CLASS SIZE AS A PREDICTOR OF STUDENTS' POOR PERFORMANCE IN MATHEMATICS: IMPLICATIONS FOR REPOSITIONING MATHEMATICS EDUCATION

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Abstract

The perennial poor performance of students in mathematics courses has attracted the concern of eminent scholars and researchers. This paper examines the statistical significance of class size as a predictor of number of students who failed a mathematics course. Data were extracted from Academic Board approved results of three sessions in Federal Polytechnic, Bida. Simple Correlation and Regression analyses were applied to the data to test the research hypotheses. Results at 5% level of significance showed a statistically significant correlation between class size and number of students who failed a mathematics course at the National Diploma level. Results of Regression analysis showed that except in 2003V2004, class size was not a reliable predictor of poor performance in mathematics. The paper suggested that current efforts to reposition mathematics education in Nigeria should consider an appropriate class size for any mathematics course in all tertiary institutions particularly the polytechnics.

Introduction

Mathematics is widely recognized as the " queen of science ". This is based on the impeccable fact that mathematics forms the basic ingredients to understanding the structure, development, and methods of science and technology. As noted in Azuka (2003 : 18) " No nation can develop without technology, and mathematics is the bedrock of sciences, which bring about technology ". In the light of this, the curriculum of virtually all higher institution's programmes in Nigeria includes mathematics. In the polytechnics, mathematics courses are specified for all programmes in the schools of Engineering Technology, Environmental Studies, Business and Management and Applied Arts and Sciences.

As observed in Ibraheem and Ogunnusi (2001), mathematics have to be taught to an ever increasing generation of engineers, chemists, physicists, biologists, medical scientists, economists, and many other highly trained professionals whose services are crucial to the development and expansion of the national economy. However, the poor performance of students in mathematics at all tiers of the educational system has attracted the concern of eminent scholars and researchers. Ale (1989) in an exposition on the effect of mathematics education on science and education, argued that 67% of causes of failure in mathematics could be attributed to teaching problem, 12% to negative attitude, and 21% to examination difficulties. This submission is not significantly different from the conclusion of Falode and Fagbaidc (1999) that the major causes of poor performance in mathematics include lack of qualified mathematics teachers, lack of teaching aids, and lack of incentives to the available qualified mathematics teachers.

Ihemelandu (2003) identified different correlates of poor performance in mathematics at the tertiary level. He posited that poor performance results mainly from students' poor background in mathematics, insufficient contact hours, class size (population), size of classroom, and students' attitude to personal study. Some of these correlates were also highlighted in Awodeyi (2003). Worried by the perennial poor performance of students in mathematics, Idahosa (2004:123) stressed that " the traditional place of mathematics in education seems to be in danger ". The need to reposition mathematics education in Nigeria is therefore imperative.

Against this background, it is necessary to conduct a correlational study to examine the statistical significance of the identified causes of poor performance in mathematics. The specific cause examined in this study is class sizes that is students' population in a class offering a mathematics course. The Federal Polytechnic, Bida, was selected for the study. The study objective is to find out the extent to which class size is related to poor performance in mathematics, in order to know how best to reposition mathematics education.

In the course of this investigation, attempts were made to satisfactorily answer the following research

questions:

Is class size correlated with students' poor performance in mathematics?

Is class size a reliable predictor of number of students who failed a mathematics course?

The research questions were modified and expressed as statistical hypotheses in the following form:

* There is no significant correlation between class size and number of students who failed mathematics, i.e, H_0: p = 0 against HI: p * 0

* There is no linear relationship between class size and number of students who failed mathematics, i. e. H_0; p = o against H, : p ^ o

Methodology

Data

The data used in this study were extracted from the Polytechnic Academic Board approved results for three academic sessions namely 2001/2002, 2002/2003, and 2003/2004. The data contained the percentage mark range and students in ten mathematics grades courses offered during the sessions. These courses and the number of students offering the courses are tabulated in Table 1:

Table 1: Population of Students in Mathematic Courses by Session.

