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CREATIVITY AS PREDICTOR OF SECONDARY SCHOOL STUDENTS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ANAMBRA STATE

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ABSTRACT

Creativity is a strong indicator and facilitator for effective learning. The study aimed to explore the students' creativity as a predictor of academic achievement in mathematics in Anambra State The study adopted a multiple regression predictive design. The population of the study comprised 21,204 SS II students from which a sample of 1500 was drawn. The multi-stage procedure was used to select the sample. A standardized research instrument such as; the Students' Epstein Creativity Competencies Inventory developed by Epstein (ECCI) was used for data collection. Students' mathematics achievement scores from the state-wide promotion examination were used to represent mathematics achievement. Cronbach's alpha was used to determine the reliability of the items in the instruments. Reliability indices were found to be .89 for the personal trait, .64 for process, .85 for press, and .71 for product respectively. The overall score of the coefficients is .77 which made the instruments fit for the study. Four research questions and three hypotheses were formulated for the study. The standard multiple regression was used to analyze the collected data. The t-test for r, F-test, and test of significance for β, were used to test hypotheses at a .05 level of significance. Findings showed that students' academic achievement scores were significantly predicted by the product scores. It was also, recommended that teachers and parents should encourage their children to adopt creativity as an adaptive behavior to motivate their learning potential to achieve academic progress more meaningfully. This is because these results document the vital influence and impact which creativity has on students' learning outcomes.

KEYWORDS

Creativity and Academic Achievement.

Encouraging students in secondary school for learning, in general, is a different and dynamic challenge for educators, and secondary school students are not exception to this. Highly creative students are easy to identify because they try, persist, and cope with challenges, but are hard to find within secondary schools in Nigeria and Anambra State in particular. More prevalent in the classrooms are the students who are not creative, who give up easily or do not enjoy academic tasks, and those who exert little effort. The widely recognized problem of student creativity within the classroom has spurred numerous studies in the Nigerian educational psychology research. An attempt to identify causes underlying the academic problems that were instigated by the students' poor creative ability and suggest practices that may, help to improve this abysmal discovery on students' creativity and academic achievement is the major aim of this study.

The continuous stream of research testifies that despite the challenges students encounter in being creative, creativity still has link with their academic achievement.Considering the importance of students' performance at the secondary school level, creativity can be defined as the crucial aspect of students' investment and one of the indicators through which their lifelong learning could be actualized successfully (Anyanwu and Emesi, 2019). Students' academic achievement is of great importance to nation building, as the interests in this aspect at all levels are being intensified. These interests range from the way the assumption is viewed, thought, administered, and understood amongst others issues.

Academic achievement is a fundamental aspect of everyday life, affecting people's work, interpersonal relationships, sense of being, and leisure (Struhers, Menec, Schonwetter, & Perry, 1996). The quintessential achievement-orientated domain in education, particularly for secondary school students, includes high performance on test, passing courses, and completing the academic programme at any level. However, academic achievement is strongly influenced by psychological factors like creativity (Naderi, , Jamaluddin, Hamid, & Kumar, 2009). Research on academic achievement of young students (Komarraju, Karau, & Schmeck, 2008), provides no reliable and consistent indication concerning the extent of creativity in predicting academic achievement. Relating to this, Hirsh and Peterson (2008) in their study suggest that academic achievement can be predicted through creativity testing. Additionally, research suggests that as students attain higher level of education, there is an apparent decline in the relationships between academic achievement and creativity (Naderi, *et al*, 2009a). This indicates that creativity tests account for a smaller portion of the variance in academic achievement. Furthermore, it could be suggested that the predictive power of creativity for academic achievement becomes almost negligible at the secondary school level. As creativity has been subjected to many different definitions, academic achievement or academic ability on the other hand, is relatively more easily defined, measured and interpreted (Palaniappan, 2007a).

Academic achievement has been defined as scores obtained from examination that measure the extent to which a person has acquired certain information or master certain skills, usually as a result of specific instruction (Meherns & Lehman, 2016). These scores characterized the academic outcome obtained from achievement test assigned to assess a person's performance in a course of study which he/she has undergone. On this note, the researchers defined academic achievement as performance outcome that reveals the areas of students' weakness and strength in a particular academic context. Suffice to say that studies on creativity and academic achievement have awakened growing interest in psychological research, in an attempt to examine the assumption that the variable could potentially predict academic achievement. For example, the researchers noted that despite profusion of studies devoted to the creativity, it is difficult to find a unanimous and accepted finding on its ability to predict academic achievement among the secondary school students' in Anambra State.

