, NY: Cambridge University Press.
- Sagiru, I. (2015). *The relationship between teachers' psychomotor abilities and students' skills acquisition in basic science in Gwale Local Government, Kano State, Nigeria*. M Ed science education dissertation, Ahmadu Bello University Zaria, Kaduna State, Nigeria.
- Shaheen, R. (2010). Creativity and education. *Creative Education*, 1, 166-169.
- Steinbüchel, N. V., Meeuwssen, M., Poinstingl, H. & Kiese-Himmel, C. (2018). The test for



- creative thinking-drawing production test in preschool children with predominantly migration background-psychometrics of the German TCT-DP. *Creativity Research Journal*, 30(2), 195-204, DOI: 10.1080/10400419.2018.1446742.
- Sternberg, R. J. (2010). Teaching for creativity. In R. A. Beghetto, J. C. Kaufman, R. A. Ton, D. H., Loc, N. P., Uyen, B. P., & Son, T. H. (2020). Enhancing Creative and Critical Thinking Skills of Students in Mathematics Classrooms: An Experimental Study of Teaching the Inequality in High Schools. *Universal Journal of Educational Research* 8(2): 477-489.
- Torrance, E. P. & Safter, H. T. (1990). *The incubation model of teaching: Getting beyond the 'aha'!* Buffalo, New York: Barely Limited.
- Ulger, K. & Morsunbul, U. (2017). The Differences in creative thinking: The Comparison of male and female students. *The Online Journal of Counselling and Education*, 5(4), 1-12.
- Wakili, L. A. (2014). Influence of guided discovery approach on creative attainment among basic science students at upper-basic education level in kafanchan inspectorate zone of Kaduna state. *Ahmadu Bello University Science Education Seminar Series*, 2(1), 337-352.
- Worwood, M. (2011). *Applying the torrance incubation model of creative teaching and learning to the digital media and movie making project.* <http://www.teachdigital.org>
- Zhang, W., Ren, P. & Deng, L. (2020). Gender differences in the creativity academic achievement relationship: A study from China. *The Journal of Creative Behaviour*, 54(3). DOI:10.1002/jocb.37.