N-TYPES ELECTRONIC EXAMINATION SYSTEM: AN EFFECTIVE APPROACH FOR COMBATING EXAMINATION MALPRACTICE

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ABSTRACT
Examination malpractice is a serious problem waging war against the nation’s educational system. It appears all the efforts of the government to arrest this ugly problem, are yet to yield positive results. This paper aims to provide a solution to examination malpractice in our educational system. An N-Type Electronic Examination System (NEES) was designed to correct this problem. The system is made up of three components: the configuration phase, examination phase and the database. The system was able to generate different variants of question sets for a particular subject. Visual Basic was used to implement the design because of its interactivity and high ability to support database. To the best knowledge of the authors, this method of conducting examination is the first electronic examination system in Nigeria supporting different variants of question sets. Testing the new NEES design with data, the result shows a system that can administer examination effectively.

Keywords: Convention Examination, e-Examination System, Examination malpractice, N-Type

INTRODUCTION
In an academic or professional context, examinations (or exams for short) are tests which aim to determine the ability of a student or a prospective practitioner. It is a tool or technique intended to measure students’ expression of knowledge, skills and/or abilities. It is an official exercise designed to evaluate knowledge and skills, and covering the contents of a course or a program of studies (Wikipedia, 2007).

Examination can be conducted manually or electronically. Manual/conventional exams are performed with the use of sheets of paper biros and/or pencil. The problems with conventional exams are absence of transparency and effective preparation of exams, lower grade of objectivity, no instant feedback on examination result, increased costs, increased teacher’s workload, no elaborate feedback on teaching success, does not enhance audit quality management and bad security. The Electronic examinations are those examinations performed through a computer where questions and answers are computer files rather than sheets of paper. As useful as examinations are, conventional method of conducting examination opens way for examination malpractices. Having
the question-types pre-printed on the ques-

tion papers as it is the case in some exami-
nations such as Senior Secondary Certificate
Examination (SSCE), Universities Matricu-
lation Examination (UME) and Polytech-
nics and Colleges of Education Examina-
tion (PCE) has not solved the problem of
cheating. Often time, candidates employ
more hands from outside to assist in solving
different question-types and with the aid of
invigilators to distribute the answer in the
exam halls.

LITERATURE REVIEW
Examination malpractices as a form of cor-
ruption and corrupt practices have crept
into the fabrics of all levels of the educa-
tional enterprise in the country. According
to Olujuwon (2004), the Nigerian education
is in a state of confusion and disarray as a
result of inconsistencies, non-
implementation of educational policies, cor-
ruption and corrupt practices perpetrated
by the stakeholders. Olujuwon (2006) be-
lieved that Examination malpractice is ”any
act of wrong doing or neglect that contra-
venes the rules of acceptable practices be-
fore, during and after an examination by
 anybody in any way is tantamount to mal-
practices”. From the elementary school to
tertiary level, exam fraud is perpetrated in
one form or the other. The criminals are
not only the students. Other stakeholders in
education are guilty by design, default or
both (Opeyemi, 2004).

Researchers on examination malpractice
had argued and contributed to the basic fac-
tors responsible for examination malprac-
tice in Nigeria, opinion and facts are gath-
ered for this argument. Aina (1996) agreed
in his submissions that the desire to pass at
all cost is responsible for examination mal-
practice. To expatiate this manifestation,

Prof. Bello Salim, JAMB Registrar in 2002
said that thirty out of one hundred and sixty-
six examination towns were involved in
cheating and malpractice while forty-five
thousand four hundred and forty-eight can-
didates seeking University admission had
their results cancelled in the year 2002 be-
cause of examination malpractice (Olushola,
2007). Daily Champion (2007), reported that
five Principals of schools in Delta State listed
as centres for public examinations were
downgraded. The five schools according to
 the report were among the 334 de-listed na-
tionwide by the Federal Ministry of Educa-
tion for their alleged involvement in exami-
nation malpractices. Oyekanmi, (2005), as-
serted that this is quite unhealthy for the
educational sector. JAMB has been quoted
as saying: “the electronic-examination is to
help sanitize the shoddy conduct of exami-
nations in the country in which most
‘Mambites’ lack the academic rigour to
graduate” the body noted (The Tide, 2006).
It is believed that the idea of e-examination
is to reduce the stress and bottleneck as well
as the attendant problems associated with
the conduct of examinations by the body.

