

Influence of Creative Style and Gender on Students' Achievement in Physics

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Abstract

The research investigated the influence of creative style and gender on students' achievement in physics. The sample consisting one hundred (100) Senior Secondary II physics students, made up of 50 males and 50 females in Oruk Anam Local Government Area of Akwa Ibom State, Nigeria, were administered the Kirton Adaptor-Innovator Inventory (KAI), and the Physics Achievement Test (PAT) as instruments for the study. The three research hypotheses formulated to guide the study were tested using multiple regression analysis. The results showed that gender and creative style as factors individually and jointly exert significant influence on students' achievement in physics. 23% of the variance in the achievement scores of the physics students were accounted for by creative style. 52% of the variance in the students physics achievement score was attributable to the joint influence of creative style and gender. Based on these findings, the paper recommends that explanation or prediction of achievement in physics test should take gender and creative style into consideration.

Keywords: Gender, creative style, students' achievement.

Introduction

Creativity is a process where there is an interplay among several interactive cognitive and affective elements. It is the ability to generate new ideas that will contribute substantially to an intellectual domain (De Haan, 2009). Creativity can involve a person's ability to think and be highly imaginative. According to Ofsted (2003), creativity in science can help students achieve new and original steps in performing the targets of science. Often, creativity in science is expressed in comprehending new ideas and concepts to scientific knowledge, in formulating new theories in science, finding new experiments presenting the natural laws, in recognizing new regulatory properties of scientific research and in giving the scientific activity plans and projects originality (Best and Thomas, 2007).

Creative style is a personal preference and a qualitative construct that looks at the different ways in which different people expresses their creativity. Kirton (1994) identified two broad creative style preferences which were classified as adaptor and innovators. Adaptors are individuals who prefer to define and approach problems within existing frameworks and structures (ie do things better) while innovators are individuals who prefer to solve problems by creating a new framework (ie do things differently). Elaborating on the adaptation – innovation orientation, Selby, Treffinger, Isaken and Power (1998) characterize adaptors as resourceful, organized, dependable and seem to supply stability, order and continuity whereas innovators are original, energetic, individualistic, spontaneous and insightful. Understanding students' creative styles is therefore important in the teaching-learning process.

Research findings support many individual differences between creative styles (Gelade, 2002; Ng and Rodrigues, 2002). Other findings subscribe that both creative styles are achievement oriented (Nicholas and Drake, 2003; Jessie, Tan and Ng, 2007). However, none of these studies is conducted in Nigeria. Also, studies related to students' achievement in physics seems to look at gender as a relevant issue in education (Sotonade, 2004). Gender as a factor in the teaching-learning process is not only seen as a significant characteristic in academic behavior but a distinguisher of roles, behaviour, mental and emotional characteristics between males and females (Koller, 1991; Okeke, 2001; Ariyibi, 2004; Naderi, Abdullah and TengkuAizan, 2008). Research reports show significantly better achievement of males over their females counterparts in science (Odigwe, 2002; Ncharam, 2004) and zero difference in achievement of male and female students in science, technology and mathematics subjects (Yilwa and Olarineye, 2004). These results are contradictory.

Studies on gender difference and the relationship between creativity and achievement is limited (Ai, 1999). Olatoye, Akintunde and Ogunsanya (2010) found a very high negative insignificant relationship between creativity and achievement. Nami, Marsooli and Ashouri (2014) studied the relationship between creativity and academic achievement using a sample size of 72 subjects. And through the field of information gathered using questionnaire and analyzed by the use of both descriptive and inferential statistics, found a positive significant relationships. On creativity, gender and achievement, Naderi, et al (2008) examined creativity, age and gender as predictors of academic achievement. A multilevel regression showed weak relationship between school achievement and creativity. Creativity was also found to relate to achievement for boys and girls (Ai, 1999). Creativity had even been hypothesized to improve the self esteem, motivation and achievement of learners (Morris, 2006; Onwugbuta-Enyi and Joseph, 2014). These studies seem to be characterized by conflicting results coupled with the fact that their methodologies differ and there is paucity of such researches in Nigeria. The

stated proposition also needed to be tested.

It has been posited that physics, one of the most fundamental scientific disciplines, is a discipline of questioning, experimenting and thinking “outside the box”; making it critical that students engage in inquiry, innovation and creativity within the science classroom (Okonkwo, 2014). Being regarded as conceptually difficult, abstract and uninteresting; secondary school students view it as involving different representations such as experiments, formulas and calculations, graphs and conceptual explanations as well as transformation among them. The question therefore arose as to whether students creative style towards the adaptive or innovative would influence their achievement in physics. Also, whether gender that has shown conflicting research evidences has any bearing on students’ achievement in physics. With these factors in mind and in the light of reviewed literature, a more reliable evidence on their contributions to achievement of students in physics becomes much desirable.

