

## INVESTIGATING THE ADOPTION OF COMPUTER BASED TESTING SYSTEM IN TERTIARY INSTITUTIONS USING CROSS-IMPACT METHOD

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### ABSTRACT

Computer-Based Test (CBT) system has become the order of the day in terms of assessing examinee capability in examinations which is not limited to students but also to job seekers because of its instant delivery of results. This paper studied each event that contributed to the adoption of CBT in the tertiary institutions and the correlation between events which made it possible to know the effect of certain event over the others. A questionnaire was administered on experts in three selected tertiary institutions in Oyo state (Ladoke Akintola University of Technology, Ogbomoso, The Polytechnic of Ibadan, Ibadan and Emmanuel Alayande College of Education, Oyo). The questionnaire was structured to collate the opinions of experts on the probabilities of single occurrence and conditional occurrence of Examination Policy (EP), Availability of Software and Hardware (SH), Lecturers Acceptance (LA), School Management Commitments (MC) and Students Performance (SP) which are the five major relevant events considered for the adoption of Computer based testing system in tertiary institutions. The data obtained through the questionnaires were analysed to derive the Initial Probability and Conditional Probability which constitute the Cross-Impact Probability matrix for the occurrence of considered events. Sensitivity testing was performed on each event by selecting initial probability value of an event and change from its original value to 1, provided other events remain constant and the test is run to determine its effect on all other events.

The results of sensitivity testing showed that with an increase in initial probabilities of SH, LA, MC and SP, the EP experienced the highest significance changes of 8, 11, 4 and 10% respectively and an increase in initial probabilities of EP, LA, MC and SP, the SH experienced the highest significance changes of 9, 14, 6 and 13% respectively. An increase in initial probability of EP, SH, MC and SP, the LA experienced the highest significance changes of 14, 16, 12 and 19% respectively, while an increase in initial probabilities of EP, SH, LA and SP, MC experienced the highest significance changes of 3, 4, 6 and 5% respectively and with an increase in initial probabilities of EP, SH, LA and MC, the SP experienced highest significant change of 12, 10, 18 and 10% respectively.

**KEYWORDS:** Computer-Based Test, Initial Probability, Conditional Probability, Cross-Impact, Sensitivity Testing

## INTRODUCTION

Examination is one of the best methods of evaluating the knowledge and ability of an individual (Adebayo and Abdulhamid, 2014). Its purpose is to assess how much each student has learnt compared to fellow students in the same course or learning situation. Various examination methods are being used in higher education institutions to assess academic progress. These include paper-pencil-based examinations, assignments and presentations which are often referred to as traditional methods. Traditional examination refers to a formal examination administered through question papers in which students respond in the form of written answers to a limited choice of previously unseen examination questions, set in advance and answered in examination centers where invigilators (examination supervisors) prevent communication between students and prohibit the use of notes or other revision aids (Harris, 2005).

Information and Communication Technology (ICT) has become, within a very short time, one of the basic building blocks of modern society. Many countries now regard understanding it and mastering its basic skills and concepts as very crucial in education. This is because it adds value to the processes of learning and to the organization and administration of learning institutions. It encompasses different types of technologies, which are utilized for capturing, processing and transmitting data and information, using computer facilities. It is an umbrella term that includes communication device or application, encompassing radio, television, cellular phones, computers, network, hardware and software, satellite systems and as well as the various services and applications associated with them (Kumar, 2006). Thus, ICT focuses specifically on the application of these new technologies in an educational context and environment, and serves as a tool for supporting the various components of education. Such components include, among others, teaching and learning, resources management (human, material, financial resources) and admission and examination processes also known as learning assessment.

One specific form of ICT for assessment is the Computer-Based Testing (CBT), also known as Computer-Based Assessment or e-exam. It is a method of administering tests in which the responses are electronically recorded, assessed, or both. It is commonly employed for several admissions tests in the developed countries. This method of testing is important because it can measure different skills or sets of knowledge in order to provide new and better information about individuals' abilities. Colleges and Universities receive CBT results more quickly than those from paper-based test, and they can make their admissions decisions more quickly. Individuals can take a CBT even with minimal computer experience, since instructions provided in a basic computer tutorial before the test will provide the experience needed to take the test using a mouse. One may spend much time on the tutorial to ensure comfortability with the computer and with the test before the official timed examination begins.

