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EFFECT OF CREATIVE EXPLORATION AMONG UPPER-BASIC III STUDENTS' CREATIVE-MINDS DEVELOPMENT IN GBOKO LOCAL GOVERNMENT AREA OF BENUE STATE

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Abstract

Effect of Creative Exploration (CE) among Upper-Basic III students' creative-minds development in Gboko local government area of Benue State was studied using pre-test, post-test control group quasi-experimental design. Two research questions and two hypotheses guided the study. A multi-stage sampling procedure was used to draw a sample of 70 (39 males and 31 females) students from a population of 1,823 (995 males and 828 female) upper-basic III Science students in 24 government grant-aided schools and was used for the study. Torrance Test of Creative Thinking (TTCT Figural-B) was adapted and used to collect data. The instrument was validated by five experts (including one Physics educationist, one Electrical/Electronic technologist, one education mathematician, one in test measurement from faculty of education, Benue State University Makurdi and a 10-year experienced Basic Science teacher from Benue State Technical College, Makurdi), it was trial-tested by test retest and yielded reliability coefficients of 0.992 as was computed using Pearson product moment correlation statistic. Data were analysed using mean and standard deviation to answer research questions and Analysis of Covariance (ANCOVA) to test the null hypotheses at 0.05 α-level. Findings revealed that a significant difference existed in the development of creative-minds of students taught Basic Science using creative exploration and those taught using expository teaching ($F(1,67) = 147.909$; $\rho = 0.001 < 0.05$). The study revealed no significant difference in the students' creative-minds development based on gender when taught using CE ($F(1, 32) = 1.527$; $\rho = 0.226 > 0.05$). The study recommended among others that creative exploration be used for teaching Basic Science at basic schools.

Key words: Creative exploration, Creative minds, Basic Science and Gender

Introduction

Policy documents on education in various nations, including Nigeria, emphasize a self-determining and activity-based curriculum that promotes hands-on learning for lasting functional education. A curriculum that allows students to explore their environment creatively, foster beneficial knowledge for both individuals and the society (Manalu, Sitohang, Heriwati & Turnip, 2022; Pantiwati, Chamisijatin, Zaenab & Aldya, 2023). Wiyanti and Hadi (2023) highlight that such curricula, might be unrestricted in delivery and may enable students to develop creative minds regardless of gender. This approach could ensure meaningful and functional education.

Education is key to unlock all potential invariably improving human standard for quality living from an individual to the larger society. That is why Agogo (2018) posits that education is fundamental to societal development, focusing on human personality growth and fundamental freedoms. This could be why the National Policy on Education (Federal Republic of Nigeria - FRN, 2013) asserts that education should equip individuals with skills for self-reliance and sustainable development. However, Agogo and Otor (2019) observe that education has not fully achieved this goal, necessitating changes in teaching methods, assessment, and learning resources. The transition from a resource-driven economy to an emerging economy (Terhemba, 2022) requires a curriculum that aligns with contemporary societal changes (Ayua, 2018). Additionally, science teaching should be student-centred, activity-based, and rich in scientific knowledge to support economic growth and stability (Ayua, 2019).

Education is crucial for national health and growth, aiming to eradicate poverty, protect the planet, and ensure prosperity. However, Ayua and Agbidye (2020) note a gap between policy and practice, largely due to ineffective teaching methods in Basic Science. Basic Science, a fundamental subject in Nigeria's education system, integrates scientific concepts to build a solid foundation for further education (Danjuma, 2015; Ayua & Eriba, 2023). The FRN (2013) emphasizes its role in fostering creativity and self-reliance, but these objectives remain unattainable without hands-on and minds-on teaching methods (Ayua & Eriba, 2023). Sagiru (2015) confirms that the current teaching approach does not promote students' creative skills necessary for national development.

Science, a product of human creativity, fosters creative minds development when meaningfully taught inside a classroom. Scientists use creative exploration to identify problems, develop hypotheses, collect and interpret data, and formulate theories (Peng, 2019). For instance, the wave theory of light was developed through analogies between light and sound, while Earth's magnetism was understood by comparing it to a magnet. Science teachers can encourage creative exploration to cultivate students' creativity, ultimately leading to economic growth, sustainability, and stability. Therefore, fostering creative minds through science education is crucial for achieving lasting functional education.

