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QUADRATIC POLYNOMIAL TRANSFORMATION MODEL AS A MEANS OF CORRECTING TEACHERS BIAS IN ASSESSMENT PROCESS

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ABSTRACT: *This study investigated quadratic polynomial transformation model as a means of correcting teachers' bias in assessment process. This was an ex-post-facto research design in which there was no treatment and manipulation of subjects instead it involved the collection of data from records. Cluster sampling technique was adopted to select six hundred (600) students that were made up of ten schools. The five questions raised were answered using coefficient of kurtosis, quadratic polynomial transformation model of statistical moderation, Pearson product moment correlation and one-way analysis of variance (ANOVA) statistical techniques. The results revealed the existence of bias in teachers' assessment scores in English Language, Integrated Science and Mathematics and that, quadratic polynomial transformation model corrected these scores in the three selected subjects to a moderate level. At the same time, there were significant relationships among the corrected or moderated teachers' scores in Integrated Science, English Language and Mathematics before and after the applicability of the quadratic polynomial transformation model. The findings justified the need for corrections of teachers' assessment scores in order to ascertain the quality control of teachers' assessment in Ekiti State junior secondary schools. The study recommends quadratic polynomial model as a means of correcting teachers' assessment scores at junior secondary schools in Ekiti State and by extension in Nigerian Junior Secondary Schools and in other countries where teachers are involved in the assessment of students in order to award certificates.*

KEYWORDS: Quadratic Polynomial Transformation, Severity, Leniency and Teacher Assessment Scores.

INTRODUCTION

Teachers' bias in the assessment process is the errors committed during the course of awarding scores to the students which might be an error of central tendency, leniency and severity errors (Abe, 1995, 2002,2006,2007,2010 & 2011, McCann, 1995, Onocha & Okpala, 1995, Bandele 1989 & 1997 and Alonge & Abe, 2007). Anastasi, (1982) and Abe (2010) argued that error of central tendency connote the tendency on the part of the teachers to bunch scores in the middle of a continuum while avoiding the extremes. Leniency error refer to conscious effort of a teacher to bunch scores in high level that is above the actual score expected of the students, such teacher committed leniency or generosity error, while severity error as opposed to leniency is the tendency of the teacher to assess the students on the low or undesirable scores which negates the purpose of moderation of school-based assessment scores to determine the final grades of the students at both Junior or Senior Secondary Schools. These errors in the assessment and evaluation process were foreseen by the committee members' that wrote the National Policy of Education in 1981&1987 But the moderation model suggested was considered by Abe (1995 and 2006) as zero moderation

models because of the arbitrary mean of 50 and standard deviation of 10, while McCann (1995) called it as conversion of raw scores to statistical unit for polynomial transformation model which was termed as standard model for moderation of school-based assessment scores.

Quadratic Polynomial Model as Means of Correcting Teachers Bias in Assessment Process

McCann (1995) and Abe (2006, 2010 &2013) described Quadratic polynomial model as Y_{ij} = aj X^2_{ij} + bj X_{ij}+Cj, where Y_{ij}= ajX$_{ij}$+bjX$_{ij}$+Cj, where Yij or y is the moderated internal score for student I in moderation group jiX$_{ij}$ or X is the standardized school assessed internal score of student I in moderation group j, then the three constants of this Quadratic polynomial are calculated thus:

$$A = \frac{d_2H - d_jL + d_3M}{D_3(S_2 + d_id_2)}$$

$B = L - M + a(S_2 - d_2d_4)$

$C = L - l(al + b)$

Where $d1 = h - m$

$D_2 = l - m$

$D_3 = h - l$

$D_4 = l + m$

H= the maximum standardized school – assesses internal moderation group under consideration

M=the mean of standardized continuous assessment scores for students, in moderation group j.

