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Mathematics Achievement, Gender and Location as Predictors of Economics Achievement in Nigeria

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Abstract: The study investigated mathematics achievement, gender and location as predictors of economics achievement in senior secondary schools in Nsukka local government of Enugu state. The population comprises of economics students that sat for WAEC within the stipulated period of study (2008-2013). The sample consists of 5410 economics students randomly selected from five schools within the study area. The data generated was analysed using ordered probit regression. The findings of the study revealed that there is a significant relationship existing between mathematics knowledge and achievement in economics. It also showed that location is a significant factor affecting student's achievement in economics. The study recommended that economics teachers should be equipped with necessary skills to handle the mathematical aspects of economics.

Key words: Mathematics achievement, economics, gender, location, data generated

INTRODUCTION

Economics is one of the elective subjects offered at the senior secondary school level as prescribed by the national policy on education. Its curriculum is based on equipping students with basic knowledge and skills to appreciate the nature of economic problems in the society and adequately prepare them for the challenges in the Nigeria economy. The philosophy of its curriculum is to present economics as a subject that has relevance in everyday life and could prepare graduates for an entrepreneurial career in future.

According to the National Open University (NOUN) 2006, Economics education involves the use of appropriate teaching methodology in enhancing the understanding of economics as a concept and facilitates the in-depth residual knowledge of the learners in order to make them contribute meaningfully to the growth and development of the society.

Onwukwe and Agwu hold that economics knowledge teaches the household and sector that is individual consumers how best to use their scare resources. It also enables a consumer to make a rational decision with regard to maximizing his total satisfaction.

Also, to Awoderu (2002) the study of economics serves a useful purpose in modern life. It gives us facts and shows us what may be expected to be the outcome of certain lines of conduct and also helps us to decide which of several alternatives to choose.

Economics as a field of study has enjoyed much scholastic attention both within and outside the discipline ranging from economists, politicians, statisticians, mathematicians, philosophers to mention a few and all in a bid to define it. This suggests that the influence of economics cuts across different disciplines and affects all business of life. In support of this, Onwukwe and Agwu stated that "Economics knowledge is of practical importance in business because understanding of the overall operation of the economic system puts the business executive (irrespective of the type of business) in a better position to formulate good policies that would ensure profit maximization for his organization". This might account for the reason why though an elective course, over the years can be seen as the third most popular secondary school subject offered and taken by students in sciences, social sciences and commercials.

Adu and Ayeni asserts that though there is an increase in the number of students that are offering the subject, achievement in economics has not been as good as it has been before the introduction of a new economics syllabus which incorporated some elements of Mathematics into the subject. The situation has been posing a serious problem for the students in the Senior Secondary School classes partly as a result of the carryover effects of the negative attitudes which they have towards Mathematics and ineffectiveness on the

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part of the teachers. Supporting the claim above, reported that performance in Economics at the secondary school level over the years has been less than satisfactory.

Achievement in economics is imperative for effective participation in economic development. For an individual to contribute towards economic development, the individual's academic achievement should be improved upon as this reveals the extent the learning content the learner was exposed to have been comprehended and could be applied in real life situations. To improve economics student achievement, there is a need to examine some of the factors that might be affecting students achievement as this will provide a guide on the approach to be adopted in handling students so as to enhance their academic performance and achievement.

According to Hanzen, previous research findings had shown that student's achievement is affected by different factors such as learning abilities, race, gender and sex. Chansarkar and Mishaeloudis explained the effects of age, qualification, distance and other factors on student achievement but to Them, achievement of students is not affected by such factors as age, sex and place of residence but is associated with performance in quantitative subjects. In a research by Educational Testing Service in 1995 quantitative ability was identified as a factor affecting student's achievement. To them, quantitative ability a measure of a student's ability to apply knowledge of mathematical concepts and principles, to demonstrate flexibility in thinking, to identify critical features on new situations, to make correct generalizations and to compare mathematical expressions. Apata (2011) defined numerical proficiency as the strength of an individual to proffer numerical solutions to mathematical problems through the manipulations of numbers.

