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Applying Context, Input, Process & Product (CIPP) Model for Performance Evaluation in E- Examination Systems

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Abstract
The paper and pen (manual) method of writing examination may not be appealing for use because of the problems usually experienced as a result of human error and other factors, which necessitate the need for automation of the examination system. The electronic examination system on the other hand needs some evaluation in order to determine its suitable functionality. This paper is concerned with evaluating and redesigning an e-exam system using a context, input, process, product (CIPP) evaluation model. Research conducted during the redesign of the e-exam followed a mixed methodology in which data was collected through a CIPP survey and focus-group interview. An initial CIPP survey sent to students, which had a response rate of approximately 75%, indicated that the e-exam system did not fully meet the needs of students. Based on these findings, the decision to improve on the design of e-exam software and the environment was agreed on. Accordingly, the system was redesigned with better supportability function, readability function, availability function, usability and security function while the hall was design with good chairs and tables for convenience and conducive atmosphere. The Visual C# was used as the programming language for the implementation of the design. The results indicated that most students were pleased with the newly designed version of the e-exam system.

Keyword: Electronic Examination System, CIPP Model, Visual C#

Aims Research Journal Reference Format:
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1. INTRODUCTION

The examination system has evolved through the years, from the manual or paper and pencil test examination to the use of optical mark reader (OMR) and optical character recognition (OCR). The optical mark reader was very fast at computing result but lacked integrity with attendant errors (Orchard, 1998).This system gradually evolved to the use of computer based examination generally known as the Electronic Examination System (EES). The electronic examination system was more effective and efficient than the Optical mark reader because it has the capacity of computing result immediately after submission. The electronic examination though was a much more improved system but still lacked confidentiality (Karimi et al., 2009). The paper and pen (manual) method of writing examination, which has been in existence for decades, may not be appealing for use because of the problems usually experienced including examination venue capacity constraints, lack of comfort for examination candidates, delay in the release of results, examination malpractices, cost implication of printing examination materials and human error (Fagbola et al., 2013). These problems necessitate the need for automation of the examination system. Over the years, various automated examination systems have been developed with one or more limitations. Some of these limitations include; lack of scalability, near-realibility, lack of robustness and lack of flexible timing functionality to automatically log-off candidates upon expiration of allotted time as challenges (Ipaye, 2009), malpractice due to questions not randomly generated (Ayo et al., 2007) and not well secured application domain in terms of data security and integrity (Levy & Ramim, 2007).

One of the effective models that have been used in the past to improve the educational system is the CIPP model. Monchai and Promote (2013), introduced a multiple intelligences supported web-based collaborative learning model using Stufflebeam's CIPP evaluation model that employed mixed innovations consisting the web-based learning, the collaborative learning technique and the Stufflebeam's CIPP evaluation model. While Hatice et al. (2013) evaluated and redesigned an online master's degree program consisting of 12 courses from the informatics field using a context, input, process, product (CIPP) evaluation model. Unfortunately, the CIPP model has not been used in the area of electronic examination system; this is a gap in knowledge that this study tends to fill.

Preliminary investigation of the operation and conduct of electronic examination in tertiary institutions especially in TASUED revealed that in spite of the strategic role and numerous benefits offered by the e-exam like eliminating examination malpractices, real time release of results, eradication of missing results or scores and many more. It is believed generally that the electronic examination system needs to be improved on, in order to increase the acceptability of electronic examination. Consequently, there is need for continuous review and improvement of the TASUED e-exam system based on the feedback from the stakeholders perceptive. It is against this background that this study aimed at evaluating TASUED electronic examination (e-exam) platform as well as redesigning it based on the findings from using the Context, Input, Process, Product evaluation (CIPP) model.

2. PURPOSE AND RESEARCH QUESTIONS OF THE STUDY

This study aimed to evaluate and redesign an electronic examination system using the CIPP model. Four main research questions guided the study:

1. What are the needs of e-exam system stakeholders (i.e students, lecturer, invigilator and management)?
2. What strategies and activities have been planned and put in place to address these needs?
3. How should the e-exam system be redesigned to better meet the needs of stakeholders?
4. What are the students', lecturers' and invigilators' perception on the modifications made to e-exam system?

3. METHODOLOGY

A mixed methodology research design was used for this study. The mixed method research design is a procedure for collecting, analyzing, and "mixing" both quantitative and qualitative research and methods in a single study to understand a research problem. To utilize this design effectively, one must understand both quantitative and qualitative research. According to Creswell & Clark (2007), mixed methodology research involves philosophical assumptions that guide the direction of the collection and analysis of data and the mixture of qualitative and quantitative approaches in many phases in the research process.