Peter *et al* (2004) mentioned that researches have been shown in several comparative works many advantages of Computer Based Testing System (CBTS) over traditional Paper-and-pencil Testing (PPT) proving that CBT is not just an alternative method for delivering examinations; it represents an important qualitative shift away from traditional methods such as paper based tests.

Hedberget *al* (1995) stated that the history of computer-based testing began in the early 1970s with the introduction of the early computers in the 1970s which revealed the potentials of using technology not only for new learning environments but also for completely new settings in the design and administration of tests. E-assessment originated with the PLATO system from the University of Illinois and was commercialized by Control Data Corporation in the 1970s, starting with a

computer testing system for National Association of Securities Dealers (now the Financial Industry Regulatory Authority). The testing business grew slowly and is today known as Thomson Prometric. Further expansion of the testing system was occasioned by Pearson VUE in 1994 which was one of the first to use the internet for CBTS.

Today many universities and institutions employ the use of computer based testing (Adegbija *et al.*, 2012). The rapid advancement in Information and Communication Technology (ICT) has resulted in a transformation in the way many manually processed activities are being performed today. One of such activities is the assessment of students which has evolved from the use of paper-and-pencil to a computer-based format in recent years (Jamila *et al.*, 2012). Dietelet *et al.* (1991) defined assessment as any method used to understand the current knowledge that a student possesses. The concepts of assessment, examination and testing stimulate students to conscientiously study, attend lectures and actively partake in assignments in order to avoid failure as well as ensuring that teachers make a proper planning of their lessons and teach carefully in class (Qiao-fang and Yong-fei, 2012). With the growth in the number of students aspiring for western education in Africa, and a limited number of qualified educators, the use of a Computer-Based Testing System (CBTS) provides a solution to meet the challenge (Rashad *et al.*, 2010). Ayo *et al.* (2007) presented that the Nigeria National Information Technology (IT) policy, which was formulated in the year 2000, is responsible for the monumental developments across the various sectors of the economy. The vision is to make Nigeria an IT capable country in Africa and a key player in the information society. Its primary mission is to use IT for education, poverty alleviation, job creation, governance, health, agriculture; etcetera.

Cross-impact analysis is a methodology developed by Theodore Gordon and Olaf Helmer in 1966 to help determine how relationships between events would impact resulting events and reduce uncertainty in the future. Cross-impact analysis is the general name given to a family of techniques designed to evaluate changes in the probability of the occurrence of a given set of events consequent on the actual occurrence of one of them. The cross impact model was introduced as a means of accounting for the interactions between a set of forecasts, when those interactions may not have been taken into consideration when individual forecasts were produced. The origin of cross-impact analysis was the problem that Delphi panelists were sometimes asked to make forecasts about individual events, when other events in the same Delphi could affect these events. In fact, cross impact models can stand alone as a method of futures research, or can be integrated with other method(s) to form powerful forecasting tools. Cross-impact analysis is a method that helps the process of scanning the field of possible futures to reduce uncertainties (Gordon and Hayward, 1968).

## RESEARCH METHODOLOGY

### Formulation of Relevant Events

Experts and literatures were consulted to know the factors (events) that immensely contributed to the adoption of Computer based testing system. Therefore, five relevant events were filtered out from the numerous events gathered from the literatures and survey conducted based on their inherent contribution in the adoption of Computer based test in tertiary institutions.

**The Five (5) Relevant Events Are;**

- Examination Policy
- Availability of Software and Hardware
- Lecturers' Acceptance
- School Management Commitments
- Students Performance

**Event 1: Examination Policy**

This policy outlines the basic principles, rules and regulations supporting examinations at the institution and the expectations of both students and staff. Examination policy sets the rules and regulations in conducting an examination which includes notification of examination timetable, date and time of the examination, question types and penalties attached to all forms of examination malpractices.

**Event 2: Availability of Software and Hardware**

Availability of hardware and software are not limited to computer and program only but also include infrastructures like standby power source, good network devices, server, building and so on. In Nigeria, most of the infrastructures for automated examinations are either obsolete or overstretched in terms of capacity, accessibility, reliability and security. The software and hardware needed for the implementation of CBT must be put in place before adoption of CBT system.