E or E_i = the minimum external score for the moderation group under consideration (ordered from the minimum as E_i, E_2)

H= the maximum external score for the moderation group under consideration

E= the minimum standardized school-assessed internal score for the moderation group under consideration (ordered from the minimum as Xi, X2, X3…)

L= the minimum external score for the moderation group under consideration (ordered from the minimum as E1, E2…)

M= the mean of external score for the moderation

S2= variance of the external score (JSCE)

According to Abe & Alonge (2010), Abe (2006&2013) & McCann (1995) constants a, b and c is derived mathematically from the imposition of three conditions:

-maximum moderated assessment in the moderated group is equal to the maximum external score H in the group

-the mean of the moderated assessments in the moderated group is equal to the mean of the external group M in the group and

-if possible, the minimum moderated assessment external score L in the group.

McCann, (1995), Abe, (2006) and Abe & Longe, (2010) argued that the final moderated scores will be reported by this formula $t_{moderated} = (y+\tilde{o}_t) + \mu_t$ where tmoderated is the weighted total of individual continuous assessment μ_t=the means of all school internal scores

$\tilde{o}_t$= the standard deviation of all school based internal scores. Thus Quadratic polynomial model strictly emphasis on the distributive nature of the assessment scores as means of determining the existence of teachers bias which stands as bench mark for the need for moderation of school based assessment scores at junior secondary schools level. In view of this, the researcher intends to investigate the existence of teachers' bias and how quadratic polynomial transformation model will be used to minimize the biasness.

Statement of the Problem

The problem of investigation in the study is related to how quadratic polynomial model of statistical moderation will be used to correct the teachers' bias in the assessment and evaluation process in schools due to arbitrary or spurious award of marks by the teachers in the junior secondary schools.

Research Questions

In addressing this problem, the following five research questions were to guide the study:

1. What are the prevalent errors committed in teachers assessment process in Mathematics, English Language and Integrated Science?
2. What are the natures of teachers' assessment score in the three selected subjects to justify the need for moderation through Quadratic polynomial transformation model?
3. Is there any significant difference in the teachers' bias in assessment process in Mathematics, English Language and Integrated Science?
4. Is there any relationship between the teachers' assessment scores before the applicability of the Quadratic polynomial transformation model?
5. Is there any relationship between teachers' assessment scores after the applicability of Quadratic polynomial transformation model?

METHODS

This study was ex-post-facto research design in which there was no treatment and manipulation of subjects instead it involved the collection of data from schools. This type of design was formulated by Champion, (1955) and expanded by Campbell and Stanly (1966) as attempt to solve the problem of randomization and control of variables in educational research. Since there was no treatment, nothing is being manipulated but the variables of interest were merely observed as found and used for the purpose in which the study was designed. Gay, (1996) and Anderson, (1998) described the design which involved collection of in order to determine whether and to what degree a relationship exists between two or more quantifiable variables. The target population consisted of all junior secondary schools in Ekiti State, Nigeria, while Cluster sampling technique was adopted to select ten schools from the three senatorial districts and simple random technique was used to select five hundred students which were made up of fifty students per school. The research assistant went to all the schools and collected the school copy of teachers assessment scores (TAS1, TAS2, and TAS3) for three consecutive years (2009-2012). The data were analysed using EXCEL and SPSS by applying the Pearson Product Moment Correlation and one way ANOVA statistical techniques'. It should be noted that the TAS1, TAS2 and TAS3 denote teachers assessment

scores for JSS1, JSS2 and JSS3 respectively while JSCE stands for correcting or moderating instrument.

RESULTS AND DISCUSSION

Question One

What are the prevalent errors committed in teachers assessment process in Mathematics, English Language and Integrated Science.

Table 1: Hypothetical Prevalent Error Committed in Teachers' Assessment Process in Mathematics, English Language and Integrated Science in a Particular School Subject.