3.1.1 Quantitative Aspect of the research

A structured questionnaire was sent to some students in TASUED as one of the stakeholders of the electronic examination system to gather their view on the existing electronic examination system.

3.1.2 Qualitative Research

An interview was conducted with some lecturers, invigilators, technical administrators and management staff members to gather their view on the unmet opportunities in the electronic examination system.

3.2 Sampling Procedure And Participants

Defining sampling procedures is an important step in research because it indicates the quality of the inferences made by the researcher with regard to the research findings (Collins et al, 2006). In this study, descriptive survey and criterion sampling procedures were applied, because the aim was to evaluate, redesign and feedback the management in the area of electronic examination system. A total number of 200 students were randomly selected. While 10 invigilators and 8 technical personnel and 10 lecturers from the lecturers that taught GNS courses in Tai Solarin University of Education took part in this study.

3.3 Instrumentation

The CIPP survey used in Phase 1 of the study was prepared based on two surveys in the literature, these include study done by Stufflebeam, (2007) and Shi, (2006) and was checked by two experts. The instrument used consists of two parts. Part 1 contains four questions pertaining to demography of the participants; whereas Part 2 contains 22 statements about the Computer Based Examination with a 5-point-Likert scale (strongly agree to strongly disagree).

3.4 The Implementation of The Cipp Model

The present study consists of four main phases of the CIPP model, which comprises the context evaluation, input evaluation, process evaluation and product evaluation. Quantitative and qualitative approaches were also applied in consecutive phases, with the results of one phase influencing the process and application of subsequent phases. An overview of the application of the CIPP model is shown in figure 1.

