



# Relationship between Intelligence Quotient, Academic Motivation and Academic Performance in Secondary School Students

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

## Article Information

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## ABSTRACT

**Background:** Students' academic performance is affected by personal factors such as students' effort, previous schooling, parent's educational background, self motivation and intelligence.

**Aim:** To determine how academic motivation and intelligence quotient uniquely contribute to differences in students' academic performance.

**Study Design:** This was a cross-sectional descriptive study.

**Methodology:** The study was carried out on 405 selected students from both private and public secondary schools in Enugu-East Local Government Area, study participants aged 9 through 15 years which is within the eligible ages for the Raven Standard Progressive Matrices. Academic scores in three subjects were obtained from the schools. Intelligence quotient was measured using Raven Standard Progressive Matrices and Academic motivation was measured using the Academic motivation scale modified for use among secondary school students. A self-administered questionnaire was used to obtain data on age, gender and parent's educational level.

**Results:** Approximately 50% of study participants had an IQ 100 and above and 7.5% were intellectually superior scoring above the 95th percentile. IQ and academic motivation significantly predicted academic performance accounting for 29.9% of variance in academic performance ( $p < 0.001$ ).

**Conclusion:** Academic motivation plays a role in students' success and academic performance. IQ alone does not account for the differences in academic performance among students.

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## 1. INTRODUCTION

Success in learning outcomes is the ultimate goal of a teacher trying to impact knowledge in students. It is expected of students to be able to understand, analyse and apply knowledge and skills taught while in school. This is usually ascertained by scheduled tests or examinations administered to the students in different forms and the grades or scores used as a yardstick for academic performance of the students [1]. Students' performance on examination vary even when all external factors are almost identical and these scores tend to resemble a normal curve [2]. This shows that differences in performance might be more closely related to personal factors such as students' effort, previous schooling, parent's educational background, self motivation and intelligence than external factors [3]. In this study we look at two important personal factors – intelligence and Motivation, which have been shown by many studies to be linked to academic performance though with differing strength of associations.

Intelligence is an abstract concept that is generally seen as the ability to understand and grasp new concepts easily, but here we adopt the definition of intelligence as “a very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings – “catching on,” “making sense” of things, or “figuring out” what to do.” Intelligence can be measured, and intelligence tests measure it well. They are among the most accurate (in technical terms, reliable and valid) of all psychological tests and assessments [4]. The intelligence quotient(IQ) is the number value gotten from administering an intelligence quotient test and reflects the subject's intellectual capacity. There are different kinds of intelligence quotient tests which are used to measure intelligence [4]. But in this study we would make use of the Raven's Standard Progressive Matrices test (RSPM) to measure the Intelligence Quotient.

Gottfredson [5] argued that a single factor 'g' for intelligence exists which can be measured with IQ tests and predict success in life invariably academic success as indicated by academic performance. Many studies have been conducted to ascertain the validity of this assertion. Thus giving rise to the following question: is the intelligence quotient a strong determinant of academic performance? There has not been a general consensus on what is true here: most researchers have found a positive strong relationship between IQ and academic performance with only a few reporting no relationship [6-12]. Hence our aim is to add our own findings to what is known in this domain.

Motivation which is the next factor we will consider can be defined as “the process responsible for the initiation, intensity, and persistence of behaviour”. While Academic Motivation refers to “the cause of behaviour that is in a way related to academic functioning and success, such as how much effort students put forth, how effectively they regulate their work, which endeavours they choose to pursue, and how persistent they are when faced with obstacles” [13]. Although it represents an internal force, motivation is affected by internal and external factors and these factors are not mutually exclusive [14]. In assessment of motivation, Deci and Ryan's (1985) self-determination theory identifies three dimensions of motivation that need to be examined: intrinsic and extrinsic motivation and amotivation [15].

