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STUDENTS CREATIVITY AND THEIR ACADEMIC PERFORMANCES IN SCIENCE SUBJECTS: IMPLICATIONS FOR EDUCATIONAL EVALUATION

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ABSTRACT: *This study carefully examined the influence of students' creativity on their academic performances in SSII science subjects. Descriptive survey research design was used for the study. Four (4) research questions and four (4) hypotheses guided the study. Sample sizes of 1000 students were drawn from the 24 senior secondary schools in Obio/Akpor local government area of Rivers State using the simple random sampling technique. The self-constructed questionnaires and the standardized promotion results in science subjects generated date for the study. Pearson product moment correlation (PPMC) was used to answer the research questions while the transformed scores into t-test statistics were used to test the hypotheses at 5% probability level. The results obtained showed that students creativity significantly influence their academic performances in science subjects. Consequently, the following are recommended; creative teaching methods and government to provide some remuneration to teachers with creative teaching abilities among others.*

KEYWORDS: Creativity, science and students' academic performance.

INTRODUCTION

In the parlace of education various scholars, experts and practitioners among others have recognized the necessity of creative education as a fact in the development of children and adults (Tsai, 2012a, Feldman & Benjamin 2006 and Sternberg, 2003) respectively. Creative education is the creative ways of thinking, teaching and learning process. Creative education support and enhance the development of creative and innovative teaching and learning. Creative education simple means the employment of creative thinking, creative teaching and learning by both teachers and the learners. Learning is a change in human temperamental make up or capability, which can be retained, and which is not simply ascribable. It is therefore, a relatively enduring eternal change in behaviour as due to practice or experience. Hence, drugs, maturation, fatigue, emotions, alcohol and motives can bring a change in behaviour but they do not constitute learning because such behaviours may not last for a long time. Thus, efforts and major funding have been geared to support the inclusion of creative teaching and learning in school curricular, policy, learning etc to mention but these with the expectation that this will reinforce educational reforms (Baer & Garrett, 2010, Craft, 2010, Ho & Ho, 2008 and Kim, 2005).

Creativity is an essential aspect of learning which helps a creative child to excel in various ways in life. A creative child generates a novel and new ideas, making exceptional in reasoning and has unique ways of doing things. He/she is always capable to produce new ideas, literary works, jokes artistic works among others. A creative child is likely to learn faster, asks challenging questions and reason ahead more than other children within the same age brackets. Therefore, the teacher should recognize students' individual differences that would accommodate a creative learner, by adopting the various teaching strategies that will enhance the talented, creative and slow learners among others.

Craft (2000) defined creativity as the application of knowledge and skills in new ways to achieve a valued goal. In furtherance, the author listed some qualities of creative children as follows;

- They are more fluent than most other people,
- They demonstrate considerable flexibility of mind,
- They have the abilities to identify new problems, rather than depending on others to define them,
- They have the abilities to transfer knowledge gained in one situation to another in order to solve problems,
- They have the capacities to focus attention in the pursuit of goals or set of goals and
- They do not quit when the going gets tough, rather they persevere.

On the foregoing, creative education is seen as one that focusing on promoting creative thinking in educational discourse (Pen and Plucker, 2012). In line with the above, creative education could be viewed as the employment of creative means and perspective to support the energization of existing educational structures. Berk (2002) describes creativity as the ability to produce work that is original, appropriate and useful in life. Creativity is a process whereby something new and valuable is created (such as an idea, a joke, a literary work, painting, musical composition, a solution, or an invention to mention but these). It is also a qualitative force behind any given act of creation, and it is generally understood to be associated with intelligence and cognition. Again, it is an act of producing something that is both original and worthwhile or characterized by originality and expressiveness of sound imaginative mind.

