COMPARATIVE EFFECT OF COMPUTERIZED-FIXED-TEST AND COMPUTER-ADAPTIVE-TEST ON MATHEMATICS TEST CHARACTERISTICS OF SENIOR SECONDARY SCHOOLS IN IMO STATE.

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Abstract
The study focused on the comparative effect of Computer-Fixed test and Computer-adaptive-test on mathematics test characteristics of senior secondary schools in Imo State. It adopted quasi-experimental pre-test post–test research design to compare the possible effect of CBT computerized-fixed-test and computer adaptive test on mathematics test characteristics of senior secondary schools, focusing on their difficulty index, discrimination index, distracter index, validity and reliability of items, among others. Three research questions and two null

hypotheses guided the study. The population for the study comprise all 2017 JAMB candidates of the six educational zones of Imo State who earlier received special training on CBT's Computerized –Fixed – Test and Computer-Adaptive test. Six secondary schools from across the six education zones of the state were selected. Purposive sampling technique was used to sample 261 students who sat for the 2017 JAMB exam based on strength of each zone. This instrument was a 15 – item questionnaire called Computerized-Fixed-Test and Computer-Adaptive- Test Questionnaire (CFT/CATQ). The test items in the instrument was validated by two experts in the field of Educational Measurement & Evaluation and one expert in the ICT Unit. To ascertain the reliability of the instrument, the Cronbach alpha reliability method was employed to determine its consistency and finally, a correlation coefficient of 0.79 was obtained. The researchers administered the instrument themselves and at last all the questionnaires were collected back ensuring a 100% return rate. The data collected were organized and then analyzed using mean and standard deviation for the research questions while the hypotheses were analyzed with the ANCOVA statistic.The findings show that CFT is more advantageous than CAT in JAMB UTME and that CFT& CAT models of CBT assessment differ significantly in influencing students performances in JAMB UTME Mathematics.

Keywords: Computer-fixed test, computer-adaptive test, senior secondary schools, instruments, analysis

Introduction

Necessity, they say is the mother of invention. This is why the Joint Admission and Matriculation Board (JAMB) whose own it is to test and admit qualified candidates into our institutions of higher learning, saddled with incessant examination misconducts was able to develop and adopt a new testing strategy called computer – based Testing (CBT). This milestone achievement came on board as a result of JAMB's adopion of the Item Response Theory (IRT) which is a modern method of item analysis and calibration. This theory provided ample volume of test items for analysis and item banking. The new system of calibration provided the basis for the development of the digital item bank where test items were delineated by subject level, instructional objectives and pertinent item characteristics such as difficulty, discrimination and susceptibility to guessing of the test items (Ojerinde 2015).Meanwhile, the item bank

contributed to the creation of parrallel forms and schedulling for computer-based testing (CBT) to ensure comparability and interchangeability that enabled the conduct of CBT on a number of days.

However, Computer-Based Testing Strategy was trial-tested in JAMBs 2013 UTME and due to its efficacy over the paper-pencil testing (PPT) approach especially in malpractice reduction, it was finally adopted in 2015 as the new system of testing for the UTME (Ojerinde, 2015). Meanwhile it has been observed that CBThas for now eight (8) test delivery modes of which the one popularly in use for JAMBs UTME is the preassembled parallel, computerized – fixed – Test form (CFT). This means that for some writers the CBT they are talking about with respect to JAMB UTME is the computerized fixed Test (CFT) form.

Theoretical & Conceptual Framework

JAMB from 1978 it was established till 2012 conducted her placementexaminations into higher institutions using the traditional paper-and-pencil mode of assessment in addition to yearly innovations to ensure quality. Yet exam malpractice and other challenges arising due largely to inadequate resources to match the unforeseen rise in students population (Ojerinde, 2014) persisted. In consideration of those enormous challenges as elucidated above, the Board introduced three examination modes in the conduct of its 2013 UTME. These exam modes were paper-and –pencil Test (PPT), Dual-Based Test (DBT) and Computer –Based Test (CBT) and their results were promptly released within five (5) days for PPT and DBT while CBT results were released each scheduled day after the test (Ojerinde, 2015:9).