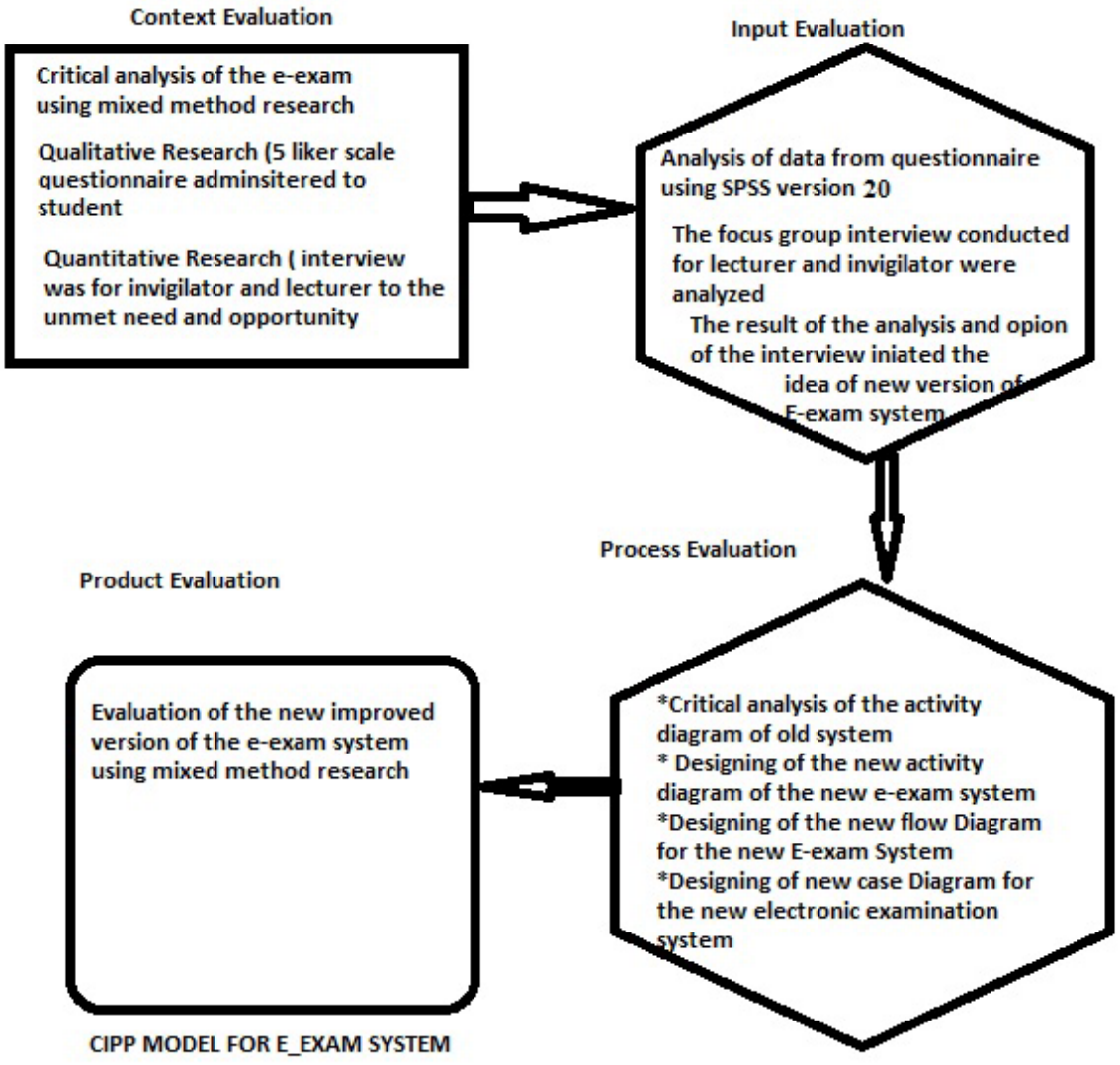

Figure 1: Overview of CIPP Model in Electronic Examination

3.4.1 Context Evaluation

The context evaluation serve as planning decisions by identifying unmet needs, unused opportunities and underlying problems that prevent the meeting of needs or the use of opportunities. In this phase the research was conducted using a qualitative and quantitative study on some of the stakeholders (administrators, invigilators, lecturers and students) to study the existing system. In context evaluation, the study focused on introduction and objectives of the present electronic examination system and unmet needs of the stakeholders. The Electronic Examination System consists of hundred (100) mini laptops that are connected to a server through wireless connection (Fig 2).

The electronic examination system of TASUED has the following objectives:

1. Provision of equal and better examination environment for stakeholders
2. Provide a software that is supportive, useable, reliable, secured and available

In this Phase, the CIPP survey was sent to some students of TASUED that enrolled for GNS exam. Of these, 70% returned the surveys. A structured interview was conducted to technical administrators, lecturers and invigilators to gather their view on the existing electronic examination system. As all information systems should undergo continuous review and improvement, the need became obvious to review the existing electronic examination platform using the high successful CIPP model.

Firstly, the stakeholder of the e-exam system were identified and by sending CIPP survey to them the unmet opportunities and challenges were harnessed to help further improve the system. The lecturers were interviewed on the unmet need and challenges. The students' opinions were sampled using 5 point liker type of questionnaire, issues and challenges experienced by students were extracted; while invigilators were interviewed on their perception on the system and their views were noted.

3.4.2 Input Evaluation

The input evaluation serves as structuring decisions by projecting and analyzing alternative procedural designs. It also considers the benefit and cost analysis of the system. In this phase data gathered from context evaluation through the CIPP survey sent to the stakeholders were analyzed using SPSS version 20. The focus-group interview conducted in the study consisted of semi-structured interview questions that were checked by two experts. The main questions used were designed to obtain stakeholder opinions about the usability design of the computer-based test as well as their suggestions for improving the course. The finding indicated that the platform did not completely meet the stakeholders' (students, lecturers and invigilators) needs in an examination. All these factors prompted the decision that initial improvements to the present electronic examination system should focus on the improving the entire EES accordingly

Figure 2: Overview of the present electronic examination system centre in TASUED

3.4.3 Process Evaluation

The process evaluation implements decisions by monitoring project operations and identifying the defects in the current designs and implementation. A focus group discussion was organized among the lecturers, invigilators and technical administrators to see whether the current design align with the information gathered from the previous evaluation (context and input). A critical observation of the activity flow diagram of the initial system (Fig 3) was carried out with some of the stakeholders to see how it can be improved upon.

