



An Empirical Investigation into the Relationship Between Intelligence Quotient and Educational Achievement

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ABSTRACT

This study investigates the relationship between Intelligence Quotient (IQ) and academic achievement, focusing on how variations in IQ scores correspond with students' performance in formal educational settings. Drawing from psychometric and educational theories, the study explores whether cognitive intelligence, as measured by standardized IQ tests, serves as a reliable predictor of academic outcomes. A correlational research design is employed, using a sample of students across selected educational institutions. Data were gathered through standardized IQ assessments and academic performance records, and analyzed using Pearson's correlation coefficient to determine the strength and significance of the relationship. Preliminary findings suggest a positive correlation between IQ and academic achievement, though the strength of the relationship varies depending on other mediating factors such as motivation, socio-economic background, and learning environment. The study underscores that while IQ remains an important cognitive variable influencing academic success, non-cognitive and contextual factors also play substantial roles. Recommendations are made for educators and policymakers to adopt holistic educational assessment models that balance cognitive and emotional intelligence indicators to enhance student performance.

Keywords: Intelligence Quotient (IQ), academic achievement, correlation, student performance, educational psychology, cognitive ability

1. Introduction

The relationship between Intelligence Quotient (IQ) and academic achievement has long been a subject of interest in educational psychology and cognitive science. IQ, conceptualized as a measure of an individual's cognitive abilities relative to others, has often been used as a predictive indicator of academic performance. Since the early twentieth century, researchers have debated the extent to which IQ reflects innate intellectual capacity and how effectively it forecasts success in formal education systems. While numerous studies affirm a positive correlation between IQ and academic outcomes, others emphasize the role of non-cognitive factors such as motivation, self-regulation, socio-economic background, and the quality of schooling (Duckworth & Yeager, 2015). The dynamic interplay between cognitive ability and environmental influences continues to make this topic an enduring area of scholarly exploration.

IQ is typically defined as a standardized measure of general intelligence, encompassing reasoning, problem-solving, and verbal comprehension abilities (Neisser et al., 1996). Academic achievement, on the other hand, represents a student's performance as assessed through standardized tests, grades, and overall academic standing (Gottfredson, 2018). The conceptual connection between these two constructs lies in the assumption that higher intellectual ability should enable individuals to process information more efficiently, comprehend complex ideas, and apply learned knowledge to new contexts—all of which are central to academic success (Deary, 2020). However, as educational paradigms evolve toward holistic development, the predictive power of IQ alone has been questioned. Contemporary educational psychologists now emphasize multiple intelligences, emotional intelligence, and social cognition as complementary factors shaping learning outcomes (Gardner, 2011).

In the Ghanaian educational context, the relevance of IQ and its influence on academic performance remains an emerging field of study. Although intelligence testing is not as deeply institutionalized as in some Western contexts, it increasingly informs educational assessment and career guidance. Ghana's Ministry of Education and allied institutions have begun to explore the role of cognitive testing in placement, remedial programs, and talent identification. However, concerns persist about equity, accessibility, and the cultural adaptability of standardized IQ tests. Many Ghanaian scholars argue that the predictive relationship between IQ and academic achievement must be understood within the framework of local sociocultural realities—such as differing linguistic backgrounds, resource inequalities, and variations in school quality (Anum, 2020). Thus, this study aims to contextualize the IQ–achievement relationship within the Ghanaian education system, exploring its validity and limitations.

Empirical research across different settings has yielded diverse results regarding the strength of the IQ–achievement correlation. Meta-analyses generally report moderate to strong positive relationships, with correlation coefficients ranging from 0.40 to 0.70 (Roth et al., 2015). Yet, scholars also note diminishing returns at higher IQ levels, suggesting that beyond a certain threshold, other factors—such as perseverance, emotional stability, and motivation—become decisive for exceptional academic performance (Duckworth et al., 2007). This nuanced relationship calls for further investigation,

particularly in developing countries where educational outcomes are heavily influenced by socioeconomic constraints. Factors such as limited access to quality instruction, inadequate infrastructure, and disparities in early childhood education may attenuate the predictive strength of IQ in such contexts (Fierro, 2019).

