

Grit As A Predictor Of Secondary School Students' Science Academic Achievement In Enugu State, Nigeria: Implication For Educational Foundations

Ifeyinwa Miriam Mamah¹, Florence Obiageli Ezeudu², Jude Uchenna Eze³, Ursula Ukamaka Nnadi⁴, Ifesinachi Jude Ezugwu^{5*} & Christian Sunday Ugwuanyi⁶

^{1,2,5*}Department of Science Education, Faculty of Education, University of Nigeria, Nsukka.

^{3,4}Department of Educational Foundations, Faculty of Education, University of Nigeria, Nsukka.

⁶Faculty of Education, University of the Free State, Bloemfontein, South Africa.

Abstract

The growing rate of poor academic achievement of students at the secondary school level, the contradictory results on the influence of grit on academic achievement from previous studies, and the dearth of study on the predictive validity of grit on academic achievement of students in Nigeria necessitated the study. The study assessed grit as a predictor of students' academic achievement in science. The study adopted a correlational survey research approach. 385 SS3 students drawn by using multi-stage sampling procedures (simple random and proportionate stratified sampling technique) participated in the study. Grit Questionnaire adapted from Duckworth and Quinn (2009) and Science Students' Score Proforma (PSSP) were used for data collection. The instruments were face-validated. The internal consistency of the questionnaire items was determined using Cronbach Alpha, which yielded a reliability coefficient of 0.83. Data collected were analyzed using regression analysis and t-test for the significance of two samples correlation coefficients. The results showed that 66% of the variation in students' academic achievement in science is attributed to or predicted by grit. Grit significantly predicts students' academic achievement while gender and location do not moderate the predictive validity of grit on students' academic achievement in science. These findings have implications for educational foundations in the sense that students will have a solid educational foundation when they have high grit for science learning. The study recommended, among others, that students must be made to understand that persistent hard work, desire, and interest over years despite a series of failures, difficulties, challenges, setbacks, and discouragement is the key that leads to success academically and otherwise.

Keywords: Educational foundations, Grit, secondary school, Science achievement

Introduction

Recently, considerable research have been directed towards identifying variables that can mar or promote positively students' achievement or school success at the secondary school level. Originally, there is this belief according to Allen and Bond (2001) and Kidd and Latif (2003) that students' intelligence is an essential component in determining who will achieve well or not academically. But then in 1970's, psychologists according to Poropat (2009) as cited in Allen et al. (2021) found that achieving high academically goes above and beyond intelligence. Hereafter, psychologists according to Allen et al. (2021) identified that certain qualities and characteristics may be associated with high academic achievement than intelligence (IQ) like grit. In education, grit is relatively a new construct and it is becoming increasingly an important factor in preparing students for greater success in academic and the most significant variable that elucidate more about success or accomplishment in various aspects of our everyday life (Duckworth et al., 2007; Duckworth, 2016; Duckworth & Gross, 2014).

Grit is a personality trait propounded by Angela Duckworth in 2007 that centers on the individuals' persistent efforts and dedication to long-term goals. Grit is a personality trait to pursue a long-term goal with incessant or untiring interest and effort over time (Duckworth et al., 2007). For Duckworth, et al. (2007) grit is "perseverance and passion for long-term goals" and it "entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress". Grit consists of two facets: consistency of interest and perseverance of effort. While consistency of interest refers to individual tendency to maintain their interest or passion for a long time. Perseverance of effort is individuals' long-lasting exertion to achieve a long-term goal even when facing obstacles or challenges (Duckworth et al., 2007). The emphasis mainly is not on a short-term strength but on a long-term strength to succeed, sustaining effort and interest over years, regardless of problems such as distractions, hindrances, difficulties and so on (Duckworth et al., 2007; Duckworth & Eskreis-Winkler, 2013). It is a student's persistent hard work and desire to achieve high academically in school notwithstanding a series of failures, difficulties, setbacks, and obstacles. It is a personality trait that allows students to stick and work hard towards achieving their long-term goals academically even with little or no sign of success.