Intrinsic motivation refers to doing something because it is inherently interesting, extrinsic motivation refers to doing something because it leads to a separable outcome, amotivation on the other hand refers to the state of lacking an intention to act [16]. Students who are intrinsically motivated to a particular task or learning activity do so for the satisfaction derived from it. This can be easily observed in an educational setting, for while some students find certain subjects inherently interesting others do not. Students engage in externally motivated behaviours not of themselves but due to external influences though their behaviour may be eventually internalised and integrated, that is to say the student starts to carry out the activities on their own, without external pressure, thus the student starts to have a sense of personal commitment to carry out the

tasks and may begin to enjoy them. Students who are amotivated lack a motive to act and wonder what they are doing in school[16].

We hold the view that IQ does not fully explain the differences in academic performance among students. This is no new thinking. Many researchers have described significant relationship between factors other than IQ and academic performance. Meyer et al. [17] in their study found that some personality traits significantly predicted academic performance. Likewise Ogundokun and Adeyemo [18] found a significant relationship between emotional intelligence and academic performance. The study also found significant correlation between some aspects of motivation and academic performance which is one of the factors we consider in this study. A study by Duckworth and Seligman [19] determined that Self-discipline predicted academic performance more than IQ, these and other studies [20-26] lend credence to the fact that factors other than IQ affect academic performance of students. Good academic performance is of great importance to educators and care-givers alike, hence the need to determine the important factors which contribute to academic performance among students. This will help create the need for the modifiable factors to be facilitated or curtailed depending on their impacts.

This study aims to measure the strength of association between Intelligence Quotient (IQ), Academic motivation and academic performance and determine how Academic motivation and IQ uniquely contribute to differences in academic performance among students.

## 2. MATERIALS AND METHODS

### 2.1 Study Population

This was a cross-sectional descriptive study. The participants were school-aged children in JSS 1 and JSS 2 attending secondary schools in Enugu-East local government area of Enugu State, Nigeria. This study was carried out from May 2021 to July 2021.

### 2.2 Sampling Technique

Random sampling technique was adopted, 5 urban secondary schools were chosen from the local government and students were

proportionately selected randomly from each school and class. The minimum sample size required was approximately 386  $[(1.962 \times 0.5 \times 0.5) / 0.05^2]$ , derived using the formula:  $n = (Z^2PQ) / d^2$  Naing et al. [27] Where (n) is the Minimum Sample Size, (Z) as Standard Normal Deviation with ( $\pm 1.96$ , CI (95%), P =50% of the total population (0.5) and Q as  $1 - p$ , while d is the Standard error 5%.

### 2.3 Procedure

Intelligence quotient was measured with the Raven's Standard Progressive Matrices. It is the most widely used of the three Raven's forms, and can be used as a language-free measure of intelligence, the Standard Progressive Matrices can be used to measure IQ from age 6 through 16 [28]. The RSPM is generally a reliable measure of intelligence when studies are carried out on an adequate sample size and the right age group [29].

Raw scores on the Raven's Standard Progressive Matrices were converted into standard scores with a mean of 100 and a SD of 15 with data from the British norms from the year 1979 for SPM [28]. IQ Values were not adjusted for the Flynn effect [30]. IQ was also grouped from Grades I to V according to percentiles scored from the British norms [28].

The overall scores in percentage for each student in the preceding terms in three subjects (Mathematics, Basic Science and Cultural and Creative Arts) were collected from the schools and the average was used as an index of academic performance.

Academic Motivation was measured using the academic motivation scale questionnaire by Vallerand et al. [31], originally developed in French as Echelle de Motivation en Education (EME), and based on the Self-determination theory, results have shown satisfactory levels of internal consistency (mean alpha value= .81) and temporal stability over a one-month period (mean test-retest correlation = .79) for the English version with a Cronbach's alpha coefficient, which ranged between 0.83 and 0.86 [32]. Several studies have been done confirming the validity of this scale to assess academic motivation [33-36]. The scale is made of 28 items which is subdivided into seven sub-scales assessing three types of intrinsic motivation (intrinsic motivation to know, to accomplish things, and to

experience stimulation); three types of extrinsic motivation (external, introjected, and identified regulation), and amotivation, each sub-scale was evaluated separately.