Mathematics can simply be seen as the process of calculating to solve problems using numbers and symbols. Devlin defined Mathematics as: "the science of numbers and shapes". For many students, mathematics is perceived as an abstract subject. Though Mathematics has some abstract attributes is not entirely abstract. As such have practical aspects. To greek philosophers, the whole life is synonymous to mathematics. The greek believes that everything can be mathematics. Thus, one can conclude that mathematics touches all aspects of human endeavours. In support of this, the Federal Republic of Nigeria in 2004 in the National Policy on Education, made mathematics a core subject which is to be offered by all students up till the tertiary levels of education. The assumed implication of this compulsory nature of mathematics being that the knowledge of the subject is imperative and essential for all members of the society. As a subject, mathematic has a special and peculiar position in the world social, political and economic discourse. To this, noted that no nation can make any meaningful progress in the information technology age, particularly in economic development without technology which has science and mathematics as its foundations.

Aiyedun (2000) pointed out that mathematics is the gate and key to science. In fact, Mathematics can be seen as the language of sciences since most science discipline cannot exist in its isolation. According to Woodrow (2003) as a 'language of science' mathematics had long assumed power and influence as the terminology of science but during the last half century it has permeated many of the social sciences including not only economics but also such social areas of debate as wealth distribution (poverty and affluence) or crime and its causes and consequences.

In economics, mathematical knowledge is important though it is not used to formulate economics policies or theories; rather it is mostly used with its assumptions to essentially describe the world of economics. According to Salman (2004). Economics relies heavily on Mathematics and Statistics which play a prominent role in the research culture of the discipline. In fact, the mathematization of economic theory is well established and has a long history (Weintraub, 2002).

According to despite the relevance of economics to everyday life especially in the area of commerce and industry, the teaching of the subject in Nigeria is characterised by many inadequacies which have affected the effectiveness of economic teachers. One of which is inadequate mathematical knowledge both on the side of teachers and students. This causes teachers to avoid teaching those areas that require mathematical proficiencies while students lose interest when such topics are raised. To Awofala (2000), majority of secondary school students often dread and show a negative attitude towards Mathematics. A concern emanating from the higher education sector for some time now has been the extent to which students are prepared for the mathematical content of their degrees, not only in Economics but in other disciplines too

There are claims that location of the school has a role to play in student's academic achievements. Akpan believes that rural schools are confronted by many problems in areas like modern library, recreational facilities, power supply, internet services and a shortage of teachers among others. It is no gainsaying that schools stocked with adequate educational facilities are usually found within urban areas and if all these facilities are effectively used in instructional delivery gives learners in

urban areas an edge in academic achievement over their rural counterpart, especially in science study areas. Poor academic achievement has also been attributed to a large extent to gender by many research works. A clear distinction is drawn between genders and sex by Nnamani and Audi who defined gender as a learned, socially and culturally constructed characteristics assigned to males and female while sex to him is an inborn physiological condition that makes one a male or female. Studies on gender revealed an inconsistency in the performance of male and female students in science subjects. Ogunkunle (2007) reported that male students were academically superior to their female counterparts in science. In contrast, Anagbogu and Ezeliora (2007) found that female students performed better than their male counterparts in science subjects. Based on these conflicting ideas, the researcher seeks to investigate the influence of mathematic achievement, gender and location on academic achievement. That is, could be that students achievements in mathematics, gender and location serve as predictors of their achievement in economics.

Literature review: Many studies on the factors that influence students achievement to claim that genders are one of the factors that influence students academic achievement, especially in the science areas. According to Okeke sex refers to those characteristics of males or females which are biologically determined and show either males or females while gender refers to the socially culturally constructed characteristics and roles which are ascribed to males and females in any society. Chansarkar and Michaeloudis (2001) in a bid to examine the degree to which gender moderates the relationship between ethnic identity and academic achievement reported that ethnic identity and racial centrality were negatively related to academic achievement for male students and positively related to academic achievement and academic self-concept for female students.

