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Intelligence Quotient As A Predictor Of College Of Education Students' Achievement In Computer Science In South-East, Nigeria

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Abstract: ***The study investigated intelligence quotient as a predictor of College of education students' achievement in Computer science in South-East, Nigeria. Two research questions and two null hypotheses guided the study. Correlation research design was adopted for the study. The population of the study was 1,028 Computer science students. The total sample size for the study was 510 students drawn using purposive and random sampling techniques. The instrument for data collection was Intelligence Quotient Test (IQT) validated by three experts. The reliability of the instrument IQT was established using Kuder-Richardson Formula 20 (KR-20) to be 0.61. The data obtained was analyzed using simple and multiple linear regressions. The findings of the study revealed among others that 1.3% of the variance in achievement in Computer science was predicted by students' intelligence quotient. Also, achievement scores in Computer science were significantly predicted by students' intelligence quotient. It was recommended that Intelligence quotient test scores should be added as criteria for admission into computer science courses.***

Keyword: Intelligence, quotient, predictor, computer, college

I. INTRODUCTION

The study of Computer science enables students to think, learn, and grow by exposing them to logical reasoning and critical thinking. With the knowledge of how programming languages work, how computing systems operate, and how networks drive connectivity, students understand technology and its adaptations and advancements; how to develop, troubleshoot, improve, and use it (Bourke, 2018).

Computer Science according to Goos, Hartmanis and Van-Leeuwen (2021) is the study of computers and computational systems. Goos, *et al.* also noted that unlike electrical and computer engineers, computer scientists deal mostly with software and software systems which includes their theory, design, development, and application. According to Bourke (2018), the principal areas of study within computer Science include artificial intelligence, computer systems and networks, security, database systems, human computer interaction, vision and graphics, numerical analysis, programming languages, software engineering, bioinformatics and theory of computing.

Computer science is applied to a wide range of disciplines that include modeling simulations such as the impacts of climate change and diseases such as Ebola virus and Corona virus. Computer science also finds application in creating art and visualization through graphics rendering, and simulating a human interface through artificial intelligence and machine learning (Ryan, 2021). The wide application of computer science has made it an indispensable course in any tertiary institution undergraduate programme in the post-modern world.

Knowing how to program is essential to the study of computer science, it is however, only one element of the field. Computer scientists design and analyze algorithms to solve problems and study the achievement of computer hardware and software. The problems that computer scientists encounter, according to Ryan (2021) range from the abstract thoughts such as determining what problems that can be solved with computers and the complexity of the algorithms that solve them, to the tangible (designing applications that perform well on handheld devices, that are easy to use, and that uphold security measures). Thus, computer science is

perceived among undergraduate students offering the course as a difficult one (Anusiuba, 2021).

The perception of Computer science as a difficult course by students has resulted in achievement in the course not meeting up with the expectation. Academic achievement is the grade attained by a student across various academic subjects (Kumar, Agarwal and Agarwal, 2021). Teachers and education officials typically measure achievement using classroom evaluations, graduation rates and results from standardized tests. The measurement of academic achievement reveals achievement gaps in public schools based on race, gender and economic circumstances. According to Abaidoo (2018) academic achievement is the knowledge gained which is assessed by marks by a teacher and/or educational goals set by students and teachers to be achieved over a specific period of time. Abaidoo added that these goals are measured by using continuous assessment or examinations results. Again, Akinleke (2017) emphasized that academic achievement of students is defined by a student's score in an examination, tests, and in a course work.

High percentages of students who graduated from Computer Science in Colleges of Education in South-East, Nigeria often do have academic achievements (rated as Cumulative Grade Point Average, CGPAs) not greater than 3.50. Majority of the students in 200 and 300 levels also have CGPA within the range of 1.90-3.80 (Bourke, 2018). Researchers such as Goos *et al.* (2021) blamed the students' achievement on the uniqueness of Computer science and the level of computer technology advancement and application in an area such as South East, Nigeria.