Electronic examination is of great interest
from both educational and pedagogical
points of view. It is aimed to resolve many
questions and limitations in the conventional
or traditional examination. It is flexible and
handy to use with complete question types
and excellent security strategy so as to make
e-examination automatic and reduce the
cost. It can be used for all kinds of different
scaled e-examination in different subjects’
primary, secondary and tertiary institutions
and in class examinations or exercises.

Due to the fact that examination is used as a
means of determining student’s ability, it is
therefore, paramount to continue to improve
on the previous method of conducting examination so as to have 100% secured examination. From literature, It is clear that students who were electronically examined performed better than those conventionally examined (Stergiopoulos et. al., 2006). This leads to this research work which is to design an N-type electronic examination that will handle multiple choice examination questions and administer an examination process effectively.

**DESIGN METHODOLOGY**

**Architecture for N-Type E-Examination System (NEES)**
The N-Type E-Examination System is developed using the Client/Server architecture. The client is the application designed to communicate with the database, which is the Server. The database is responsible for storing all information such as the Questions, all Questions type-set generated by some internal functions and all users unique identification number (UIN) with their subject type(s), answers and scores.

The main task of the N-Type E-Examination System is to generate multiple question types for a given subject and map these types to each candidate using the monotonic (1:1) mapping scheme such that candidates adjacent to each other do not have the same type even if they are taking the same subject examination.

Under the procedure design, the N-Type e-Examination System is made up of three components: the configuration phase, examination phase and the database. These components are shown in figure (1).
Within this engine, we define the degree of closeness between 2 types to mean the ordinal similarity between corresponding questions using their positional reference. Also, we define the Type Variance of a particular type, which is the overall effect of the degree of closeness of that type against all other generated types within the Type Set for that subject. Mathematically, this can be expressed as

\[
\text{Type Variance} = \frac{\sum \text{degrees of closeness}}{(n-1)}
\]

Where \( n \) is the type cardinality. A Type variance Value \( \mu \) for a particular type key is regarded as healthy if and only if \( \mu < 0.01 \). This means that if we have One Hundred (100) Question types in a type set for a subject that 100 candidates are to take, the likelihood of two students having the same type will be less than one (1%) percent.

N-Candidates-Types Mapping Engine

The other significant component of the system is the N-Candidate-Types Mapping Engine. This component is capable of mapping generated subject types to each student such that adjacent candidates offering the same subject may not be allocated the same type. This engine repeats this function for as many subjects registered by each candidate.

The algorithm for this procedure is as follows:

Algorithm for the N-Types Generator

Get subject type count information
For \( i=1 \) to \( |\text{subject type set}| \) (cardinality of type set)
  Assign a type element identifier for each type in the type set
  Create an array field column for its questions number set
Loop
  For \( i=1 \) to \( |\text{subject type set}| \) (cardinality of type set)
    Get the \( i-1 \) array field column \( FA() \) (if \( i=0 \), then the original question number order will be called i.e. 1,2,3,……,50)
    For \( j=1 \) to \( |\text{question No. Set}| \) (cardinality of selected question number set)
      If \( FA(j) \) mod 2 <>0 and \( FA(j) \) mod 3 <>0 then
        \( \text{Prime}(x)=FA(j) \)
        \( x=x+1 \)
      elseif \( FA(j) \) mod 2 <>0 then
        \( \text{even}(y)=FA(j) \)
        \( y=y+1 \)
      else
        \( \text{odd}(z)=FA(j) \)
        \( z=z+1 \)
      end if
    End if loop
  End if loop
For \( i=1 \) to \( |\text{Question Set}| \) (cardinality of Question set)
  Get the \( i-1 \) array field column \( FA() \) (if \( i=0 \), then the original question number order will be called i.e. 1,2,3,……,50)
  If \( FA(j) \) mod 2 <>0 and \( FA(j) \) mod 3 <>0 then