A self-administered questionnaire was used to obtain the following data: age, gender, and parent’s educational level.

**2.4 Data Analysis and Presentation**

Data analysis was done using SPSS for Windows software version 26. Descriptive statistics were used to determine the associations between academic motivation, intelligence quotient and academic performance. Multiple linear regression analysis was done for academic motivation sub-scales that had statistical significance on bivariate analysis, intelligence quotient and academic performance, P < 0.05 was accepted as statistically significant.

**3. RESULTS AND DISCUSSION**

**3.1 Socio-Demographic Characteristics**

The data on the demographic characteristics of the study group is displayed in Table 1. Total number of participants that completed the study was 387. 59.8% of participants attended public schools while 40.2% attended private schools. Mean age of the students was 12.07±0.95.

The average IQ value greatly differed from the estimate by Lynn[36], who argued that average IQ value of sub-Saharan Africa would be 66. This might be due to increase in socio-economic status since this finding was reported over a decade ago as suggested by the Flynn Effect.

**3.2 IQ Level in Study Population**

Table 2 displays the IQ test scores from administration of Raven’s SPM, Uncorrected British IQ is shown, according to the 1979 British standardization norm tables [28]. From the table highest IQ is found in the 11 year old age group, mean IQ was 97.48 with an S.D of 17.98.

Table 3 displays the test performance according to grades where Grade I represents “intellectually superior”; Grade II “Definitely above the average in intellectual capacity”; Grade III “intellectually average”; Grade IV “Definitely below average in intellectual capacity” and Grade V “intellectually impaired”. The RSPM has been noted to be restricted in it’s ability to differentiate clearly among very low scores and very high scores [28]. 0.7% of participants had IQ above the 100th percentile, and 3.7% had scores below the 1st percentile from the British norms, they were not included in the data analysis. Figure 1 shows a Boxplot of IQ by Age while Figure 2 shows the IQ distribution by Gender.

**3.3 Relationship between Academic Motivation and Academic Performance**

To determine the relationship between academic motivation and academic performance, students’ average performance and the academic motivation sub-scales were analysed by means of Pearson correlation coefficient and is shown in Table 4. There was a statistically significant relationship between the sub-scales of intrinsic motivation – to know, intrinsic motivation – to accomplish, extrinsic motivation – identified, amotivation and academic performance.

**Table 1. Characteristics of subjects by sex**

Variable	Male N=167(%)	Female N=174(%)	Total N=341(%)	χ <sup>2</sup>	p- value
<b>School</b>					
Public	122(53.3)	107(46.7)	229(59.2)		
Private	72(45.6)	86(54.4)	158(40.8)	2.220	0.136
<b>Age(years)</b>					
9	0(0)	1(100)	1(0.3)		
10	2(20)	8(80)	10(2.6)		
11	45(52.9)	40(49.1)	85(22.0)		
12	71(44.7)	88(55.3)	159(41.1)	12.094	0.060
13	58(55.8)	46(44.2)	104(26.9)		
14	15(60)	10(40)	20(6.5)		
15	3(100)	0(0)	3(0.8)		