Creative Exploration (CE) encourages students to learn through curiosity-driven, self-directed approaches that foster creative, critical thinking and problem-solving skills. This aligns with Bruner's (1960) theory of discovery learning, which emphasizes active exploration and problem-solving as essential for constructing knowledge. Milne, Ian, Cremin and Teresa (2016) argue that children naturally explore their environment to make sense of the world, requiring space and support to ask questions, experiment, and draw conclusions. This student-centred, constructivist approach promotes experiential learning and interdisciplinary education (Archie, 2019; Valarie, 2023). It allows students to direct their learning, interact with peers and materials, and express themselves in various ways (Arce & Ferguson, 2013). This approach also acknowledges that students, regardless of gender, have the right to develop their creative potential (Biermeier, 2015). From the forgoing, it means that when learners construct their own understanding and knowledge of the world, through experiencing and reflecting on those experiences, they learn more effectively and by so doing such as using creative exploration, Upper-Basic III students could enhance creative-minds effectively.

A creative mind is open to possibilities and capable of generating unique, original ideas, making it a valuable skill in various careers. Developing a creative mindset involves questioning conventional boundaries and exploring new ideas (Abazov, 2022). Students that are taught Basic Science at the upper-basic education level might be engaged in environmental exploration for creativity without gender bias.

Gender differences have long been a topic of academic discussion. In Africa, gender disparity hinders equal participation in science education (Danjuma, 2015). Female students often face barriers that limit their potential in science such as male superiority stereotype, teacher bias,

limited visibility of female scientists, importance of female role model, societal expectations and cultural norms (Ali, Raza & Raza, 2014; Hamdallah, Ozovehe & Dyaji, 2014). While some studies suggest cognitive differences between boys and girls in creative thinking (Ulger & Morsunbul, 2017), others find no significant gender-based differences (Terhemba, 2022).

Empirical studies on creativity and gender reveal varied findings. Pournesaei, Alireza, Pirkhaefi, Mojtaba and Sedaghatifard (2020) found that the Neuropsychological Model of Creative-Mind Development improved perceptual-motion, spatial-vision, and memory functions in children with dyscalculia. In Nigeria, Ayua, Terhemba & Ikyernum (2022) found that creative teaching significantly enhanced students' creative thinking compared to the lecture method. Similarly, Shaf, Khaeruddin and Haris (2023) reported that mind-mapping improved creative thinking among Indonesian students more than traditional methods. Williams and Lee (2021) observed that male students in Sydney, Australia, excelled in divergent thinking. However, Terhemba, Ayua and Gamat (2023) found no significant gender differences in creative thinking originality among Nigerian students. Kim and Brown (2022) concluded that both genders possess potential for creative development.

While these studies relate to creative minds, gender, and learning environments, gaps such as differences in geographical locations from the previous studies, variations in methodology, differences in population, sample size and sampling, disparities of instruments for data collection and inconsistences on gender issues remained paramount. To bridge the yawning gaps the current study seeks to investigate effect creative exploration on Upper-Basic III Students' creative-minds development in Gboko local government area of Benue State, Nigeria.

1.2 Statement of the Problem

The aim of meaningful and functional education is to ensure that an educated person is meaningfully fit into the dynamic society. This means that, if science is properly nurtured through science education, it may build the wealth and health of every nation, and in deed might serve as a key to attaining human right for all by eliminating poverty, shielding the planet and guaranteeing success and prosperity across the ever-dynamic globe. However, there exist a yawning gap in creativity (creative-minds inclusively) as a result of poor creativity teaching methods, despite the urgent need for creative-minds as a tool for innovation and national development. United Nations Industrial Development Organization (UNIDO, 2016) reveal that Nigerian teachers and students are deficient in creativity. Similarly, Mellander and King (2015) on global creativity index (GCI) and related indices for some selected African countries showed that Nigeria was not ranked in the 2015 global creativity index for African countries. This implies that Nigeria has serious creativity problem which needs urgent attention. The poor creativity index in Nigeria linked with poor creative teaching methods, resulting in low development of creative-minds is worrisome; thus, the problem of this study was to investigate the effect of Creative Exploration (CE) among Upper-Basic III students' creative-minds development in Gboko local government area of Benue State.

Purpose of the Study

This study sought to investigate effect of Creative Exploration (CE) among Upper-Basic III students' creative-minds development in Gboko local government area of Benue State Specific objectives of the study include to:

1. dtermine the difference in creative-minds development between students taught Basic Science using Creative Exploration (CE) and those taught using Expository Teaching (ET).
2. fnd out the difference in creative-minds development between male and female students taught Basic Science using Creative Exploration (CE).

Research Questions

The following research questions guided this study

1. What is the mean difference in the creative-minds development between students taught Basic Science using Creative Exploration (CE) and those taught using Expository Teaching (ET)?
2. What is the mean difference in the creative-minds development between male and female students taught Basic Science using Creative Exploration (CE)?

Hypotheses

The following null hypotheses were formulated and tested at $p \leq 0.05$ α-level

1. There is no significant difference in the mean creative-minds development between students taught Basic Science using Creative Exploration (CE) and those taught using Expository Teaching (ET).
2. There is no significant difference in the mean creative-minds development between male and female students taught Basic Science using Creative Exploration (CE).