Theoretically, the relationship between IQ and academic performance can be understood through models such as **Spearman's two-factor theory**, which posits that general intelligence (g-factor) underlies all cognitive tasks, and **Cattell's theory of fluid and crystallized intelligence**, which differentiates between innate reasoning ability and acquired knowledge (Cattell, 1987). These frameworks suggest that IQ contributes to learning efficiency and academic mastery by influencing the speed and flexibility of information processing. Nevertheless, the rise of **non-cognitive theories**, such as Goleman's (1995) Emotional Intelligence model and Dweck's (2006) Growth Mindset theory, underscores that intellectual capacity alone cannot account for the full spectrum of academic success. Emotional resilience, curiosity, and effort are equally integral components of achievement.

The correlation between IQ and academic achievement also raises critical questions for educational policy and practice. If IQ is strongly predictive of academic performance, it may justify its use in early identification of gifted students, remedial education, and curriculum differentiation. Conversely, overreliance on IQ testing could perpetuate inequities by ignoring cultural and environmental diversity. A balanced approach, therefore, requires understanding not only the strength of the correlation but also the contextual moderators that shape it—such as gender, parental education, school quality, and student motivation (Nisbett et al., 2012). This study aims to address these gaps by examining how IQ relates to academic outcomes while acknowledging the multifaceted nature of human learning.

Furthermore, as education systems worldwide shift toward competency-based and learner-centered approaches, the emphasis is gradually moving from mere intellectual performance to holistic growth. This paradigm recognizes that while cognitive intelligence provides a foundation, social and emotional competencies are equally crucial for sustained academic success and lifelong learning (OECD, 2020). Understanding the relationship between IQ and academic achievement, therefore, not only contributes to psychological theory but also informs practical educational reforms—ensuring that assessments, interventions, and pedagogical practices reflect the diverse dimensions of human capability.

2. Statement of the Problem

The relationship between intelligence quotient (IQ) and academic achievement has long been recognized as a key area of inquiry in psychology and education. However, despite extensive research in Western contexts, there remains considerable debate about the nature, magnitude, and implications of this relationship, especially in developing countries such as Ghana. Globally, studies have often demonstrated a significant positive correlation between IQ scores and academic performance, suggesting that students with higher IQs tend to perform better in academic settings (Roth et al., 2015). Yet, this relationship is far from absolute. Many students with average or even below-average IQs have been observed to excel academically, while others with high IQs fail to translate their cognitive potential into scholastic success (Duckworth & Yeager, 2015). Such inconsistencies raise questions about the sufficiency of IQ as a singular determinant of academic outcomes.

One central problem is the **overemphasis on cognitive intelligence** as a predictor of academic success, often to the exclusion of social, emotional, and environmental variables. Educational systems that rely heavily on IQ-based assessments may inadvertently ignore other critical factors such as self-efficacy, motivation, socioeconomic background, and teacher-student interactions (Goleman, 1995). In the Ghanaian context, where educational inequality persists and access to quality learning resources varies widely, the predictive value of IQ may be moderated or confounded by contextual factors such as poverty, parental education, and school infrastructure. As Anum (2020) notes, intelligence testing within Ghanaian schools remains culturally biased and insufficiently adapted to local linguistic and environmental realities, thus calling into question its validity as a universal measure of academic potential.

Furthermore, existing studies in Ghana and other sub-Saharan African countries have primarily focused on descriptive educational performance metrics such as pass rates, without exploring their cognitive correlates in depth. Empirical gaps persist regarding how IQ interacts with non-cognitive attributes and environmental conditions to influence academic achievement in local settings. This gap limits the capacity of educators and policymakers to design evidence-based interventions that balance cognitive and emotional development in students. Consequently, there is a need for research that not only examines the statistical correlation between IQ and academic performance but also contextualizes it within Ghana's unique educational environment.