Kissau (2006) believes that gender of the student influence student academic achievement in some subject areas. Benedict and Hoag discovered that >38% of their student sample was worried about taking Economics but male students were found to be less worried than female students. In a study carried out on chemistry students, Udousoro (2000), found out that there is no significant difference in the academic achievement of male and female students in chemistry. In support of this, Viann (2004) investigated differences and the effects of cooperative learning in mathematics classroom setting and found no significant gender-related differences in mathematics achievement but female students achieved slightly higher grades than male students. Bilesanmi-Awoderu carried out a study on the concept-mapping, student's locus of control and gender as determinants of Nigerian high school student's achievement in Biology using Analysis of Covariance to analyze the data collected; she found that there was no significant main effect of gender on student's achievement in Biology. Contrary to these findings, Frempong and Ayia observed that female students are less successful in learning mathematics, due to their low interest and confidence in learning mathematics and their low academic expectation. Croxford reported that male students achieved significantly better than female students in science education while Anagbogu and Ezeliora (2007) found that female students performed better than their male counterparts in science subjects. Also, Odo in a work to ascertain the influence of mathematics knowledge on students performance in economics reported that students gender significantly affect students performance in economics and mathematics.

Mathematics skills also have been identified by some studies as a factor influencing economic achievement. Tregear and Bachan and Barrow, in their works discovered that the choice of students between economics and business studies as subjects to be offered at a level, only students with more ability in terms of their average GCSE score and with mathematics, are likely to opt for economics. Supporting this, Ballard and Johnson reported that the mathematics test scores had a strong and significant effect on performance in the economics course. Contrary to this view, Odo in a work to ascertain the influence of mathematics knowledge on student's performance in economics found that a good background in mathematics has no significant influence on the performance of students in economics.

The location is another factor among the front liners in studies trying to ascertain factors influencing student's academic achievements in different subjects. Kissau (2006) reported that location of school influences student's academic achievement in some areas. Another work supporting this claim is that of Weintraub (2002) who observed that girls and women from Northern Nigeria and rural communities are affected by this poor achievement. Owoeye (2002) and Onah (2011) in their studies indicated that schools in the urban areas achieved more than schools in the rural areas in science subjects. In a contrary opinion, Ezeudu and Theresa (2013) reported that location has no effect on student's academic achievement. Studies on the impact of gender, mathematical knowledge and school location on student's achievement are yet to produce conclusive results. It is against these contrary opinions and findings the research seeks to further investigate the existing relationship and

the extent to which mathematical achievement, gender and school location could serve as predictor of student's achievement in economics.

Purpose of the study: The specific objectives of the study include the following:

- To show the influence of mathematics achievement on economics achievement of senior secondary school students
- Show the relationship between genders and economics students achievement in senior secondary schools
- Show the relationship between location and senior secondary school students achievement in economics

Research questions: The study is guided by the following research questions:

- What is the relationship between mathematics achievement and economics achievement
- What is the relationship between student's gender and achievement in economics
- What is the relationship between the location of students and their achievement in economics

Research hypothesis: The study was guided by the following formulated hypotheses which were tested at 0.05 level of significance:

- H_{01}: there is no significant difference relationship between student's achievement in mathematics and their achievement in economics
- H_{02}: no significant relationship exists between male and female students achievement in economics
- H_{03}: there is no significant relationship achievement in economics and students location

Albert Bandura's social learning theory in 1977: Albert Bandura social learning theory is significant to this study. The theory states that behaviour is learned from the environment through the process of observational learning. This is in line with constructivist theories of learning but in opposition to behaviourist theories. Bandura believes that humans are active information processors and think about the relationship between their behaviour and its consequences.

