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Design and Development of a Web-based Questionnaire for Survey Research in Abia State College of Education (Technical), Arochukwu

OKECHUKWU H. NZEADIBE[1], A K. JIBRIL PH. D[2]
[1]*Department of Economics Education, Abia State College of Education (Technical) Arochukwu*
[2]*Department of Electrical/Electronic Technology, Abia State College of Education (Technical) Arochukwu*

Abstract- ***Presently, researchers in Abia State College of Education (Technical) Arochukwu are using paper based questionnaire and manual method of administration of questionnaire as well. This manual method is costly, stressful and time consuming. To mitigate these problems, the researchers developed a web-based questionnaire for survey research in Abia State College of Education (Technical) Arochukwu. With this web based questionnaire in the College's website, respondents can fill and submit their responses from their comport zones. The system has database that stores all the responses of the respondents. In addition the system arranges the responses of the respondents in frequency table. The system was implemented using html, PHP, CSS and Javascript web technologies. The developed system was tested by some staff and students of the College using real data. Thereafter, 12 copies of questionnaire designed to measure user's satisfaction with the developed system were administered to staff and the students that tested the developed system. The data was then collected from the questionnaire and analyzed. The result of the analysis shows that the evaluators are satisfied with the performance of the developed system. Furthermore, the evaluators recommended that the developed system can be used by the College for survey researches. Although the developed system has capabilities of allowing respondents to fill and submit their responses as well as arranging their responses in summary frequency table, but it will be better for the system to analyse the responses of the respondents as well(eg calculate mean and standard deviation) to reduce the stress researchers are facing during survey research and to reduce research time in the College. Hence, the need for a further research in this direction.***

Keywords: Design, Development, Research, Survey research, Questionnaire, web based questionnaire , Abia State College of Education (Technical) Arochukwu

I. INTRODUCTION

Research remains one of the main functions of all tertiary educational institutions in Nigeria and beyond. In this sense, lecturers in tertiary educational institutions are expected to be conducting researches from time to time in order to advance knowledge as well as to pave way for the application of the generated knowledge in quest for social, economic, political and technological development. Research process involves the use of instruments for data collection as well as the analysis of the data collected from such instruments among others. The instruments for data collection in educational and social science research include achievement test, observation schedule, interview guide and questionnaire among others. Of these instruments, questionnaire remains the most versatile instruments in education and social sciences.

Questionnaire in simple terms is a list of questions and the accompanying response options to be chosen by a respondent as well as the instruction on how to use the questionnaire itself. The questions together with the options constitute a scale (eg. Likert scale). Questionnaires therefore, incorporate scales and hence can be used for the measurement of variables (Jibril, 2010). Questionnaires are broadly divided into paper (hard copy) and electronic (soft copy). The paper-base questionnaires are divided into mail and face-to-face questionnaires. The mail questionnaire as the name implies are those questionnaires mailed to the respondents through postal service while the face-to-face questionnaires are delivered to the respondents face-to-face(or hand-to-hand). Electronic questionnaire falls into three types; telephone, e-mail and web questionnaires. As their name implies, telephone questionnaire survey is conducted through the telephone, e-mail questionnaire survey is administered through e-mail and web questionnaire survey is administered through the website.

Both paper-based and electronic counterparts are used in social surveys as well as in educational

researches. Each type has its own strengths and weaknesses. Surveys with paper-based questionnaires lead to high response rate and can remain anonymous(Mierzwa, Souidi.& Savel,2016), But conducting surveys using paper-based questionnaires are associated with high cost as result of printing and photocopying as well as cost of transportation in case of the use of face-to-face questionnaires or postal charges in case of using mail questionnaires. Furthermore, survey with paper-based questionnaires use to be labour intensive as well as time consuming. However, the emergence of e-mail and web-based questionnaires reduce greatly the aforementioned problems.

Surveys with web-based questionnaires are more cost-effective, take less effort and time and can reach large respondents compared with surveys conducted with paper-based questionnaires (Minnaar&Heystek,2013; Nayak & Narayan, 2019).Furthermore, surveys with web-based questionnaires can take place at anytime, anywhere and irrespective of the weather condition. Surveys using web-based questionnaires enable responses to be automatically inserted into spreadsheets, databases or statistical packages (Fleming* & Bowden, 2008).These competitive advantages of web-based questionnaire and more prompted the researchers to propose the development of a web-based for researchers in Abia State College of Education(Technical) Arochukwu to ease the high cost of survey research in the College.

II. PROBLEM STATEMENT/JUSTIFICATION

Research continue to be one of the functions of all academic staff of Abia State College of Education (Technical) Arochukwu in particular and Nigeria in general. Research process in education and social sciences involves the use of questionnaire for data collection. The current research process in Abia State College of Education (Technical) Arochukwu and other tertiary educational institutions in Nigeria involve the use of paper-based questionnaire. The use of paper-based questionnaire in research process requires the researcher or research assistants to mail the questionnaire to all the respondents or carry the copies of the questionnaire directly to the respondents(face-to-face) . With inefficiency in Nigerian postal services, such mailed questionnaires take longer time to reach the expected respondents and come back. Furthermore, there high tendency of having some of the mailed questionnaires get lost while in transit.

Even the use of face-to-face method of delivering copies of paper-based questionnaires faces some problems. Such problems include taking longer time to distribute and collect back the filled questionnaire, spending of large amount of money for printing the questionnaires as well as expending effort in the course of administration of the copies of the questionnaire. To reduce these aforementioned problems, the researchers, set out to design and develop a web-based questionnaire for researchers in Abia State College of education (Technical) Arochukwu. The web-based questionnaire will be integrated to the College web-site so that both academic staff and students can use it during their research work.