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Configuration Phase

The system will first have to be configured before it can be used for administering any examination. Firstly, the subject interface will appear where the examiner(s) will enter the number of subjects with subject identification for each subject that students will be examined on. Next is the Question/Type Interface where the number of Questions for each subject as well as the number of types they wish the system to generate will be entered into the system. For example, an examiner may have a subject A, with 30 questions and would like the question types to be 8.

When this is done, the next step will be an Interface that allows the examiner to specify either static/dynamic allocation of types to each candidate. If static is chosen, then the examiner will have to supply each candidate’s Unique Identification Number (UIN) together with the subject(s) to be taken by each candidate. If Dynamic allocation is selected, then it is the user that will supply this information during the examination phase. When this is done, the system will now generate a type-set for all subjects to be examined and allocate subject type to each candidate and this information will be stored in a database.

The configuration phase on the client-side involves four major sub-phases namely;

a. Students’ Registration: this function will authenticate users whenever they login and verify if they have previously participated in the examination process.

b. Room Information Entry/Seat allocation: This function will dynamically allocate seats to each registered candidate thereby filling up the room. The function will detect if a room has been filled up so that it can automatically move to the next room.

c. Subjects’ Information Entry: This function will allow candidates to select their pre-registered subjects and take part in the examination for that subject after a successful login. The routine just maps the type allocated to that students to the original question format in order to display the correct question. This engine also provides for a candidate who is seating for multiple subjects to switch between subjects while the time slot for the entire examination is still valid. The time remaining is displayed on top of the Title Bar for the Engine’s interface so that the candidate is abreast of time used. The engine automatically shuts out the student when the time slot expires.

d. Type Generation: This is the main component of the N-Type E-Examination system. This function is capable of creating an N-Type Question Set for each subject registered by an examiner. In designing this engine, the following constraints will be enforced:

   i. Types will be created based on the maximum number specified by the examiner.
   ii. Each Type generated will be allocated a Unique Type Identifier (UTI).
   iii. Each subject type will be generated based on a pivot key supplied by the examiner. The Value of the pivot key will be in the neighborhood of the midpoint of the total number of questions available for that subject.
   iv. Type keys will be filtered into even, odd and prime number arrays.
   v. Type keys will now be re-arranged into the type key list
   vi. Each type key will be saved along with the corresponding type list.
Algorithm to Compute Type Variance For Each Type Set Element

Select an \( i^{th} \) type element from the type set

Pivotal element = selected type element

For each type element in set excluding pivotal element

Select a \( j^{th} \) type element \( j \)-th array = selected type element

For \( x=1 \) to \(|\text{Question Set}|\)

If pivotalelement\((x) = j\)-tharray\((x)\) then

\[ \text{RepeatedOccurrence} = \text{RepeatedOccurrence} + 1 \]

End if

Loop

\[ \text{Likeratio} = \frac{\text{RepeatedOccurence}}{|\text{Question Set}|} \]

Loop

Pivotal type variance = \( \sum \text{Likeratio} / |\text{Type Set}| - 1 \)

Mapping of Subject Types to Students

Get subject information

Set NextType = type pointer

Get candidate’s type and seat number as \( j \)

For each candidate in room

If TypeOfCandidate\((j-1)\) or TypeOfCandidate\((j+1)\) = NextType then

NextType = typepointer + 1  'get next type in order

End if

TypeOfCandidate\((z) = \text{TypeSet(NextType)} \)