Method

A pre-test post-test quasi-experimental design was employed to study the effect of creative exploration among upper-basic III students' creative-minds development in Gboko local government area of Benue state. The study aimed to develop students' ability to harness their environment for novel and unique production. A multistage sampling technique (stratified, purposive, and random) was used to select 70 Upper-Basic III science students (17 males, 18 females in the experimental group; 13 males, 22 females in the control group) from a population of 1,823 students in 24 Government Grant-Aided schools in Gboko Local Government Area. Schools were first stratified into single and coeducational Basic Science schools, then purposively selected from urban areas due to comparable amenities. To ensure fairness and objectivity, random selection was done before assigning subjects into experimental and control groups by raffle draw.

Torrance Test of Creative Thinking (TTCT-Figural B) was adapted and used for data collection. Section A captured students' bio-data, while Section B included three 10-minute activities allowing multiple responses to assess students' creative-minds development in Basic Science. The TTCT was validated by five experts from different educational fields. Their feedback improved the face and content of the instrument. A trial test was conducted with 22 Upper-Basic III students from a non-sampled school, and a reliability coefficient of 0.99 was determined by trial test and test scores were computed by Pearson Product Moment Correlation. After trial test and pretest, the experimental group was taught the concept of "electrical energy" instead of any other topic in Basic Science, this was because electricity is relevance to daily life, build foundational knowledge, develop critical thinking and problem-solving skills and it allows career opportunities in STEM education. The electrical energy was taught using Creative Exploration, while the control group was taught using Expository Teaching for six weeks before the post-test. In the process of the experimental procedure the extraneous variables such as group initial differences, interaction effects, and priming were controlled. Pre-test and post-test were administered under standard examination conditions. Mean and standard deviation were used to answer research questions, while hypotheses were tested at a 0.05 significance level using Analysis of Covariance (ANCOVA). This was because of the two independent variables (creative exploration and expository teaching) comparing group means while controlling for previous creative-minds development, data was on interval scale and the data was normally distributed (Emaikwu, 2013).

Results

Research Questions One: What is the mean score difference in the Creative-Minds Development (CMD) of students taught Basic Science using Creative Exploration (CE) and those taught using Expository Teaching (ET)?

Table 1: *Mean and Standard Deviation of Students' Creative-Minds Development (CMD) based on Teaching Method*

Method	Sample (n)	Pre-CMD		Post- CMD		Gain	Mean Gain Difference
		Mean	St. D	Mean	SD		
Creative Exploration	35	10.11	3.01	21.00	3.68	**10.89**	**9.84**
Expository Teaching	35	10.06	2.36	11.11	3.11	**1.05**	

The results in Table 1 revealed that students taught Basic Science using creative exploration had mean gain scores of 10.89 while those taught using Expository Teaching (ET) had a mean gain score of 1.05. Thus, there was a mean gain difference of 9.84 in favour of students taught Basic Science using Creative Exploration (CE). This showed that students taught using CE developed creative-minds more as compared to those taught using ET. However, SD for ET at post-CMD was lower showing that their scores were clustered closer to their mean scores than for CE.

Research Questions Two: What is the mean score difference in the creative-minds development between male and female students taught Basic Science using Creative Exploration (CE)?

Table 2: *Mean and Standard Deviation of Creative-Minds Development (CMD) of Male and Female Students Taught Basic Science using Creative Exploration*

Gender	Sample (n)	Pre-CMD		Post- CMD		Gain	Mean Gain Difference
		Mean	St. D	Mean	SD		
Male	20	10.65	2.70	20.35	3.36	**9 .70**	**2.77**
Female	15	9.40	3.33	21.87	4.02	**12.47**	

Table 2 revealed that male students taught Basic Science using CE had mean gain scores of 9.70 while female students taught using the same CE had a mean gain score of 12.47 with a trivial mean gain difference of 2.77 in favour of the female students taught Basic Science using Creative Exploration (CE). This explained that female students taught using CE developed creative-minds as compared to their male counterpart students taught Basic Science using the CE. There was an SD difference of 0.06 in favour of females, showing males scored clustered closer to their mean score than female students.

Hypotheses One: There is no significant difference in the mean creative-minds development scores of students taught Basic Science using Creative Exploration (CE) and those taught using Expository Teaching (ET).