Mean ages ± SD(years) 12.21±0.96 11.94±0.92 12.07±0.95

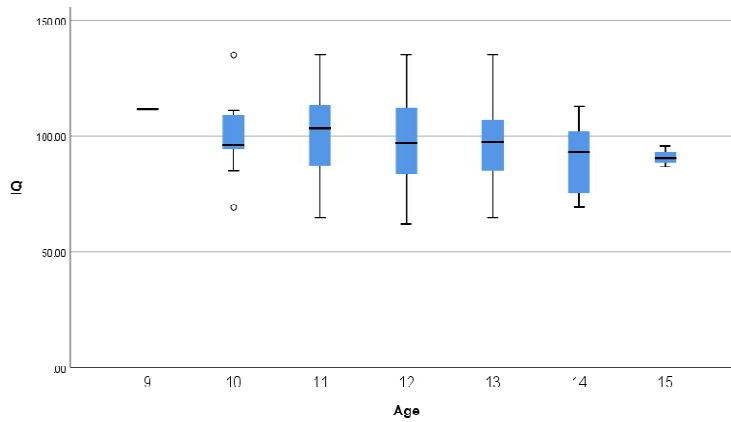
**Table 2. Mean IQ Level in Study Population by Age**

Age	N	British Percentile	British IQ	SD
9	1	-	-	17.21
10	10	47.20	99.23	19.46
11	85	53.69	101.46	18.58
12	159	47.17	97.48	16.21
13	104	43.71	96.67	13.77
14	25	30.08	89.37	4.53
15	3	28.00	91.00	

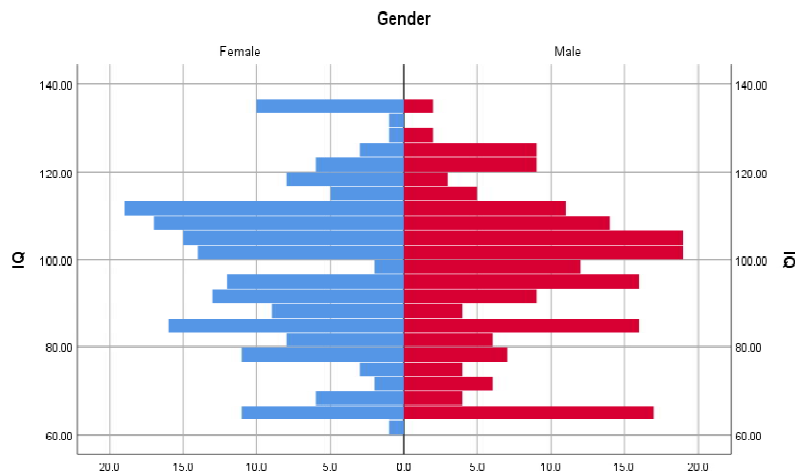
Mean IQ±SD 97.48±17.98

**Table 3. IQ Level by grade**

Grade	Percentiles	N(%)
Grade I	95-99	29(7.5)
Grade II	75-94	65(16.8)
Grade III	26-74	160(41.3)
Grade IV	6-25	80(20.7)
Grade V	1-5	53(13.7)



**Fig. 1. Box Plot of IQ by Age**



**Fig. 2. Population pyramid frequency of IQ by gender**

**Table 4. Academic motivation and academic performance**

AMS Sub-scales	Pearson's correlation							
	8	8	8	8	8	8	8	8
1. IM-to know	0.223**							
2. IM-to accomplish		0.167**						
3. IM-to experience stimulation			0.053					
4. EM-identified				0.119*				
5. EM-introjected					-0.040			
6. EM-external regulation						0.043		
7. Amotivation								-0.299**
8. Academic Performance								

\*p < 0.05, \*\*p<0.001, 2-tailed

These results support the studies done by other researchers. Dramanu and Mohammed [22] and Adepoju, T. L. [23] reported significant relationship between academic motivation and academic performance in their studies. Their studies involved secondary school students which is the same as this study. Studies involving post secondary students have also reported significant associations between academic performance and academic motivation [24,25].

The largest correlation is in amotivation followed by intrinsic motivation – to know, amotivation as expected had a negative correlation with academic performance, this is because students who are amotivated feel they are wasting their time in school and have no interest in academic activities. The significant positive correlation between intrinsic motivation – to know suggests that students who are inquisitive and eager to acquire new knowledge and skills will have greater academic performance than their peers without such nature.