Over and above, the upward trend in the understanding of the importance of creativity was the production of a white paper on Creative Education that strongly supported the growth of creativity and innovation in the educational system. These are the recognized key survival skills in the era of knowledge driven economy (Ministry of Education, 2002). In addition, Cheng, Wang, Liu & Chen (2010) opined that to enhance students' creative learning, the teachers must have the creative teaching strategies and creative knowledge drive among others to achieve the objectives. Therefore, these are the panacea to achieve unprecedented breakthrough in technology and to bring about changes in many aspect of life including education. These rapid change in the educational system need to be modified in such a way that learning is geared towards creative ways of reaching knowledge, improve skills of decision making and to solve problems among others. Creative teaching is seen as teaching creativity and teaching for creativity. The former means teachers to employ imaginative approaches to make learning interesting, exciting and effective while the latter aimed at developing learners creative thinking.

In line with the foregoing, creativity relates to divergent of ideas and not one-way traffic to situations but several and perhaps unlimited ways. It refers to doing simple things differently and in one's own way of life. To this end, creativity is the innate ability to solve problems, fluency of thinking, flexibility of thinking and originality. Following as a result, creativity = intelligence + Personality. This calls for equipping students with better thinking skills and creative learning abilities at all levels of education, specifically in the sciences to enhance their performances.

Science is seen as knowledge ascertained by observation, experiment critically tested, systematized and brought under general principles. Again, it is an organized body of accumulated wealth of knowledge in the form of concepts, laws and theories concerning the physical world with both living and non-living things. Science does not have one universally accepted definition, firstly, Abdullahi (2005) defined science as activities culminating into testable and verifiable body of knowledge. Secondly, Webster in Green-Osahogulu (2017) defined science as a knowledge acquired by careful observation, deduction of laws, which govern changes and conditions and by testing those deductions by experiments.

So from the above premise science is a product, a process or means of man benefiting through understanding of his environment for a better tomorrow. It is an indication that science is a panacea for the total development of the individual and his environment. To achieve this noble goal, the Federal Government of Nigeria makes sciences core subjects in both junior and Senior Secondary school levels in Nigeria (National Policy on Education, 2013:30).

Thus for science class to be creative, would imply that students are given the free hand to venture answers which may not have been provided by the teachers or teachers asking questions (problems) whose answers are not in the text books or students are allowed to do something new which had not been done before in solving problems etc. In this vain, problem solving refers to a learning process where students/individuals are confronted with problems and solve related problems in variety of contexts. Interestingly, they are step-by-step instructional processes where learners are allowed to construct their knowledge while the teacher serves as a facilitator.

On the other hand, selecting the appropriate problems and provide students with the necessary support and strategies, teachers can use problem solving method as a way to actively involve students in their learning process. In addition, Adesoji (2008) maintained that problem-solving method involves asking learners to observe, understand facts, analyze, interpret data, find solutions and perform various applications that could lead to the understanding of the concepts.

Again, the crucial role of problem-solving skills in the teaching and learning of science is widely recognized as a fact by various experts in the educational field. Specifically speaking, it enhances the learners' creativity and pointing out ways of carrying out careful analysis of the results, thereby improving students academic performances.

Sawyer (2010) in his study stated that teachers who use creative ways of imparting knowledge, their students perform better than those teachers who use conventional ways of imparting knowledge. This shows that creativity leads to empower the learners cognition and improve their

academic excellence. Again, Ufot (2015) conducted a study on the influence of science students creative performance in the laboratory. The results admitted that students with creative ability performed better in physics and biology than those with non-creative ability. In the same spirit, the above study is in line with that of Burnard (2012) who in return investigated the influence of using imaginative skills in teaching and learning to produce new things artistically. In his remark, the author maintained that students with creative learning abilities performed wonderfully better than those with little or no creative abilities. The implication of the foregoing shows that creative students have the abilities for critical thinking and imaginative reasoning skills such as; analytical thinking, good reasoning skills and good creative thinking among others. So, they have imaginative and creative abilities in all their engagements. These could be responsible for their academic prowess in all their life spans.