III. OBJECTIVES OF THE STUDY

The main objective of this study is to design and develop a web-based questionnaire for research in Abia State College of Education (Technical) Arochukwu. Specifically, the study will:

1. Determine the web-based questionnaire specification requirements
2. Design the web-based questionnaire
3. Develop the web-based questionnaire
4. Test the developed web-based questionnaire
5. Determine user's satisfaction with the developed web-based questionnaire

IV. LITERATURE REVIEW

This section presents issues concerning electronic questionnaire design. The section also presents guidelines for the development of electronic questionnaires and some developed electronic questionnaires. The section ends with issues concerning testing of developed electronic questionnaires.

Web-based Questionnaire Design

The main objective of developing questionnaire, irrespective of the type is to collect data. To achieve this objective, the questionnaire must be well designed. Questionnaire design according to Brancato, Macchia, Murgia, Signo, Blanke,Koner, Nimmergut,Lima and Hoffmeyer-Zlotnik (2005) consists of three successive steps, namely, the development of the conceptual frame of the

questionnaire, writing and sequencing the questions and establishing the visual design elements of the questionnaire.

- *Conceptual Frame*

Before questions can be formulated, it is strongly advocated to start with a review of relevant literature as well as analyses of available data from other surveys and studies on the topic. In the next step, the objectives and concepts of the research domain need specification (conceptualisation).
Subsequently, these concepts are translated into suitable indicators and measured by observable variables (operationalisation) of relevance

- *Writing and Sequencing the Questions*

The major concern with writing questions for a questionnaire should be to provide a set of questions that globally contribute to minimize errors due to the questionnaire and the respondent. Accordingly, good writing – as part of good questionnaire design – should contribute to attain a questionnaire that is respondent friendly and may also reduce response burden. In order to minimize the errors arising from writing questions, a set of principles should be taken into account concerning the relevance of the questions, the type of questions to be used, the logical sequence and wording of questions. There is a general agreement on some fundamental principles in questions' wording. The respondent should:

- clearly understand what he or she is being asked,
- in principle be able to answer to the question, and
- understand how the answer has to be given

- *Establishing the Visual Design Elements of the Questionnaire*

Visual design elements comprise all design elements except the wording of the questions and the sequence of the questions. They include the layout of questionnaires (either on paper or as computer screens), the fonts, the structure of the tasks required in the questions and also the "look and feel" of the questionnaire. Visual design elements guide the respondent as well as the interviewer when filling in the questionnaire. They include the questionnaire layout as well as the use of symbols and other graphical elements. To implement an optimal screen layout, other elements have been studied, like:

- the number of questions to be shown in each screen;
- the identification of different parts of the screen to be used for different purposes;
- the length of displayed texts;
- the use of colours;
- the use of graphical solutions (CAPITAL, bold, underline, *italics*);
- the use of icons;
- etc

Principles of Web-based Design

There are many principles of web-based design. Sumi(2019) identified the following principles of web-design:

- Start the web questionnaire with a welcome screen that will motivate the respondents to continue
- Provide a PIN (personal identification number) in order to limit access to those people sought in the sample
- Ensure that the first question can be seen in its entirety on the first screen
- The first question must be easy to understand and complete
- Ensure that the layout of each question is as close as possible to paper format
- Ensure that the use of colour keeps the consistency and readability
- Avoid differences in the visual appearances of questions that may happen as a result of different computers, configurations, operating systems etc.
- Keep the line length short, to fit in the screen size
- Minimize the use of drop down boxes
- Keep instructions wherever necessary without giving it in the starting
- Avoid requiring respondents to answer each question before being able to move on to the next question
- Ensure that questionnaires scroll easily from question to question unless orders effects are important
- Provide symbols or words to indicate where the respondent has reached in the questionnaire

Web-based Questionnaire Development

1. Guidelines for development of web-based Questionnaires

Web-based questionnaires are developed using some guidelines. Figure 1 shows an *overall* questionnaire

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guideline organization proposed by Saaya, Mustafa & Devaraju(2008).

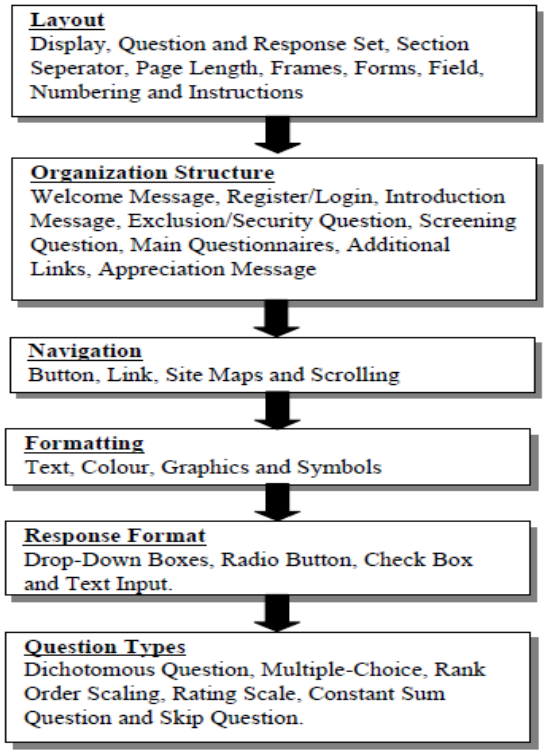

Figure 1: Overall Questionnaire Guideline Organization

2. Some Developed Web-based Questionnaires

Researchers have developed a number of web-based (online) questionnaires. This sub-section reviewed some of them. Thereafter, the sub-section took a closer look at features of one of them, the Online Questionnaire Builder (OQB).