Interestingly, as a result of this observation, the researchers were spurred to explore whether a link existed between creativity and academic achievement. It could be acceptable to state that creativity will lead the country to change the way her citizens think about issues and can be a driving force behind the country's development. This shows that creative thinking is a thought that is characterized by its ability to discard unnecessary assumptions and carve original ideas. Awotalo and Fatade (2005) revealed that Torrance (1969) defined creativity broadly as the process of sensing a problem, searching for possible selections, drawing hypotheses, testing and evaluating, and communicating the results to others. This shows that the process involves original ideas, different point of view, breaking out of the mould, recombining ideas or seeing new

relationships among ideas. On this note, the researchers operationally defined creativity as the capacity of a person to invent innovative ideas that is essentially novel and previously unknown to others. This means that students' creativity could have a the potential to predict academic achievement. Though, many studies have indicated that creativity can influence students' academic achievement in many level of schooling. For example, the study of Naderi *et al* (2009) reveals that creativity is not significantpredictor ofstudents' academic achievement of undergraduate students. Also, Olatoye, Akintunde and Ogunsanya (2010) recorded that creativity does not significantly predict academic achievement of students in polytechnic system. The study of Naderi, Abdullah, Aizan, Sharir and Kumar (2009b) reported that the level of interaction between creativity and academic achievement was significantly low as creativity interactive effect was low in predicting academic achievement.

Of all the personal and psychological variables that have attracted researchers in this area of academic achievement, creativity seems to have been neglected. In an effort to improve on students' cognitive and affective outcomes in mathematics achievement, educational psychologist and mathematics educators have continued to search for variables that could be manipulated to predict academic achievement. Such psychological constructs can be seen in creativity. For this reason, the present study aimed to investigate this motivational construct to see how it will impact and predict academic achievement in a collaborative learning situation. Examining this variable could motivate and attract tacit knowledge of the students towards learning scenarios. The problem is could creativity predict academic achievement in mathematics. Therefore examining this construct in association with mathematics achievement is empirically needed in the Nigerian educational research. Against this backdrop, the researchers examined creativity as a predictor of secondary school students' academic achievement in mathematics in Anambra State.

Research Questions

1. To what extent are the assumptions of the regression equation for predicting students' academic achievement in mathematics using creativity scores met?
2. What is the nature of the regression equation for predicting students' academic achievement in mathematics using creativity scores?
3. What proportion of variance in students' academic achievement in mathematics is explained by variance in creativity scores?
4. Which of the independent variables best predict students' academic achievement in mathematics?

Hypotheses

1. The regression equation does not significantly predict academic achievement in mathematics using creativity scores.
2. The proportion of variance in students' academic achievement in mathematics explained by variance in creativity is not significant.
3. Creativity does not significantly predict students' academic achievement in mathematics.

Research Method

The researchers adopted a multiple regression predictive research and used questionnaires to collect data for the study. The population of this study consisted of 21,204 which represented all the Senior Secondary School Students II in Anambra State. A sample of 1500 SS2 students were drawn from the senior secondary schools in the six education zones in Anambra State. Probability sampling procedure was used to select the respondents. The procedures for the selection were as follows: In stage one, three education zones were selected from the six education zones in the state by simple random sampling. Then in stage two, from each sampled education zone, one local government area (L.G.A) was selected through simple random sampling given a total of three (3) L.G.As. In stage three, from each sampled L.G.A, 10 schools were randomly selected giving a total of 60 schools. Then, from each of the schools, 25 SSII students were selected for the study using a table of simple random sampling. This gave a total number of 1500 students used in the study.

The study adapted a standardized research questionnaire namely, Epstein Creativity Competencies Inventory developed by Epstein (ECCI, 2008). The students' achievement scores were obtained from that state wide Senior Secondary One (SS1) promotion examination from the schools before the administration of the

instruments. The methods used for validating the instruments were face and construct validity by the three experts from the Faculty of Education, Nnamdi Azikiwe University Awka. Cronbach's alpha reliability method was used to determine the internal consistency of the sub-scales for the instrument such as; personal trait, process, press and product were .89, .64, .85, and .71 respectively. The overall scores of the coefficients is .77 which made the instruments fit for the study. The data were analyzed using standard multiple regression analyses. The t-test for r, F-test and test of significance for β, were used to test hypotheses at .05 level of significance.