Theoretical Frameworks

The underpinning theories applied in this study are; (i) Charles Spearman Theory of Intelligence (CSTI) and (ii) Robert Sternberg Theory of Intelligence (RSTI). In CSTI, the emphasis is on intelligence as a general intelligence or a factor. The theory uses factor analysis to study a number of mental tests (i.e. creative abilities tests) on students and came to a conclusion that scores generated from these tests were remarkably similar. Spearman explained that testees who did well on one cognitive test equally performed well on other tests, while those who did not perform well on one test tend to performed poorly on others. The theorists concluded that intelligence is general cognitive ability that could be quantified in terms of students' creativity.

On the other side, RSTI assumes that intelligence is a mental activity directed towards purposive adaptation to select and shaping of the real-world environment that is relevant to one's life. This theory consists of three distinct factors namely. Firstly, the analytic intelligence which refers to problem-solving abilities of the students, secondly, the creative intelligence of the students which embraces the ability to deal or create new situations using past experiences and current skills, thirdly, the practical intelligence which refers to students ability to adopt to a changing environment. On the whole, the theory sees mental activity as individual talents (i.e. creativity) of doing something difference in life. This is because there is certain level of intelligence that is required for one to be creative. Therefore, this study hinged on the two theoretical frameworks of CSTI and RSTI.

Statement of the Problem

Several studies such as Abdullahi (2005), Nwagbo (2008), Asuk and West (2014) were conducted to determine the various influences of teaching and learning methods on students' academic achievement in sciences and related subjects. The results showed consistent poor academic achievement in all areas. Consequently, Asuk (2017) attributed this to poor reasoning, poor manipulative skills and poor creative thinking abilities among others in the science subjects.

Against this background, the researcher is poised to investigate the influence of students creative thinking on their academic performance in science subjects. It is therefore, within this seemingly gap and other critical issues that the study intends to underscore, with a view of proffering solutions to the ensuring problems.

Purpose of the study

The main purpose of this study is to examine the influence of students' creative thinking on their academic performance in science subjects in Obio/Akpor Local Government Area of Rivers State.

The specific objectives of this study were to;

1. Ascertain the relationship between students creative thinking and their academic performance in physics.
2. Determine the relationship between students creative thinking and their academic performance in biology.
3. Find out the relationship between students creative thinking and their academic performance in chemistry
4. Investigate the relationship between students' creative thinking and their academic performance in mathematics.

Significance of the study

This study would be significant in the following ways.

i. It would direct the attention of educational planners to the proper and functional use of creative learning methods.
ii. The results of the findings and recommendations would improve the students' creative thinking in science subjects.
iii. The recommendations would also equip the classroom teachers better on the use of creative teaching methods to enhance science students academic performance.
iv. It would also add up to improve the quality of teaching and learning of science subjects for better results.
v. It will turn the world around for creativity.

Scope of the Study

The study is therefore base on the senior secondary two (SS II) science students' creative thinking in Obio/Akpor Local Government Area of Rivers State. Specifically, the study focused on the influence of students' creative thinking on their academic performance in physics, Biology, chemistry and mathematics in the ten (10) senior secondary schools in the study area.

Research Questions

The following research questions are stated to guide the study.

1. What is the relationship between students' creative thinking and their academic performance in SSII physics?
2. To what extent do students creative thinking influence their academic performance in SS II Biology?
3. Do students creative thinking influence their academic performance in SS II Chemistry?
4. What is the relationship between students creative thinking and their academic performance in SS II mathematics?

Hypotheses

The following null hypotheses are formulated to guide the study and tested at 5% probability level;

1. There is no significant relationship between students creative thinking and their academic performance in SS II physics.
2. The relationship between students creative thinking and their academic performance in SS II Biology is not significant.
3. There is no significant relationship between students creative thinking and their academic performance in SS II Chemistry.
4. The relationship between SSII students academic performance in mathematics is not significantly dependent on their creative thinking.