**Event 3: Lecturers Acceptance**

Lecturers' acceptance is highly needed in adoption of Computer Based Test in tertiary institutions because they are the decider on how the examinations can take place. Some lecturers are kicking against the adoption of CBT mainly because they believe it cannot perfectly measure the students' abilities while some lecturers supported its adoption only because it eradicates the stress of marking.

**Event 4: School Management Commitment**

School management members are the major stakeholders in adopting CBT as a mode of accessing student abilities in tertiary institutions. Their commitment must be strong in order to provide all necessary needs for the implementation of CBT.

**Event 5: Student Performance**

Any form of students' assessment that will affect the student performance negatively would not be accepted as mode of assessment. CBT adds values to students' performance, it encourage the students to read extensively to understand their course well. The immediate release of CBT results and prevention of examination malpractices encouraged students to buckle up for their examinations.

## Design of Questionnaire and Data Collection

Delphitechnique was adopted in designing the questionnaire used to carry out a survey that captured critical data on the adoption of Computer Based Test in Tertiary Institutions.

The questionnaire was divided into two parts. In the first part, experts were asked to provide the initial probability of occurrence of each single event. The judgment referred to the school management members, lecturers and IT staff of Ladok Akintola University of Technology, Ogbomoso, The Polytechnic of Ibadan, Ibadan and Emmanuel Alayande College of Education, Oyo. In the second part of the questionnaire, experts were asked to indicate the conditional probability of the events, whereby referring to the probability each of the other events listed were implemented given that the selected event turned out to be true (or occurred).

A likert rating scale is psychometric scale commonly used in questionnaires and is the most widely used scale in survey research. The experts responded to the questionnaire using a likert probability rating scale ranges from 1 to 5. The meaning of the Likert probability scale follows this trend:

1= event almost impossible (0-10 %)

2= event unlikely-(11-30 %)

3= event equally likely or unlikely (31-50 %)

4= event likely-(51-70 %)

5= event almost certain-(71-90 %)

## Data Collection

The questionnaire was administered to gather the opinions of the experts; school management members, lecturers and as well as Information Technology (IT) staff on the five relevant events. Oral interview was conducted with most respondents in Ladok Akintola University of Technology, Ogbomoso, The Polytechnic of Ibadan, Ibadan and Emmanuel Alayande College of Education, Oyo.

Table 1 showed the numbers of the questionnaires administered to each tertiary institutions and Table 2 presents the demographic information and descriptive statistics of the experts. 61.9 % males and 38.1 % females were participated in the survey. Highest percentages (51.5 %) of experts have educational qualification of Ph.D degree, followed by experts (25.8 %) with Master degree followed by first degree holder (21.7 %) in IT and related courses and OND holder was (1.0 %). However, the degree of expertise of the experts were measured with the results that show 61.9 % were expert with the topic, 20.6 % knowledgeable, 10.3 % familiar, 6.2 % casually acquainted and 1.0 % were unfamiliar with the topic.

**Table 1: Analysis of the Administered and Returned Questionnaires**

Institution	No of Administered Questionnaire	No of Returned Questionnaire	% of Returned Questionnaire	% of unreturned Questionnaire
LAUTECH	60	43	71.7 %	28.3 %
IbadanPoly	35	32	91.4 %	8.6 %
EACOED	25	22	88.0 %	12.0 %
Total	120	97	80.8 %	19.2 %

**Table 2: Demographic Information of the Experts**

Item			Percentage (%)
Sex Distribution	Male	60	61.9 %
	female	37	38.1 %
Education Qualification	Ph. D	50	51.5 %
	M. Tech/M. Sc/M. Ed	25	25.8 %
	B. Tech/B. Sc/B. Ed	21	21.7 %
	OND	1	1.0 %
Degree of Expertise	Expert	60	61.9 %
	Knowledgeable	20	20.6 %
	Familiar	10	10.3 %
	Casually Acquainted	6	6.2 %
	Unfamiliar with the topic	1	1.0 %

### Formulation of Cross Impact Probability Matrix

A total number of 120 copies of questionnaire were distributed in ratio 60:35:25 among LadokeAkintola University of Technology, Ogbomoso, (LAUTECH), The Polytechnic of Ibadan, Ibadan (Ibadan Poly) and Emmanuel Alayande College of Education, Oyo (EACOED) respectively. A total number of 97 questionnaires were returned and used for this research.