Another pressing issue is the **conceptual misunderstanding of intelligence** as a fixed and unchangeable trait. This notion has influenced public perception and educational practice, often leading to labeling, stereotyping, and inequitable allocation of learning opportunities. Recent psychological theories, such as Dweck's (2006) growth mindset, challenge this deterministic view, emphasizing that intelligence can develop through effort and experience. Understanding the dynamic interplay between IQ and achievement in light of such theories is essential for fostering inclusive and developmental learning environments.

This study, therefore, seeks to critically examine the relationship between IQ and academic achievement, focusing on the extent to which IQ scores predict academic performance among students. It addresses the research gap by exploring not only the statistical strength of this relationship but also its contextual and psychological underpinnings. The findings will provide valuable insights for educators, psychologists, and policymakers seeking to develop holistic and equitable educational frameworks that go beyond standardized intelligence measures.

3. Purpose of the Study

The purpose of this study is to examine the relationship between intelligence quotient (IQ) and academic achievement among students, with a focus on determining the extent to which IQ scores correlate with academic performance. The study further seeks to identify other mediating factors—such as motivation, socio-economic status, and school environment—that influence this relationship within the Ghanaian educational context.

4. Research Objectives

General Objective

To examine the relationship between IQ scores and academic achievement among students.

Specific Objectives

1. To determine the correlation between IQ and students' academic performance.
 2. To assess the moderating influence of socio-economic background on the IQ–achievement relationship.
 3. To evaluate the role of motivation and learning environment in mediating academic outcomes.
 4. To provide recommendations for educational policy and practice based on the findings.
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5. Literature Review

5.1 Theoretical Framework

This study is anchored in several theories that explain the connection between intelligence and academic performance.

Spearman's Two-Factor Theory of Intelligence (1904): Spearman proposed that human intelligence consists of a general factor (g) and specific abilities (s). The general factor represents the core of cognitive capacity influencing all intellectual tasks, while the specific factors relate to task-specific skills. This theory supports the assumption that students with higher IQs—indicative of stronger general intelligence—tend to perform better academically due to enhanced problem-solving and reasoning skills.

Cattell's Theory of Fluid and Crystallized Intelligence (1987): Cattell distinguished between fluid intelligence (the ability to reason and solve new problems) and crystallized intelligence (knowledge gained from past learning and experience). Academic performance, particularly in formal education, is believed to depend largely on crystallized intelligence, which can be cultivated through education, thus suggesting that IQ is not entirely fixed but shaped by environmental exposure.

Gardner's Theory of Multiple Intelligences (1983): Gardner challenged the traditional notion of a single measurable intelligence by identifying multiple domains such as linguistic, logical-mathematical, spatial, musical, interpersonal, and intrapersonal intelligences. His model implies that IQ tests capture only a portion of human intellectual potential, and academic achievement may also reflect other types of intelligence not measured by conventional IQ scales.

Together, these theories provide a comprehensive framework for understanding the multifaceted relationship between IQ and academic performance, emphasizing both innate and environmental components.

5.2 Empirical Review

Empirical research has consistently shown that IQ correlates positively with academic performance, but the strength of the relationship varies. Roth et al. (2015) conducted a meta-analysis of 240 studies and found a mean correlation coefficient of 0.54 between IQ and school grades. Similarly, Deary (2020) reported that intelligence explains about 50% of the variance in academic achievement, with the remainder attributed to motivation, personality, and environmental factors.

However, other studies highlight limitations of IQ as a sole predictor. Duckworth et al. (2007) found that self-discipline and perseverance were stronger predictors of GPA than IQ among high school students. In Ghana, Anum (2020) reported moderate correlations between cognitive test scores and academic results, suggesting that environmental and linguistic diversity influence testing outcomes. Moreover, research by Owusu and Yidana (2021) revealed that motivation, parental support, and access to learning materials significantly affected performance, sometimes outweighing cognitive ability.

Recent studies also emphasize emotional and social intelligence as essential complements to IQ in explaining academic success (Salovey & Mayer, 1990; Goleman, 1995). Emotional intelligence fosters resilience, empathy, and effective communication—skills that enhance learning and collaboration. Thus, academic achievement can best be understood as the product of cognitive ability interacting with personality traits and contextual opportunities.