Typepointer = typepointer + 1

Mark and Grade Candidates Performance

Get all candidates performance in selected subject

For \( i=1 \) to total number of candidates

For each question

If answer chosen = answer expected then

\[ \text{RightAnswer} = \text{RightAnswer} + 2 \]

Else

If answer chosen is not blank then

\[ \text{Missed} = \text{missed} + 1 \]

End if

End if
\textbf{Examination Phase}

There will be a login interface where users (candidates) are able to access the examination module. The typical security for this area will be that each student is expected to login with a Unique Identification Number (UIN). If during the configuration phase the examiner selected dynamic allocation, then when the user gains access to the system, the subject interface will appear where the user will select the subject(s) to be taken. After this interface, the system now dynamically maps subject(s)-type(s) to the candidate and the examination clock begins to count down as the student answers each question. Since the Format for each Question is Multiple Choice Answer, the Candidate just enters an appropriate letter corresponding to an option in a white coloured answer box. This box automatically shades itself when an option is entered and reverses back to white when the option is erased. The user may go back and forth to view each question for each subject and may submit all answers whenever it is desired. However, if the Examination Clock Located on the Title Bar of the Window expires, then the user will be automatically disabled from doing any more work while the Test-Engine collects all answers supplied by the user.

\textbf{Database}

Each entry made by the each candidate for all subjects both correct and incorrect options are collated and stored in the database. The database consists of various relational tables used for data storage and management. Some of these tables are Subject Table, Candidate Table, SubjectCode & Type, SubjectCode & Q, WorkingInfo, Subject_Answered, Subcode & TypeInfo, studentSeatMap, SeatingPlan. The architecture of the database are highlighted using the schematic diagrams in table (1 – 9).

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Field name} & \textbf{Description} \\
\hline
SubCode & Code for each subject and Primary key for the table \\
Subtitle & Title of the subject \\
QuestionCount & Number of Questions In Set \\
TypeCount & Number of Types to be Created for this Subject \\
Types Prepared & If Types have been created or not \\
Next Assigned & Next Type to be assigned \\
\hline
\end{tabular}
\caption{Subjects Table}
\end{table}
Table 2: Candidates Table

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration No</td>
<td>Candidate's Unique Identification Number</td>
</tr>
<tr>
<td>Surname</td>
<td>Candidate’s Surname</td>
</tr>
<tr>
<td>First Name</td>
<td>Candidate’s First Name</td>
</tr>
<tr>
<td>Gender</td>
<td>Gender</td>
</tr>
<tr>
<td>Telephone</td>
<td>Telephone Number of candidate/guardian</td>
</tr>
<tr>
<td>Address</td>
<td>Residential address</td>
</tr>
<tr>
<td>Picture</td>
<td></td>
</tr>
<tr>
<td>Authenticated</td>
<td>Determines if candidate has been verified by administrator (YES/NO)</td>
</tr>
<tr>
<td>Exam Status</td>
<td>Determines candidates status during the examination (NOT YET TAKEN/COMPLETED)</td>
</tr>
</tbody>
</table>

Table 3: “SubjectCode” & _TYPES

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Primary key of table</td>
</tr>
<tr>
<td>Typed(i)</td>
<td>Dynamically created Field(s) for each element in type set for all subjects and i&lt;=n where n is the type cardinality</td>
</tr>
</tbody>
</table>

Dynamically created table that contains information about the question order for each type created. Table Cardinality increases as the number of types increases. Each subject has its own typeInfo.

Table 4: “SubjectCode” & Q

<table>
<thead>
<tr>
<th>Field Id</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question No</td>
<td>Question number and primary key for table</td>
</tr>
<tr>
<td>File</td>
<td>Corresponding file containing details of question</td>
</tr>
<tr>
<td>Answer</td>
<td>Answer to that question</td>
</tr>
</tbody>
</table>

Dynamically created table for each subject to hold information about each question for that subject.