There are a number of web-based questionnaires developed for conducting web-based research. Some of them are free while others are not. Farmer, Oakman and Rice(2018) listed the following as some examples of free web-based(online) survey tools: Survey Monkey, Smart Survey, Kwik Survey, Free Online Survey, Question Pro,eSurv, Poll Daddy, Google Forms, Qualtrics, and Quick Surveys. Online Questionnaire Builder (OQB) is another type of online survey tool. OQB according to Saaya, Devaraju, Mustafa and Leong.(2008) is a web-based survey software that provides complete set of tools for users to conduct the overall survey process from questionnaire design and distribution to the presentation of the survey results.OQB assist the researchers in doing self-administered survey using web-based technology. The software is developed using technologies such as HTML, CSS, JavaScript, and PHP. For the data storage, MySQL was used and the Apache was used as Web server. The Figure 2 shows the architectural overview on OQB which can be divided into three layers which are presentation layer, application layer and data layer. The presentation layer is the user interface of the system. Here, the user uses web browser (for instance, Internet Explorer) to access OQB via online. In the application layer, the web server receives user's request. The server may retrieve data from data storage for processing the request, before returning relevant results to the web browser.

Questionnaire Testing

Questionnaire testing fall into two categories, namely, functionality and usability test.

- *Functionality Test*

This type of test is concern with finding out whether the developed questionnaire performs according to the given specifications and if the system is robust with respect to unexpected events (Tarnai & Moore, 2004). Such a test represents a first step, concerning the functionality of the system. The functionality test should be performed during or at the end of the questionnaire implementation step, therefore before it is released for the data collection on the field (Brancato, Macchia, Murgia, Signo, Blanke,Koner, Nimmergut,Lima & Hoffmeyer-Zlotnik,2005).

- *Usability Test*

Successful data collection through electronic questionnaire (web-base questionnaire) to a large extent depends on the ease of interaction between the user and the questionnaire interface. In simple terms, usability test is concern with ease in which the user interacts with the system interface. Usability tests are usually carried out through the use of questionnaires aimed at finding the satisfaction of the user after interacting with the system. More specifically, the usability test addresses issues on how efficiently and effectively the users (respondents) make use of the system. In usability testing, the focus shifts from system functionality to the evaluation of instruments from the user's perspective.

In the literature, usability evaluation methods are divided into two main sets: i) usability inspection methods and ii) end-users evaluation methods. In usability inspection methods, also known in the literature as heuristic evaluations, a group of experts

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evaluate the instrument on the basis of a set of heuristics or evaluation criteria. Examples of these criteria are: navigation easiness, consistency, minimization of user memory load, and so on. The method can be considered as part of the functionality test and is equivalent to the expert review in the evaluation of surveys questionnaire. It is reported that, in general, three to five experts are required for this task and that it can be completed within few days. The end-user evaluation method involves the ultimate users of the systems. This test can be carried out in the laboratory or in the field, on experimental or non-experimental basis. In the laboratory, the method can take advantage of the equipment usually available in such an environment (video-recording, possibility to observe scan-converted images of the interviewer's screen). In the field, the advantage is to test the questions into the survey environment away from the artificial setting of question development ((Brancato, Macchia, Murgia, Signo, Blanke,Koner, Nimmergut,Lima & Hoffmeyer-Zlotnik.2005).

V. METHODOLOGY

The study adopted Software Development Life Cycle (SDLC) model. SDLC is said to be a framework that shows a combination of stages involved in a software development process and what is done at each particular stage (Tawfeeq, 2018). SDLC consist of the following stages; planning, analysis, design, implementation, testing& integration and maintenance as shown in figure 2.

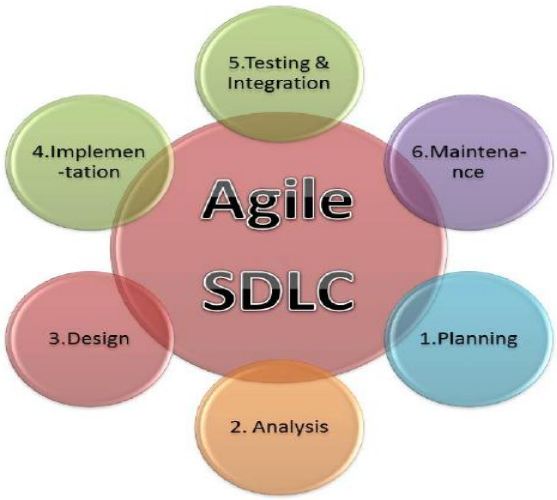

Figure 2: Agile SDLC Source: (Rani, 2017)

Planning Stage

The researcher will itemize things to be achieved, how to achieve them, the material, financial and human resources required. The researcher will also determine the approximate time required to complete the project.

Analysis Stage

The researcher will first examine the paper-based questionnaire and the procedure of its administration. The researcher will then interview the users of paper-based questionnaires. The information gathered will then be used to conceptualize the web-based questionnaire to be developed. The researcher will then formulate the main function of the web-based questionnaire. The main function will then be broken into sub-functions. These sub-functions then form the functional requirements for the new web-based questionnaire. Finally, the researcher will formulate the non-functional requirements for the web-based questionnaire.

Design Stage

The researcher will then document the functional requirements using various UML diagrams such as use case and activity diagrams. The researcher then integrates various functional requirements to form a system (Web-based questionnaires).