Presentation of Results

Research question 1: To what extent are the assumptions of the regression equation for predicting students' academic achievement in mathematics using creativity scores met?

Table 1: Correlation and descriptive statistics of independent and dependent variables in the regression model for this study.

Variables	PT	PRC	PRE	PR	Achievement
PT	1				
PRC	.320	1			
PRE	.338	.315	1		
PR	.265	.292	.296	1	
Achievement	.002	-.025 -.038	046		1
Mean	21.3318	22.2911	21.9079	21.5961	57.3151
SD	3.87308	4.12781	3.94512	3.71250	8.34331
Variance	15.001	17.039	15.564	13.783	69.611
Skewness	.119	.063	.382	.274	.163
Kurtosis	2.062	1.212	1.508	2.037	-.669
VIF	1.221	1.219	1.236	1.173	----------
TF	.819	.821	.809	.852	----------

Std. Residual Min = -2.760, Std. residual Max = 2.689
Durbin Waston statistics = 1.892
PT = Personal Trait, PRC = Process, PRE = Press, PR = Product, and Academic Achievement.

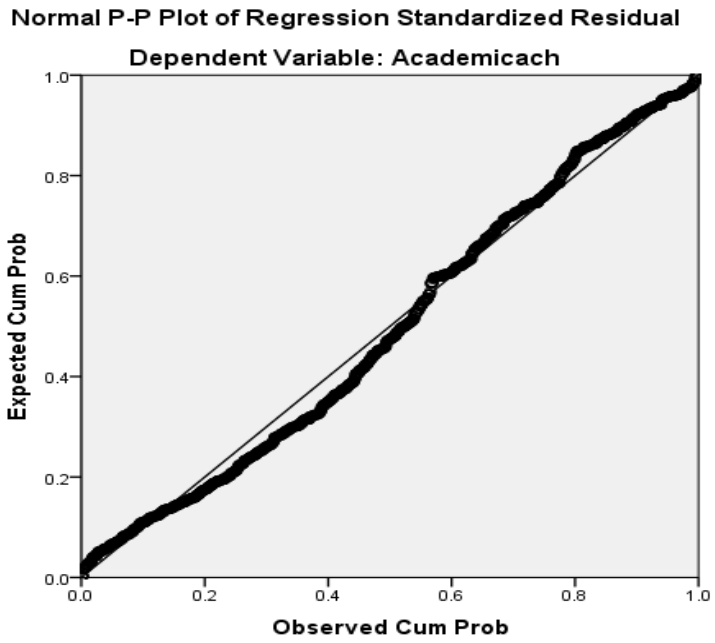

Fig 1 the normal P-P plot of standardized residuals data points.

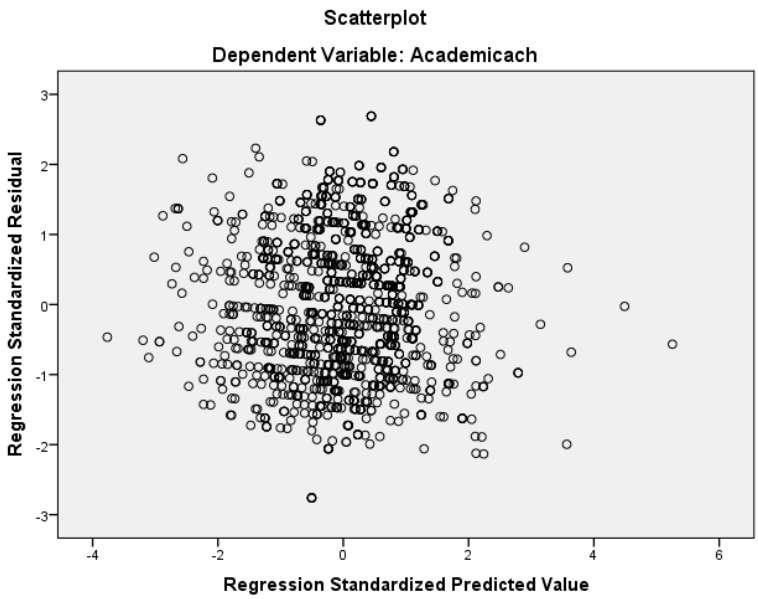

Fig 2 scatter plot of standardized predicted values.