Children observe the people around them behaving in various ways and these Individuals that are observed are called models. It further asserts that children living within a society are influenced by many models, such as parents within the family, characters on children's TV, friends within their peer group and teachers at school. These models provide examples of behaviour to observe and imitate, e.g., masculine and feminine, pro and anti-social, etc. Thus, Albert Bandura's social learning theory, therefore, predicts that family, peers, teachers and media images of men and women affect children in their learning and performance of gender-appropriate behaviours. He further asserts that whatever the child initiated from the society is either reinforced or punished. While behaviours responded to by punishment are likely not to be repeated, behaviours rewarded are likely to be repeated. Bandura proposed that four main cognitive processes are required for social learning theory and these are Attention, Retention, Reproduction, Motivation (ARRM).

The theory asserts that the society to a large extent influences learner's perceptions of themselves as regards to gender ascribed roles and proficiency. That is to say, the location of students as defined by their environment determines what the learner observes and accepts as the befitting socially ascribed characteristics and ability within a gender. Since, the child learns through observing models within a given environment, a number of processes make it more likely that a child will reproduce the behaviour that its society deems appropriate for its sex. These processes include, imitation of people of same sex, behaviours imitated are responded to by punishment or reinforcement and the child will also take into account of what happens to other people when deciding whether or not to copy someone's actions. For instance, For instance, a boy learning to play football seeing his father as his role model; using Bandura's ARRM theory in relation to gender development. The boy will identify with his father as they are both male, he will observe his father kicking the football; the boy pays attention to the foot contacting the ball (attention). The boy will then record the information (retention). The boy will then imitate the behaviour by attempting to kick the football (reproduction). The boy will receive the praise of his dad for attempting and so will kick the football again (motivation).

Another implication of this theory to learning is that subjects leading to courses considered and treated as masculine course tend to attract less interest and motivation by female verse and studies have shown that interest and motivation directly affect student's academic achievement not only in economics but in all subjects. Thus, teachers and schools authority should ensure that they provide a learning environment where a particular sex

is not appreciated or esteem beyond another through the assignment of roles, responsibility and subjects to offer as these can affect student's achievement.

MATERIALS AND METHODS

The study adopted survey research design of the ex-post facto type. According to Kerlinger and Lee (2000) in these types of research, researchers have no direct control over independent variables as their manifestations have already occurred. There was neither treatment nor manipulation of subjects rather; it involved the collection of data from existing records. The population for this study was made up of public senior secondary schools in Udenue local government of Enugu State. The sample consisted of 5404 students that sat for West African School Certificate Examinations (WASCE) from 2008-2013 randomly selected from five public senior secondary schools in the area.

Data collected was further analysed to ascertain and test the hypothesis with respect to knowing the relationship among variables been considered. Data from the study was analysed using ordered probit regression. This is because data gathered is categorical in nature and contains polytomous variables.

RESULTS AND DISCUSSION

Relationship between mathematics achievement and economics achievement:

- H_{01}: there is no significant difference relationship between student's achievement in mathematics and their achievement in economics

Table 1 economics achievement was positively related to mathematics achievement ($p<0.05$). In other words, the higher the mathematical grade, the more likely the student would achieve high in economics. The implication of the result is that among mathematics students, those who have higher grades in mathematics versus those that have lower grades in mathematics increases the log odds by 0.0336. However, we can easily transform this into odds ratios by exponentiating the coefficients.

EXP (0.0336) = 1.03. This shows that students with higher mathematical are 1.03 times more likely to achieve higher Economics grade than those with the low mathematical grade.

Relationship between gender and mathematical achievement:

- H_{02}: no significant relationship exists between male and female students achievement in economics

Economics achievement was negatively related to gender ($p<0.05$). In boys were less likely to achieve a higher grade in economics than girls because boys were coded to be 1 and girls 0. In fact, the odds of a boy achieving less were 0.2438. We can easily transform this into odds ratios by exponentiating the coefficients: Exp (0.2438) = 1.28. This shows that male students are 1.28 times less likely to achieve higher Economics grade than female students.

Relationship between location and economics achievement:

- H_{03}: there is no significant relationship achievement in economics and students location

Economics achievement was negatively related to location ($p<0.05$). Rural students were less likely to achieve ahigher grade in economics than urban students because rural students were coded to be 1 and urban students 0. In fact, the odds of rural students achieving less were 0.0930.