High grit students are not easily discouraged by setbacks, they maintain focus on a project, work hard, try always to complete tasks, and persevere in sustaining interest so as to achieve their goals in academics while battling with failures and hitches (Duckworth & Quinn, 2009; Arslan et al., 2013). While low grit students are described as unfocussed individual in the face of new projects and challenges, being indecisive in selecting a goal, and easily give up the effort when they encounter challenges and failures or choose alternative actions, (Duckworth et al., 2007). According to Ivcevic and Brackett (2014), grit students work very hard and longer and are more disposed to engaging in the cautious practice to foster school success or academic achievement. Grit students are usually tenacious and industrious and are not easily dispirited by impediments (Owusu et al., 2020). On the other hand, less grit students are less determined or less assiduous (Perez, 2015). They are regularly influenced by new activities and are not able to set lasting goals

for themselves. Moreover, they usually lack the impetus to concentrate on enduring academic projects, tasks, or assignments. In addition, according to Cross (2013), Datu et al. (2018), and Lee and Sohn (2017) grit students are likely to be more involved in their academic activities and as a result achieve better in academics. It was also found that high grit students spend more time studying than those with low grit (Cross, 2013). In other words, learners with high grit levels put extra efforts and time to their academic activities or studies in school thereby attaining higher academically.

In relation to academic achievement, grit according to Bowman et al. (2015) affect students' academic achievement, grades, life satisfaction, and sense of belonging. Some studies like Datu et al. (2018), Duckworth et al. (2007) and Cross (2013) have emphasized the importance of assessing and observing grit in learners while predicting educational success. According to Duckworth et al. (2007) high levels of grit have been associated with greater educational attainment, successful outcomes, and have predicted achievement beyond an individual's capability. In contrast, some studies (Bazelais et al., 2018; Dixson et al., 2017) are of the view that grit is of no significant importance to students' academic performance in school. Bazelais et al. (2018) found that grit does not predict academic achievement or course success. Studies carried out by Palisoc et al. (2017) and Gruenberg et al. (2018) found no significant link between grit and academic achievement. Although the study was on American students and the findings cannot be generalized to students outside the study area. Nelson (2016) also found that grit does not significantly predict students' performance in academics. This inconsistency in findings among researchers shows that the influence of grit on students' academic achievement is inconclusive, unsatisfying and questionable. More so, since students differ in many ways especially in the area of gender and their location, studies are yet to establish how gender and location in relation to grit account for the variations in students' academic achievement or the variation in academic achievement that is predicted by grit. Importantly, it was observed that no study of this nature has been carried out among secondary school students in Nigeria Enugu state in particular and in science as a subject. The dearth of literature on this topic on secondary school students in Nigeria offers a gap in the existing literature, which has prompted this present study. This study is deemed necessary. Therefore, this study is needed to determine the degree of variation in students' science academic achievement that may be attributed to or predicted by grit, as well as the moderating role of gender and location in the prediction.

Purpose of the Study

The main purpose of this study is to determine the amount of variation in students' academic achievement that can be predicted by grit and the moderating influence of gender and location on the predictive validity of grit and students' academic achievement.

Research Questions

The study was guided by the following research questions

1. What proportion of the variation in students' academic achievement in science can be predicted by grit?
2. What is the moderating influence of gender in the predictive validity of grit on students' academic achievement in science?
3. What is the moderating influence of location in the predictive validity of grit on students' academic achievement in science?

Hypotheses

The research was guided by the following null hypotheses, which were assessed at 0.05 level of significance

1. Grit does not significantly predict students' achievement in science.
2. There is no significant relationship in the predictive validity of grit on students' academic achievement due to gender or based on gender
3. There is no significant relationship in the predictive validity of grit on students' academic achievement due to location or based on location

Materials and Methods

Study setting and design

This study used a correlational survey research approach and was conducted in Enugu State, Nigeria. Similarly, Achagh et al. (2020), Eya et al. (2020), Ezema et al. (2019), Gana et al. (2019), Ugwuanyi and Okeke (2020), Ugwuanyi et al. (2020), Ugwuanyi, Okeke and Njeze (2020), Ugwuanyi, Okeke and Ageda (2020), Ugwuanyi, Okeke and Asomugha (2020) have adopted this design in recent studies. Enugu state has six education zones which include: Enugu, Awgu, Agbani, Nsukka, Obollo-Afor, and Udi education zones. Enugu education zone consists of Enugu East, Isi-Uzo, and Enugu North Local Government Areas (LGAs); Awgu education zone consisting of Awgu, Aninri, and Oji River LGAs; Agbani education zone consists of Enugu South, Nkanu East, and Nkanu West LGAs; Nsukka education zone consisting of Nsukka, Igbo-Etiti, and Uzo-Uwani LGAs; Obollo-Afor education zone consisting of Igbo-Eze North, Igbo-Eze South, and Udeni LGAs and Udi education zone: consisting of Ezeagu and Udi LGAs. The residents of these Zones are mainly farmers, traders, craftsperson and civil servants. The choice of this area is informed by the increasing rate of poor academic performance of students and the dearth of research of this nature in Enugu state.