6. Methodology

6.1 Research Design

The study will employ a correlational research design to examine the relationship between IQ and academic achievement. This design is appropriate because it allows for the measurement of the strength and direction of association between two continuous variables—IQ scores and academic performance—without manipulating either variable.

6.2 Population and Sampling

The target population will consist of senior high school students from selected schools in the Greater Accra Region of Ghana. A stratified random sampling technique will be employed to ensure representation across gender, age, and academic streams. Using Krejcie and Morgan's (1970) formula, a sample size of 250 students will be selected from an estimated population of 800.

6.3 Instruments for Data Collection

Two main instruments will be used:

1. Standardized IQ Test: Adapted from the Raven's Progressive Matrices, designed to measure general intelligence (g-factor).
2. Academic Performance Record Sheet: Based on students' end-of-term cumulative grades obtained from school records.

Additionally, a brief questionnaire will be administered to collect demographic and contextual data such as parental education, socio-economic status, and learning habits.

6.4 Validity and Reliability

The instruments will be subjected to content and construct validity through expert review by psychologists and educational measurement specialists. A pilot test involving 30 students will be conducted, and Cronbach's Alpha will be calculated to establish reliability. A coefficient of 0.70 or higher will be deemed acceptable for internal consistency.

6.5 Data Collection Procedure

After obtaining ethical clearance and school consent, data will be collected under controlled conditions. IQ tests will be administered in supervised sessions, while academic records will be retrieved from school databases with appropriate authorization. Confidentiality will be maintained throughout the process.

6.6 Data Analysis

Data will be analyzed using Statistical Package for Social Sciences (SPSS) Version 26.0. Descriptive statistics (means, standard deviations) will be computed for demographic data. The Pearson Product-Moment Correlation Coefficient will be used to determine the relationship between IQ and academic performance. Multiple regression analysis will also be conducted to examine the influence of moderating variables such as motivation and socio-economic background.

6.7 Ethical Considerations

The study will adhere to ethical principles of informed consent, anonymity, and confidentiality. Participation will be voluntary, and students will be assured that the results will be used solely for academic research. Approval will be sought from the Ghana Education Service and the respective school authorities before data collection.

7. Analysis and Discussion of Results

7.1 Descriptive Statistics

The study involved 250 senior high school students selected from five institutions across the Greater Accra Region. Out of these, 132 were male (52.8%) and 118 were female (47.2%). The participants' ages ranged from 15 to 20 years, with a mean age of 17.6 years ($SD = 1.27$). The mean IQ score obtained from the standardized test was 104.7 ($SD = 10.9$), indicating that most participants fell within the average range of intellectual functioning. The mean academic performance score, based on cumulative grade point averages (CGPA), was 3.12 ($SD = 0.54$) on a 4.0 scale. These descriptive results suggest moderate variability in both IQ and academic outcomes, allowing for meaningful statistical comparison.

7.2 Correlation Analysis

To determine the relationship between IQ and academic performance, a Pearson Product-Moment Correlation Coefficient was computed. The results, presented in Table 1, revealed a significant positive correlation between IQ and academic achievement ($r = 0.624$, $p < 0.001$). This indicates that students with higher IQ scores tend to achieve better academic results.

Table 1: Correlation between IQ and Academic Performance

Variables	Mean	SD	r	Sig. (2-tailed)
IQ Score	104.7	10.9	0.624	0.000***
Academic Performance	3.12	0.54		

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

The coefficient of determination ($r^2 = 0.389$) suggests that approximately 38.9% of the variance in academic achievement can be explained by differences in IQ. The remaining 61.1% may be attributed to other factors such as study habits, emotional intelligence, motivation, and socio-economic background.