METHODS

The correlation research design was adopted for this study. The reason is that the researcher intends to explore the relationships between students creative thinking and their academic performance in science subjects. The area of study is Obio/Akpor Local Government Area of Rivers State with about 24 senior secondary schools including both private and public schools.

The population of this study consisted of all the students in the 24 senior secondary schools in the study area. The stratified simple random sampling technique was used to draw fifty (50) students from each of the twenty (20) selected schools to give a sample size of one thousand (1000) students.

Instruments for Data Collection

The instruments for data collection were self-constructed questionnaires using 4-pionts rating scale and standardized students promotion results in physics, biology, chemistry and mathematics. The instruments were made up of three parts; namely sections A, B and C respectively. Sections A contains the demographic information of the students, B contains forty (40) items that focused on science students creative thinking while C contains standardized promotion results for SS II students in physics, biology, chemistry and mathematics respectively.

Validity and Reliability of the Instruments

In this study, the face and content validities were used. The experts in measurement and evaluation and content specialists vetted the items on the questionnaire and considered them fit for the study. For the internal consistency of the measuring instrument, the reliability coefficient (r) of 0.89 was obtained using Rulon statistical technique. On the promotion results the scores were all standardized. Thus, the instruments were declared reliable.

Procedure for Data Collection

Data used in this study were collected from the responses on the administered self-constructed questionnaires and the standardized SSII promotion examination results on science subjects collected from the principals of the schools involved in the study. These generated data for the study.

Method of Data Analysis

The Pearson Product Moment Correlation (PPMC) was used to answer the research questions while the transformed scores into t-test statistics were used to test the hypotheses at 5% probability level.

RESULTS

Data presented in this study were based on the results of research questions answered, and the hypotheses tested at 5% probability level.

Research Question One

What is the relationship between students' creative thinking and their academic performance in SS II Physics?

Hypothesis One

There is no significant relationship between students creative thinking and their academic performance in SS II physics

Table I: Summary of Relationship Between Students' Creative thinking and their Academic Performance in SS II Physics.

Variables	N	$\sum x$	$\sum y$	$\sum x^2$	$\sum y^2$	$\sum xy$	r	r^2	t-cal	t-crit
Students' creative thinking (X)	1000	1427	152	44177	10657	30732	.84	.71	5.82	1.96
Physics Academic Performance (Y)										

Table 1 shows the correlation coefficient (r) .84, t-calculated value 5.82 while t-critical value 1.96 with df 998 at 5% probability level and the coefficient of determination of the relationship .71 respectively. Thus, the null hypothesis of no significant relationship between students creative thinking and their academic performance in physics is rejected and the alternate hypothesis accepted because the t-calculated value 5.82 is greater than the t-critical value 1.96.

Research Question Two

To what extent do students creative thinking influence their academic performance in SS II Biology?

Hypothesis Two

The relationship between students creative thinking and their academic performance in SS II Biology is not significant.

Table 2: Summary of Relationship between Students Creative thinking and their Academic Performance in SS II Biology

Variables	N	∑x	∑y	$\sum x^2$	$\sum y^2$	∑xy	r	r^2	t-cal	t-crit
Students' creative thinking (X)	1000	13914	12732	27218	27386	43132	.80	.64	9.45	1.96
Biology Academic Performance (Y)										

The results in Table 2 showed correlation coefficient (r) .80, coefficient of determination of the relationship (r^2) .64, t-calculated value 9.45 and t-critical value with df 998 at 5% probability level is 1.96. From the foregoing, the table critical value 1.96 is less than the t-calculated value 9.45. Thus, the null hypothesis which states that the relationship between students creative thinking and their academic performance in biology is not significant is rejected and the alternate hypothesis is accepted.

Research Question Three

Do students creative thinking influence their academic performance in SS II chemistry?