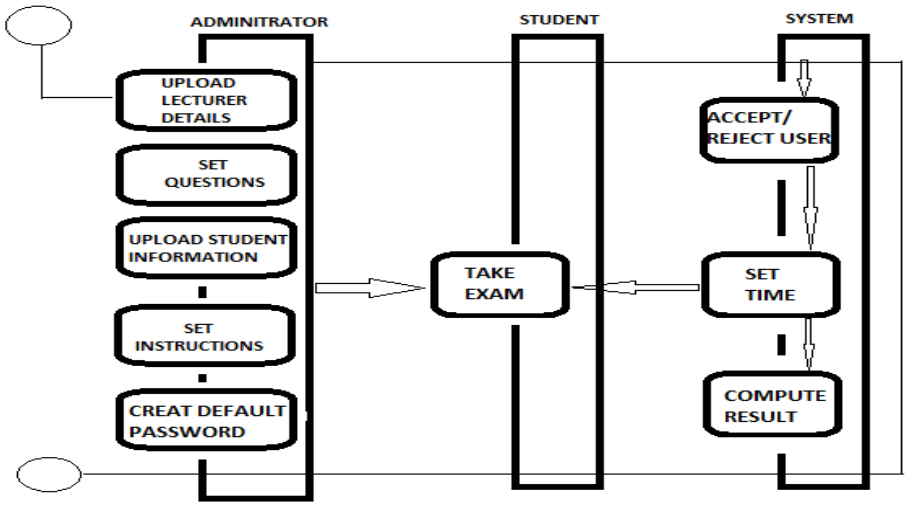

Figure 3: Activity Diagram flow of the initial system

The results of this interview and their recommendations were adequately noted which later influenced the decision to implement user friendly e-exam platform with the Activity Diagram of the improved version of the electronic examination (Fig 4).

3.4.3.1 Activity Diagram for the New E-Exam System

Activity diagrams are graphical representations of workflows depicting stepwise activities and actions with support for choice, iteration, and concurrency. In the unified modeling language, activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control. Figure 3 presents the activity diagram for the improved version of the Computer Based Test (CBT) system developed. The administrators are saddled with the responsibility of uploading lecturers' detailed information, uploading the students' information and creating default password. Lecturers are responsible for uploading questions and instructions into the system. Investigator will check the candidate and oversee the exam to avoid impersonation and checking in the examination. The students login to the system to take the examination. The system could accept or reject the user; could set the timer and could finally compute the results.

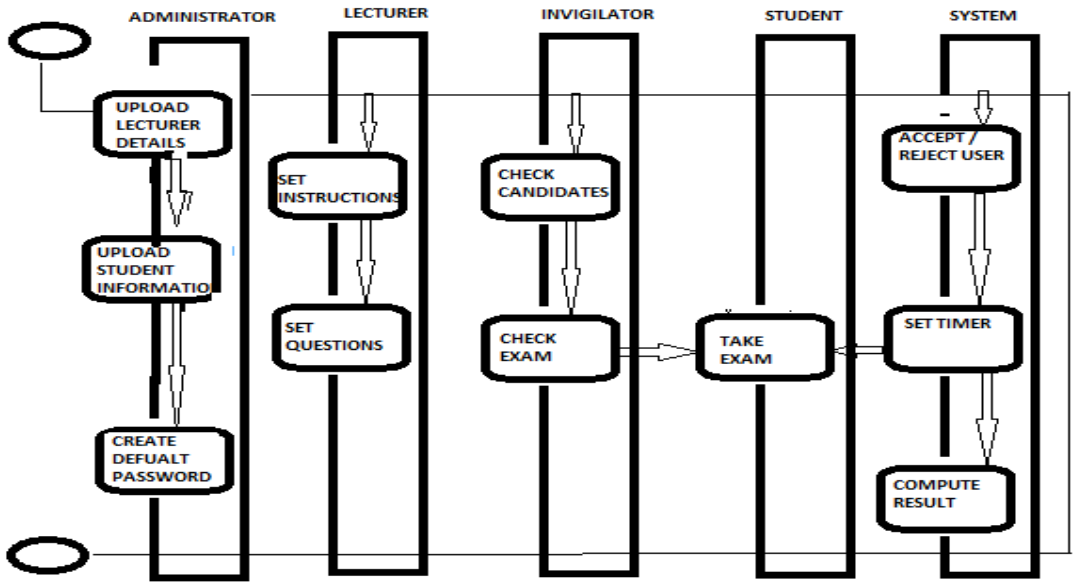

Figure 4: Activity diagram for the e-exam system

3.4.3.2 Data Flow Diagram (DFD) for the Improved E-Exam System

A data flow diagram (DFD) uses very limited number of primitive symbols to represent the functions performed by a system and the data flow among the functions. Starting with a set of high-level functions that a system performs, a DFD model hierarchy represents various sub-functions. The data flow diagram depicted in figure 5 below shows the relationship among the entities in the CBT system. The entity "STUDENT" could take examination after he or she gains access to the system. The entity "LECTURER" could upload questions to be answered by students into the CBT database using any preferred question format, could set the examination instructions and could configure the correct options or set of options for the questions. The entity "TECHNICAL ADMINISTRATOR" is saddled with the responsibility of inserting students, lecturers and invigilators and setting the default password for the users of the system. The entity "INVIGILATOR" is saddled with the responsibility of checking the candidate's identification to avoid impersonation, ensuring that the candidate took the right examination and ensuring that students leaves the examination hall after the examination. The entity "SERVER" is responsible for authenticating the users of the system and providing the timing functionality for the examination. The system logs off a student upon expiration of the time for the exam.