Table 5: Working Info

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>Primary key</td>
</tr>
<tr>
<td>Registration No</td>
<td>Candidate’s Unique Number</td>
</tr>
<tr>
<td>Sub-Code</td>
<td>Subject code for subject taken by candidate</td>
</tr>
<tr>
<td>QNumber</td>
<td>Number corresponding to the question to be attempted</td>
</tr>
<tr>
<td>Ans Chosen</td>
<td>Answer Selected by Candidate</td>
</tr>
<tr>
<td>Ans Expected</td>
<td>Answer Expected by the System</td>
</tr>
<tr>
<td>Validation</td>
<td>Validates User Supplied Answer to see if Right/Wrong</td>
</tr>
</tbody>
</table>

This table contains Selected Options for questions attempted by candidates during the examination.
Table 6: Subjects Answered

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Id</td>
<td>Primary key</td>
</tr>
<tr>
<td>Registration No</td>
<td>Candidate’s Unique Number</td>
</tr>
<tr>
<td>Sub Code</td>
<td>Code for selected subject</td>
</tr>
<tr>
<td>Type Taken</td>
<td>Code for type assigned to candidate</td>
</tr>
<tr>
<td>Score Obtained</td>
<td>Stores Percentage Scored by candidate in this Subject</td>
</tr>
</tbody>
</table>

Table 7: “SubCode” & _TYPEINFO

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type Id</td>
<td>Code for each type generated and primary key</td>
</tr>
<tr>
<td>Variance</td>
<td>Stores Variance computed for each type created</td>
</tr>
</tbody>
</table>

Table 8: Students SeatMap

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registration No</td>
<td>Candidate’s UIN and primary key</td>
</tr>
<tr>
<td>Room No</td>
<td>Room allocated</td>
</tr>
<tr>
<td>Row No</td>
<td>Row allocated to candidate</td>
</tr>
<tr>
<td>Seat No</td>
<td>Seat number in room allocated</td>
</tr>
</tbody>
</table>

Table 9: Seating Plan

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room No</td>
<td>Room Identification Number</td>
</tr>
<tr>
<td>Expected No</td>
<td>Number of candidates to use this room</td>
</tr>
<tr>
<td>Row Count</td>
<td>Number of candidates to seat per row</td>
</tr>
<tr>
<td>Available</td>
<td>Number of Seats unallocated</td>
</tr>
</tbody>
</table>

Implementation Procedure

The two (2) categories of software used are the system software and the application software. The system software consists of the operating system which was Windows XP professional Service Pack 2. The application software architecture is further subdivided into three categories; the programming language aspect in which Visual Basic 6.0 was used to build the client side architecture, the Microsoft Access database system used to develop the Server Side architecture and Structured Query Language (SQL) used as the Major Link Platform between the Client Side and Server side. The data used for the implementation was collected from the past questions of Universities Matriculation Examination (UME) conducted by Joint Admission Matriculation Board (JAMB), Nigeria. The output contains the following information: List of all registered Candidates, Analysis of Type Variance for Subject, Subject Type’s Allocation Schedule, and Seats Allocation Schedule. Figure (2) shows the flowchart/design view of the N-Type Electronic Examination System.
Figure 2: Design View of the N-Type E-Examination System
Interface Design
This is done with a deep sense of creativity and artistic effort to make the interfaces as interactive as possible and thereby ensuring that the user comprehension is unambiguous. Figures (3 & 4) show the administrative and candidate console. On the Console, there are various tasks that have been labeled to guide the user. Each task is initiated by clicking on the arrow pointing to its label.

Figure 3: Administrator Console

Figure 4: Candidate Console
Under the Administrator’s Console in figure (3), we have the following tasks:

**Subjects Configuration Area**
This allows you to enter a new subject into the system database. To create a new subject profile, you will need the subject title, number of questions to be answered and number of types to be generated for the subject.