Implementation Stage

The UML diagrams drawn will serve as guides in building the new web-based questionnaire. The web-based questionnaire will be built using PHP and Javascript programming languages. Visual studio will serve as code editor. Web technologies such as HTML and XAMPP with also be used during the implementation stage.

Testing& Integration Stage

The web-based questionnaire to be developed will undergo two types of tests, namely, functionality and usability tests. The functionality test will aim at finding out whether the developed web-based questionnaire meets both functional and non-functional requirements. The usability test on the other hand will measure users' satisfaction concerning the use of the web-based questionnaires' interface. The developed web-based questionnaire is to be integrated into the College website.

Hardware Requirements

(a) RAM: 1 GB or above
(b) Hard disk: 4 GB or above
(c) Processor: 2.4GHZ or above

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Software Requirements

The following specification are needed

(a) Window 10
(b) MySql
(c) Microsoft visual studio
(d) XAMPP
(e) phpMyAdmin

System Users

1. Admin
2. Respondents
3. Visitors

Functional Requirement Specifications

Admin

1. Login and logout
2. Add username and password
3. View, add, delete, update and print staff records
4. View frequency table
5. Print frequency table

Respondents

1. Login and logout.
2. Read guidelines on how to fill questionnaire
3. Fill questionnaire

Visitors

1. View information about the College
2. Read guidelines on how to fill questionnaire
3. View questionnaire

Non-Functional Requirement Specifications

1. Provide data security
2. Be efficient during operations
3. Be portable
4. Be reliable
5. Accommodates mo re than 10,000 records
6. Be Scalable
7. Be robust
8. Maintainable

Design

System Architecture

The project adopted client-server architecture with three layers; the presentation, application and the database. The presentation layer consists of the browser. The application layer is the, Graphical User Interface (GUI) while the database layer serves as the database system (MySQL). The system architecture is shown in figure 3.

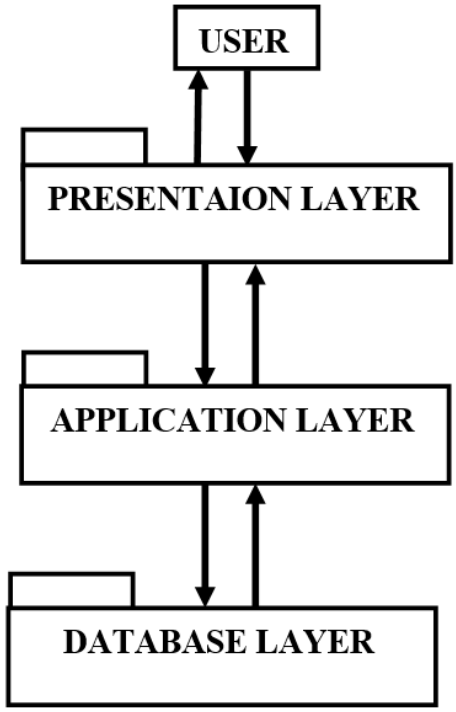

Figure 3: Three Layer Architecture

Use Case

The Use case diagram that shows the major functions of the users using UML (Unified Modelling Language) shown in figure 4.

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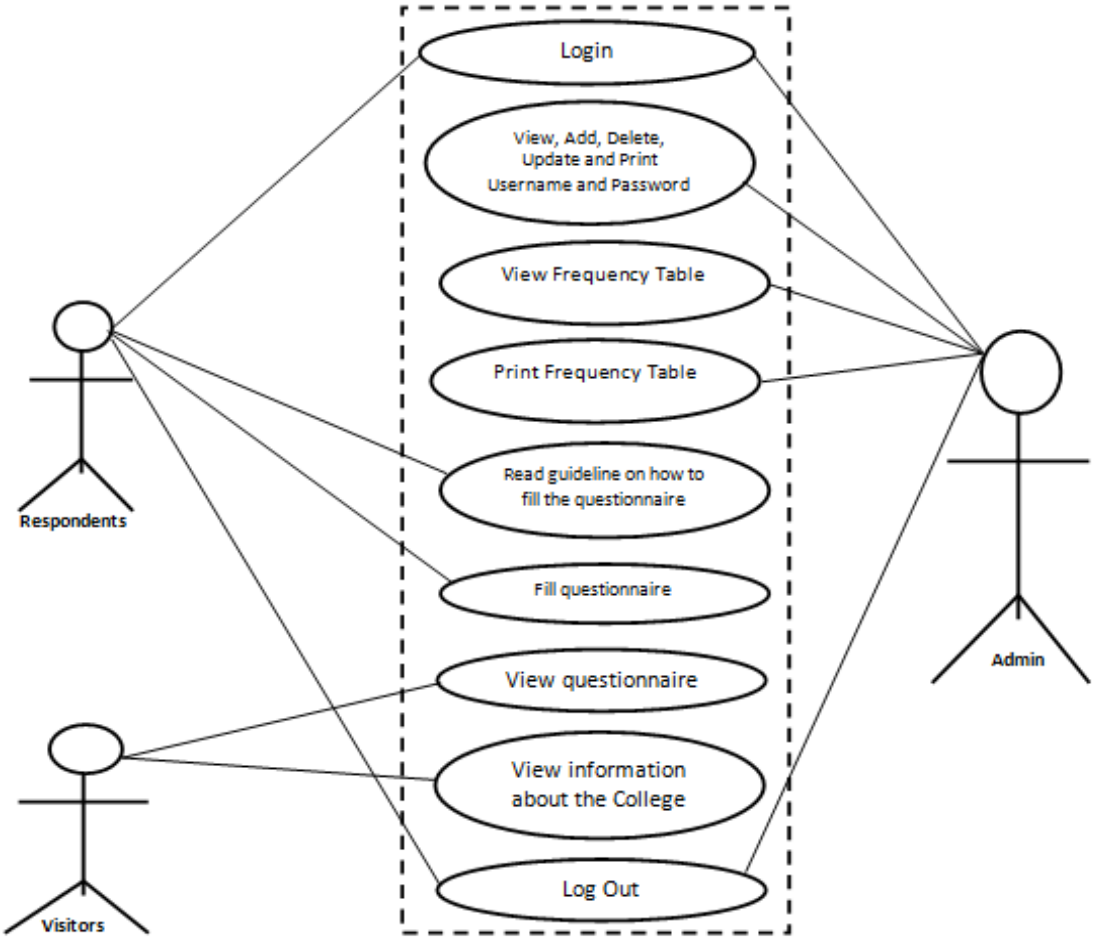