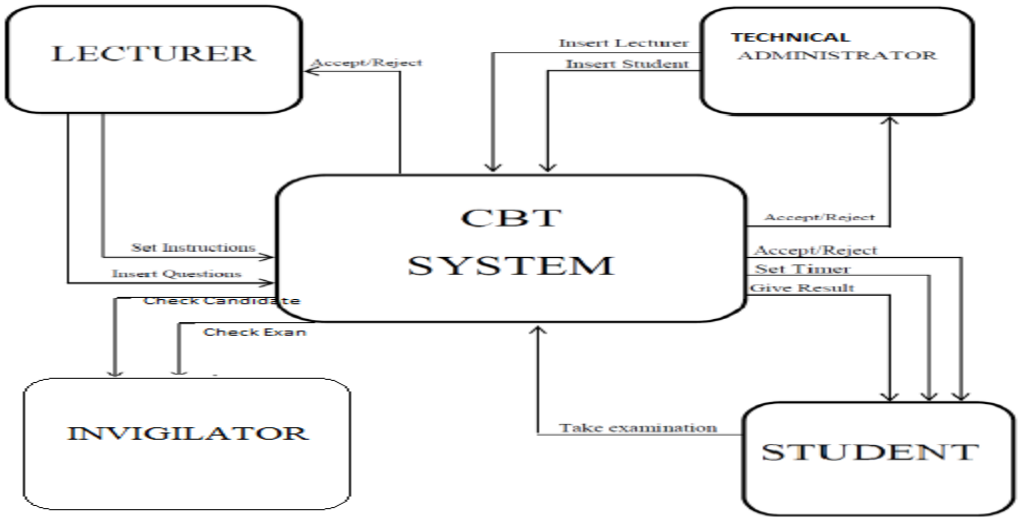

Figure 5: Data flow diagram for the CBT system

3.4.3.3 Use Cases Diagram for the New E-Exam System

Use cases diagram for each entity present in the CBT system is presented here. These include use cases diagram for the administrator, lecturer, system, invigilator and student. The use cases diagram for the administrator is presented in figure 6 to figure 9. They show the activities that are required of each stakeholder.