**Rooms Configuration Area**
This area allows the administrator to specify the number of rooms to be used for the examination. To complete the information you will be required to supply the number of rooms to be used for the examination, the number of students in each room, the number of students to seat per row, time duration (in hh:mm:ss) for the examination and the time of commencement for the examination.

**Question by Question Set up Area**
This area allows you to specify the questions set for each subject. To accomplish this, first select a subject from the subject list and then click on the “Get Subject Info” Button. Once this is done, a text screen appears where you can type your questions and also the correct option letter to each question. You can also add diagrams to each question as desired. The previous and Next Buttons allows you to move to the previous or next question as required. As you click on either of these buttons, your questions are automatically saved to the database. Mark is assigned to each question for a particular subject in the subject mark area and this is automatically updated in the database.

**N Types Question Generator**
This engine allows you to generate the N-Type Set for each subject. First select the subject title from the subject list then click on “Get Subject Info”. If the type set for this subject has been previously generated, the “View Type Variance Report” button will appear where you can view the analysis of type variance generated for the subject. You may wish to delete the previous generated values by clicking on “Reset Values”. Before you can generate type set for a subject, you must first enter a pivot element, which the range has already been given. After this is done, then click on generate types. A message will appear prompting the user if the analysis of type variance is to be done. Just answer yes to do the analysis. After completion, you may view the report.

**Candidates Registration Area**
This area allows administrators to register candidates for the examination. The information to be collected here includes candidate’s name, address, telephone number and passport photograph. The photograph is a precondition for registration as it will be used for authentication. Either a scanner or digital camera may be used to upload the photograph.

**Authenticate a Candidate**
Before a Candidate can access the examination area; he/she must have been authenticated by the administrator. Authentication requires the entering of the candidate’s registration number in the pop up menu that will appear. To grant access, just click on the allow access option. To deny access, just click on the deny access option. Click close window to exit authentication Window.

**Subjects Marking Area**
This area allows administrators to automatically mark and grade examination perform-
ance for all students per subject. Just select the subject from the subject list and click on the “Mark and Grade Subject” Button. If you wish to apply negative marking, just check the negative marking box and enter the value to be deducted on each incorrect question. After you have done this, you may click on the “Preview Results” button to preview all students’ performance in a selected subject.

**Candidates Results Preview Area**
This area allows a candidate to preview his/her performance in all subjects taken during an examination. Just enter the candidate’s registration number and click on the “Preview results” button.

**Preview Candidates Type Mappings**
This section allows Administrators to preview how the various subject types have been mapped to each candidate. Preview may be done by room or by subject.

**Preview seating plan**
This section allows administrators to preview how the students have been allocated seats in a room. Just select a room number and click on the “Preview Seating Arrangement” button.

**Questions Types Preview**
This area allows administrators to preview question types and print them out incase there has been a situation where the e-examination implementation is no longer feasible. The procedure for doing this is as follows:

a. Select the subject title
b. Click on “Get Subject Info” button
c. The Back and Forward buttons allows you to scroll through the type set.
d. The “Preview Hard Copy” allows you to preview the type structure for the type identified by the current number appearing above the back and forward buttons.

The “Print Hard Copy” allow you to print the type structure for the currently viewed type. The output will be sent immediately to the default printer.

**Logout from Admin Console**
Takes you out of your status console to the Select Status Gate.

For the Candidate’s Console area in figure (4), the two tasks available to them are:

**Candidates’ Registration Area**
In this area, candidates are expected to register for their subjects of choice. All that is required by the candidate is for him/her to select a subject from the list on the left by clicking it and use the > button to move it to the right. After this has been done, click on the “register Candidates for selected Subjects” button to complete subject registration. After this has been done, the candidate may now proceed to the e-Examination console which is the testing area. Once the candidate gets here, he/she is expected to click on the “Start Test Engine” button to commence the examination proper. However, the engine will be started if only the candidate has been authenticated by the administrator in charge.