S/No	Course Code	Course Title	2001/2002	2002/2003	2003/2004
1	MTH311	Advanced Algebra	225	227	385
2	MTH321	Numerical Methods	234	186	240
3	MTH313	Statistical Methods for Engineering	222	228	234
4	MTH312	Advanced Calculus	204	279	362
5	MTH211	Calculus	636-	644	785
6	MTH 111	Logic and Linear Algebra	599	679	783
1	MTH112	Algebra and Elementary Trig.	779	795	791
8	MTH 122	Trig, and Analytical Geometry	374	413	469
9	MTH 131	Business Mathematics f	645	1161	1998
10	MTH 132	Business Mathematics II	521	956	1392

For ease of analysis, the data were re-classified into two groups, that is number of students who passed and number of students who failed in each mathematics course for each session.

Variables'

The explanatory variable in this study is "class size". The number of students in a class is a key factor that facilitates teaching and learning. With a competent tutor, it is easier to teach efficiently, maintain discipline and effectively monitor performance in a class. With astronomical growth in enrolments into the polytechnics, average class size has increased without corresponding expansion in existing facilities. This may hinder effective teaching and learning, thereby negatively affecting the performance.

The dependent variable used in this study is "number of students who failed". The variable was regressed on class size to determine if class size is a reliable predictor of poor performance in mathematics.

Statistical Analysis

Simple correlation and regression techniques were applied to the data. The Karl Pearson product moment correlation coefficient {r) was computed for each session to determine the strength of linear relationship between the research variables. The correlation coefficients were tested for significance. A regression model ($Y_r = p_0 + p,+ e$) was constructed to test the hypothesis of the relationship between the variables. The unknown regression parameters (P_0 and pj) were estimated and sample regression line fitted

using the method of least squares. The t- statistic described in Hanke and Reitsch (1991) was used to test the hypotheses about the linearity of the relationship between the variables and to corroborate the coefficient of simple determination (r^2) often used to determine the goodness -of- fit of the regression model. For the purpose of comparison, analysis was performed separately for ND and HND students. All hypotheses were at the 5% level of significance.

Results

Results of simple correlation analysis shown in Table 2 shows that in the three sessions studied, class size and number of students who failed mathematics are positively correlated at both ND and HND levels, though, the correlation coefficient was stronger at the ND level i. e. .885 vs .835 in 2001/2002, .864 vs .785 in 2002/2003 and .938 vs .673 in 2003/2004. Results of the test of hypotheses for the significance of the correlation coefficients show that at HND level, there was no significant correlation between class size and number of students who failed mathematics. At the ND level, result shows there was significant correlation between class size and number of students who failed mathematics. Table 2: Summary of analysis of hypothesis \

Session	Correlation Coefficient (r)	Critical value to/2, df	Degree of_ freedom	Computed Value t_c	Decision	Conclusion
HND						
2001/2002	.835	4.303	2	2.145	Accept Ho	There is Correlation but not Statistically Significant.
2002/2003	.785	4.303	2	1.792	Accept Ho	There is Correlation but not Statistically Significant
2003/2004	.673	4.303	2	1.287	Accept Ho	There is Correlation but not Statistically Significant
ND						
2002/2003	.885	2.776	4	3.801	Reject Ho	There is Correlation, Statistically Significant.
2002/2003	.864	2.776	4	3.432	Reject Ho	There is Correlation, Statistically Significant
2003/2004	.938	2.776	4	5.412	Reject Ho	There is Correlation, Statistically Significant

The hypotheses concerning the linearity of the research variables were tested by examining the significance of the slopes of the regression equations. Results as shown in Table 3, shows that at both ND and HND levels, there was no significant linear relationship between class size and number of students who failed mathematics in 2001/2002 and 2002/2003. This is an indication that in the two sessions, class size does not contribute sufficient information for the prediction of number of students who failed mathematics. However, results show that in 2003/2004, there was a significant linear relationship between the variables.