Figure 4: The Use Case

Database Design

This project made use of MySQL database to store all the information required by the system to function. The database named questionniare_db contain two tables, viz, admin login_tb and item_tb. Figure 5 shows the two tables. The database and its tables were created using *phpMyAdmin* .

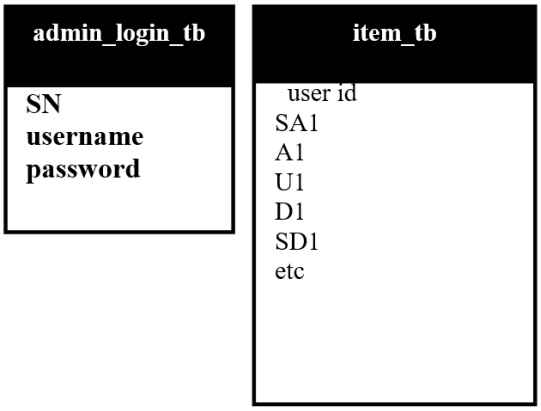

Figure 5: Database tables

Implementation

Writing Program Code

The project was implemented using PHP and javasript programming languages. The database and its tables were constructed using *phpMyAdmin* The codes were written under Microsoft visual studio.

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Sample Outputs

The following are a sample of the outputs of the system when running.