However, Computer Based-Testing (CBT) which is widely seen as a catalyst for change in this era of information technology was later finally adopted. According to Lukeman and Ogechi (2012;5) cited in ldika, (2015) "the use of CBT simplifies the entire testing cycle including generation, execution, evaluation and presentation of test". Computerized – fixed-test (CFT) includes reconstructed, intact test forms that are administered by computer to large numbers of students. In this test form, different examinees may see different forms of the test, but al examinees administered the same form will see exactly the same items (i.e the items are fixed for each form. Parshall etal (2002) described this model as computerized – fixed – tests (CFT) which is the model currently used by

JAMB for its UTME. Another example of a CFT is the physical therapist licensing exam. In typical implementation of this model, several test forms (of the same fixed length) are available for administration and one is (randomly) selected for each examinee. The different forms are parallel with respect to test content and are either formally equated for difficulty (using CTT as IRT) or are assumed to be randomly equivalent.

As a matter of fact, it has been established that there is not a singular CBT model that fits for every testing programme, and a group of thought having observed some of the deficiencies of the CFT in the UTME of JAMB, have started to suggest for the use of another CBT model called Computer-Adaptive-Test (CAT) as an alternative to CFT use in JAMBs UTME.

Computer-Adaptive Test (CAT) is a form that adapts or tailors its exam to each examinee. The tailoring is done by keeping track of an examinees' performance on each test item and then using this information to select the next item to be administered. Thus CATs are sequentially developed item-by-item in real time by the test-delivery software. The idea of using the computer to match the difficulty of an item to the proficiency of an examinee was initially proposed by Lord in 1977 and 1980. Lord's idea was to begin a test administration by presenting an item of moderate difficulty to an examinee. If the examinee answers the question correctly, a slightly more difficult question is administered to him next, but if his answer is incorrect, a slightlyeasier item is administered.

This interactionin process continues until a sufficient number of items are administered for confident estimation of the examineesscore. The basic principle behind adaptive testing is, "avoid asking questions that are much too difficult or much too easy for the students being tested.

However, Mathematics test item characteristics includes the difficulty indices, discrimination indices, distracter indices as well as validity and reliability of the test items. While CAT assessment mode seems to deal squarely on these item characteristics which makes it appear time wasting and cost effective, CFT assessment mode is popularly used because of its easy administration and shortness of time to actualize on a large number of people.

Consequently,having seen the onerous advantages of the CFI model of test delivery over the PPT model, and considering CAT as being on the leading edge of assessment technology, the researchers are poised to

compare the possible effects of CFT and CAT models of test delivery on mathematics test item characteristics of senior secondary schools in Imo State.

However, the main objective of the study is to compare CFT and CAT modes of assessment and determine which of them should be better used on Mathematics test characteristics of senior secondary schools.

Research Questions

To achieve the above objective, the following questions were formulated to guide the study;

1. To what extent do UTME candidates have Do UTME candidates have favorable disposition of CFT over CAT use?
2. What advantages has CFT over the CAT in the JAMB's UTME?

Hypotheses

H0: Computerized-Fixed Test and Computer-Adaptive Test assessment modes does not differ significantly in influencing students performance in Mathematics test characteristics.

H1: CFT and CAT assessment modes differ significantly in their influence on students performance in Mathematics test characteristics.

Method:

The study adopted quasi-experimental pre-test post–test research design using random numbers to compare the possible effect of CBT computerized-fixed-test and computer adaptive test on mathematicstest characteristics, of senior secondary schools by focusing on their difficulty, discrimination and distracter indices. The population for the study comprise all 2017 JAMB candidates of the six educational zones of Imo State who had earlier taken Mock exam in Mathematics using the CBTs computerized fixed test and computer adaptive test modes. Six secondary schools from across the six education zones of the state were selected. Purposive sampling technique was used to sample 261 students who sat for the 2017 JAMB exambased on strength of each zone. The sampled students were all tested immediately after the Mock exam on the same 30 mathematics test questions, first using the CFT and secondly using the CAT approach as pre-test. Two weeks later, the same sample of students