**Test Engine**
The interface for the test engine allows a candidate to switch between subjects, save current selections and exit the testing area completely. Also, the time duration for the examination is appearing on the title bar of the test engine window to allow students keep track of their time spent. All the subjects the student has registered for appear at the top left-hand corner of the test engine.
RESULTS AND DISCUSSION
In this work, the running and testing of the design was carried out and the summary of the result are shown in tables 10 to 13.

Logout from Candidate’s Console
Takes a candidate out of your status console to the Status Gate.

Table 10: List of all registered candidate

<table>
<thead>
<tr>
<th>Registration No</th>
<th>Name</th>
<th>Gender</th>
<th>Telephone No</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG481Z1038H</td>
<td>Olakunle Lola</td>
<td>Female</td>
<td>08065443212</td>
</tr>
<tr>
<td>GG488Z1038H</td>
<td>Otobo Lawrence</td>
<td>Male</td>
<td>08023658790</td>
</tr>
<tr>
<td>GG495Z1038H</td>
<td>Olowofoyeku</td>
<td>Male</td>
<td>08023765443</td>
</tr>
<tr>
<td>GG502Z1038H</td>
<td>Olagunju Samuel</td>
<td>Male</td>
<td>08023541287</td>
</tr>
<tr>
<td>GG509Z1038H</td>
<td>Olawale Samuel</td>
<td>Male</td>
<td>08023564532</td>
</tr>
<tr>
<td>GG516Z1038H</td>
<td>Enowa Caroline</td>
<td>Female</td>
<td>08023657912</td>
</tr>
<tr>
<td>GG523Z1038H</td>
<td>Olonisakin Adura</td>
<td>Female</td>
<td>08055343219</td>
</tr>
<tr>
<td>GG530Z1038H</td>
<td>Adegbenro David</td>
<td>Male</td>
<td>08023764553</td>
</tr>
<tr>
<td>GG537Z1038H</td>
<td>Popoola Aliu</td>
<td>Male</td>
<td>08023654376</td>
</tr>
<tr>
<td>GG544Z1038H</td>
<td>Banjo Alice</td>
<td>Female</td>
<td>08055435631</td>
</tr>
<tr>
<td>GG551Z1038H</td>
<td>Buhariheleen</td>
<td>Female</td>
<td>08023547612</td>
</tr>
<tr>
<td>GG558Z1038H</td>
<td>Adualer Grace</td>
<td>Female</td>
<td>08055478790</td>
</tr>
</tbody>
</table>

Total Number Registered 12
In Table10, the list of all registered candidates is generated by the system for the administrator verification.

Table 11: Analysis of Type Variance of Question Set : Physics

<table>
<thead>
<tr>
<th>Type Number</th>
<th>Type Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.0072</td>
</tr>
<tr>
<td>2</td>
<td>0.0102</td>
</tr>
<tr>
<td>3</td>
<td>0.0068</td>
</tr>
<tr>
<td>4</td>
<td>0.0112</td>
</tr>
<tr>
<td>5</td>
<td>0.0085</td>
</tr>
<tr>
<td>6</td>
<td>0.0072</td>
</tr>
<tr>
<td>7</td>
<td>0.0051</td>
</tr>
<tr>
<td>8</td>
<td>0.0051</td>
</tr>
<tr>
<td>9</td>
<td>0.0051</td>
</tr>
<tr>
<td>10</td>
<td>0.0051</td>
</tr>
<tr>
<td>11</td>
<td>0.0085</td>
</tr>
<tr>
<td>12</td>
<td>0.0111</td>
</tr>
</tbody>
</table>

In Table 11, the Type Variance for a particular type key is less than 0.01, meaning that if we have one hundred question types in a type set for a subject that 100 candidates are to take, the possibility of two candidates having the same type of question will be less than 1%.
Table 12: Seat Allocation Schedule for Student in the Exam Room
Room Number:  1 Candidates Expected:  30