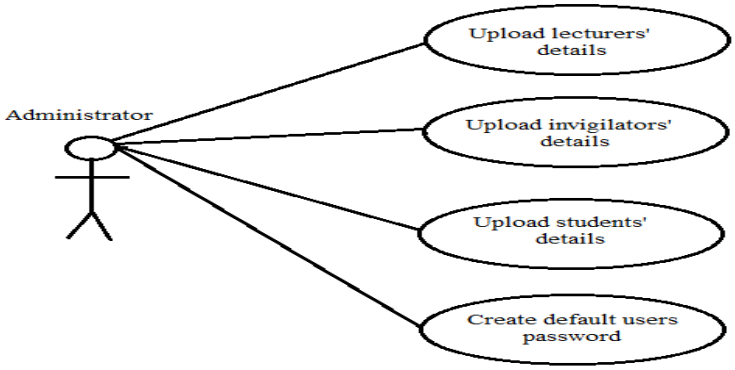

Figure 6: Use cases diagram for the new CBT Administrator

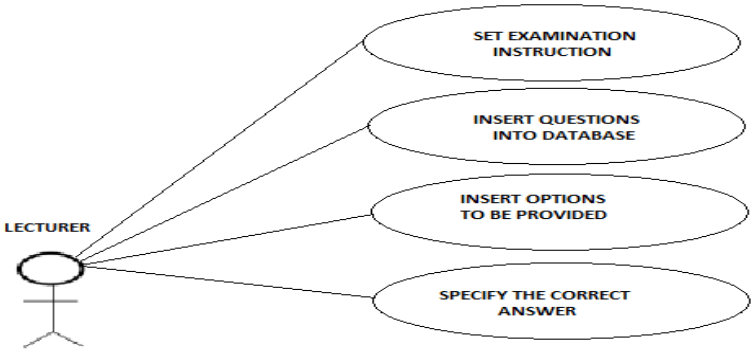

Figure 7: Use cases diagram for the Lecturer

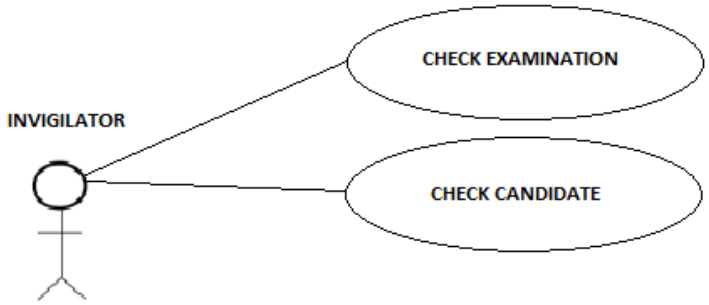

Figure 8: Use cases diagram for the Invigilator

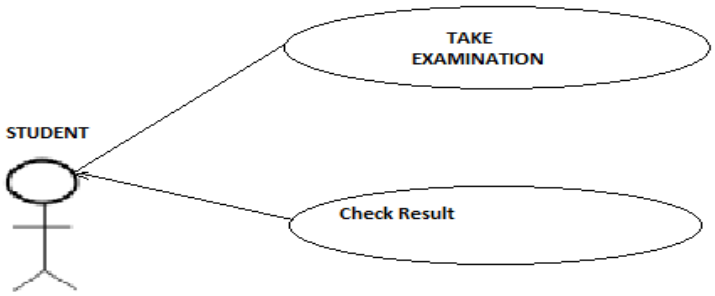

Figure 9: Use cases diagram for the Student

3.4.4 Product Evaluation

The product evaluation recycles decisions by determining the degree to which objectives have been achieved and by determining the cause of the obtained results. In this stage of the study, modifications to the computer-based test were implemented and the students who took part in the e- exam were sent an open-ended form to fill out pertaining to their observation about the modifications made to the e-exam platform. The open-ended form used consisted of five open-ended questions designed to obtain students' opinions about the modifications to the electronic examination. This form was checked by an expert, revised accordingly, and the revised version of the e-exam platform was used in the study.

3.5 Validity Of The Research

Wallen and Freankel (2001) stated that researchers should focus on collecting reliable and valid data using instruments. For this reason, the researchers developed the instruments used in this study in consultation with experts in order to ensure content-related validity. Moreover, reliability of the instrument was checked by implementing a pilot survey with Computer Based Examination students

4. RESULTS AND DISCUSSION

4.1 Context Evaluation

The operation of the implemented TASUED EES was assessed through the analysis of the CIPP 5-likert-scale questionnaire, which revealed that from the 200 questionnaires administered to Tai Solarin University of Education students. As shown in table 4.1, majority of the respondents were males (60.0%), while the remaining were females (40.0%), the table also shows that majority of the student who took part in the survey were in their final year (400 level); this is advantageous to this research as it will ensure accurate information concerning the electronic examination system of the university.

The table further shows that majority of the respondents were between the ages of 20-24 (54.0%). The analysis of the survey questions focused on five main areas that included the supportability, reliability, availability, usability and security of the electronic examination system.

Table 4.1 Demographic Information of Students

Sex	Frequency	Percent
Male	120	60
Female	80	40
Total	200	100
Educational Level	Frequency	Percent
200	44	22
300	30	15
400	126	63
Total	200	100
Age	Frequency	Percent
less 20	34	17
20 to 25	108	54
25 to 30	46	23
above 30	12	6
Total	200	100

4.1.1 Supportability of the Electronic Examination System

When asked about the supportability of electronic examination system, majority of students pointed out that the system was not well designed with good help facilities (64.0%), the graphics user interface of the e-exam system does not help to understand the system better (72.5%). Furthermore, majority of the student disagreed that the electronic examination system was designed in a way that students will know that options checked were successfully added (57.5%). While majority of the student were of the opinion that the electronic examination system was not designed for easy management of questions (52.5%) this goes to show that the electronic examination system did not possess the ability to provide information that were helpful for identifying and resolving issues when it fails to work correctly. Hence, the e-examination system Supportable need to improve upon (Table 4.2).