Table 3: Summary of Analysis of Hypothesis 2

Session	%R-Sq	Intereept 3o.	Slope P.	Critical Value	Computed Value	Degree of Freedom	Decision	Conclusion
HND								
2001/02	69.7	1.30	.126	4.303 .,	.294	2	Accept Ho	There is no Significant Linear relationship
2002/03	61.7	2.73	.931	4.303	323	2	Accept No	There is no Significant Linear relationship
2003/04	45.3	-12.3	.150	4.303	1.287	2	Accept Ho	There is no Significant linear relationship
ND								
2001/02	78.4	-13.9	.330	2.776	1.453	4	Accept Ho	There is no significant linear relationship
2002/03	74.7	-52.9	..327	2.776	2.521	4	Accept Ho	There is no significant linear relationship
2003/04	87.9	13.4	.224	2.776	4.865	4	Reject Ho	There is no linear relationship

The coefficient of determination (r) was computed to determine the goodness- of - fit of the regression equations. Results shows that in the three sessions studied, the coefficients of determination was stronger at the ND than HND level i.e. 78.4% Vs 69.7% in 2001\2002, 74.7% Vs 61.7% in 2002\2003, and 87.9% Vs 45.3% in 2003\2004.

Discussion

Class sizes have some influence on students[1] poor performance in mathematics courses. The extent of the influence is however not the same at the ND and HND levels. At the ND level the strong positive correlation found between class size and number of students who failed a mathematics course, coupled with the statistical significance of the correlation coefficients implies that class size contributes to the number of students in mathematics. At the HND level, the correlation coefficient was who failed a mathematics course. In many institutions of higher learning, the numbers of the students offering at least one course in mathematics have increase tremendously over the years, while the facilities available for teaching and learning mathematics either remain the same or become

obsolete. It is not uncommon to see students overcrowding a lecture hall or outwitting one another in order to get a seat during a mathematics lecture. This type of occurrence can dampen the morale of an average student, and thereby results in- poor or low achievement not statistically significant. This implies that class size offers no suitable explanation for number of students who failed a mathematics course. The result is consistent with the lower students' enrolments at the HMD level. Results of the significance of the regression coefficient (p,) at both ND and HND levels in 2001/2002, and 2002/2003 revealed no significant linear relationship between class size and number of students who failed a mathematics course. This -is sufficient to infer that class size offers only a little help to explain the variation in number who failed mathematics in the two sessions.

However, in 2003/2004, the coefficient of determination (r^2) for ND was stronger than the values in the two previous sessions, and the regression coefficient (pi) was statistically significant, indicating the existence of a linear relationship which implies that for the session class size contributes sufficient information for the explanation and prediction of number of students who failed a mathematics course.

To this effect, curtailing class size for mathematics courses is one of the practical steps to be taken in order to create more condusive environment for learning the subject. As observed, by backhouse Haggarty, Pirie, and Stratton (1999), to create a conducive environment for learning mathematics, the focus of planning should include the physical environment such as the seat arrangements, and arrangement of instructional materials as these factors directly relates to the class size.

Recommendations and Conclusion

This study has highlighted several causes of students' poor performance in mathematics courses. One of the identified causes of poor performance (class size) was examined for statistical significance. Analysis revealed that at the ND level, class size was strongly correlated with number of students who failed a mathematics course in the three sessions studied. However, the regression analysis carried out shows that except in 2003/2004, class size has not proved to be a reliable predictor of number of students who failed a mathematics course. If the situation of large class size that prevailed in 2003/2004 remains unchanged, class size is likely to become a key factor students' performance in mathematics.

In order to reposition mathematics education in Nigerian, the following recommendations are made

1. A joint consultative forum of mathematicians and schools administrators should be organized consider an appropriate class size for any mathematics course in tertiary institution. The Mathematical Association of Nigerian can organize such forum
2. A nationwide qualitative research should be sponsored either by the Federal Ministry Science and Technology or by the National Mathematical Center to investigate in detail cause of poor achievement in mathematics courses.

Unless the cause(s) are identified and addressed, the traditional place of mathematics in our march towards technological development may be compromised.

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