Study population and sampling method

The population consists of 10,560 SSS3 (4865 male and 5695 female) science students of 2020/2021 academic session in all the 290 schools owned by the government in Enugu State. (Source: Post Primary School Management Board Enugu State, 2021). A sample of 385 SS3 (177 male and 208) students was used for the study. The choice of SS3 students is because it is assumed

that they have been taught mostly all the various concepts in science curriculum and are getting ready for WAEC and other external examinations. This study used a multi-stage sampling approach. At the first stage, a simple random sampling technique by balloting with replacement was used to sample three education zones (Enugu, Obollo-Afor, and Nsukka). At the second stage, a simple random sampling technique with replacement was also used to draw six LGAs (Isi-Uzo, Enugu North, Nsukka, Igbo-Etiti, Igbo-Eze South, and Udenu) from the selected three education zones. At the third stage, a proportionate stratified sampling technique was used to sample fifteen (15) secondary schools from the six selected LGAs and this yielded two secondary schools from Isi-Uzo local government area; one from Enugu North; three from Udenu; two from Igbo-Eze South; five and two schools were selected from Nsukka and Igbo-Etiti local government areas respectively. In the third stage, a proportionate stratified sampling technique was also used to sample 43 students from the Isi-Uzo local government area; 59 from Enugu North; 67 from Udenu; 57 from Igbo-Eze South; 102 and 57 students were selected from Nsukka and Igbo-Etiti local government areas respectively. In the fourth stage, a proportionate stratified sampling technique was also used to sample 177 male students (i.e., 20 male students from Isi-Uzo local government area; 27 from Enugu North; 31 from Udenu; 26 from Igbo-Eze South; 47 and 26 male students were selected from Nsukka and Igbo-Etiti LGAs respectively) and 208 female students (i.e., 23 female students from Isi-Uzo local government area; 32 from Enugu North; 36 from Udenu; 31 from Igbo-Eze South; 55 and 31 female students were selected from Nsukka and Igbo-Etiti LGAs respectively) Proportionate stratified sampling technique was used in the third and fourth stages because the number of schools, male and female students in the six LGAs were not equal.

Data collection tools and procedures

For the data collection, two instruments (Questionnaire and Science Students' Score Proforma) were used. The questionnaire titled "Grit questionnaire" consists of 8 items relating to grit and was adapted from Duckworth and Quinn (2009). The questionnaire was structured on a five (5) points rating scale. The items response options are Very much like me, Mostly like me, Somewhat like me, Not much like me, Not like me at all with numerical values of 5, 4, 3, 2, and 1 points allocated correspondingly to each of the responses. Science Students Score Proforma (PSSP) designed by the researcher was utilized to collect the sampled students' previous three consecutive end-of-term examination scores.

The instruments [Grit Questionnaire and Science Students' Score Proforma (PSSP)] were face-validated by three professionals; one in Measurement and Evaluation from the Department of Science Education and two in Education Psychology from the Department of Educational Foundations, all from University of Nigeria, Nsukka. The questionnaire was trial tested on 20 SS3 students in 4 secondary schools in Enugu East in Enugu Education Zone which was not part of the sampled Local Government Areas. Cronbach Alpha reliability estimate was utilized to determine the internal consistency of the items and the reliability coefficient of 0.83 was obtained.

Data Analysis

Pearson Product Moment Correlation Coefficient, as well as coefficient of determination, was used to answer research question 1, while research questions 2 and 3 were answered by comparing the correlation coefficients (r) obtained for male and female and for urban and rural. A correlation coefficient value between 0.30 and above is considered as ‘low coefficients’, above 0.30 to below 0.80 ‘moderate’ coefficients while from 0.80 and above are considered as ‘high coefficients’ (Nworgu, 2015). Regression analysis was used to test hypothesis 1, while t-test for the significance of two samples correlation coefficients was used to test hypotheses 2 and 3 at 0.05 level of significance.

Results

Table 1 Pearson’s product-moment correlation analysis of the proportion of variation in students’ academic achievement in science predicted by grit

Variable	\bar{X}	SD	N	r	r^2
Grit	66.54	9.11	385	0.81	0.66
Students’ Achievement	69.33	10.12			

$\alpha = 0.05$, r = correlation coefficient, r^2 = coefficient of determination

Table 1 shows that the correlation coefficient (r) obtained between grit and students’ academic achievement was .81. This implies that a high and positive relationship exists between grit and students’ achievement in science. The result also shows that the r^2 associated with r of 0.81 was 0.66. This r^2 of 0.66 indicates that 66% of the variation in the students’ academic achievement in science is attributed to or predicted by grit.