South East, Nigiera is one of the six geopolitical zones in Nigeria. Although, there has been relatively infrastructural development in South-East, the advancement of computer technology and its applications is still at its infancy. It is believed that the achievement of College of Education students in Computer science in South-East could be because Computer Science is a field where some of its more difficult components take years to learn; requiring an understanding of discrete mathematics, calculus, linear algebra, number theory, and graph theory. Goos *et al.* (2021) also added that because Mathematics is a subject that slowly builds on itself, students have to take several Mathematics courses before getting into the more advanced classes of Computer science. The abstract nature of Computer science and its demand for sound knowledge of Mathematics make students to feel that the course is only for the very intelligent students who have high intelligence quotient.

Intelligence is narrowly defined as the capacity to acquire knowledge and understanding, and use it in different novel situations (Alberto, Alejandro, Zaira and Sandra, 2021). According to Sania (2019), it is the ability, or capacity, of an individual to deal with real situations and profit intellectually from sensory experience. Intelligence quotient (IQ) is a common term used to explain the attributes of thoughts encompassing a number of abilities, such as, reasoning, planning, problem solving, abstract thinking, concept understanding, language using, and learning (Sania, 2019). IQ therefore, is the ability of the individuals which enable them to give the appropriate response towards a stimulus received. A test of intelligence known as intelligence quotient test (IQ test) is designed to formally study, under test conditions, the success of an individual in adapting to a specific situation. There had been a plethora of studies (Akubuilo, Iloh, Onu, Ayuk, Ubesie and Ikefuna ,2020; Mikail, Najibullah and Jamil, 2019; Pratama, Syamsuri, Adi and Aloysius, 2015) on prediction of achievement by intelligence quotient as a predictor of achievement, with all concluding that high intelligence does not mean knowledge but that intelligence affects achievement. However, from the earliest studies to the most recent ones, researchers have been challenged by the problem of how to test true intelligence to determine intelligence level through scores on such tests.

Scores from standardised intelligence tests (IQ scores) are often used to define one's intelligence level. It is, however, becoming increasingly acceptable that they do not reveal the complete picture and only provide a snapshot of a person's ability in the area under examination. For example, someone who has scored highly on a verbal test can only be said to have a high verbal IQ and someone who has scored highly on a mathematical test can only be said to have a high numerical IQ. Obviously, therefore, the more different types of disciplines that are tested and examined, the more accurately the intelligence level of the individual can be assessed. According to Kpoloviw (2017), a lot of standardized intelligence test have been developed and administered by trained psychologist. Examples include Wechsler Adult Intelligence Scale for Adults, Wechsler Intelligence Scale for Children, the Stanford-Binet Intelligence Scales, the Kaufman Assessment Battery for Children, the Cognitive Assessment System, the Differential Ability Scales and the Woodcock-Johnson Tests of Cognitive Abilities among others (Kpoloviw, 2017).

The lack of a single standardized test of intelligence that can measure intelligence exhaustively in the view of Kpoloviw (2017) have created a huge gap in studies relating to intelligence. These gaps exist because each test measure different aspects of intelligence such as general intelligence, verbal/linguistic intelligence, logical intelligence, visual/spatial intelligence and intrapersonal intelligence among others. The use of tests measuring different aspect of intelligence has made it difficult to conclude on what dimensions of intelligence positively predict achievement in subjects such as Computer science. In this study, effort is focused on numerical and verbal aptitudes, spatial intelligence and logical reasoning.

Numerical and verbal aptitudes examine students' lexical skills, formal speech, verbal and numerical debate, creative writing; spatial intelligence determines the students' patterns and designs, painting, drawing, active imagination, sculpture, colour schemes while the logical reasoning examines their numerical aptitude, problem solving, deciphering codes, abstract symbols and formulae. The focus on these aspects is because they form part of Gardner's (1983) multiple intelligence which is important in the learning of a student unlike those examined in the earliest studies of intelligence quotient. There is the need therefore, to establish not just how IQ but also the different dimensions of IQ predict College of education students' achievement in Computer science.