The first step of the analysis is data coding. The data was coded into a format with alphanumerical code using the SPSS. The major events under consideration were coded as follows:

**Event 1:** Examination Policy (EP)

**Event 2:** Availability of Software and hardware (SH)

**Event 3:** Lecturers Acceptance (LA)

**Event 4:** School Management Commitment (MC)

**Event 5:** Effects of CBT on Student Performance (SP)

The coded events were then analyzed using descriptive statistic in SPSS. Therefore, the Cross-Impact probability matrix for occurrence of the events was formulated as shown in Table 3.

**Table 3: Cross-Impact Probability Matrix When Events Occurred.**

Events	Initial Probability	EP	SH	LA	MC	SP
EP	0.59		0.80	0.58	0.79	0.31
SH	0.50	0.66		0.63	0.81	0.57
LA	0.33	0.75	0.85		0.86	0.51
MC	0.73	0.75	0.83	0.75		0.43
SP	0.40	0.17	0.24	0.24	0.13	

### SENSITIVITY TESTING

Sensitivity testing is carried out on SPSS using initial probability of the considered events. Each initial probability is selected (an initial probability estimate), the value was changed from its original value to 1 and the test was run for 30times. Tables 4, 5, 6, 7 and 8 shows the effect of change of initial probabilities of Examination Policy, Availability of Software and Hardware, Lecturers' Acceptance, School Management Commitment and Student Performance respectively had on all other initial probabilities.

**Table 4: Sensitivity Testing On Event EP**

Events	Initial Probability	Test Probability	Final Probability	Change
EP	0.59	1.00	1.00	0.00
SH	0.50	0.50	0.59	0.09
LA	0.33	0.33	0.47	0.14
MC	0.73	0.73	0.76	0.03
SP	0.40	0.40	0.52	0.12

**Table 5: Sensitivity Testing On Event SH**

Events	Initial Probability	Test Probability	Final Probability	Change
EP	0.59	0.59	0.67	0.08
SH	0.50	1.00	1.00	0.00
LA	0.33	0.33	0.49	0.16
MC	0.73	0.73	0.77	0.04
SP	0.40	0.40	0.50	0.10

**Table 6: Sensitivity Testing On Event LA**

Events	Initial Probability	Test Probability	Final Probability	Change
EP	0.59	0.59	0.70	0.11
SH	0.50	0.50	0.64	0.14
LA	0.33	1.00	1.00	0.00
MC	0.73	0.73	0.79	0.06
SP	0.40	0.40	0.58	0.18

**Table 7: Sensitivity Testing On Event MC**

Events	Initial Probability	Test Probability	Final Probability	Change
EP	0.59	0.59	0.63	0.04
SH	0.50	0.50	0.56	0.06
LA	0.33	1.00	0.45	0.12
MC	0.73	0.40	1.00	0.00
SP	0.40	0.40	0.50	0.10

**Table 8: Sensitivity Testing On Event SP**

Events	Initial Probability	Test Probability	Final Probability	Change
EP	0.59	0.59	0.69	0.10
SH	0.50	0.50	0.63	0.13
LA	0.33	0.33	0.52	0.19
MC	0.73	0.73	0.78	0.05
SP	0.40	1.00	1.00	0.00

## CONCLUSIONS

The future is an extension of the present, and that it is possible to define routes and laws to describe past, present and future behaviours of the issues studied. The purpose of a cross-impact exercise is primarily to gain more insight into future developments (Godet, 1991). Cross-impact method is a technique designed to evaluate changes in the probability of the occurrence of a given set of events consequent on the actual occurrence of one of them. The research was carried out by Consultation of experts and review of literature which made the research work established five major events that contributed to the adoption of Computer Based Test in tertiary institutions. The five major events are: Examination Policy (EP), Availability of Software and Hardware (SH), Lecturers' Acceptance (LA), School Management Commitments (MC) and Students Performance (SP). It is recommended that the result of this research should put into practice in order to have effective adoption of CBT.

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