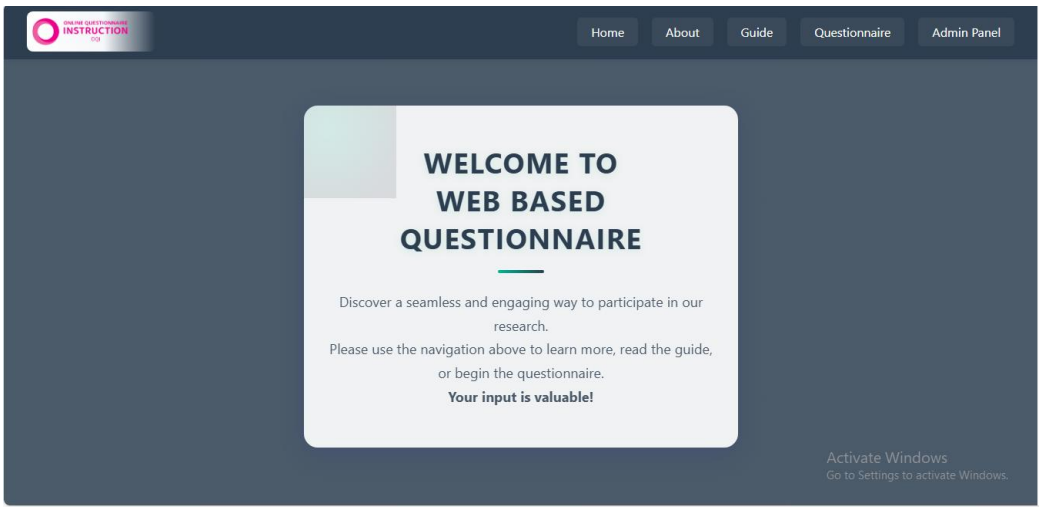

Figure 6: Home Page

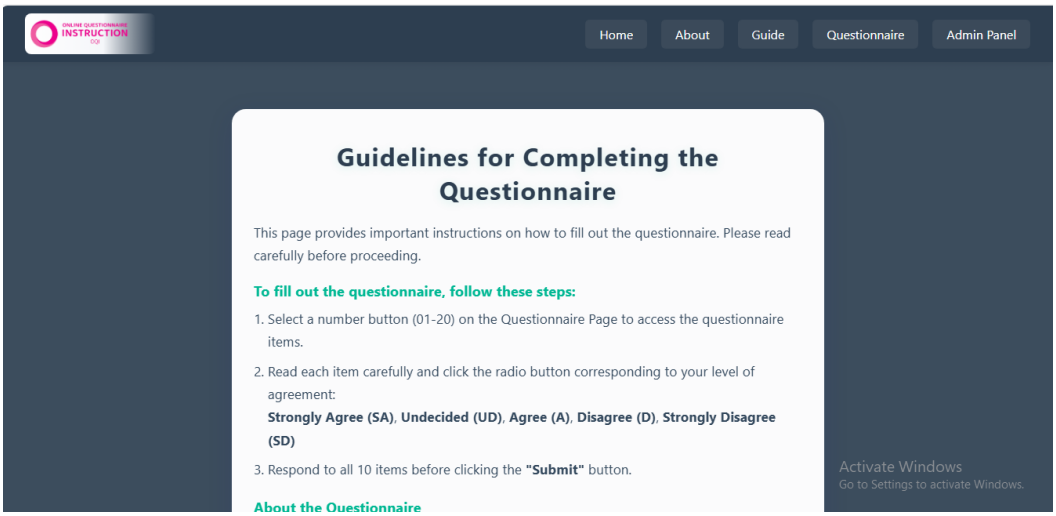

Figure 7: Guidelines for Completing the Questionnaire

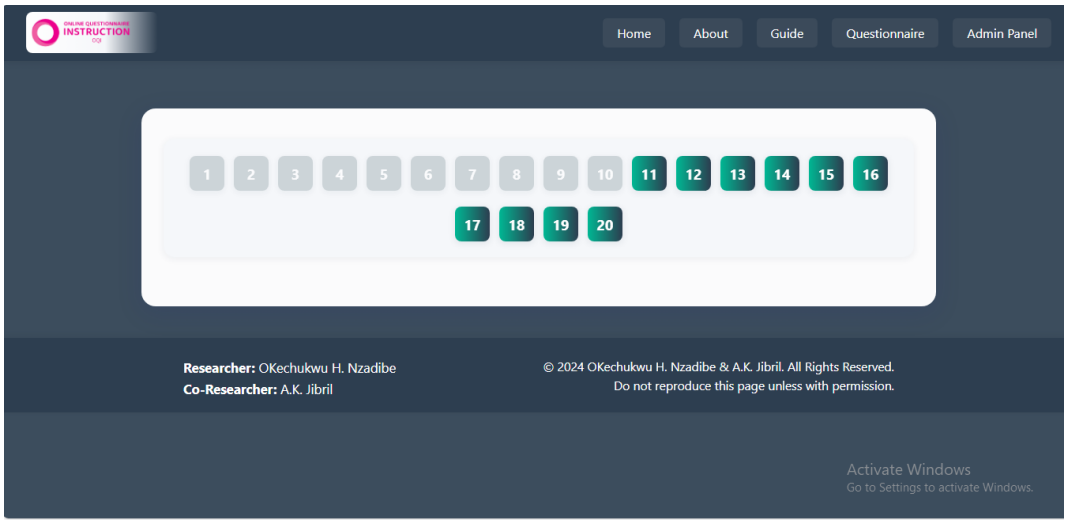

Figure 8: Number of respondent that have filled the questionnaire

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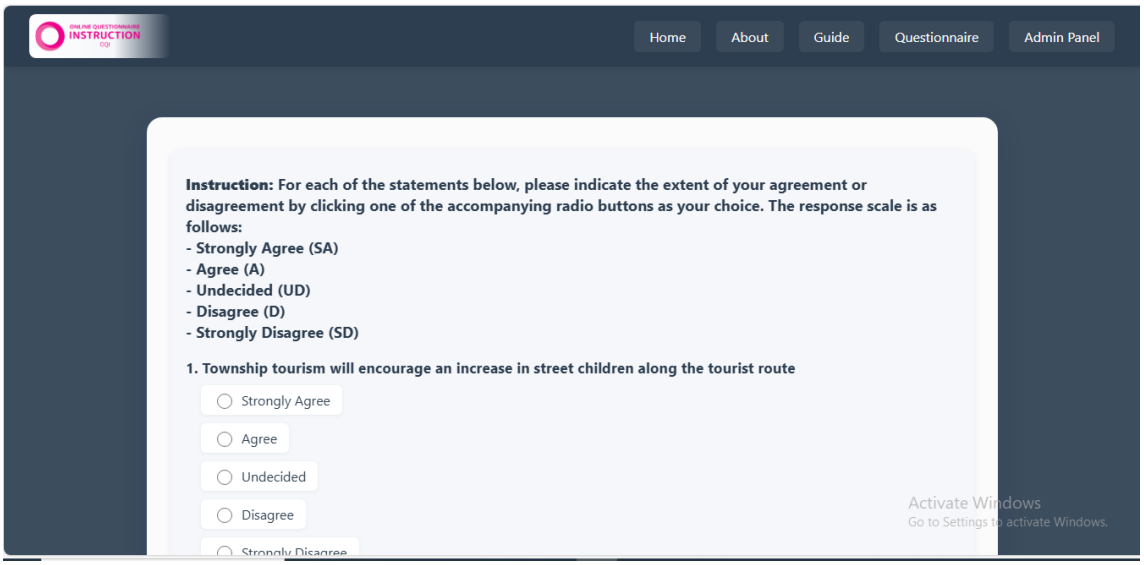