Though inherent, intrinsic motivation can be modified by social and environmental factors. Deci and Ryan [16] analysed three basic psychological needs – competence, autonomy and relatedness which are satisfied by intrinsically motivated behaviour. On the basis of these needs, factors that sustain or undermine intrinsic motivation can be described. For instance, rewards which give a

feeling of competency can enhance intrinsic motivation for that action, this is true when the student does not see the reward as controlling his behaviour, that is, when autonomy is preserved [16].

### 3.4 Relationship between IQ and Academic Performance

The relationship between IQ and academic performance were analyzed with the Pearson correlation coefficient and result shown in Table 5. There was a significant association between IQ and academic performance.

These findings are consistent with a number of studies, Akubuilu et al. [11] found a significant relationship between IQ and academic performance in their study. Contrary, Kulkarni et al. [8] found no significant relationship between IQ and academic performance. This may be related to the sample selection technique since only one particular school was used for the study.

IQ reflects an individual's potential or natural capability, some students are naturally more intelligent than others, though studies have shown that the environment exerts a strong role in determining IQ which isn't within the scope of this study. Nevertheless IQ doesn't account for all the differences in academic performance as this is no perfect correlation.

**Table 5. Intelligence Quotient and Academic Performance**

Variables	Pearson's correlation 2
1. Intelligence Quotient	0.463**
2. General Academic Performance	

\*\*p<0.001, 2-tailed

**Table 6. Multiple regression for variables predicting academic performance**

Variables	B	SE B	Academic Performance			
			$\beta$	R	R <sup>2</sup>	AR <sup>2</sup>
1. IM-to know	0.533	0.168	0.176*			
2. IM-to accomplish	0.156	0.163	0.054			
3. EM-identified	-0.051	0.167	-0.015			
4. Amotivation	-0.478	0.174	-0.134*			
5. IQ	0.356	0.040	0.436**			
				0.547	0.299	0.288

\* $p < 0.05$ , \*\* $p < 0.001$ 

### 3.5 Prediction of Academic Performance by Academic Motivation and IQ

The aim of this study is to determine how academic motivation and IQ uniquely contribute to differences in student's academic performance. To answer this multiple regression analysis is used to determine the most predictor variable of academic performance. Results are displayed in Table 6.

Entering the significant academic motivation sub-scales and IQ as predictor variables and academic performance as the dependent variable in the multiple regression analysis, the model accounted for 29.9% variance,  $R^2 = 0.299$   $F(5,332) = 28.293$ ,  $p = 0.001$ . The academic motivation sub-scales of intrinsic motivation-to know and amotivation and IQ contributed significantly to the model, while extrinsic motivation-identified did not. From the standardised coefficients, IQ was a more important predictor of academic performance, this is followed by intrinsic motivation- to know and amotivation.

Thus intelligence is not the only contributor to students' academic performance. Yesikar et al. [12] in their study found similar academic performance between students with average IQ and students with higher IQ. Several researchers have delved into determining other predictors of academic performance aside IQ but very similar to this study is that conducted by Duckworth and Seligman [19], in their study they determined that Self-discipline predicted academic performance more than IQ. Here, academic motivation predicted academic performance but not as well as IQ.

### 4. CONCLUSION

From this study it could be seen that IQ and academic motivation both significantly predict academic performance. Aside IQ academic

motivation plays a significant role in determining students' academic performance. Amotivation and intrinsic motivation-to know significantly predicted academic performance, thus measures to help students understand the reasons for going to school and purpose of education in addition to encouraging students to develop intrinsic interest in learning will help improve students' academic performance.

### CONSENT AND ETHICAL APPROVAL

Ethical approval was obtained from the Ethics and Research Committee of the University of Nigeria Teaching Hospital with protocol number NHREC/05/01/2008B-FWA00002458-IRB00002323. Consent was obtained from the school authorities and all participants agreed to participate.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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