To find out if assumptions of the regression model were met, the influence of outliers on the outcome of the result was checked using standardized residual. Result in table 1 indicated that the data contains no outliers (Std. Residual min = -2.760, Std. Residual max = 2.689) as standardized values lies between -3 to 3 as recommended (Tabachnick & Fidell, 2018). To test if the assumption of absence of multicollinearity among the predicting variables was violated; Variance Inflated Factor (VIF) and Tolerance Factor (TF) (Personal trait, Tolerance Factor = .819, VIF = 1.221; Process, Tolerance Factor = .821, VIF = 1.219; Press, Tolerance Factor = .809, VIF = 1.236; Product, Tolerance Factor = .852, VIF = 1.173; of the independent variables were examined, results in table 1 also show that values are less than 10 for VIF and greater than.20 for TF respectively as recommended by (Schumacker, 2015). Durbin Waston statistics was used to test if the assumption of independent errors was violated; the results showed that Durbin Waston statistics is 1.892 less than 4 but greater than zero as recommended by (Denis, 2020). Hence, the assumption of independent variables was met. Fig 1 shows that the normal P-P plot of standardized residuals data points were completely off the line, but close.

Hence, the errors were normally distributed. The scatter plot of standardize predicted values in Fig 2 shows that the data met the assumptions of homogeneity of variance and linearity as the data were distributed above zero in both dimensions and do not show any pattern. The data also met the assumption of non-zero variances (Personal trait, Variance = 15.001; Process, Variance = 17.039; Press, Variance = 15.564; Product, Variance = 13.783; Academic achievement, Variance = 69.611) as there is no zero variance for any of the variable in the study as shown in table 1.

Research Question 2: What is the nature of the regression equation for predicting students' academic achievement using creativity scores.

Table 2: Regression coefficient for academic engagement scores.

Model	Unstandardized Beta	Std. Error	Standardized Beta
Constant	57.339	1.752	
Persona trait	.025	.061	.012
Process	-.065	.058	-.032
Press	-.111	.061	-.053
Product	.153	.063	.068

Using the information in table 2, the nature of the regression equation for predicting students' academic achievement in mathematics using creativity scores follows:

Y = b0 + b1x1 + b2 x 2 + b3 x3 + b4 x4

Y = 57.339 + .025 x 1+ -.065 x 2 + -.111 x 3 + .153 x 4

Ach = 57.339 + 0.025 - 0.13- 0.333 + 0.612

Achievement = 57.339+ 0.025 PT - 0.13 PRC - 0.333 PRE + 0.612 PR

The equation shows that for every unit increase in personal trait, achievement increased by 0.025. For every unit decreased in process, achievement decreased by - 0.13. For every unit decrease in press, achievement decreased by - 0.333. For every unit increase in product, achievement increased by 0.612.

Research Question 3: What is the proportion of variance in academic achievement in mathematics scores that is explained by variance in creativity.

Table 3: Regression model summary of creativity scores on students' academic achievement in mathematics

Model	R	R-Square	Adjusted R-Square	Std. Error of the Estimate
	.078[a]	.006	.003	8.32931

To answer this research question the adjusted multiple regression R square in 3 was used. The result of the table show that using creativity scores yielded an adjusted R squared of .003. This implies that predictors accounted for about 0.3% of the variance scores in mathematics academic achievement.

Research Question 4: Which of the independent variables best predict Students' academic Achievement in Mathematics?

Table 4: Regression coefficient for students' academic achievement scores in mathematics using creativity scores.

Model	Unstandardized Beta	Std. Error	Standardized Beta
Constant	57.339	1.752	
Persona trait	.025	.061	.012
Process	-.065	.058	-.032
Press	-.111	.061	-.053
Product	.153	.063	.068

To answer this research question 4 the standardized regression coefficient (B) in table 4 was used for comparison. The regression coefficients presented in table 4 shows unstandardized (B) and standardized regression coefficient (B) personal trait scores are .025 and .012. For process scores are -.065 and -.032. For press scores are - .111 and -.053. For product scores are .153 and .068 respectively. Using the standardized beta for comparison, product is mostly predicted students' academic achievement in mathematics as shown by the B of .153. Personal trait is the second most predicted students' academic achievement in mathematics as shown by the B of .025. Press is the third most predicted students' academic achievement in mathematics as shown by the B of -111. While process is the forth most predicted students' academic achievement in mathematics as shown by the B of -.065.

Hypothesis 1: The regression model does not significantly predict academic achievement in mathematics.

Table 5: F- test for regression model of creativity scores on students' academic achievement in mathematics scores.