Figure 9: The Questionnaire

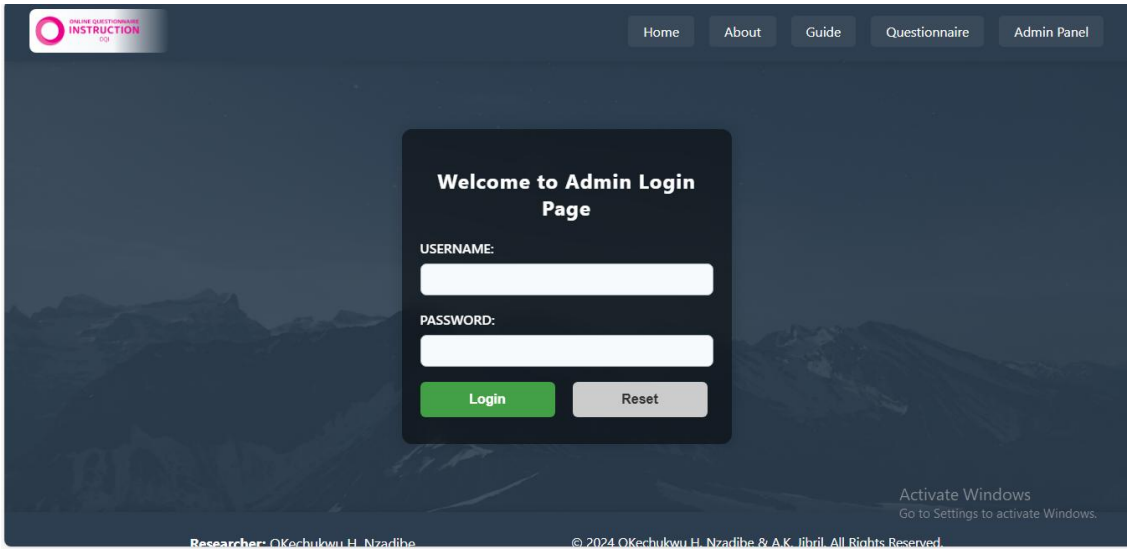

Figure 10: Admin Login

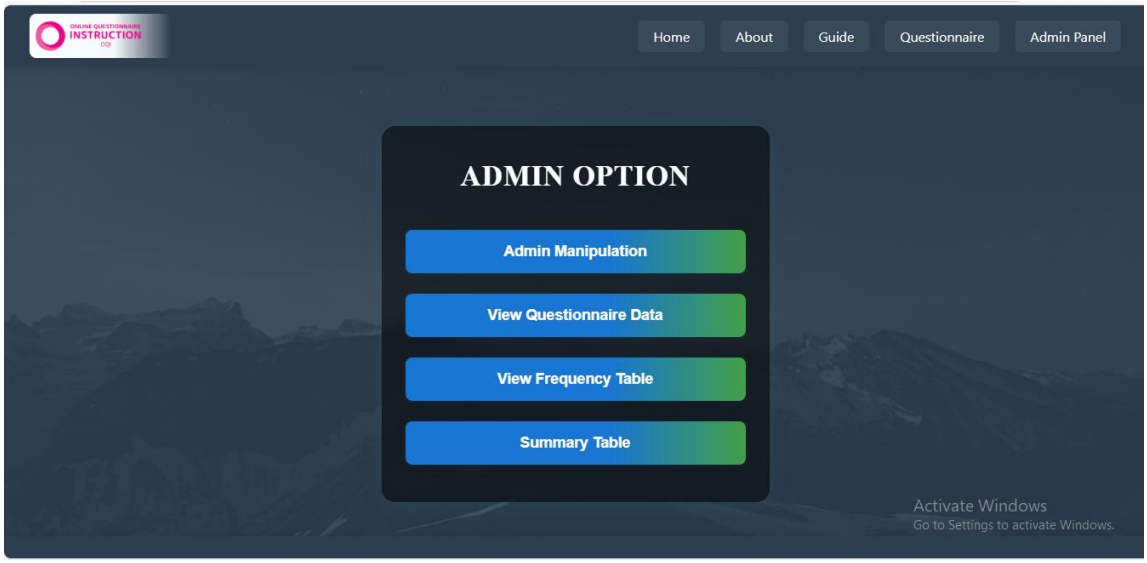

Figure 11: Admin Options

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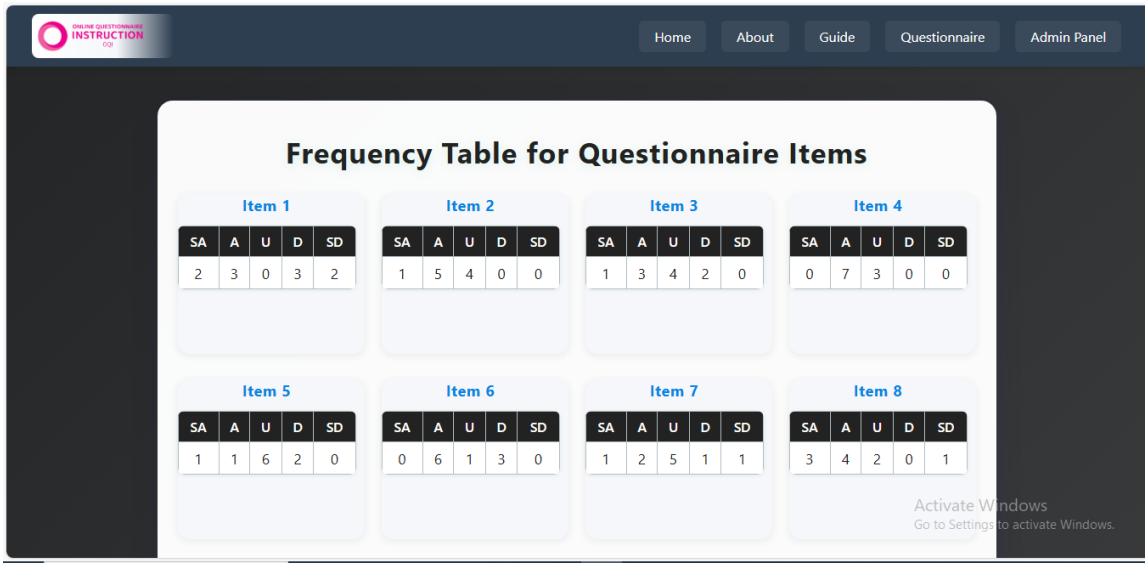