Furthermore we can transform this into odds ratios by exponentiating the coefficients: EXP (0.0930) = 1.10. This shows that rural students are 1.10 times less likely to achieve higher economics grade than urban students.

Discussion of findings: The result of this study revealed that a positive relationship exists between mathematics achievement and economics achievements. That is to say, high knowledge of mathematics increases the probability of a student achieving ahigher grade in economics. This finding corroborates the findings of Ballard and Johnson who reported that the mathematics test scores had a strong and significant effect on performance in the economics course. Furthermore, Dawson asserted that economics relies heavily on Mathematics and Statistics

Table 1: Ordered probit regression of economics achievement with maths grade, gender and location as predictor variables

Economic grade	Coef.	SE	Z-values	p>|z|	95% Conf.	Interval
Mathsgrade	0.0336392	0.0018443	18.24	0.000	0.0300244	0.0372541
Gender	-0.2437765	0.0288411	-8.45	0.000	-0.3003041	-0.1872490
Location	-0.0930275	0.0316205	-2.94	0.003	-0.1550024	-0.0310525

Ordered probit regression; number of obs = 5408; LR χ^2 (3) = 502.35; Prob>χ^2 = 0.0000; Log likelihood = -8105.4696; PSEUDO R^2 = 0.0301

which play a prominent role in the research culture of the discipline. Contrary to these views, Odo in a work to ascertain the influence of mathematics knowledge on student's performance in economics found that a good background in mathematics has no significant influence on the performance of students in economics.

The study further revealed that a negative but significant relationship exists between gender and achievement in economics. Further probe into such finding revealed that male students were discovered to have less probability of achieving high in economics compared to their female counterpart. This finding is in tandem with the findings Kissau (2006) who believes that gender of the student influence student academic achievement in some subject areas. Kevin and Paul in a work on gender and achievement also reported that ethnic identity and racial centrality were negatively related to academic achievement for m ale students and positively related to academic achievement and academic self-concept for female students. Contrary to these findings, Frempong (2010) observed that female students are less successful in learning mathematics, due to their low interest and confidence in learning mathematics and their low academic expectation. Onuka and Durowoju also revealed that gender had no significant effect on student's achievement in economics.

The study further revealed a negatively significant relationship existing between student's achievement in economics and location. That is to say, the location of students has a likelihood of affecting their academic achievement in economics. This is supported by Weintraub (2006) who reported that location of school influences student's academic achievement in some areas. A further probe into the result revealed that students in rural areas were discovered to have less probability of achieving high in economics compared to students in urban areas. This finding corroborates the findings of Kissau (2006) who observed that girls and women from Northern Nigeria and rural communities are affected by this poor achievement. In a contrary view, Ezeudu and Theresa (2013), reported that location has no effect on student's academic achievement.

CONCLUSION

The findings of this study revealed that a good knowledge of mathematics denoted by mathematics grade significantly affects student's achievement in economics in West African Senior Certificate Examination (WAEC) in Enugu state for 2008-2012 examination sessions. This may be because economics as a subject is highly analytical and as such requires critical thinking skills which mathematics can afford. It furthers shows that male students are more likely to achieve less in economics compared to their female counterparts. It further showed that location significantly affects students performance in economics as students in the rural areas where found to be less likely to perform high economics when compared to their counterparts in urban areas. This may be because students in urban areas are better exposed to modern and innovative teaching materials which are indispensable for proper understanding and application of economics concepts.

RECOMMENDATIONS

Since, some mathematical concepts have been integrated into economics, economics teachers should also be highly exposed to mathematics especially during their training periods so as to equip them the necessary skills needed to handle the mathematical aspects of economics. Economics teachers should also make use of mathematic teachers as instructional resources personals or for team teaching as this will help stimulate interest and make learning very interactive.

Government and other stakeholders in education should endeavour to bridge the gap between urban and rural students in terms of provision and access to some of the innovative teaching materials and infrastructures needed for effective learning situation.

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