The purpose of this study therefore was to ascertain the influence of creative style and gender on senior secondary two (SS II) achievement in physics.

Research Hypotheses

The following hypotheses were formulated to guide the study:

1. Adaptive-innovative creative style orientation does not significantly influence students’ achievement in physics.
2. Gender has no significant influence on students’ achievement in physics.
3. The joint influence of adaptive-innovative creative style orientation and gender on students’ achievement in physics is not significant.

Research Design

The study employed the casual-comparative research design.

Area of Study

The study was conducted in Oruk Anam Local Government Area of Akwa Ibom State, Nigeria.

Population

This was made up of all senior secondary two (SS II) physics students in all the fourteen (14) government owned institutions in the area. The estimated population stood at 1345.

Sample and Sampling Technique

Stratified random sampling technique was used to select the 100 students that constituted the sample for the study. Four (4) single-sex government-owned secondary schools made up of two (2) boys and two (2) girls schools were randomly chosen from the schools in the area where effective physics has been done to school certificate level with yearly presentation of students for external certificate examinations conducted by the two recognized bodies – the West African Examination Council (WAEC) and the National Examination Council (NECO). The sample for the study had 50 males and 50 female physics students.

Instrumentation

Two instruments were utilized in the study. They were the Kirton Adaptor-Innovator Inventory (KAI) and the Physics Achievement Test PAT). The 32-items Kirton Adaptor-Innovator Inventory measure students creative traits. It consist of three aspects that represents the factor traits of sufficiency of originality, Rule Governance and Efficiency. The students responded by rating how the inventory items describe them in a 5-point scale (1 = Not well, and 5 = well). The range of scores on the KAI was between 32 and 160; and scores obtained by the students reflected adaptive and innovative orientations. This measure of creative style was both reliable and valid. The physics achievement test was a restricted-response essay-type test. It had 10 short answer questions that assesses the performance of students in magnetism task in physics. A table of specification constructed ensured that areas of behaviours expected to be covered by the physics task met content validity. The reliability of PAT was found using Cronbach Alpha by administering the instrument on 28 SS II students of a secondary school within the study area not selected for the study. The reliability coefficient as calculated was 0.85, making the instrument reliable to be used for the study.

Data Collection

Both instruments (KAI and PAT) were administered to the students in turn and students responded following stated instructions. The students responded satisfactorily as required.

Method of Data Analysis

The data was analysed using stepwise multiple regression and the hypotheses were tested at 0.05 level of significance.

Results

The results of the study are presented in Tables 1, 2 and 3 to guide the hypotheses stated.

Table 1: Multiple Regression Analysis of Gender and Creative Style on Physics Students Achievement

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------------------|----------|-------------------|----------------------------|
| 1 | .478 ^a | .229 | .221 | 9.397 |
| 2 | .721 ^b | .519 | .510 | 7.455 |

- Predictors: (Constant), creative style of students
- Predictors: (Constant), creative style of students, gender of students in the study.
- Dependent variable: Physics Achievement Score of students

The results in Table 1 shows that for model 1 where students achievement in physics is to be predicted using creative style of students, $R^2 = 0.229$ suggesting that 23% of the variance in students achievement can be accounted for by their creative style whereas in model 2, where both the creative style and gender of students are predictors, the Rsquare value is 0.519, implying that 52% of the variance in students achievement in physics can be accounted for by these predictors.

Table 2: F-test of the Joint Influence of Creative Style and Gender on Students Achievement in Physics

| Model | Sum of Squares | df | Mean Square | F | Sig. |
|---------------|----------------|----|-------------|--------|-------------------|
| 1. Regression | 2564.463 | 1 | 2564.463 | 29.040 | .000 ^a |
| Residual | 8654.287 | 98 | 88.309 | | |
| Total | 11218.750 | 99 | | | |
| 2. Regression | 5828.094 | 2 | 2914.047 | 52.436 | .000 ^a |
| Residual | 5390.656 | 97 | 55.574 | | |
| Total | 11218.750 | 99 | | | |

- Predictors: (Constant), creative style of students
- Predictors: (Constant), creative style of students, gender of students in the study.
- Dependent variable: Physics Achievement Score of students

An F-statistics of 29.040 and 52.436 in Table 2 suggest that a regression model containing either creative style or creative style/gender of students are both better than a model without any predictor variables (using the mean achievement score as an estimate for anyone).