Mathematics	**CRS**	**MS**	**CRS-Mods**	**Result**
JSS1	60	50.68	9.32	Leniency
JSS2	69	57.06	12.94	Leniency
JSS3	70	64.84	15.46	Leniency
English Language				
JSS 1	50	46.84	3.16	Leniency
JSS2	60	54.24	5.76	Leniency
JSS3	69	65.12	3.08	Leniency
Integrated Science				
JSS 1	70	60.46	9.54	Leniency
JSS2	75	63.31	11.69	Leniency
JSS3	80	75.80	14.20	Leniency

N/B: Class Raw Score (CRS), Moderated Scores (MDS).
Source: Fieldwork 2011. This was analysed using regression model of statistical moderation to get the nature of teachers bias as whether leniency or severity, from the table 1 above. The prevalent error by the assessors is leniency error as a justification for the need of statistical moderation of teachers' assessment process. The table also illustrates how the errors are been derived and the result justifies the existence of leniency error in the three subjects. However, the common teachers' bias in the assessment process in schools was severity in Mathematics why the prevalent error in English Language and Integrated Science was Leniency error.

Question Two

2. What are the nature of these teachers' assessment scores to justify the need for moderation in Mathematics, English Language and Integrated Science?
In answering this question the data collected were analysed using the formula, percentile coefficient of kurtosis which is given by:
K= Q

$2(P_{90}-P_{20})$ where Q is the Second interquartile deviation given by Q=1/2 (Q2-Q1). The interquartile range and P_{90} and P_{10} are 90^{th} and 10^{th} percentiles respectively, therefore, k= $\frac{Q_2-Q_1}{2(P_{90}-P_{20})}$

For a Platykurtic distribution k<0.263. For a Leptokurtic distribution k<0.263 for a Mesokurtic distribution k=0.263 which was in consonance with the assertion Afonja (1982), Ojikutu (1992) Adedayo (1998), Abe & Abe (2000) and Alonge (1989) argued that as a test and measurement tool, kurtosis statistic shows the homogeneity and heterogeneity of test scores.

Coefficient of Kurtosis of Teachers' Assessment Scores in Mathematics English Language and Integrated Science.

Subject	N	TAS	Mean	SD	Coefficients	Type of Kurtosis
Mathematics	600	1	48.08	17.02	-0.12	Platykurtic
		2	51.69	14.84	-0.25	Platykurtic
		3	49.42	13.34	0.73	Leptokurtic
English Language	600	1	49.07	13.28	0.70	Leptokurtic
		2	49.08	13.69	-0.22	Platykurtic
		3	48.52	12.23	0.27	Leptokurtic
Integrated Science	600	1	48.83	13.83	0.54	Leptokurtic
		2	51.55	13.89	3.36	Leptokurtic
		3	50.17	14.49	-0.31	Platykurtic

From the table 2 above TA1 above TA2 in Mathematics, TA2 in English Language and TA3 in integrated science exhibited Platykurtic frequency distribution with negative coefficient of

kurtosis, while TA3 in Mathematics TA1 and TA3 in English Language and TA1 and TA2 in integrated science shows positive coefficient of kurtosis hence the scores were Leptokurtic frequency distribution. This is an attestation to the biasness in the teachers' assessment process among the junior secondary schools in Ekiti State, Nigeria. Therefore, there is need for correction of Teachers assessment process through standard quadratic polynomial statistical moderation model.

Question Three

3. Is there any significant difference in the teachers' bias in assessment process in Mathematics, English Language and Integrated Science?

In analysing this problem, the question was transformed into the following hypothesis:

HO1: There is no significant difference in the teachers' bias in assessment process in Mathematics, English Language and Integrated Science

Table 3: One Way ANOVA Summary for Teachers' Bias in Assessment Process in Mathematics, English Language and Integrated Science.

Subject	SSbg	SSWg	Dfbg	Msbg	Mswg	Dfwg	Fcal
Mathematics	3328.37	41876.89	2	1664.83	27.8	1497	59.49
English Language	346.98	80476.96	2	173.49	53.76	1497	3.23
Integrated Science	1853.44	24912.78	2	926.72	16.641	1492	55.69

At $p<0.05$, Fcal = 3.00

Table 3 shows significant differences in Leniency or severity in TAS1, TAS2 and TAS3 in Mathematics, English Language and Integrated Science with $f_{calculated}$ 59.49, 3.23 and 55.69 respectively with dfbg 2 and dfwg 1497. These values s were at $p<0.05$, therefore post-hoc analysis was carried out using Scheffe multiple comparisons.