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PURPOSE OF THE STUDY

The purpose of the study was to investigate intelligence quotient as a predictor of Computer Science students' academic achievement in Colleges of Education in South-East, Nigeria. Specifically, the study sought to determine the:

- ✓ Extent of prediction of College of Education students' achievement scores in computer sciences by intelligence quotient.
- ✓ Extent of prediction of Computer Science students' achievement scores by the dimensions (Numerical and verbal aptitude, Spatial intelligence and logical reasoning) of intelligence quotient.

RESEARCH QUESTIONS

The following research questions guided the study:

- ✓ To what extent does intelligence quotient predict Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria?
- ✓ What is the relative contribution of the various dimensions of intelligence quotient in the prediction Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria?

HYPOTHESES

The following null hypotheses were tested at 0.05 level of significance:

- ✓ Intelligence quotient scores do not significantly predict Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria.
- ✓ The relative contribution of the various dimensions of intelligence quotient in the prediction of Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria is not significant.

II. METHOD

The study adopted correlation research design. Correlation design is a study in which the relationship existing between two or more variables of interest to the researcher is established (Nworgu, 2015). According to Nworgu, correlation studies indicate the direction and magnitude of the relationship between the variables employing a special group of statistics known as correlation coefficients or regression analysis for data analysis. Thus, studies that determine relationships are correlation studies whether they are predictive or ordinary correlation studies. The design was adopted as the present study sought to establish the predictive relationship between College of Education students' intelligence quotient and academic achievement in Computer science.

The study was carried out in South East. Nigeria. South East of Nigeria is one of the six geopolitical zones in the country. South East Nigeria (Igboland) is a region of Nigeria that borders Cameroon to the east and the Atlantic Ocean to the south. South East Geo political zone is 99.9% of population of Igbo people. It is composed of the following states: Abia, Anambra, Ebonyi, Enugu, and Imo. The different states have some occupation and craft specific to them as well as mineral resource by which they are known such as Enugu which is known for coal. Again, while most are civil servant, a lot of the South Easterners are traders and profess Christianity. The area was chosen as there are many Colleges of Education in South Eastern Nigeria where the findings of the study may be of importance and may drive academic changes why recommendations are applied.

The population of the study is 1028 year three (300level) Computer Science students in eight Colleges of Education in South East, Nigeria. The Colleges of Education in South East Nigeria include Federal College of Education (Technical), Umunze (FCET) and Nwafor Orizu College of Education, Nsugbe (NOCEN), Federal College of Education, Eha-Amufu, Enugu state, Alvan Ikoku Federal College of Education, Owerri, Imo state, Abia State College of Education (Technical), Ebonyi State College of Education, Enugu State College of Education (Technical) and Osisatech College of Education, Enugu.

The sample for the study is 510 year three Computer science students in the six Colleges of Education in south east, Nigeria. The two-stage sampling procedure was used. Six Colleges of Education were chosen purposively at the first stage. The reason was because the Colleges have the approved complete results, (CGPA) of the students in Computer science as at the time of the study. Secondly, in each of the six Colleges, 85 students were chosen at random for the study.

The instrument for data collection was Intelligence Quotient Test (IQT). IQT is a 40-item question test adapted from Carter and Russell (2007). It has four dimensions of intelligence namely: Numeral, aptitude, spatial and logical reasoning. The test has a time frame of 90 minutes after which it goes off. There are 10 questions each for the four dimensions. The adaptation involved introducing the dimensions. The Computer Science students' achievement was obtained from their cumulative grade point average for 2 years (100L and 200L) using a profoma. The CGPA for the four semesters was used as the achievement score for the analysis.

The instrument, purpose of the study, research questions and hypotheses were given to three lecturers one from the Department of Science Education, one from the Department of Educational Foundations (measurement and evaluation unit) and another from the Department of Computer Science Nnamdi Azikiwe University, Awka for validation. They were requested to vet the instrument in terms of clarity of language, sentence structure and items relatedness to the construct being measured. The validators were asked to write 'R', 'M' and 'D' against any items they wish the researcher to retain, modify and delete. Their corrections were effected in the final copy of the instruments.

