RELATIONSHIP BETWEEN CHRONOLOGICAL AGE AND INTELLIGENCE QUOTIENT OF PUPILS IN SCHOOLS IN IMO STATE

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Abstract
This study investigates the relationship between chronological age and intelligence quotients (IQ) across three learning domains (cognitive, psychomotor and affective) among primary school pupils. Using a quantitative research design, secondary data from 107 pupils in a private primary school in Imo State, Nigeria, were analyzed. The data comprised the pupils' ages and their performance scores in cognitive, psychomotor, and affective domains. Simple linear regression was employed to examine the relationship between age and each of the domains of learning. The results of the analyses indicate that age does not significantly predict cognitive or psychomotor performance. However, age has a significant negative effect on affective performance. These findings suggest that chronological age alone is not a sufficient criterion for class placement, as it does not consistently correlate with performance across all domains of learning. This research provides insights for educational policymakers to reconsider age-based class placements and highlights the need for more comprehensive criteria that account for individual differences in intellectual development.

Keywords: Intelligent quotient, Chronological age, Domains of learning

Introduction:

The argument of children being placed in their respective class in accord with their age is a long-standing controversy which has generated some heat into the Nigerian education arena. Thus, this study investigates the relationship between the age and intelligence quotients of pupils in primary school. Intelligence as a human attribute can be defined as the capability to learn and apply knowledge in dealing with various life situations in any given environment. The degree of intelligence differs from one individual to another. Hence, the measure of the degree of intelligence of an individual is referred to as intelligence quotient IQ which invariably is a measure of intellectual capacity. The IQ is influenced by certain internal and external (biological and environmental factors) which are also known as nature and nurture. These factors contribute collectively in determining the intelligence quotient of individuals. IQ score is obtained by dividing a person's mental age (got from an intelligence test instrument) by the chronological age and multiplied by 100 Alison, *et al.* (2016). This idea is supported by the Encyclopedia Britannica which defines intelligence quotient IQ as a number used to express the relative intelligence of a person. This is one of the many intelligent tests, computed by taking the ratio of performing age or mental age of the child to the physical Chronological (i.e. age as a number) multiplied by 100. Thus, if a 5-year-old child had a test performing age or mental age of 6 (i.e., the child's performance on a test is at the level of an average of 6-year-old child), then the child will have an IQ of $6/5 \times 100$, or 120. Based on this calculation, a score of 100 where the mental age equals the chronological age would be seen to be average. In this study, we measure intelligence quotient with the three component domains of learning, Cognitive, Psychomotor and affective domains. The standardized tests designed to assess relative intelligence were based on age disparity; for instance, the Stanford-Binet intelligence scale which is used for cognitive ability and intelligence test to diagnose developmental or cognitive deficiency in children. Oommen (2014).

Intelligence Quotient (IQ) has been the principal predictor of academic achievement in schooling. It is other times determined by using questions. However, humans employed to administer questions sometimes tend to be biased. The use of rule-based systems complemented with multiple regression technique proposed by Opoku (2017). Here, questions were divided into four sections, namely, word comprehension, logical reasoning, mathematics skills and picture analysis. The timing of each question is based on child's age and the number of characters in the question through multiple regression analysis whilst the determination of the IQ is done by the expert system.

Determination of Intelligence Quotient (IQ) has been a predominant method of measuring relative intelligence which is found by a standardized test developed to measure a person cognitive ability. It also extends to the other two domains of learning namely, Psychomotor and affective domains of leaning Borghans et *al.* (2016). These measures of intelligent helps parent to know the type of program their child should take in school and to determine the capabilities of their children. It is a means of measure of the child's level of intelligence determining placement in commensurate class while identify strengths and weaknesses in children's learning styles. IQ covers logical reasoning, word comprehension and math skills hence People with higher IQ can think in abstracts and make connections by making generalizations easier Spurgin et al. (2013). Often, cooperation employs IQ testing in assessing potential employees at job interviews.

One of the many attempts made at determining IQ was championed by a French psychologist by name Alfred Binet. His research was based on the idea that intelligence could be expressed in terms of age and so he came up with the concept of "mental age," according to which the test performance of a child of average intelligence would match his or her age, while a gifted child's performance would be on par with that of an older child, and slow learner ability would be equal to those of a younger child. His test was first introduced to the United States in a modified form in 1916 by Lewis Terman. However, a German psychologist William Stern devised a new scoring system which consisted of dividing a child's mental age by his or her chronological age and multiplying the quotient by 100 to arrive at an "intelligence quotient Chudacoff (1992). Over time there has been several research work on this subject to date, Wechsler Intelligence Scales, developed in 1949 by David Wechsler, addressed an issue that still provokes criticism of IQ tests today: the fact that there are different types of intelligence. The Wechsler scales replaced the single mental-age score with a verbal scale and a performance scale for nonverbal skills to address each test taker's individual combination of strengths and weaknesses. However, Stanford-Binet and Wechsler tests in their updated form remain the most widely administered IQ tests. Average performance at each age level is still assigned a score of 100, but today's scores are calculated solely by comparison with the performance of others in the same age group rather than test takers of various ages Cronin et al. (2017).