(261) were grouped into three of 87 each. Group A and B answered the 30 item questions under Type A and type B using the CFT and CAT strategies (the treatment) while group C served as the control group. The total sum of squares onboth variables CFT (x) and CAT (y) were partitioned into components – a between groups sum of squares (treatment) and a within – groups sum of squares (see table iii). Adjusted total sum of squares between and within groups were determined, adjusted degrees of freedom as well as adjusted mean squares were also estimated and finally the calculated f-value (f-ratio) of ANCOVA was determined. Later, another instrument (questionnaire) was issued to them to elicit some other information of their disposition on the advantages. This instrument was a 15 – item questionnaire called Computerized-Fixed-Test and Computer-Adaptive- Test Questionnaire (CFT/CATQ). The test items in the instruments were validated by two experts in the field of Educational Measurement & Evaluation and one expert in the ICT Unit.To ascertain the reliability of the instruments, the Cronbach alpha method was employed to determine their consistency, acorrelation coefficient of 0.79 was obtained. The researchers administered the instruments themselves and at last all the instruments were collected back ensuring a 100% return rate. The data collected were organized and then analyzed using mean and standard deviation for the research questions while hypotheses were analyzed using the analysis of co-variance (ANCOVA) statistic.

Results

Table I: Mean and standard deviation responses on the extent of favourable disposition of students on CFT and CAT used in Jamb CBT.

S/N	Jamb's CBT Model	No.	X	SD	Remarks
1	Computerized –Fixed Test (CFT)	156	66.6	14.61	V. High Ext
2	Computer-Adaptive Test (CAT)	105	49.0	11.79	Low Ext
	Grand mean		57.8	12.95	High Ext

Table 1 shows mean and standard deviation analysis on the extent of favourable disposition of students on CFT and CAT se in JAMB CBT in Mathematics. From the total responses, 156 respondents with the mean

response of 66.6 and standard deviation of 14.61 expressed very high extent of favourable disposition on use of computerized fixed test over the Computer – Adaptive Test (CAT) which 105 respondents with mean score of 49.0 and standard deviation of 11.79 revealed a low extent of favourable disposition of its usage.

Table II: Mean and standard deviation responses of candidates on advantages of CFT over the CAT in JAMB's UTME

S/N	**Variables**	**No.**	**Mean**	**Standard Deviation**	**Remarks**
1	CFT	148	30.7	1.78	Highly Advantageous
2	CAT	113	15.65	2.46	Advantageous
	Grand mean		23.18	1.99	

Table 2 shows that the mean responses for CFT advantage group is 30.7 with a standard deviation of 1.78 while the mean response of CAT advantage group is 15.65 with a standard deviation of 2.46 an indication that CFT is more advantages to the respondents than the CAT use in JAMB UTME.

Table 3: Mean and standard deviation responses on the effect of availability or non-availability of infrastructural facilities on the use of CFT or CAT in JAMB UTME Maths.

SN	Item	NO	X	SD	Decision
1	Availability	139	3.26	0.89	Strongly accepted
2	Non-availability	122	2.40	0.97	Low acceptance
	Grand mean	261	2.83	1.01	Accepted

Table 3 shows mean score responses on the effect of availability or non-availability of infrastructural facilities on the use of CFT or CAT in JAMB UTME Mathematics. 139 respondents with a mean score of 3.26 and standard deviation of 0.89 indicated strong acceptance to availability while 122 respondents with mean score of 2.40 indicated low acceptance to non-availability of infrastructural facilities.

Table IV: t-test analysis of effect of the availability or non-availability of infrastructural facilities on the use of CFT or CAT in JAMB UTME.

Variables	N	X	SD	df	Cal t-value	Crit t-value	Decision
Availability	139	3.26	0.89	259	1.94	1.96	Accepted
Non-availability	122	2.40	0.98				

Sig @ 0.05, df = 2.59

Table 4 reveals that the mean scores for 139 respondents for effect of availability is 3.26 while the mean scores for non-availability (122 respondents) is 2.40. However, the table further shows that the calculated t-value of 1.94 is less than the critical t-value of 1.96, hence the hypothesis is accepted; that there's no significant effect of the availability or non-availability of infrastructural facilities on the use of CFT or CAT in JAMBs UTME especially in the mathematics test item characteristics.