<table>
<thead>
<tr>
<th>Row</th>
<th>Seat No</th>
<th>Registration Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>14</td>
<td>GG558Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>15</td>
<td>GG551Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>GG544Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>17</td>
<td>GG537Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>GG530Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>GG523Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>GG516Z1038H</td>
</tr>
<tr>
<td>4</td>
<td>21</td>
<td>GG509Z1038H</td>
</tr>
<tr>
<td>5</td>
<td>22</td>
<td>GG502Z1038H</td>
</tr>
<tr>
<td>5</td>
<td>23</td>
<td>GG495Z1038H</td>
</tr>
<tr>
<td>5</td>
<td>24</td>
<td>GG488Z1038H</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>GG481Z1038H</td>
</tr>
</tbody>
</table>

In Table 12, the room and seat number are dynamically allocated to each registered candidate thereby filling up the room. The system will detect if a room has been filled up (the expected number of student per room is 30) so that it can automatically move to the next room. The room and seat no are allocated by the system for the candidate to sit for the e-exam.

Table 13: Subject Types’ Allocation Schedule
Subject:  Physics

<table>
<thead>
<tr>
<th>Registration No</th>
<th>Room No</th>
<th>Seat No</th>
<th>Type Allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GG558Z1038H</td>
<td>1</td>
<td>14</td>
<td>D28A</td>
</tr>
<tr>
<td>GG551Z1038H</td>
<td>1</td>
<td>15</td>
<td>Q41A</td>
</tr>
<tr>
<td>GG544Z1038H</td>
<td>1</td>
<td>16</td>
<td>J94A</td>
</tr>
<tr>
<td>GG537Z1038H</td>
<td>1</td>
<td>17</td>
<td>E29A</td>
</tr>
<tr>
<td>GG530Z1038H</td>
<td>1</td>
<td>18</td>
<td>K10A</td>
</tr>
<tr>
<td>GG523Z1038H</td>
<td>1</td>
<td>19</td>
<td>R42A</td>
</tr>
<tr>
<td>GG516Z1038H</td>
<td>1</td>
<td>20</td>
<td>L11A</td>
</tr>
<tr>
<td>GG509Z1038H</td>
<td>1</td>
<td>21</td>
<td>S43A</td>
</tr>
<tr>
<td>GG495Z1038H</td>
<td>1</td>
<td>22</td>
<td>M12A</td>
</tr>
<tr>
<td>GG551Z1038H</td>
<td>1</td>
<td>23</td>
<td>F30A</td>
</tr>
<tr>
<td>GG488Z1038H</td>
<td>1</td>
<td>24</td>
<td>N13A</td>
</tr>
<tr>
<td>GG481Z1038H</td>
<td>1</td>
<td>25</td>
<td>T44A</td>
</tr>
</tbody>
</table>

In Table 13, the system generate different variant of type-question set for all subjects to be examined and allocate subject type to each candidate such that the type identification will be hidden to both the candidate as well as the examiner in order to ensure the integrity of the exam.
CONCLUSION

This work presents a solution to the problems of conventional examination. We have been able to design and implement an N-type examination system, a system that is able to:

(a) Generate different variants of a question set for each subject such that each type's identification will be hidden to both the candidate as well as the examiner in order to ensure the integrity of the exam.

(b) Promote transparency of an examination process by making available a real time analysis of student’s performance.

(c) Reduce the administrative costs/overhead associated with a manual process of examination.

(d) Simplify the overall process of examination administration by lighting the burden on the examiners so that they can concentrate on other professional duties.

(e) Develop a process that will evaluate each candidate’s performance and save information.

Based on the implementation of our approach, we have derived performance results that indicate that using an N-type electronic examination can address the major problems of conventional examination. Our algorithm successfully administered an examination process effectively.

REFERENCES


Oyekanmi, R. 2005. “Exam Malpractices forces JAMB to cancel 95,000 Results”, Guardian Newspaper, Thursday July 28th 2005. 2


The Tide, 2006. “JAMB and e-Examination” May 20, 2006. 4


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