The reliability of IQT was established using Kuder-Richardson Formula 20 (KR-20). This is because the instrument is dichotomously scored. The instrument was administered to 300L computer science students in Federal College of Education (Technical), Asaba, Delta state in South South, Nigeria which was not part of the population. The scores generated were subjected to KR-20 and Cronbach's Alpha computations respectively. The coefficient of internal consistency obtained for IQT is 0.61.

The instruments were administered with the aid of three research assistants. These research assistants were the computer science lecturers in each of the colleges of education that were involved in the study. The researcher visited the research assistants having obtained permission from the Head of Department to acquaint them with the objectives of the study and how to collect data. First, the researcher obtained from the lecturers the students' scores in computer science for any two recent semesters along with the last three digits of the matriculation numbers. Through the aid of the lecturers, the researcher obtained the phone number of the 'course rep' through whom the hyperlink for the online test for data collection was sent to students. The researcher sent the hyperlink to the lecturers who forwarded it to the course-rep requesting each student to fill the last three digits of their matriculation numbers on the space provided in the instrument. This enabled the researcher to collate the students' scores in the instruments against their achievement in their course programme

The hyperlink for the instrument was generated using google form. The link is an online survey development cloud-based software which function as a service application, providing free, customizable surveys, as well as a suite of freeback-end programs that include data analysis, sample selection, bias elimination and data representation tools. It allowed the students to submit their response to each instrument only when it is completed. After submitting a completely filled questionnaire, the application collated and sent the response pattern and summated scores of each student's response to the researcher's default e-mail address automatically. The researcher thereafter collated the students' scores in the three instruments using their matriculation numbers against their CGPA in Computer Science Department for analysis.

Data generated from the study was analyzed using simple linear and multiple regressions. The interpretation of the correlation coefficient was according Nworgu (2015) who provided a three-way guide for interpreting correlation coefficient values when a large number of pairs of scores have been correlated. They are as follows: $r = \pm.30$ *and below*, low relationship; $r = \pm.30$ *to below* ± 0.80, moderate relationship and $r = \mp.80$ and above, high relationship. The null hypotheses were tested at 0.05 level of significance with the decision rule that: whenever Pvalue is less than or equals 0.05 ($P \leq 0.05$) the null hypothesis was rejected and was accepted whenever Pvalue is greater than 0.05 ($P > 0.05$). The regression equation for each prediction was established using the beta coefficients.

III. RESULTS

RESEARCH QUESTION 1: To what extent does intelligence quotient predict Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria?

Model	R	R^2	Adjusted R^2	Unstandardized coefficients (b)	Std. Error	Decision
Constant Int. Quo.	.114[a]	.013	.011	64.091 .116	12.571	Low positive relationship

a. Predictors: (Constant), Intelligence Quotient

Table 1: Prediction of Students' Achievement in computer studies by Intelligence Quotient

Table 1 shows a low positive relationship (R = 0.114) exists between students' intelligence quotient and their achievement in computer studies. The R-Square value of 0.013 indicates that 1.3% of the variance in computer studies scores is predicted by intelligence quotient.

RESEARCH QUESTION 2: What is the relative contribution of the various dimensions of intelligence quotient in the prediction Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria?

Model		Unstandardized Coefficients		Standardized Coefficients	R	R-squared	t	Sig.
		B	Std. Error	Beta				
1	(Constant)	62.444	2.681		.213	.046	23.292	.000
	Numerical	.154	.080	.084			1.920	.045
	Aptitude	.309	.127	.106			2.444	.015
	Spatial	.282	.092	.135			3.068	.002
	Logical reasoning	.177	.085	.091			2.076	.038

a. Dependent Variable: Computer Studies Achievement

Table 2: Contributions of the Individual Dimensions of Intelligence Quotient in the Prediction of Achievement Scores in Computer Studies