Table 2 Pearson’s product-moment correlation analysis on moderating influence of gender in the predictive validity of grit and students’ academic achievement in science

Variable (Gender)	n	r	r^2
Male	177	0.64	0.41
Female	208	0.62	0.38

$\alpha = 0.05$, r = correlation coefficient, r^2 = coefficient of determination

The result in Table 2 shows the mean scores from the responses of male and female respondents on the moderating influence of gender in the predictive validity of grit and students' academic achievement in science. The result shows that the correlation coefficient (r) of 0.64 and 0.62 with associated coefficients of determination (r^2) of 0.41 and 0.38 were obtained for male and female students, respectively. The results show that a positive and moderate relationship exists between grit and students' academic achievement for male and female students in favour of the male students. The difference in the relationship between grit and students' academic achievement is 0.02 in favour of the male students. The result also shows that the coefficients of determination r^2 indicate that 41% variation in the academic achievement of male students can be attributed to grit while 38% of the variation in the academic achievement of female students can be attributed to grit. The difference in the variation of male and female students' academic achievement as predicted by grit is 3% in favour of male students. Therefore, gender moderated 3% of the variation in students' academic achievement in favour of the male than their female counterparts.

Table 3 Pearson's product-moment correlation analysis on the moderating influence of location on the predictive validity of grit on students' academic achievement

Variable (Location)	n	r	r ²
Urban	205	0.62	0.38
Rural	180	0.59	0.35

$\alpha = 0.05$, $r^2 =$ coefficient of determination

Results in Table 3 shows the mean scores from the responses of urban and rural respondents on the moderating influence of location in the predictive validity of grit and students' academic achievement in science. The result shows that the correlation coefficient (r) of 0.62 and 0.59 with associated coefficients of determination (r^2) of 0.38 and 0.35 were obtained for students in urban and rural areas, respectively. This means that there is a positive and moderate relationship between grit and academic achievement of students in urban and rural areas in favour of students in urban areas. The difference in the relationship between grit and students' academic achievement is 0.03 in favour of the urban students. The coefficients of determination r^2 indicate that 38% of the variation in the academic achievement of students in the urban areas can be attributed to grit while 35% variation in the academic achievement of students in rural areas can be attributed to grit. The difference in the variation of urban and rural students' academic achievement as predicted by grit is 3% in favour of urban students. Hence, location moderated 3% of the variation in students' academic achievement in favour of students in urban areas than their rural counterparts.

Table 4 Regression Analysis of grit and Students' Academic Achievement

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	33162.498	1	33162.498	231.320	.000
Residual	53584.130	383	122.430		
Total	86746.628	384			

$\alpha = 0.05$

The F-ratio was 231.320, with an exact probability value of 0.00, as shown in Table 4. The level of significance for evaluating the hypothesis was set at 0.05, which was compared to the probability value of 0.00. Since $p = 0.00 < 0.05$, it means that the result is significant. Therefore, the null hypothesis which stated that; grit does not significantly predict students' academic achievement in science was not accepted. The conclusion drawn was that grit significantly predicts students' academic achievement in science. And so, grit is a good predictor of students' academic achievement in science.

Table 5 t-test analysis of the significant difference between the correlation coefficients (r) of male and female in the predictive validity of grit on students' academic achievement

Variable (Gender)	N	r	df	S.E	t-cal	t-crit	Dec
Male	177	0.59	379	0.09	-0.22	1.97	NS
Female	208	0.61					

Key: r = correlation coefficient, N = Number of respondents (students), df = Degree of freedom, S.E = Standard Error, t-cal = t-test value calculated, t-crit = t-test critical or table value, Dec = Decision, Ns = Not Significant

Table 5 shows the t-test analysis of the significant difference due to gender in the predictive validity of grit on students' academic achievement in science. The result indicates that a t-cal of -0.22 was obtained, while the t-crit at 0.05 level of significance and 494 degree of freedom was 1.97. The decision rule is to reject the null hypothesis if the $t\text{-cal} > t\text{-crit}$, otherwise do not reject. Thus, since the $t\text{-cal} (-0.22) < t\text{-crit} (1.97)$, the null hypothesis which stated that there is no significant relationship in the predictive validity of grit on students' academic achievement in science due to gender or based on gender is not rejected. In other words, there is no significant relationship between the correlation coefficient of male and female students in the predictive validity of grit on students' academic achievement. The inference drawn is that gender does not significantly moderate the predictive validity of grit on students' academic achievement.