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	626.7724	156.6932.259	.061[b]		
Residual	103580.507	1493	69.377		
Total	104207.279	1497			

The analysis of variance in the table shows that the regression equation was significant (4, 1493) = 2.259, $p < .05$. This implies that at least one of the independent variables significantly predicted the academic achievement in mathematics.

Hypothesis 2: The proportion of variance in academic achievement scores in mathematics explained by creativity scores is not statistically significant.

Model	R	R- Square	Adjusted R- Square	Std. Error Estimate	t – cal for adj. R^2	DF	t- crt.	Remark
	.078[a]	.006	.003	8.32931	0.49055	1498	1.960	NS

To test hypothesis 2, t-test for adjustment R square was conducted. Results of the study shown in table 5 indicates that t-critical for adjusted R square is 1.960 while that of the calculated is 0.49055. Since the t-calculated for adjusted R square 0.49055 is less than t-critical 1.960, the null hypothesis which states that the proportion of variance academic achievement scores in mathematics explained by creativity scores is not statistically significant is accepted and the alternative hypothesis is rejected. In other words, the proportion of variance academic achievement scores in mathematics explained by creativity scores is statistically significant.

Effect sizes were also evaluated using adjusted R^2comparing it with Cohen's *d* statistics guideline, where d < 0.20 indicates a minimal effects size, 0.20 < d < 0.50 indicates a small effect size, 0.50 < d < 0.80 indicates a moderate effect size, and d > 0.80 indicates a large effect size. The value of R adjusted square .008 indicates a minimal effect.

Hypothesis 3: Creativity does not significantly predict students' academic achievement in mathematics.

Table 6: t-test of regression coefficient of students' academic achievement scores in mathematics using academic engagement scores.

Model	Unstandardized Beta	Std. Error	Standardized B	T	p-value	remark
Constant	57.339	1.752		32.736	.000	S
Personal trait	.025	.061	.012	.412	.680	NS
Process	-.065	.058	-.032	-1.125	.261	NS
Press	-.111	.061	-.053	-1.831	.067	NS
Product	.153	.063	.068	2.443	.015	S

Table 6 shows that product scores significantly predict students' academic achievement scores in mathematics since the p-value is less than .05. Then, personal trait, process and press scores does not significantly predict academic achievement in mathematics since their p-values are greater than .05.

Discussion of findings

The researchers found that the proportion of variance in academic achievement scores in mathematics explained by creativity is significant. This implies that 0.3% variability in mathematics achievement scores can be explained by dimensions of scores such as; personal trait, process, press and product. This is not in line with the study of Naderi *et al* (2009a) which reveals that creativity is not a significant predictor of students' academic achievement of undergraduate students. Also, the present findings do not support the study of Olatoye, Akintunde and Ogunsanya (2010) which recorded that creativity does not significantly predict academic achievement of students in the polytechnic system. Finally, the multiple regression analysis showed interaction effects between creativity and academic achievement as the F-value 2.259, p < .05, as creativity explained .061 of variance in academic achievement. This implies that at least one of the independent variables significantly predicted the academic achievement in mathematics. This is in line with the study of Naderi *et al* (2009b) which reveals that the interaction effects between creativity and academic achievement as the F-value 8.294, p < .05, creativity explained 0.41 of variance in academic achievement.

Conclusion

It could be concluded that the intention of creativity and academic achievement in mathematics can significantly affect students' academic achievement in the subject domain of mathematics. It is found in the present study that creativity has significant predicting strength with academic achievement in mathematics.

Recommendations

Based on the findings, the following recommendations were made:

1. These results have clear implications for intervention research to be designed by the educational psychologists to enhance the cognitive achievement of the underachieving students as a result of poor creative ability.
2. The findings recommended that educators and family members should give primacy to focusing young people on ambitious specific future goals, highlighting how those goals affect behaviours and influence outcomes through creativity. This shows that students with no creative aspiration do little better than students who have no creative aspiration in the academic tasks.
3. The researchers recommended that interventions to enhance educational outcomes through that will represent creative-behavioural therapy for underachieving students are needed in the classroom. This will be successful with the help of these findings if teachers strengthen students' motivation through messages that communicate high expectations from the students in relation to specific learning goal.
4. With the findings from the study, it was recommended that teachers and parents should encourage their children to adopt creativity as an adaptive behaviour to motivate their learning potential to achieve more meaningfully. This is because these results document the vital influence and impact which creativity has over students' learning outcomes.

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