In light of the foregoing, the presumption that age and intelligence quotient have a close link is buttressed considering the fact that for the measure or score of IQ to be obtained, both mental and chronological age must be involved. Relating intelligence quotient and the three domains of learning, Oommen showed that the IQ of children between the ages of two to twelve (2-12) years old (pupils) is easily influenced by environmental factors, the reason for the above is because their brain is in the process of growing and development, unlike adults whose brain/IQ may have reached the peak of development. Therefore, age as a predisposing factor to environmental influence on the intelligence quotient of a child can either be in favor of or against the cognitive, affective or psychomotor development.

Literature Review

Oommen (2014) in his theoretical study on factors influencing intelligence quotient observed that in addition to genetic factors, environmental influences can also affect the intelligence quotient of an individual. Adigun *et al*. (2015) did a study on the relationship between students' gender and academic performance in Computer science in secondary schools in New Bussa, Nigeria. The data used in the study were collected using a questionnaire method of data collection. A sample of 275 students who were randomly drawn from both private and public schools in New Bussa filled out and returned the questionnaire. The data were organized and analyzed using independent t-test. The result of the analysis shows that academic performance is independent of gender.

Rani and Prakash (2015) carried out research on the intelligence level of high school students in Madurai and Virudhunagar Districts. A sample of 1564 high school students from the Districts was selected using a stratified random sampling technique. The intelligence levels of the selected students were measured using Raven's Standard Progressive Matrices (RSPM), The data obtained were analyzed using the t-test. The results indicate that the intelligence test scores of high school students differ significantly in terms of area of study, gender, medium of instruction and board of school.
Adedeji *et al.* (2017) conducted a study to assess the relationship between the nutritional status of pupils and their cognitive function. 407 pupils aged between 6 and 1 2 years in J05 City, Plateau State were randomly selected. Their nutritional status was determined using anthropometric methods while their intelligence quotient was assessed with the help of Raven's Standard.

Progressive Matrices (RSPM). Data on the socio-economic class of the pupils were obtained from their parents. The data were analyzed using students' t-test, chi-square test, logistic regression analysis and odd ratios. The results of these analyses disclosed that a strong relationship exists between undernutrition and IQ. More so, socio-economic class, type of school (private and public) and age also contribute to the level of intelligence quotient.
Akubuiloh *et al.* (2020) examined the relationship between academic performance and intelligence quotient of primary school children in Enugu. A sample of 1122 pupils from both private and public schools were selected using a proportionate multistage sampling technique. The pupils' academic performances which were classified into high, average and low were obtained using their past records of class assessment while their intelligence quotients which were grouped into optimal and suboptimal were assessed using the Raven's Standard Progressive Matrices (RSPM). Additional data on age, gender, socio-economic indices and family size were collected from the selected pupils using a semi-structured questionnaire. The data were analyzed using chi-square test of independence, binary and multinomial logistic regression and independent t-test. The results of the analyses reveal that age, low socio-economic status, large family size and public-school attendance impact negatively on intelligence and academic performance.

It is generally known that no two persons are born with the same capabilities, some are born genius so much so that at a tender age they could perform task above their age grade. It then presents a problem to place a child in a class according to the chronological age irrespective of the mental age or ability of such child. We thus undertake to investigate the relationship between the age as a number and the indigent quotient.

The objectives of this research were to investigate:

- the relationship between age and cognitive performance of the pupils.
- the relationship between age and psychomotor performance of the pupils
- the relationship between age and affective performance of the pupils.

This research was thus anchored on the following research questions

i. What is relationship between age and cognitive level of pupils?
ii. What is the relationship between age and psychomotor development of pupils?
iii. What is the relationship between age and affective domain of learning of pupils?

Hypotheses

Ho1: There is no significant relationship between age and the cognitive level of pupils.
Ho2: There is no significant relationship between age and the psychomotor development of pupils.
Ho3: There is no significant relationship between age and the affective domain of learning of pupils.

Rationale for the research

It is expected that this study provides relevant insight into the relationship between age and intelligent quotient from our analyzed data and throw more light on the relationship between age and domains of learning. This finding is a source of information for leaders and actors in the Education sector, both private and public about their policy on the placement of pupils in their respective classes so that undue consideration is not given to age as criterion for admission.

