

PRIOR-MATHEMATICS KNOWLEDGE AS A PREDICTOR OF STUDENTS' ACADEMIC PERFORMANCE IN INTEGRATED SCIENCE COURSES IN UNIVERSITY OF ABUJA

*Sumbabi Umoru Tawari and Orji Nwokedirioha Onyemaechi

Department of Science and Environmental Education, University of Abuja, Nigeria

Department of Science and Environmental Education, University of Abuja, Nigeria

Corresponding author: Sutumoru@yahoo.com, +2348037399546

ABSTRACT

This study investigated prior mathematics knowledge, as a predictor of students' academic performance in Integrated Science Courses as measured by School certificate worth in the University of Abuja. The data for the research was drawn from the results of the seventy Integrated Science Students admitted into University of Abuja, Nigeria, between 2006 and 2010. The data consisted of Senior Secondary Certificate Examination (SSCE) Mathematics results and results for the students in four selected Integrated Science Courses offered by them, which are: Mathematics Methods for Integrated Science, General Physics for Integrated Science, General Chemistry for Integrated Science and General Biology for Integrated Science. Correlational survey design was adopted for the study. The findings indicated that students' performance in the selected Integrated Science Courses taken was clearly dependent on their prior mathematics knowledge. Implications of the findings were highlighted and recommendations made in the light of the findings.

KEYWORDS: Predictor, prior-knowledge, Mathematics, Integrated Science.

INTRODUCTION

Integrated science as a subject taught in Nigerian Secondary schools took effect in the 1980s after the September 1970 conference organized by the Federal Ministry of Education on Curriculum.

The reasons for its introduction was to bring about a mode of teaching science that reflects child-centered activities rather than the factual contents which the books in use then presented. It also aimed at correcting the modes of behavior of the students both in their approach to problems in their science studies at school and in the outside world which was unsatisfactory. The conference therefore, emphasized the following:

- (i) The use of discovery teaching tactics
- (ii) The inclusion of problem - solving activities
- (iii) The involvement of students in open field or laboratory exercise.

The Science Teachers Association of Nigeria (STAN) Integrated Science projects in book series, have been in use for over a decade in our secondary schools. Specifically STAN authored Junior Secondary School Integrated Science texts together with the Teacher's guide. From these series of books it has been observed that though science subjects have high interdisciplinary affiliation with Mathematics, the contents and methodology of these books has neglected the roles or importance of mathematics as a scientific tool which is used to interpret scientific phenomena Ezenweani (1998). Mathematics is a unifying discipline and students' interest in Science and Social Science subjects cannot be separated from mathematics. Raghubir (2000) opined that mathematics is a unifying science with its branches interrelated, so that the contribution of each branch is utilized to the best advantage. Ezenweani (1998) pointed out that in solving any problem of Economy the

Mathematician uses the abstract ideas to theories about the problems in the society. He does this by gathering data and seeking means of stating the nature of relationship among the variables that he thinks constitute the problem. Hence mathematics should be seen as central in the teaching of sciences at all levels of education.

Nasir (2001) sees Mathematics as a precision and indispensable tool used by Engineers and Scientists in their search for a clear understanding of the physical world and as well used by many professionals. He stressed further that Mathematics is mostly considered a tool in that it contains the skills for problem solving, organizing, simplifying, interpreting data and performing calculations that are necessary in the fields of Science, Business and Industry.

Mathematics is compulsory for all students in Nigerian Secondary schools. Its importance hinges on the fact that a credit in Mathematics is a basic requirement for candidates seeking admission into various Departments in Universities and other Institutions of higher learning, particularly in the social sciences, sciences and technology related courses.

Therefore, in the University used for the study, at least a credit pass at the senior school certificate level is a pre-requisite for admission to study a bachelor degree in Integrated Science and other Science and Technology related courses.

There has been a strong argument over the years, on the relationship between Mathematics and Integrated Science. There is the assumption that candidates who perform well in Mathematics would surely do well in Integrated Science. This claim is based on the fact that the manipulation of figures has its practical application in the field of Integrated Science.

Some Integrated Science courses are mathematically oriented. For example, the teaching of mathematical methods for Integrated Science, general Physics for Integrated Science, general Chemistry for Integrated Science, etc. are facilitated and made easier by the understanding of Mathematics.

Raghubir (2000) is of the opinion that Mathematics, apart from being an intellectually stimulating discipline, is a corner stone in nearly every field in Education.