Table 4: Scheffe Multiple Comparisons of TAS1, TAS2 and TAS3 in Mathematics

Mean	Comparison	TAS1	TAS2	TAS3
-1.92	TAS1		*	*
1.69	TAS2			*
-0.58	TAS3			

*denoted pairs with significant differences of teachers bias in TAS1, TAS2 and TAS3 in Mathematics while significant difference existed between TAS1 and TAS2, TAS1 and TAS3, and TAS2 and TAS3

Table 5: Scheffe Multiple Comparison of TAS1, TAS2 and TAS3 in English Language

Mean	Comparison	TAS1	TAS2	TAS3
-1.94	TAS1			
-0.93	TAS2			
-0.92	TAS3			

Post-hoc in English Language shows no significant difference in Teachers bias in a, TAS2 and TAS3.

Table 6: Scheffe Multiple Comparison of TAS1, TAS2 and TAS3 in Integrated Science

Mean	Comparison	TAS1	TAS2	TAS3
1.17	TAS1		*	*
1.55	TAS2			*
0.71	TAS3			

Table 6, shows that significant differences existed in teachers' bias between TAS1 and TAS2, TAS1 and TAS3 and between TAS2 and TAS3.

Question 4

Is there any relationship between the teachers' assessment scores before the applicability of the quadratic polynomial transformation model?

In analysing the problem, the question was transformed into the following hypothesis:

HO1: There is no significant relationship between teachers' assessment scores before the applicability of quadratic polynomial model in Mathematics, English Language and Integrated Science.

Table 7 Correlation Coefficients of Teachers Assessment Scores in Mathematics, English Language and Integrated Science before correction by quadratic polynomial transformation model.

Subject	TAS1 and TAS2	TAS1and TAS2	TAS2 and TAS3
Mathematics	0.61	0.58	0.65
English Language	0.51	0.53	0.51
Integrated Science	0.48	0.48	0.45

P<0.05, significant results

Magnitude

0.0-0.2 Very Low

0.2-0.4 Low

0.4-0.6 Moderate

0.7-0.8 High

0.8-1.0 Very High

Table 7 above shows high and positive relationship between (TAS1 and TAS2), (TAS2 and TAS3) in Mathematics, moderate and positive relationship between (TAS1 and TAS2),

(TAS2 and TAS3) in Mathematics, moderate and positive relationships existed between (TAS1 and TAS3) in Mathematics likewise between (TAS1 and TAS2) (TAS1and TAS3) and (TAS2 and TAS3) in English Language and Integrated Science respectively before moderation at $p<0.05$. This confirmed that significant relationship existed among the teachers assessment scores in the three subjects.

Question 5

Is there any relationship between the teachers' assessment scores after the applicability of Quadratic polynomial transformation model in Mathematics, English Language and Integrated Science?

In answering this question, the data collected were analysed using the formula of Quadratic polynomial transformation model to correct the teachers assessment scores and the corrected (moderated scores) were subjected to Pearson Product Moment Correlation Statistic to test whether there was a relationship between the corrected or moderated scores and the results are shown in Table 8.

Table 8 Correlation Coefficient of Corrected Moderated Scores (TAS1, TAS2, and TAS3) after the Applicability of Quadratic Polynomial Transformation Model

Subject	Mod (TAS1 and TAS2)	Mod (TAS1 and TAS3)	Mod TAS2 and TAS3
Mathematics	0.58*	0.58*	0.58*
English Language	0.49*	0.49*	0.49*
Integrated Science	0.47*	0.47*	0.47*

At $p<0.05$ (Significant results)

Table 8 shows positive and moderate relationship among the corrected moderated teachers scores in Mathematics English Language and Integrated Science, while at $p<0.05$ significant relationship existed among the moderated or corrected scores in the teachers assessment scores after the applicability of Quadratic polynomial transformation model.