4.1.2 Reliability of the electronic examination system

The analysis of the questionnaires revealed that the electronic examination system was not reliable at all time in assessing and answering questions based on the opinion of most respondents (63.0%). Majority of the student disagreed that the electronic examination system was error free when being operated (80.0%), while majority of the student agreed that the electronic examination system does not provide easy examination access (57.5%). On the other hand, majority of the student agreed that the electronic examination system facilitated early release of results but not instantly (56.5%). This goes to show that the reliability of TASUED electronic examination system needs improvement.

4.1.3 Availability of the Electronic Examination System

According to majority of the students, the electronic examination system did not have adequate computer systems (65.5%). Majority of the student disagreed that the computers used for the electronic examinations were fast to carry out their operations (67.5%). In addition, majority of the students agreed that the lack of constant supply of electric power affects the process of electronic examination (57.5%). From the analysis, the electronic examination system was not functional; hence, there was a need for the improvement of the availability.

Table 4.2 Supportability, Reliability and Availability of TASUED's Electronic Examination System

Supportability	SA	A	N	SD	D
The system are well designed with good help facilities	18.5%	16.5%	0%	36.5%	28.5%
The graphics user interface (GUI) helps to understand the system better	10.0%	10.0%	7.5%	46.5%	26.0%
The electronic examination system was designed in a way student will know that option checked was successfully added	27.5%	15.0%	0.0%	27.0%	30.5%
The electronic examination system does not require high level of computer literacy to operate	13.5%	16.5%	11.5%	16.0%	42.5%
The electronic examination system was designed for easy management of questions	27.0%	20.5%	0.0%	38.0%	14.5%
RELIABILITY	SA	A	N	SD	D
Electronic examination system is reliable at all time in assessing and answering questions	10.0%	10.0%	17.0%	35.0%	28.0%
Electronic examination system is error fee when being operated	10.0%	10.0%	0.0%	42.0%	38.0%
The electronic examination system does not provides easy examination access	32.5%	25.0%	6.0%	26.5%	10.0%
The electronic examination system facilitates early release of results	31.5%	25.0%	11.5%	16.0%	16.0%
AVAILABILITY	SA	A	N	SD	D
The numbers of computer system used for electronic examination is adequate	10.0%	15.0%	9.5%	20.5%	45.0%
Computers machine used for the electronic examination are very fast to carry out the operations	34.5%	32.5%	5.0%	15.5%	12.5%
The lack of constant supply of electric power affects the process of electronic examination	32.5%	25.0%	6.0%	26.5%	10.0%

4.1.4 Usability of the Electronic Examination System

The analysis of the questionnaires revealed that majority of the respondents agreed that the size of the computer screen could influence readability of the questions during examination (75.0%), it was also agreed by many of the students that the color combination of the questions could affect comprehension of the exam in electronic examination questions (68.5%). Furthermore, when asked about proper preparation and introduction of the electronic examination software's, many of the students agreed that proper preparation and introduction of the software could affect the usability of the electronic examination system (78.0%). The quality of image and the positioning of the buttons for the selection of the answers were agreed to affect the usability of the electronic examination systems (72.5% and 78.0% respectively).

When asked about the effect of student login process on the electronic examination system, majority of the student agreed that student log in process affects the usability of the electronic examination system (37.0%). In addition majority disagreed that electronic examination system was easy to recover from mistakes (that is picking another option when mistakenly choose wrong option) (51.5%); while most of the student agreed that the non-availability of manuals for electronic examination affects the usability of the system (66.5%). Furthermore, majority of the student disagreed that a well-illuminated hall could not affect the usage of the electronic examination system (56.0%); while majority agreed that the cooling system put in place makes the electronic examination more conducive (65.0%). This analysis goes to show that the usability of the electronic examination system of the university needs improvement.

4.1.5 Security of the Electronic Examination System

The analysis of the CIPP likert type questionnaires showed that majority of the student agreed that the electronic examination did not reduce examination malpractices due to no option type (65.0%). Furthermore, most of the student agreed that the electronic examination system did not reduce impersonation during exams (80.0%). Majority also agreed that the electronic examination system helps to curb the level of victimization (75.0%). Concerning the guarantee of real marks, majority of the students disagreed that the electronic examination system could guarantee the real marks of the students (68.0%). There were further claims of few missing scores in the last electronic examination conducted. Finally, according to majority of the students the electronic examination system did not fully encouraged the privacy of the individual involvement of students (74.5%). This goes to show that there was great need for improvement of the TASUED electronic examination system security.