Hypothesis Three

There is no significant relationship between students creative thinking and their academic performance in SS II chemistry.

Table 3: Summary of Relationship between Students Creative thinking and their Academic Performance in SS II Chemistry.

Variables	N	∑x	∑y	$\sum x^2$	$\sum y^2$	∑xy	r	r^2	t-cal	t-crit
Students' creative thinking (X)	1000	19318	14636	26409	23818	42432	.88	.77	8.47	1.96
Chemistry Academic Performance (Y)										

Table 3 results revealed that the correlation coefficient (r) .88, coefficient of determination of the relationship (r^2) .77, t-calculated value 8.47 is greater than t-critical value 1.96 with df 998 at 5% probability level. Hence, the null hypothesis of no significant relationship between students' creative thinking and their academic performance in SS II chemistry is rejected and the alternate hypothesis accepted. This shows that there is a significant relationship between students' creative thinking and their academic performance in SS II chemistry.

Research Question four

What is the relationship between students' creative thinking and their academic performance in SS II Mathematics?

Hypothesis Four
The relationship between students' academic performance in SSII mathematics is not significantly dependent on their creative thinking.

Table 4: Summary of Relationship between Students' Creative thinking and their Academic Performance in SS II Mathematics

Variables	N	∑x	∑y	$\sum x^2$	$\sum y^2$	∑xy	r	r^2	t-cal	t-crit
Students' creative thinking (X)	1000	14278	14295	22129	19430	28479	.85	.72	7.04	1.96
Mathematics Academic Performance (Y)										

As shown in table 4, correlation coefficient (r) .85 coefficient of determination of the relationship (r^2) .72, t-calculated value 7.04 and t-critical value 1.96 with df 998 at 5% probability level. Thus, the table critical value 1.96 is less than the t- calculated value of .7.04 and therefore the null hypothesis is rejected while the alternate hypothesis accepted. So, students' creative thinking influence students' academic performance in mathematics.

DISCUSSION

The research questions answered and hypotheses tested constitute the basis of discussions in this study. The finding obtained in table 1 shows that r = .84 as the relationship between students creative thinking and their academic performance in physics while coefficient of determination of the relationship (r^2) .71. Subjecting r = .84 to t-test statistics, the t-calculated value 5.82 is greater than the t-critical table value 1.96 with df 998 at 5% probability level. Thus, the null hypothesis of no significant relationship between students' creative thinking and their academic performance in physics is rejected. The foregoing shows that there is a significant relationship between students' creative thinking and their academic performance in physics.

The results of the findings in this study is in agreement with that of Tella (2008) who investigated the influence of various components of learning on students' academic achievement in mathematics. The result showed that the component of learning such as laboratories, creative method of teaching, good classroom condition among others significantly influenced science students' academic performance. Therefore from the foregoing, students' academic performance is dependent on their creativity. The reason for this could be attributed to good reasoning ability, high level thinking and manipulative abilities among others.

In table 2, the results showed that r= .80 and r^2 = .64 indicating high positive relationship between students creative thinking and their academic performance in biology. When r = .80 is further subjected to t-test statistics, gives t-calculated value 9.45 which was greater than the critical table value 1.96 with df 998 at 5% probability level. Therefore, the null hypothesis which states that the relationship between students creative thinking and their academic performance in SS II biology

is not significant is rejected while the alternate hypothesis accepted. This revealed significant relationship between students' creative thinking and their academic performance in biology.

Consequent upon the above submissions, the findings of this study supported that of Abudullahi (2005) and Nwagbu (2008) who in their independent investigations submitted that students' capacities to produce new, good original ideas, insights, restructurings among others influence their academic performances in schools. This is because they have innate abilities to transfer knowledge gain in one context to another in order to solve problems. From here, the reason for the high creative influence on students' academic performance could be attributed to their imaginative and thinking abilities they possessed. Thus, they apply the knowledge and skills in various ways to achieve valued goal in life.