Table 3: *ANCOVA Summary of Students' Creative-Minds Development Based on Teaching Method*

Source	Type III Sum of Squares	Df	Mean Square	F	ρ	Partial Eta Squared
Corrected Model	1726.793[a]	2	863.396	74.837	.000	.691
Intercept	923.821	1	923.821	80.075	.000	.544
Pre-CMD	16.564	1	16.564	1.436	.235	.021
Teaching Method	**1706.427**	**1**	**1706.427**	**147.909**	**.000**	**.688**
Error	772.979	67	11.537			
Total	20548.000	70				
Corrected Total	2499.771	69				

a. R Squared = .691 (Adjusted R Squared = .682)
b. Computed using alpha = .05

The ANCOVA statistic summary in Table 3 shows that F (1,67) = 147.909; ρ = 0.000 < 0.05. This suggests that the probability level is less than the specified alpha of 0.05. Consequently, the null hypothesis is rejected. It means that there is a significant difference in the development of creative-minds mean scores of students taught using CE and those taught using the ET in Basic Science. This implies that CE significantly develops students' creative-minds abilities more than ET in Basic Science. The partial eta squared value of 0.688 is considered a large effect size, indicating that the CE has a substantial impact on students' creative-minds development. This means that approximately 68.8% of the variance in students' creative-minds can be attributed to the difference between the two teaching methods.

Hypotheses Two: There is no significant difference in the mean creative-minds development scores between male and female students taught Basic Science using Creative Exploration (CE).

Table 4: *ANCOVA Summary of Students' Creative-Minds Development Based on Gender*

Source	Type III Sum of Squares	Df	Mean Square	F	P	Partial Eta Squared
Corrected Model	20.976[a]	2	10.488	.764	.474	.046
Intercept	1127.994	1	1127.994	82.218	.000	.720
Pre-CMD	1.260	1	1.260	.092	.764	.003
Gender	**20.947**	**1**	**20.947**	**1.527**	**.226**	**.046**
Error	439.024	32	13.719			
Total	15895.000	35				
Corrected Total	460.000	34				

a. R Squared = .046 (Adjusted R Squared = -.014)
b. Computed using alpha = .05

The ANCOVA statistic summary in Table 4 states that F (1, 32) = 1.527; ρ = 0.226 > 0.05. This specifies that the probability level is greater than the stated alpha of 0.05. Thus, the null hypothesis is not rejected. This indicates that there is no significant difference in the development of creative-minds mean scores of male and female students taught using CE in Basic Science. It means that CE is effective and has no significant gender-based disparities in learning outcomes for both males and females. The partial eta squared value of 0.046 is considered as a small effect size, indicating that male and female students perform similarly in creative-minds development when taught using CE. This means that approximately 4.6% of the variance of students' creative-minds can be attributed creative exploration used.

Discussion

On students' creative-minds based on teaching methods, it showed a significant difference in the creative-minds of upper-basic III students taught Basic Science using creative exploration and those taught using expository teaching in favour of creative exploration as was indicated by their means. Creative exploration engaged students to explore, observe evidence, create explanations, investigate, carryout further investigations and make connections with instructional materials. In the creative exploration students took ownership of the class and developed creative-minds as they were fully motivated to learn meaningfully. However, such opportunities are limited in the expository teaching where students are taught by the teacher in directing instructions, lecturing, presenting information and focusing on transmission of knowledge only. The finding agrees with Pournesaei et al. (2020), Ayua, Terhemba and Ikyernum (2022) and Shaf et al. (2023) who found in their studies that there was significant in the creativity mean difference between students taught using creative teaching methods than those taught using mare traditional methods. This suggests that the findings are robust and not isolated to a single study. It also means that the studies may have used similar methodologies, populations or sampling frames, which could contribute to the agreement in the findings.

Concerning gender, the study indicates that there was no significant difference in the development of creative-minds mean scores of male and female students taught using creative exploration in Basic Science. It means that creative exploration is effective and has no significant gender-based disparities in creative-minds of both males and females. The finding corroborates with those made by Terhemba et al. (2023) and Kim and Brown (2022) whose findings revealed that both genders show potential for creative development. However, the findings of the study disagree with Williams and Lee (2021) who found that male students performed better in domains requiring divergent thinking than **females.** This difference may be, due to variation in study designs, sample and sampling frames, instrument used, demographic differences and differences in the environment used.

Conclusion and Recommendations

Based on the findings, it was concluded that: The creative-minds of students was enhanced without gender disparity when taught Basic Science using Creative Exploration (CT). Based on the findings, the following were recommended:

i. Teachers should teach Basic Science using Creative Exploration (CT) to enhance the development of students' creative-minds in Basic Science.
ii. Government through the Ministries of Education and teacher training institutions in Nigeria should ensure in-service training and retraining of teachers on Creative Exploration lesson delivery to enhance the development of students' creative-minds in Basic Science.
iii. Teacher training institutions in Nigeria should include constructive teaching strategies such as creative exploration in the teacher training programmes to enhance the development of students' creative-minds in Basic Science.

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