Figure 12: Frequency table for Questionnaire items

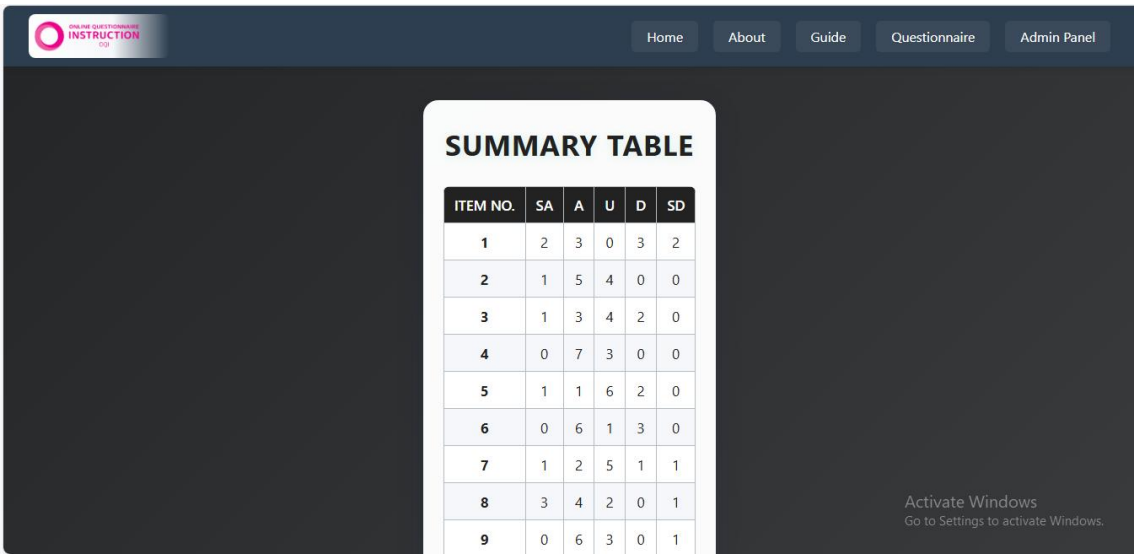

Figure 13: Frequency Summary table for ten respondents

Testing and Evaluation

The researchers tested each newly created file and make necessary correction(s) before creating another one. The process continues until all the files were created. The researchers then handed over the developed system to evaluators for testing and evaluation. The evaluators, comprising of 12 academic staff and students tested the developed system. Thereafter, copies of a questionnaire designed to test users' satisfaction with the developed system were issued to 12 respondents. The data collected from the questionnaire were then analyzed. The result of the analysis is shown in table 1.

Table 1: Mean and Standard Deviations of the responses of the staff and students

N=12

S/N	Item	$\overline{X}$	SD	Remark
	Functional Software Requirements			
	Admin			
1	The software enables admin to add username and password	3.75	0.45	Agree
2	The software enables admin to login	3.61	0.49	Agree
3	The software enables admin to logout	3.58	0.51	Agree

4	The software enables admin to update and delete user records	3.58	0.51	Agree
5	The software enables admin to view records	3.58	0.51	Agree
6	The software enables admin to view questionnaire data in the database	3.67	0.49	Agree
	Student/staff			
7	The software enable student/staff to read guidelines on how to fill the questionnaire	3.50	0.17	Agree
8	The software enables student/staff to fill the questionnaire	3.50	0.17	Agree
9	The software enables student/staff to view questionnaire data	3.67	0.21	Agree
	Visitor			
10	The software enables a visitor to view information about the researcher	3.50	0.17	Agree
11	The software enables a visitor to view guidelines on how to fill the questionnaire	3.42	0.67	Agree
	Non-Functional Software Requirements			
12	The software is well organized	3.83	0.59	Agree
13	The Software window environments are attractive	3.50	0.17	Agree
14	The software buttons are responding to mouse click quickly	3.58	0.51	Agree
15	The feedback massages provided by the software are self-explanatory	3.50	0.17	Agree
16	The software has data security	3.58	0.51	Agree
17	I felt comfortable when using the software	3.75	0.45	Agree
18	It is easy to navigate to different parts of the software	3.17	0.49	Agree
19	The software is well designed	3.83	0.39	Agree
	Recommendation			
20	The developed software can be used for online web base questionnaire in the College	3.88	0.30	Agree

N=Number of respondent SD=Standard Deviation $\overline{X}$ *=Mean*

The data from table 1 shows the means and standard deviations of the questionnaire items. A close look at the values of the means indicated that all the means have values not less than 2.50 which is the cut-off point. This implies that the respondents are satisfied with the performance of the web based questionnaire. Another close look at the table shows that the values of the standard deviations (SD) are small, implying that the respondents' opinions on the items were very close. Finally, the mean value of item 20 (3.88) indicated that evaluators agreed that the developed web based questionnaire can be used for web based research survey in the College.

VI. CONCLUSION/RECOMMENDATION

Presently, academic staff of Abia State College of Education (Technical) Arochukwu are using paper based questionnaire and face-to-face administration of the questionnaire. This mode of administration is not only stressful but also makes academic staff to waste useful time that they could use for other academic activities. To mitigate these problems, the researchers designed and developed a web-based questionnaire for survey research in Abia State College of Education (Technical), Arochukwu. With the developed survey questionnaire in the College's web site, targeted respondents can fill and submit the questionnaire from their respective comport zones. The developed questionnaire stores the responses of the respondents in frequency distribution table. An initial testing of the questionnaire indicated that the developed questionnaire is effective and efficient. The evaluators of the system recommended it is use in the College for survey researches.

Need for Further Research

Although the developed system has capabilities of allowing respondents to fill and submit their responses as well and arranged their responses in summary frequency table, but it will be better for the system to analyse the responses of the respondents as well(eg calculate mean and standard deviation). By this way, the system will reduce the stress researchers are facing during survey research in the College. The system will also reduce research time. Hence, the need for a further research in this direction.

VII. ACKNOWLEDGMENTS

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