Table 6 t-test analysis of the significant difference between the correlation coefficients (r) of urban and rural in the predictive validity of grit on students' academic achievement

Variable (Location)	N	R	df	S.E	t-cal	t-crit	Dec
Urban	205	0.58	379	0.09	-0.55	1.97	NS
Rural	180	0.63					

Key: r = correlation coefficient, N = Number of respondents (students), df = Degree of freedom, S.E = Standard Error, t-cal = t-test value calculated, t-crit = t-test critical or table value, Dec = Decision, Ns = Not Significant.

Table 6 shows the t-test analysis of the significant difference due to location in the predictive validity of r on students' academic achievement in science. The result shows that the t-cal of -0.55 with the t-crit of 1.97 at 0.05 level of significance and 494 degree of freedom was obtained respectively. In order to take decision on whether to reject or accept the null hypothesis, the rule says reject if the t-cal > t-crit value, otherwise do not reject. Therefore, since the t-cal of (-0.55) < t-crit value of (1.97), the null hypothesis which stated that there is no significant relationship in the predictive validity of r on students' academic achievement due to location is not rejected. In other words, there is no significant relationship between the correlation coefficient of students in urban and rural areas in the predictive validity of r on students' academic achievement. The inference drawn is that location does not significantly moderate the predictive validity of r on students' academic achievement.

Discussion

The study's findings revealed that a high and positive relationship exists between grit and secondary school students' academic achievement in science. The result also revealed that 66% of the variation in students' academic achievement in science is predicted by or attributed to grit. The corresponding hypothesis revealed that grit significantly predicted students' academic achievement in science. This implies that grit is a good predictor of students' academic achievement. The result also revealed that gender and location do not significantly moderate the predictive validity of grit on students' academic achievement in science. These findings are in accordance with the findings of Cross (2013), Bowman, et al. (2015), Datu et al. (2018), and Duckworth, et al. (2007) that grit is strongly associated with students' academic achievement. Duckworth et al. (2007) opined that a higher level of grit is linked with high educational attainment and have predicted academic achievement beyond students' ability. In addition, De Vera et al., (2015) and Ivcevic and Brackett (2014) argue that trait-like perseverance is linked to improved performance and success in both academics and the real world. This means that the higher the level of grit a student has, the higher his/her academic achievement in school irrespective of the student's gender and location. However, the results of this study disagreed with the findings of Bazalais et al. (2018) found that grit is not a significant predictor of students' academic achievement.

Supporting, Palisoc et al. (2017) and Gruenberg et al. (2018) in their separate studies found no significant association between grit and academic achievement.

Conclusions

Grit significantly predicted secondary school students' academic achievement in science. Also, gender and location do not moderate the predictive validity of grit on students' academic achievement. This study, therefore, provides information required by teachers and other stakeholders in education in understanding the influence of grit on students' academic achievement especially at the secondary school level and thereby providing real opportunity for the use of this information in predicting students' achievement. It gives stakeholders the opportunity to understand and to be in a position to help improve students' academic achievement in our secondary schools irrespective of their location and gender.

Recommendations

Since grit significantly predicted academic achievement and that gender and location do not moderate its predictive validity on students' academic achievement in science. Students whether a male or a female, reside in the urban or rural areas must be made to realize that persistent hard work and interest over years despite series of failures, difficulties, setbacks, and discouragements are the key that leads to success academically and otherwise. That is to say, that for you to achieve a long-term goal either in academic or in life, you have to maintain your interest, work hard, and not be discouraged in the face of challenges, failures, and setbacks. Grit enhancement programs should be organized in schools by the school administrators. These would allow the students to examine their thoughts, feelings and know the importance of possessing a high level of grit personality towards achieving success academically and for long-time goals in life. Meanwhile, parents should help guide their children properly and provide the love and support they deserve so that they can develop adequately high grit spirit in their academic endeavors. Subsequently, the students' academic achievement in school will be improved. Also, the government should recruit in our secondary schools more professionals in guidance and counseling so that the students will be properly guided towards improving their personality traits positively especially grit

Correspondence: All correspondence for this article should be addressed to: Ezugwu Ifesinachi Jude, Department of Science Education, University of Nigeria, Nsukka.

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