Table 4.3 Usability, Security of TASUED's Electronic Examination System

USABILITY	SA	A	N	SD	D
The size of the computer screen can influence readability of the questions during examination	54.5%	20.5%	5.0%	10.0%	10.0%
The selection of clour blends affect the comprehension of the questions	33.5%	35.0%	7.5%	10.0%	14.0%
Proper preparation and introduction of the software to student can affect the usability of the systems	42.5%	35.5%	2.0%	10.0%	10.0%
The quality of the image can affect the usability of the system	10.0%	10.0%	7.5%	32.5%	40.0%
The positioning of the buttons for the selection of the answers can not affect the usability of the electronic examination system	10.0%	12.0%	0.0%	41.0%	37.0%
The student log in process affect the usability of the electronic examination system	17.0%	20.0%	28.0%	21.5%	13.5%
Electronic examination system is easy to recover from mistakes	10.0%	16.0%	22.5%	38.0%	13.5%
The non-availability of manuals for electronic examination does not affects the usability of the system	10.0%	10.0%	13.5%	45.0%	21.5%
A well-illuminated hall could not affect the usage of the electronic examination system	10.0%	10.0%	24.0%	37.0%	19.0%
The cooling system put in place makes the electronic examination more conducive	55.0%	10.0%	24.0%	37.0%	19.0%
SECURITY	SA	A	N	SD	D
Electronic examination system does not reduces examination malpractices	43.5%	21.5%	10.0%	15.0%	10.0%
Electronic examination system does not reduce impersonation during exams	50.0%	30.0%	0.0%	10.0%	10.0%
Electronic examination system does not help to curb the level of victimization	47.5%	27.5%	2.0%	13.0%	10.0%
Electronic examination system does have high level of security measure put in place with the operations.	38.0%	30.0%	7.5%	14.5%	10.0%
Electronic examination system has increased and encouraged the privacy of the individual involvement	40.5%	34.0%	3.5%	10.0%	12.0%

4.2 Input Evaluation

Modifications were implemented in this phase of the study. Supportability of the e-exam system was improved on and was designed with good help facilities. The option checked was designed in a way that the students were alerted properly. The reliability of the e-exam system was improved upon. The login process was designed to be simple for easy login. The time required to fetch the question the question from the server was very fast. The system was designed to release the result immediately. Availability of the e-exam system was improved upon. The number of client system was increased. The client system used was of high configuration to make the exam operation very fast. The e-exam system was designed with alternative power backup.

Usability of the e-exam system was improved on. The size of the computer screen was minimum of 15 inch. The colour combinations of the question were properly managed. The positioning of the option button was well placed. The process of changing a wrong option was designed to be easy with just a click. The hall was well illuminated. Security was greatly improved on. The questions were well randomized to reduce malpractices. The e-exam system was designed to show the candidate picture and other detail when writing the exam to avoid impersonation.

Overview of the new e-exam design

5. SUMMARY AND CONCLUSION

The aim of this study was to evaluate and redesign e-exam system. The project chose to conduct an evaluation study in line with a context, input, process, product (CIPP) model, since this model is based on evaluating and redesigning programs by defining the needs of participants in terms of context, strategies, plans, activities, interaction, and assessment. Moreover, the CIPP model aims to help decision makers make improvements in programs (Boulmetis & Dutwin, 2005). CIPP Model is a good model which can be used to improve educational platoform like e-exam platform.

For this study four stackholders of the Tasued examination system were consulted which include students, lectures, adminitrators and invigilators. The Liket 5 scale questionnaire was used to assess the students' perception on the formal electronic examination system of TASUED, which brought to light that there was the need to improve the supportability, reliability, availabity, usability and secuerity of the electronic examination system. The students needs were analyzed in an interview meeting with other stackholders where it was concluded to improve the electronic examination system.

The improved version of the TAUED electronic examination system was designed with good help facilities and ability to alert students when options were properly or not properly checked. The login process was well designed for easy login, while the time required to fetch and answer the questions from the server was improved upon. In addition, the new system was designed to release results immediately.

In addition, the number of client systems with high configuration and alternative power backup were increased. Computers with minimum screen size of 15 inches were purchased; while colour combination of the questions, positioning of the option buttons, and illumination of examination halls were properly managed, furthermore, process of changing a wrong option was improved.

Finally, the Security the new electronic examination system, the questions were well randomized to reduce malpractices, candidate pictures were shown, and automated results processing were implemented to avoid impersonation and minimized missing score to zero level.

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