DISCUSSION

The findings of this study revealed that, the prevalent error frequently committed by the teachers was Leniency error in English Language and Integrated Science, while severity error was committed by the Mathematics teachers, this was in line with the findings of the (2006, 2009 & 2010). The result of this study also showed that, the teachers assessment scores in TAS1 and TAS2 in Mathematics TAS2 in English Language and TAS3 in Integrated Science exhibited Platykurtic frequency distribution with a positive coefficient of kurtosis, the result is as attestation to co-existence of teachers bias in the assessment process that is to say, there was familiarity and unfamiliarity with students in Ekiti State junior secondary schools. Therefore, the result is in line with the findings of Bandele (1989 & 1997) Abe (1995, 2006 & 2010) and McCann (1995). Hence there is urgent need for correcting the teachers' assessment

scores among the junior secondary schools in Nigeria. However, the result of the coefficients of kurtosis on the teachers' assessment scores was adequately in consonance with the assertions of Alonge, (1989), Ojikutu (1992), Afemikhe & Onyemunwa (1997), and Olaitan & Ndomi (2000). Abe & Alonge (2010) stated that the purpose of kurtosis is to determine whether the scores are normally or abnormally distributed. The finding also shows that, there is significant difference in teachers bias among TAS1, TAS2 and TAS3 in three subjects at $p<0.05$. This was in support of findings of Bandele (1989) and Abe (2010) but in consonance with that of Abe (2006) whose finding shows significant difference among the leniency and severity in TAS1, TAS2 and TAS3 in Mathematics and Integrated Science.

The finding revealed that, high and positive relationship existed between (TAS1 and TAS2) (TAS2 and TAS3) in Mathematics while moderated and positive relationship existed between (TAS1 and TAS3) in Mathematics and between (TAS1 and TAS2) (TAS1 and TAS3) and (TAS2 and TAS3) in English Language and Integrated Science before the applicability of Quadratic polynomial model. This is also in consonance with the findings of the (2004, 2006, 2007 & 2010). The finding was also upheld after the correction by the applicability of Quadratic polynomial transformation model. The strength of relationship among the corrected scores was moderated and positive in Mathematics, English Language and Integrated Science. This is in line with the studies of McCann, (1995) Abe & Gbore, (2006), Abe (2006, 2007a, & 2010) and Abe & Alonge (2010). The findings also revealed that at $p<0.05$ significant relationship existed among the teachers assessment scores before and after the applicability of quadratic polynomial transformation model. This upheld the principle of statistical moderation as asserted by Smith (1978), Hornsby, (1980), Ward, (1981) Bandele (1989), McCann (1995) and Abe (1995, 2002, 2006, 2007a & 2010).

CONCLUSION

The findings of the study identified the existence of teachers' bias in assessment process such as Leniency and Severity among the three subjects, which shows that they need to be corrected using appropriate statistical moderation model. Quadratic polynomial transformation model did the correction in the strength of relationship before its application to the assessment scores by the teachers in the three subjects that is to the model strengthens the relationship among the teachers assessment scores in all the subjects at the same time leveled the variations in the strength of relationships among the teachers assessment scores in Mathematics.

RECOMMENDATION

The finding revealed the efficacy of the model as applied to the three subjects, quadratic polynomial transformation is recommended to be used in examining body like NECO, SSCE and in both State and Federal Ministries of Education in Nigeria where it was mandatory to correct the teachers assessment scores before combining with external scores as initiated in National Policy on Education. Other researchers' who is/are statistically/Mathematically inclined may adopt the formula and use it correct the teachers' bias in their state or country.

REFERENCES

Abe, T.O (1995). Scaling Moderation of Internal Scores in Owo Local government area in Ondo State. Unpublished M.Ed Thesis, Ondo State University Ado Ekiti.

Abe, T.O (2002). Improving the Internal Scores of JSS Mathematics throughScaling Moderation Journal of counseling and Applied Psychology 1(1), 89-96.

Abe T.O (2006). Statistical Moderation of Internal Assessment Scores in Senior Schools in Ekiti State Nigeria. Unpublished Ph.D Thesis University of Ado Ekiti.