Table 2 shows a low positive relationship (R = 0.213) exists among all the dimensions intelligence quotient and achievement in computer studies. The R-Square value of 0.046 indicates that 4.6% of the variance in computer studies scores is jointly predicted by the dimensions of intelligence quotient. Table 2 also shows the standardized beta coefficient which indicates correlation between variables. The unstandardized beta coefficient shows the prediction powers of each dimension of intelligence quotient which indicates their relative contribution to achievement in computer studies. It shows that numerical dimension has a low positive predictive relationship (R = 0.084) with students' achievement in computer studies, aptitude has a low positive relationship (R = 0.106) with achievement in computer studies, while spatial dimension has a low positive relationship (R = 0.135) with achievement, and logical reasoning has a low positive relationship (R = 0.091) with achievement in computer studies. Table 2 further reveals that numerical dimension of intelligence quotient contributes 0.154 to achievement in computer studies whenever a students' numerical dimension of intelligence quotient increase by one unit. With a unit increase, aptitude increases achievement by 0.309, spatial dimension increases achievement by 0.282, where logical reasoning increases achievement by 0.177. The order of relative contribution to achievement in computer studies from the highest to lowest by each dimension of intelligence quotient is; aptitude (0.309), followed by spatial (0.282), logical reasoning (0.177), and then numerical dimension (0.154).

HYPOTHESIS 1: Intelligence quotient scores do not significantly predict Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1050.892	1	1050.892	6.650	.010[b]
	Residual	80273.312	508	158.018		
	Total	81324.204	509			

a. Dependent Variable: Computer Studies Achievement
b. Predictors: (Constant), Intelligence Quotient

Table 3: ANOVA on Significance of Prediction of Achievement in Computer studies by Students' Intelligence Quotient

Table 3 shows that intelligence quotient is a significant predictor of achievement scores in computer studies F (1, 508) = 6.650, P (0.010) < 0.05. The null hypothesis was therefore rejected implying that intelligence quotient is a significant predictor of school students' achievement scores in Computer studies.

Since intelligence quotient is a significant predictor of achievement scores in computer studies, the regression model (Y= a + bX) for the prediction of achievement score in computer studies as derived from Table 1, where constant = 64.091 and b value = 0.116 is:

CSP = 64.091 + 0.116(IQ)

Where, SCP = Computer studies Achievement and IQ = Intelligence Quotient

HYPOTHESIS 2: The relative contribution of the various dimensions of intelligence quotient in the prediction of Computer Science students' achievement scores in Colleges of Education in South-East, Nigeria is not significant.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3703.485	4	925.871	6.024	.000[b]
	Residual	77620.719	505	153.704		
	Total	81324.204	509			

a. Dependent Variable: Computer Studies Achievement
b. Predictors: (Constant), Logical reasoning, Aptitude, Numerical, Spatial

Table 4: ANOVA on Significance of Prediction of Achievement in Computer studies by the Individual Dimensions of Intelligence Quotient

Table 4 shows that all the individual dimension of intelligence quotient jointly predicted the students' achievement scores in computer studies significantly F (4, 505) = 6.024, P (0.000) < 0.000. However, data contained in Table 4 shows the significance of the contributions of the individual dimensions to the prediction of achievement scores in computer studies.

Table 4 shows that numerical dimension is not a significant predictor of achievement scores in computer studies, t = 1.920, P (0.045) < 0.05, aptitude is a significant predictor of achievement scores in computer studies, t = 2.444, P (0.015) < 0.05, spatial dimension is a significant predictor of achievement scores in computer studies, t = 3.068, P (0.002) and logical reasoning is also a significant predictor of achievement scores in computer studies, t = 2.076, P (0.038) < 0.05. Thus, all the dimensions of intelligence quotient are significant contributors to the achievement of students in computer studies. Since the joint prediction of all the dimensions of intelligence quotient in the prediction of achievement score in computer studies is significant, the regression model ($Y= a + bX_1 + cX_2 + dX_3 + eX_4$) for the prediction of achievement score in computer studies as can be derived from Table 2, where constant = 62.444 and b value = 0.154, c value = 0.309, d value = 0.282 and e value = 0.177 is:

CSP = 62.444 + 0.154(N) + 0.309(A) + 0.282(S) + 0.177(LR)