Kalejaiye (1997) conducted a study on the mathematical knowledge and skills required by Nigerian Secondary School Teachers to learn school sciences when he

found that the biggest and the most important group of mathematical ideas required in science in Nigerian schools are ratios, rates, proportion, straight line graphs, linear equation and change of subject of formula. He concluded that certain mathematical skills were fundamental to performing the four basic operations on real numbers and in using the four figure table to find squares and square roots, reciprocals and logarithms, and that prior mathematical ability has a primary influence on performance in physics courses.

A correlational study on the performance of National Diploma (ND) students who entered the programme through the school of preliminary studies, found that performance in mathematics indicated good performances in the ND programme (Sirajo and Bello, 2004). In a related study, Ojerinde (1984) also reported that performance in Arithmetic in the Teacher's grade II certificate examination sufficiently predicted success in accounting in the NCE.

In another study Erinta (1994) examined the relevance of prior knowledge of Mathematics to performance in geography and he reported that performance in some geography courses was dependent on previous knowledge of Mathematics. The study, however, found out that for some Geography courses, prior knowledge of mathematics did not play significant role in learners' performance. Meltzer (2002) found no significant correlation between students' normalized learning gains and performance in Physics. However, he reported a significant correlation between normalized learning gains and students' pre-instruction Mathematics skill. In a study investigating Nigerian undergraduate students in American Universities, it was found that students' West African School Certificate (WASC) results grades obtained in English and Mathematics could not sufficiently predict students' academic performance and that

Students' first semester grade point Average (GPA) and educational background were however, found to be good predictors of academic achievement (Ohuche, 2000).

Statement of the Problem

My years of experience at the University of Abuja made it clear that some students of Integrated Science Programme, could not do well in some of their courses while few of them do. Some of the reasons attributed to their various performances could be as a result of their background in Mathematics. In the light of various studies earlier conducted on the relevance of Mathematics as compared to other field, it is considered appropriate to examine the extent to which the situation is true with respect to Integrated Science. No previous study was conducted to examine the relationship between prior knowledge in Mathematics as measured by school certificate worth and students' academic performance in Integrated Science courses in University of Abuja. This is an attempt to study the Prior-Mathematics Knowledge as a factor that determines the performance of students in Integrated Science related courses in the University of Abuja.

Research Hypothesis

The following Hypothesis was stated and tested at 0.05 level of significance. H_{01} : There is no significant relationship between Prior-Mathematics knowledge as a predictor of students' academic performance in integrated science courses in University of Abuja.

Research Method

The study was a correlational survey research involving the correlation of performance of students in Mathematics in Senior Secondary Certificate Examination (SSCE) with performance in some selected courses of undergraduate Integrated Science programme. Data was collected from the SSCE and the end of semester results of students admitted to study integrated science education in University of Abuja, Nigeria. These were for 70 students admitted between 2006 and 2010 (13 in 2007, 22 in 2008, 16 in 2009 and 19 in 2010). It should be noted that all the students admitted into the University to study Integrated Science during the period under investigation formed the sample. In line with the admission requirements into Integrated Science programme, each of the students had at least a credit pass in Mathematics. In other words, none of them failed mathematics at SSCE. For the purpose of this study, different letter grades were used to denote different levels of achievement in SSCE (Table 1) and University examinations (Table 2).

Table 1 Performance and corresponding letter grades as used in SSCE

Performance	Letter Grades
Distinction (A1 - A3)	A
Credit (C4 - C6)	B
Pass (D7 -D8)	C
Fail (F9)	F

Table 2 Performance and corresponding letter grades as used in the University under study.

Performance	Letter Grades
70 and above	A
60-69	B
50-59	C
45-49	D
40-44	E

With the classifications adopted in tables 1 and 2 students in this study were those who passed mathematics with grades A, B, C at the SSCE and those who passed with grades A,B,C,D, or F in the case of performance in selected Integrated Science courses in the University. The selected Integrated Science courses taken were Mathematics methods for Integrated Science, General Physics for Integrated Science, General Chemistry for Integrated Science and General Biology for Integrated Science. Pearson correlation was computed to determine the level of relationship between prior mathematics knowledge at SSCE and each of the selected Integrated Science courses taken at the undergraduate level. In addition, linear regression was also computed. The letter grades A to E were weighted 5 to 1 which is a convention in the University.