The results of research question and hypothesis in table 3 showed that r = .88 as the coefficient of relationship between students creative thinking and their academic performance in chemistry, and r^2 = .77 is the coefficient of determination of the relationship. The 77% of students' academic performance could be attributed to the influence of students' creative thinking. When r is subjected to t-test statistical analysis gives t-calculated value 8.47 and was greater than t-critical value 1.96 with df 998 at 5% probability level. From here, the null hypothesis which states that there is no significant relationship between students' creative thinking and their academic performance in chemistry is rejected and the alternate hypothesis accepted. It indicates that students' creative thinking influence students' academic performance in schools.

The result of this study is in agreement with that of Sawyer (2010) and Burnard (2012) respectively. Sawyer in his study on practical biology maintained that students with high imaginative thinking skills performed better in schools. Again, Burnard investigated the influence of students' manipulative thinking skills on their academic performance in science subjects. The results proofed that students with high manipulative abilities performed better than those with little or no manipulative thinking abilities in schools. The reason for the high performance of students with high manipulative abilities could be attributed to the innovative, exploring, problem solving abilities and talented qualities of these students. Hence, their performances are higher than others in the same school settings.

Again, the results of research question and hypothesis in table 4 showed that r= .85 is the coefficient of the relationship between students creative thinking and academic performance in mathematics, and r^2 = .72 is the coefficient of determination of the relationship. Thus, 72% of students' academic performance could be attributed to the influence of students' imaginative thinking skills. And when r is subjected to t-test statistical analysis the results showed that t-calculated value 7.94 was greater than t-critical value 1.96 with df 998 at 5% probability level. Consequently, the null hypothesis which states that the relationship between students' academic performance in SSII mathematics is not significantly dependent on students' creative thinking is rejected and the alternate hypothesis accepted. It is an implication that students creative thinking influence their academic performance in mathematics.

The result of this finding agreed with that of Tsai (2013a) who in his study correlated students' academic performance with their manipulative and high thinking abilities in biology. The result obtained showed that r = .86 indicating that students creative thinking significantly influence their academic performance in various spheres of life. The reason is that creative students are always inspiring, illuminating and are able to come out from their incubation. These and others accounted for the high performances of the creative thinking students in schools, and other areas of life they find themselves than those with little or no creative abilities.

Implications for Educational Evaluation

Evaluation is a systematic process of collecting, analyzing and interpreting data to determine the extent to which pupils achieve instructional objectives, or it is the process of delineating, obtaining and providing useful information for judging decision alternatives. Again, it is used to specify the criteria to judge, ascribe quality, value or worth of a thing or programme etc.

Interestingly, the evaluation implication of this study is to ensure that accurate measures are taking so as to achieve the best results in students' creativity. For this reason, the need to determine the worth of students' creative thinking skills on their academic performance in sciences become necessary. This is because the early useful information on the influence of students' creative thinking in science subjects and identification of the various barriers, delineating and providing useful remedial measures will ensure effective creative teaching and learning methods at the various levels of education. This will enhance students' creativity and improve their academic performance in science subjects.

CONCLUSION

This study examined the influence of students' creative thinking on science students' academic performance in senior secondary two (SS II). The finding of the study revealed that the factors considered hold significant position in the relationship between creative thinking and students' academic performance. Again, when the teaching and learning is creative they complement students' academic performance and vice versa. Based on the foregoing, this paper concludes that students' creative thinking significantly influence their academic performances in science subjects.

Recommendations

In line with the findings of the study, the following recommendations are made for immediate implementation to achieve the noble objectives of the study:

1. The use of creative teaching and learning methods in schools to enhance students' creative thinking skills and to improve their performances in schools.
2. Curriculum planners should ensure that creative teaching method is enshrined as part of the regular teaching methods in schools.
3. Government to encourage teachers with creative teaching abilities by providing some remunerations to enhance the sustain abilities.

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