Where, CSP = Computer studies Achievement and N = numerical, A = Aptitude, S = Spatial, LR = logical reasoning

IV. DISCUSSION

The findings of the study showed that there is a low positive relationship between students' Intelligence Quotient (IQ) and their achievement in Computer science with intelligence quotient significantly predicting 1.3% of the variance in Computer science scores. The observation is attributed to the fact that IQ is important in understanding abilities and overall achievement. Students who score higher on IQ tests will, on average, go on to do better in conventional measures of success in life such as academic achievement. Students with greater propensity for intelligence go on to complete more education, or a longer education increases intelligence. The students who are able to understand their studies well, grasp it well, and perform better in examinations as compared to low IQ students. The low IQ students need more time to grasp the concept as they have poor learning power and so it is obvious that their academic achievement will be low. This is more clearly shown in role of the different aspects of intelligence quotient in learning science subject such as Computer science.

Numerical intelligence is closely aligned with academic problem solving and computations. Thus, students with high numerical intelligence could so most computer mathematics, understand binary numbers as well as computer digit operations. The capacity to excel in a particular field such as Computer science is known as aptitude. Since it can be innate, natural, learned, or acquired or may be a unique talent or a collection of skills that might aid someone in performing particular duties well, it is very important in computer programming and design as well as computer configuration. When a students is aware of these strength, they can make an informed decision. Aptitude can help a student identify his or her vocational strengths and weaknesses in specific Computer science areas thereby improving achievement in that particular content. Testing can also help identify an individual's level of intelligence, which can help them learn more effectively and achieve their goals.

Spatial thinking allow students to understand the location and dimension of objects, and how different objects are related. It also allows you to visualize and manipulate objects and shapes in their head. Knowledge of object categories and attributes allows students to mentally and physically organize things in their world. Spatial awareness and spatial relations allow students to locate objects and navigate successfully in Computer environments. Thus, students' spatial intelligence in utmost in graphics and animations. Visual-spatial abilities (VSA) are cognitive skills considered necessary for solving many everyday tasks, such as reading computer maps, navigating through highly dense graphics and algorithms, adjusting to new computer environments and configuration.

The students make use of reasoning ability in various life patterns in general and education in particular. It helps

students to draw conclusions and these conclusions help them to solve their problems. It assists students in gaining true knowledge, because knowledge is based on logic and rationality. Verbal reasoning when combined with logical reasoning tests enable students to distinguish between fact and fiction, animate and inanimate objects, shapes and models in mathematics, theory, and complex computer equations. Thus, it truly unlocks the full potential of the brain. Logical thinking skills require and involve a progressive analysis, for example, by weighing all available options, using facts and figures, and making important decisions based on the pros and cons, students can develop different programmes through unique algorithms. Such strategies require the ability to make connections among events or ideas, such as cause and effect relationships and comparisons.

The findings of the study is in line with the findings of Pratama, Syamsuri, Adi and Aloysius (2015) that there was a significant correlation between intelligence quotient (IQ) and students' academic achievement in Biology. The findings of the study support the findings of Kpoloviw (2017) that there is statistically significant relationship between IQ and Mathematics achievement. The findings of Sania (2019) that private students possess a significant IQ, and their academic achievement is primarily driven by IQ support the findings of the present study. The findings of the study did not conflict with the findings of Akubuilo et al. (2020) that IQ is a significant determinant of achievement. The findings of the study are also in line with the findings of Alberto, Alejandro, Zaira and Sandra (2021) that that IQ, short-term memory and study habits are significantly related to academic achievement.

V. CONCLUSION

The study concludes that intelligence quotient is significant predictor of students' achievement in Computer science. The study also establishes all the dimensions of intelligence quotient examined bear significant influence on students' achievement in Computer science.

VI. RECOMMENDATIONS

The following recommendations are made based on the findings of the study:

- ✓ Test exercises targeted at improving students' intelligence quotient should be used by Computer science teachers in a manner quite often, in order to improve students' achievement in the subject.
- ✓ Intelligence quotient test scores should be added as criteria for admission into computer studies courses.

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