The F-test result shown in Table 2 indicates that the joint influence of creative style and gender on the achievement of students in physics is significant beyond the probability level of 0.05 ($F = 52.436, P < 0.000$). Hypothesis 3 which stated that the joint influence of adaptive-innovative creative style orientation and gender on students is not significant, is therefore rejected. Creative style and gender contributes 52% to the total influence on achievement in physics.

Table 3: Coefficients of Joint Influence of Creative Style and Gender on Students Achievement in Physics

| Model | Unstandardized Coefficients | | Unstandardized Coefficients | t | Sig. |
|---------------------------------|-----------------------------|-----------|-----------------------------|--------|------|
| | B | Std Error | Beta | | |
| 1. (Constant) | 49.752 | 2.938 | | 16.933 | .000 |
| Creative styles of students | -10.136 | 1.88 | -.478 | -5.389 | .000 |
| 2. (Constant) | 64.369 | 3.012 | | 21.372 | .000 |
| Creative style of students | -8.281 | 1.512 | -.391 | -5.478 | .000 |
| Gender of students in the study | -11.575 | 1.510 | -.546 | -7.663 | .000 |

The result in Table 3 shows that the regression equation are:

Physics achievement score = $49.751 + (-10.136) * \text{creative style of students}$ (Model 1).

Physics achievement score = $64.369 + (-8.281) * \text{creative style} + (-11.575) * \text{gender}$ (Model 2).

The t-statistics for each independent variable (creative style, gender) is large enough in magnitude to reject null hypothesis 1. The t-value for creative style is 5.478 and is statistically significant beyond probability level of 0.05, implying that the influence of adaptive-innovative orientation on students' achievement in physics is therefore significant. Creative style explains 23% of the variance in the physics achievement scores of the students.

The result also reveals that gender influences the achievement of students in physics beyond the

probability level of 0.05 ($t = 7.663$; $P < 0.000$). Hypothesis 2 is hereby rejected. Gender influences students achievement by accounting for appreciable percentage of the total influence of all factors. Male students performed better than female students as depicted by the negative t-value.

Discussion of Results

As shown by the results, the creative style of adaptive-innovative creative style orientation and gender individually or jointly, are factors that explain or predicts students achievement in physics. Considering the students creative style, the adaptors performed better than the innovators. This result is in consonance with the research evidence by Gelade (2002) and Jessie, Tan and Ng (2007) that individual differences exist between creative styles and that creative styles are achievement oriented. Thus, the adaptive creative style students are superior to the innovative creative style students in academic achievement. The conceptually difficult and abstract nature of physics involving different representations and transformations was adequately responded to by the adaptors in a precise and methodical manner with solutions sought to problems in tried and understood ways. But the innovators thought tangentially, and approached tasks from unsuspected angles, querying basic assumptions. This resulted to the tilt in achievement in favour of the adaptive creative style learners. This is in agreement with the findings of Nami, Marsvoli and Ashouri (2014).

The results has also shown that male students performed better than female students in the physics achievement test. The adjusted creative style of students explained 23% of the variance in the achievement scores of the students while both creative style and gender accounted for 52% of the variance in the achievement scores of the students. This shows an increase of 29% attributed to the influence of gender. Therefore, the relationship between the two factors can be used to explain the influence of gender in achievement in physics. Students differ on the basis of school type, school conditions, individual differences in creative ability, motivation and attitude which characterizes their receptivity to learning. This finding is in agreement with that of Ai (1999) and Naderi et al (2008) and in disagreement with the findings of Yilwa and Olarineye (2004).

The findings that the joint influence of creative style and gender accounts for 52% of the variance in the students achievement in physics is interesting. Thus in explaining achievement scores in physics, creative style and gender should be regarded as variables of considerable importance. They should also be treated as having potentials to indicate systematic relation in physics students achievement.

Conclusion

This study revealed that:

- i. Adaptive style of creativity significantly influence the achievement of students in physics. Students with adaptive orientation performed better than their innovative counterpart. Creative style accounts for 23% of the influence on achievement.
- ii. Gender influences students' achievement in physics by an increase of 39% over the creative style variations in students' scores. Male students performed better than female students in physics.
- iii. The joint influence of creative style and gender on students' achievement in physics is significant, offering a convincing explanation to the tune of 52% of the total variation in achievement.

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