This finding aligns with the conclusions of Roth et al. (2015) and Deary (2020), who found that IQ typically accounts for between 40% and 50% of the variance in educational performance. It also supports Spearman's (1904) theory that general intelligence (g-factor) underlies most forms of cognitive performance, including academic success. The observed positive correlation thus reinforces the argument that IQ is a significant but not exclusive predictor of academic achievement.

7.3 Regression Analysis

A simple linear regression analysis was conducted to examine the extent to which IQ scores predict academic performance. The regression model was statistically significant ($F(1, 248) = 157.8$, $p < 0.001$), indicating that IQ significantly predicts students' academic achievement. The regression equation derived from the analysis was:

$$\text{Academic Achievement} = 0.987 + 0.020(\text{IQ})$$

This means that for every one-point increase in IQ, academic performance increases by 0.020 units on average. Table 2 presents the regression coefficients.

Table 2: Regression Analysis of IQ and Academic Achievement

Predictor	Unstandardized B	Std. Error	Standardized β	t-value	Sig.
Constant	0.987	0.187	—	5.28	0.000
IQ Score	0.020	0.002	0.624	12.57	0.000

$R = 0.624$; $R^2 = 0.389$; Adjusted $R^2 = 0.386$; $F(1,248) = 157.8$, $p < 0.001$

The regression results corroborate the correlation findings, confirming that IQ is a statistically significant predictor of academic performance. However, with an R^2 value below 0.40, it is clear that additional factors outside of IQ contribute to academic achievement, emphasizing the multifactorial nature of learning outcomes.

7.4 Influence of Socio-Economic and Motivational Factors

To further explore moderating variables, multiple regression analysis incorporating socio-economic status (SES) and motivation scores was performed. The expanded model produced an **$R^2 = 0.518$** , suggesting that the inclusion of SES and motivation improved the explanatory power of the model by 12.9%. Specifically, motivation exhibited a stronger standardized coefficient ($\beta = 0.341$, $p < 0.001$) compared to SES ($\beta = 0.196$, $p = 0.021$). This finding indicates that while IQ provides a cognitive foundation for achievement, motivational drive plays a crucial role in converting intellectual potential into measurable academic performance.

These results align with Duckworth et al. (2007), who emphasized "grit" and perseverance as stronger predictors of success than intelligence alone. Similarly, Goleman (1995) and Dweck (2006) asserted that emotional regulation and mindset are critical determinants of sustained academic performance. In the Ghanaian context, where socio-economic disparities and resource limitations persist, these findings highlight the need to consider non-cognitive and contextual factors alongside IQ in educational assessment.

7.5 Discussion of Findings

The findings from this study confirm a significant positive relationship between IQ and academic achievement, supporting previous global research (Roth et al., 2015; Deary, 2020). Students with higher IQs were generally better equipped to process complex academic content, perform reasoning tasks, and

demonstrate superior comprehension and retention. However, the data also revealed substantial variability in performance among students with similar IQ ranges, reinforcing the argument that intelligence is not the sole determinant of academic success.

The results substantiate **Spearman's two-factor theory**, affirming that general intelligence contributes to broad learning outcomes. However, they also validate **Gardner's theory of multiple intelligences**, which recognizes diverse intellectual capacities—linguistic, interpersonal, and intrapersonal—that influence academic success beyond what IQ tests capture. This multidimensional understanding is particularly relevant in multicultural and resource-diverse contexts like Ghana, where academic achievement is shaped by language proficiency, teaching quality, and socio-cultural factors.

Moreover, the moderating influence of motivation and socio-economic status underscores the importance of **Cattell's fluid and crystallized intelligence theory**. While fluid intelligence (problem-solving) may be relatively innate, crystallized intelligence (knowledge acquired through experience) depends heavily on exposure, environment, and sustained effort. Students from higher socio-economic backgrounds likely benefit from enriched learning environments that facilitate the development of crystallized intelligence, thereby improving academic outcomes even when IQ levels are comparable.

The implications for educational practice are profound. Overreliance on IQ assessments for academic placement or talent identification risks overlooking students who possess strong non-cognitive or contextual strengths. Educators must therefore adopt a balanced approach that integrates cognitive assessment with evaluations of motivation, emotional intelligence, and learning resilience. Such an approach aligns with contemporary calls for holistic education and equitable learning opportunities (OECD, 2020).