Table V: ANCOVA summary table of the comparative effect of two assessment modes on students' performance in Maths test characteristics with 261 students assigned at Covariance

Sources of variation	Covariate sum of squares	Dependent variables	Df	Sum of squares	Mean square	f-ratio
Between	185.8	896.93	2	229.21	114.61	7.95
Within	293.6	418.40	257	158.67	14.42	
Total	2144.4	1315.33	259	387.88		

Sig @ 0.05 and 0.01 alpha levels.

The table III above shows analysis of Covariance (ANCOVA) on the effect of two assessment modes on students' performance in Mathematics test characteristics using a sample of 261 students. The degree of freedom for between sum of squares is 2 while the degree of freedom for within sum of squares is 257. The Critical F-value for 0.05 and 0.01 levels of significance are 3.98 and 7.21 respectively. Since the calculated f-value (7.95) is greater than the critical f-value at 0.05 and 0.01 respectively, the null hypothesis is rejected. The alternate hypothesis is then accepted. This means that CFT and CAT assessment modes of CBT differ significantly in influencing students' performance in mathematics.

Discussion

The findings of this study reveal that JAMB candidates have favourable disposition on the use of Computer-fixed-test (CFT) over the use of Computer Adaptive-test (CAT) of JAMB UTME. This is indicated by156 respondents with a mean score of 66.6 which showed very high extent of favourable disposition, 105 respondents a mean of 49.0 which showed low extent of disposition (criterion =50 mean). This could not be far from the fact that CFT has been rooted in the secondary schools some years back whereas CAT has not been so long it was introduced in Nigerian secondary schools. The above result seems to go contrary to a similar study carried out by Idika (2015) whose result reveals that parents of UTME candidates had unfavourable dispositions to the use of CFT in JAMB UTME, because of certain unavailable requirements and the candidates must have transfered such concerns to the CAT that made them favour the use of CFT as against CAT. The findings in table two shows that 148 candidates responses with mean score of 30.7 as against (113) or mean of 15.65 respectively admit that computer-fixed-test (CFT) is more advantageous to them than the computer-adaptive-test (CAT) in the mathematics test characteristics. They are right in thier positions because one cannot see the advantage on what he doesent know much about or what is new to him. However, one advantage of a CFT over the CAT is that the presention sequence for the items may be scrambled and this prevents certain type of cheating. CFT has a distinct advantage in terms of quality control because every form can be checked or at least sample audited while CAT involves formal quality controldata checks that takes time and cost before release. (Lucht & Nurgester, 1998; Zenisky etal

2010). Due to simplicity CFT is cost effective but CAT is demonstrated to be twice as efficient as a CFT (Luecht, 2005).

The findings in table four reveals that there is no significant effect of the availability or non-availability of infrastructural facilities on the use of the two assessments modes being compared in JAMB mathematics aspect of UTME. The calculated t-value of 1.94 is below the critical-value of 1.96 which prompted the acceptance of the hypothesis. This result is in contrast to the study of Wasanju et al (2005) whose findings confirmed that availability of infrastructure is the basic requirement for on-line assessment.Nevertheless, all models have their strengths and weakness, and some are better suited to the characteristics of a particular testing programme than others.

Lastly, table 5 reveals that there is a significant difference between the influence of CFT and CAT assessment modes in students' performance in JAMB CBT in Mathematics. The calculated f-value of 7.95 which is greater than the critical f-value at 0.05 and 0.01 respectively made the hypothesis to be rejected and the alternative hypothesis accepted.

Conclusion

The foregoing discussion has shown that for now computerized – fixed – test (CFT) is more effective than the computer-adaptive-test (CAT) in JAMB UTME. However, lessons have to be learnt from this finding. The effectiveness of the CFT may not be unconnected with the fact that CFT is directly analogous to having fixed-item paper-and-pencil text (PPT) form which the candidates already know much about. It should be noted that no singular CBT model of assessment fits for every testing program. All eight CBT models are at serious risks if the test item banks are too small, yet some models like CFT need larger item banks relative to others e.g CAT. It should also be noted that the best test-delivery models are those that minimize the greatest number of risks and simultaneously reduce the magnitude of specific security risks, all without requiring excessive sacrifices or trade-offs elsewhere and without substantially adding to overall costs and CFT is one.

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