Pieces of literature have shown that several research findings have previously dwelt on subjects which are different from those presented here. The work which is close to what was considered is Akubuilo *el al.* (2020) who examined the relationship between academic performance and intelligence quotient of primary school children in Enugu. Our research effort is however novel because it dwells on practical application of statistical analysis to determine if IQ is dependent on age with real data from known schools in Imo Stale.

Methodology

Research Design

This research work is a quantitative study undertaken to determine the relationship existing between age and the three domains of learning (cognitive, psychomotor and affective) among primary five and six pupils using secondary data.

Source of Data

The data used in this study are secondary data obtained from a private primary school in Imo State, Nigeria. The data, which were provided by the headmaster of the school, comprise the age (in years) and cognitive, psychomotor and affective performance (in %) of 107 pupils of the school. The permission to use the data was obtained from the school management; and the data are anonymized to ensure the confidentiality of the pupils and school.

Variables

Independent variable: Age of the pupils
Dependent variable: Cognitive performance, Psychomotor performance and Affective performance.

Statistical Analysis
The analysis was conducted in SPSS using simple linear regression method of analysis. Simple linear regression models were specified to examine the relationship between age and each performance metric (domain of learning).

Results of the Analyses

H_0 : The chronological age of pupils has no significant effect on their cognitive performance versus

H_1 : The chronolgical age of pupils has a significant effect on their cognitive performance

The results here were obtained from the simple linear regresssion analysis conducted to deteremine the effects of chronological age on cognitive perfromance among the pupils.

The fitted regression equation is:

$$\hat{Y} = 54.885 + 1.184(\text{Age}) \quad (4)$$

Table 1: ANOVA Table for the Test of Regression Model Significance for Cognitive Performance on Age of the pupils

SV	SS	df	MS	F	Sig (p-value)
Regression	477.154	1	477.154	1.777	0.185
Error	2819.575	105	268.529		
Total	28672.729	106			

The ANOVA table provides an F value of 1.777 with a p-value of 0.185. Since the p-value is greater than 0.05 (p > 0.05), we fail to null hypothesis, indicating that age is not a statistically significant predictor of cognitive performance.

Table 2: Regression Coefficients and Related Statistics for Relationship between Cognitive Performance and Age of the pupils

Model	Unstandardized Coefficients		T	sig
	B	Std error		
(constant)	54.885	7.375	7.443	0.000
Age of pupils	1.184	0.888	1.333	0.185

The Table of coefficients shows that the unstandardized coefficient (B) for age of pupils is 1.184, which implies that for each additional year of age, cognitive performance is expected to increase by 1.184 units. However, the significance level for age is 0.185, which is above the coventional threshold of 0.05, indicating that the effect of age on cognitive performance is not statistically significant.

Again, a regression analysis is carried out to explore the impact of age of primary school pupils on their psychomotor domain.

H_0 : The chronological age of primary school pupils has no impact on their psychomotor domain versus

H_1 : The chronolgical age of primary school pupils has a significant impact on their psychomotor domain

The results here were obtained from the simple linear regresssion analysis conducted to deteremine the effects of chronological age on psychomotor perfromance among the pupils.

The fitted regression equation is:

$$\text{Psychomotor Performance} = 68.359 - 0.272(\text{Age}) \tag{5}$$

Table 3: ANOVA Table for the Test of Regression Model Significance for Psychomotor Performance on Age of the pupils

SV	SS	df	MS	F	Sig (p-value)
Regression	25.277	1	25.277	0.505	0.479
Error	5260.330	105	50.098		
Total	5285.607	106			

The ANOVA table provides an F value of 0.505 with a p-value of 0.479. Since the p-value is greater than 0.05 ($p > 0.05$), we fail to null hypothesis, indicating that age is not a statistically significant predictor of psychomotor performance.

Table 4: Regression Coefficients and Related Statistics for Relationship between Psychomotor Performance and Age of the pupils.

Model	Unstandardized Coefficients		t	sig
	B	Std error		
(constant)	68.359	3.185	21.461	0.000
Age of pupils	-0.272	0.383	-0.710	0.479

The table of coefficients shows that the unstandardized coefficient (B) for age of pupils is -0.272, which implies that for each additional year of age, cognitive performance is expected to decrease by 0.272 units. However, the significance level for age is 0.479, which is above the coventional threshold of 0.05, indicating that the effect of age on psychomotor performance is not statistically significant.

Finally, a regression analysis is also conducted to discover whether age of primary school pupils affects their affective performance.

H_0 : The chronological age of the pupils does not have any effect on their affective performance versus

H_1 : The chronolgical age of the pupils has a significant effect on their affective performance

The results here were obtained from the simple linear regresssion analysis conducted to deteremine the effects of chronological age on affective perfromance among the pupils.