8. Conclusion and Recommendations

8.1 Conclusion

This study examined the relationship between intelligence quotient (IQ) and academic achievement among students within the Ghanaian educational context. The findings revealed a statistically significant positive correlation between IQ scores and academic performance, affirming that cognitive ability remains an essential determinant of scholastic success. Students with higher IQ scores tended to demonstrate superior academic outcomes, lending support to classical theories such as Spearman's two-factor model and Cattell's fluid and crystallized intelligence theory. The regression analysis further confirmed that IQ significantly predicts academic achievement, accounting for approximately 39 percent of the variance in students' academic performance.

Nonetheless, the results also highlighted that IQ alone does not provide a comprehensive explanation for academic achievement. Factors such as motivation, socio-economic background, and the learning environment were found to play critical complementary roles. When these variables were included in the analytical model, the predictive strength of the model increased substantially, revealing that non-cognitive and contextual influences are integral to understanding educational outcomes. These findings align with contemporary perspectives such as Gardner's theory of multiple intelligences and Dweck's growth mindset, both of which emphasize that intellectual ability is dynamic and interacts with environmental and psychological conditions to shape learning outcomes.

It can therefore be concluded that intelligence, though central to cognitive performance, is not a fixed or isolated attribute. Academic success arises from the interaction of cognitive, emotional, motivational, and environmental factors. Within the Ghanaian educational landscape, where disparities in learning resources and socio-economic conditions persist, it becomes imperative to adopt a holistic understanding of intelligence that appreciates the diversity of learners' strengths and potentials. Ultimately, this study affirms that while IQ provides a foundation for academic competence, genuine educational success depends on the cultivation of both intellectual and non-intellectual capacities.

8.2 Recommendations

The findings of this study have several implications for educational policy, practice, and research. Educational institutions should move beyond a narrow reliance on IQ-based assessments and adopt more comprehensive evaluation frameworks that incorporate cognitive, emotional, and social dimensions of learning. When educators assess students through multiple lenses, they are better positioned to identify varied talents and tailor instructional strategies to different learning profiles.

Improving the quality of the learning environment remains crucial. Schools must be resourced adequately with learning materials, technology, and supportive infrastructure to nurture intellectual growth. At the same time, efforts should be made to provide psychosocial support through counseling and mentorship programs that strengthen students' motivation and resilience. These interventions can help bridge the gap between potential and performance, particularly for learners from disadvantaged backgrounds. Socio-economic inequalities that influence educational achievement must be addressed through inclusive policies. Government agencies and the Ministry of Education should intensify programs that support under-resourced schools and provide financial aid for students from low-income families. Equalizing access to quality education will ensure that variations in academic performance reflect true ability rather than differences in opportunity.

Furthermore, teachers should cultivate a classroom culture that encourages perseverance, curiosity, and a growth mindset among learners. When students are taught that intelligence is not fixed but can be developed through effort and persistence, they are more likely to engage deeply and sustain their academic motivation. Training teachers in motivational and emotional intelligence strategies would also enhance their ability to foster positive learning climates. Another important recommendation concerns the adaptation of IQ and psychometric tests to Ghana's cultural and linguistic context. Locally

validated instruments are needed to ensure fairness, accuracy, and cultural sensitivity in intelligence assessment. Collaboration between educational psychologists, linguists, and curriculum developers will be essential in achieving this objective.

Future research should also expand the scope of inquiry by exploring how other forms of intelligence—such as emotional, social, and creative intelligence—interact with cognitive ability to influence academic outcomes. Longitudinal studies may provide deeper insights into how these factors evolve over time and contribute to students' long-term academic trajectories. At the policy level, the institutionalization of psychological assessment and counseling services within schools is strongly encouraged. A national framework that integrates cognitive and socio-emotional evaluation will provide early identification of students' strengths and challenges, allowing for timely interventions that enhance learning and personal development.

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