RESULTS AND DISCUSSION

Analysis revealed statistically that there is significant correlation ($r=.724$) between

mathematics performance at the SSCE and performance at the University Integrated Science courses that were selected for the study. Also, linear regression analysis computed corroborated this. The value of the adjusted R square ($R^2 = .75$) implies that prior mathematics knowledge as a statistically significant predictor ($F(1,68) = 526.24$ $p<.05$), accounted for 75% of the variance in performance at the university integrated science courses selected for the study.

Further analysis was done to examine the nature of correlation between Mathematics performance at SSCE and each of the four courses selected for the study as being offered at the under graduate level. It is observed (Table 3) that performance in all but one course (General Biology in Integrated Science) was statistically positively correlated with performance in the SSCE Mathematics. This indicates that the quality of passing very well in the selected Integrated Science courses relates very well to adequate prior mathematics knowledge.

Table 3 is the Analysis of correlation between mathematics performance at SSCE and each of the four courses selected in undergraduate programme.

S/N	Courses	r
1	Mathematics Method for Int Sc.	.753*
2	General Physic for Int. Sc.	.768*
3	General Chemistry for Int Sc.	.802*
4.	General Biology for Int. Sc.	.062

*Correlation is significant at the 0.05 level of confidence (2-tailed)

The hypothesis earlier stated is therefore rejected. This result suggests that Integrated Science courses being offered at the undergraduate level possess elements of interdisciplinary affiliation with mathematics. A critical look at the courses content of each of these courses corroborates this observation.

CONCLUSION

The findings of this study clearly showed that performance in the Integrated Science courses selected for the study was identified to be dependent on the learner having some degree of previous Mathematics knowledge. This result coincides with that of Ihejieto and Emenalo (1994) on the correlation between performance in mathematics and performance in the NCE Science courses. It also agreed with the findings of Erinta (1994) which reported that performance in some Geography courses was dependent on

previous knowledge of Mathematics. Furthermore, results of this study tend to justify the current practice of insisting on mathematics requirement at the school certificate level as a pre-requisite for admission into science and social science based courses in Tertiary institutions in Nigeria.

A critical look at the undergraduate Integrated Science curriculum shows that about 70% of the courses reflect varying degrees of interdisciplinary affiliation with mathematics. To this effect, more courses in Mathematic especially aspects related to the subject should be added to complement those already in the curriculum. Lecturers should also present their lectures in such a way that the connections of mathematical concept with Integrated Science concepts would be appreciated. It is hoped that further studies would be conducted to enhance the generalization of this study.

REFERENCES

- Erinta, B. O. (1994) The relationship between Prior Mathematics knowledge and Students' academic performance in Geography: *Journal to Teach Education*, 3 (182) 62-72.
- EzenWeani, U.Z. (1998). The relevance of Mathematics in a broad field curriculum for Integrated Science in Secondary Schools: *Journal of Research in Curriculum Studies*, 1(1), 29-30
- Ihejieto, D.O. & Emenalo S.I. (1994) correlation trends in performance of Mathematics students - matching the special science programme on the Nigerian certificate of Education: *International Journal of Mathematical Education in Science and Technology*, 25(2), 203-209.
- Kalejaiye, A. O. (1997). Mathematical knowledge and skills required by Nigerian Secondary School students in learning school science. *Journal of Science Teachers Association of Nigeria* 18 (1) 68-75.
- Meltzer, D. E (2002). The relationship between Mathematics preparation and conceptual learning gains in physics. A possible "hidden variable" in diagnostic protest scores. *American Journal of physics Teachers*.70(12), 1259-1268.
- Nasir, M.O. (2001) Mathematics: A fundamental tool of science and engineering. *Jigawa Journal of Education*, 2(2) 3, 137 - 144.
- Ohuche, R.O. (2000). Academic Achievement of Nigerian undergraduates as a function of previous educational experiences. *West African Journal of Education* 18, 11-15.
- Ojerinde, S.A. (1984). Entry qualification of business education students as a predictor of success in the N.C.E. course. *Unpublished M.Ed. Thesis. University of Ibadan*.
- Raghubir I.A. (2000) Areas of difficulties in Primary Mathematics curriculum as perceived by in service Mathematic Teachers. *Journal of science Teachers Association of Nigeria*, 27 (2), 66-70.
- Sirajo, A & Bello, Y. (2004). An Assessment of academic performance of Pre-ND Students: A case study of the Federal Polytechnic, Bida, Niger State. A paper presented at the 1st SAAS National Conference held at Federal Polytechnic, Bida from 25th - 29th October 2004. Unpublished.