The fitted regression equation is:

$$\text{Affective Performance} = 95.430 - 2.293(\text{Age}) \tag{6}$$

Table 5: ANOVA Table for the Test of Regression Model Significance for Affective Performance on Age of the pupils

SV	SS	df	MS	F	Sig (p-value)
Regression	1790.472	1	1790.472	32.366	0.000
Error	5808.500	105	55.319		
Total	7598.972	106			

The ANOVA Table provides an F value of 0.505 with a p-value of 0.479. Since the p-value is greater than 0.05 ($p > 0.05$), we fail to null hypothesis, indicating that age is not a statistically significant predictor of psychomotor performance.

Table 6: Regression Coefficients and Related Statistics for Relationship between Affective Performance and Age of the pupils.

Model	Unstandardized Coefficients		t	Sig
	B	Std error		
(constant)	95.430	3.347	28.511	0.000
Age of pupils	-2.293	0.403	-5.689	0.000

The table of coefficients shows that the unstandardized coefficient (B) for age of pupils is -2.293, which implies that for each additional year of age, affective performance is expected to decrease by 2.293 units. The significance level for age is 0.000, which is below the coventional threshold of 0.05, indicating that the effect of age on affective performance is statistically significant.

Discussion

The study aimed to explore the relationship between chronological age and intelligence quotients (IQ) across three learning domains among primary school pupils. The regression analyses conducted provided mixed results.

Cognitive Performance: The analysis showed that while there is a positive coefficient indicating a slight increase in cognitive performance with age, this relationship was not statistically significant. This implies that age alone is not a strong predictor of cognitive abilities among the pupils. This finding aligns with Oommen's (2014) theoretical study, which highlighted that environmental factors significantly influence IQ. Our results suggest that other factors beyond chronological age, such as learning experiences and environmental influences, play a crucial role in cognitive development. This finding contrasts with Adedeji et al. (2017), who found a significant relationship between age and cognitive function, indicating that age, when combined with nutritional status, plays a role in cognitive development. Our study's context and sample might explain the difference, suggesting the need for more context-specific research.

Psychomotor Performance: Similar to cognitive performance, the analysis revealed no significant relationship between age and psychomotor performance. The negative coefficient suggests a slight decrease in performance with age, but this effect was not statistically significant. This outcome indicates that psychomotor skills, which involve physical coordination and movement, may be influenced by other factors beyond age, such as physical activity levels and specific skill training. This aligns with findings by Rani and Prakash (2015), who observed that intelligence test scores differ significantly in terms of several factors, implying that age might not be a sole predictor of performance in specific domains.

Affective Performance: Unlike the other two domains, affective performance showed a significant negative relationship with age. The results suggest that as age increases, affective performance decreases significantly. This finding could reflect various developmental changes, such as shifts in emotional regulation and social interactions, which may become more complex as children grow older. This aligns with the findings of Akubuiloh et al. (2020), who observed that age, among other factors, impacts academic performance. However, while their study focused broadly on academic performance, our study provides a more focused insight into the affective domain, highlighting the importance of considering emotional and social factors in educational assessments and placements.

In comparing our findings with Adigun et al. (2015), who found that academic performance is independent of gender, it is evident that various demographic factors, including age and gender, might interact differently with different domains of learning. This complexity underscores the need for a multifaceted approach to understanding and addressing educational outcomes.

Summary

This research investigated the impact of chronological age on three domains of learning—cognitive, psychomotor, and affective—among primary school pupils. The key findings are:

- Age does not significantly affect cognitive performance, indicating that intellectual development in this domain may be influenced more by other factors, aligning with Oommen (2014) and contrasting with Adedeji et al. (2017).
- Psychomotor performance is also not significantly impacted by age, suggesting that physical coordination and movement skills develop independently of chronological age, aligning with Rani and Prakash (2015).
- Affective performance significantly decreases with age, pointing to the need to address emotional and social factors in educational strategies, aligning with Akubuiloh et al. (2020).

Conclusion

The findings of this study challenge the traditional practice of placing children in classes strictly based on their chronological age. Given that age does not significantly predict cognitive or psychomotor performance and has a significant negative impact on affective performance, it is crucial for educational policymakers to adopt a more holistic approach to class placements. Such an approach should consider a child's individual learning needs, emotional and social development, and other relevant factors. This research underscores the complexity of intellectual development and the necessity for tailored educational practices that accommodate the diverse abilities and growth patterns of pupils. Further studies are recommended to explore additional factors influencing learning domains and to develop comprehensive assessment tools for more effective educational planning.

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