Abe, T.O (2007a). Skewness and Kurtosis of School-Based Assessment Scores as Determinants of the Need for Moderation. International Journal of Research in Education 4, 40-46.

Abe, T.O and Gbore I.O (2006). Kurtosis as a Means of Comparing Internal Assessment Scores in Schools Subjects. Journal of Educational Thought 5(1), 74-82

Abe, T.O (2010). Teachers Bias in Assessment Process in Selected Schools Subjects in Ekiti State Nigeria. Journal of Research in Education and Society, 1(1), 84-96.

Abe, T.O (2011). Applicability of Quadratic Polynomial Transformation Model in Moderating Continuous Assessment Scores in Selected Schools Subject. A Capacity Building Workshop for Mathematical Science Lecturers in Tertiary Institution Workshop Proceedings 20th-25th June, 2011, pp112-119.

Abe,T.0(2013) Verification of Quadratic Polynomial Transformation andScaling Models of Statistical Moderation. International Journal of Research and Advancement in Physical Science,3 (2) ,113-120.

Abe, T.O & Alonge (2010). Statistical Moderation of Continuous Assessment and Terminal Examination Scores of Junior Secondary Schools in Ekiti State Nigeria. International Journal of Research in Counseling and Sports Sciences 1(1), 6-18.

Afemikhe O.A and Onyemunw, S.G (1997). An Introduction to Statistics. Apapa, Lagos, Amfitop Books publications.

Alonge M.F & Abe T.O (2007). An Investigation into the Distributive Nature of Continuous Assessment Scores among the Senior Secondary Schools in Ekiti State Nigeria. Journal of Counseling and Applied Psychology 3(1), 45-53.

Alonge M.F (1989). Measurement and Evaluation in Education and Psychology. Ado Ekiti: Adebayo Publishing Company (Nig) Ltd, Ado- Ekiti.

Anastassi A.C (1982). Psychology Testing. Macmillan Publishing Co Inc.: 4th Edition.

Anderson G (1998). Fundamentals of Educational Research. London: Macmillan

Publishing Co. Inc.

Bandele S.O (1989). Statistical Moderation as a Means of Comparing Informal

Assessment of some JSS Subjects in Ondo State. Unpublished Ph.D thesis, University of Ibadan. Ibadan.

Bandele S.O (1997). Quality of Educational Assessment through Statistical Moderation. A Paper for Educational Research and Evaluation, Institute of Education, University of Ado Ekiti.

Campbell D.A & Stanley S.C (1966). Experimental and Quasi Experimental Design for Research. Chicago. Rand M.C Malty.

Chappin F.S (1955). Experimental Design in Sociological Research. New York: Harper.

Federal Government of Nigeria (1981). National Policy on Education. Lagos: Federal Ministry of Education, NERDC.

Federal Government of Nigeria (1987). Review of the National Policy on Education, Proposal Suggestions/Comments of State/Institutions/Organisation.

Gay, L.R (1996). Educational Research Competencies for Analysis and Application. New Jersey: Prentice Hall Inc. A Simon Schuster Company 5th edition

Hornby A.S (1980). Oxford Advanced Learners Dictionary of Current English. Oxford. University Press 6th edition

Mac Cann (1995). The Moderation of Higher School Certificate Assessment Using a Quadratic Polynomial Transformation. A Technical Paper NSW Board of

Studies.Olaitan, S.O and Ndoms B.M (2000). Vocametrics : A High-Tech Problem Solving Quantitative Test with Computer Skills. Onitsha: Cape Publishers

Ojikutu R.K (1992). Statistics Problems and Solutions. Lagos: Malthouse Press Ltd.

Onocha, C.O & Okpala P.N (1995). Tools for Education Research. Lagos: Sterling Horden Publishers (WA) Ltd.

Smith, G.A (1968). JAMB Experience of the Moderation of Internal Assessment. Abuja: JAMB.

Ward M (1981). Teachers Assessment in Public Examination. The Association

Examining Board (AEB).