

## Development, User Satisfaction and Acceptability Evaluation of a Multimodal Admission Requirements Search System

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### Abstract

Admission seekers into Nigerian tertiary institutions of learning are currently supplied with a compact disc that contains among others, an electronic brochure which contains the requirements for being admitted into their preferred courses of study in PDF format. The brochure is also downloadable from the Joint Admissions and Matriculation Board's (JAMB) website. Searching through the compact disc requires a personal computer (PC), a tablet computer or a smartphone. However, these devices are not widely accessible considering the population of Nigerians that have access to them because of the cost implications of obtaining one. Consequently, there is a need to make it accessible via a platform that is widely accessible. Furthermore, even though the board provides a mobile app to access some of its services, admission requirements service is not inclusive. In this work, a multimodal admission requirements search system that enables access to the brochure's contents electronically, in both text and audio formats via PC and as well as mobile phones (including feature phones) was developed and evaluated for its acceptability and user satisfaction. The results obtained show that the system was widely accepted and the users were satisfied with the system. This means that if adopted, the system will be widely accepted and will engender cost-effectiveness.

**Keywords:** Dialogue system; admission requirements; acceptability; user satisfaction; JAMB.

### 1. Introduction

JAMB in Nigeria is saddled with the responsibility of conducting matriculation examinations for entry into all the universities, polytechnics and colleges of education in Nigeria [1]. Towards this, the board supplies compact discs containing the brochure that contains among others, the list of courses offered in all the tertiary institutions of learning in Nigeria and their respective admission requirements. Currently, the eBrochure contains admission requirements for 40 federal universities, 39 state universities, 55 private universities, 122 polytechnics, 63 colleges of education and 14 innovative enterprise institutes, all totaling 333 schools. These admission requirements consist of five ordinary level credit passes in the subjects required for the courses they intend to pursue in the university and a combination of four subjects required to be sat for, during the Unified Tertiary Matriculation Examination (UTME). In addition, the eBrochure's contents include whether direct entry admission is allowed for a particular course of study, the nature and type of certificate for direct admission, and the grade a prospective student must have obtained for eligibility. The brochure supplied by the Joint Admissions and Matriculation Board (JAMB) also contains the names of the schools that offer those courses as well the cities and states where the schools are located. The information in the eBrochure is in essence, massive.

The eBrochure provides an easy and faster means of searching through the contents of the hard copy brochure, but requires the use of any of PC, tablet computer and smartphone. However, the majority of Nigerians can only afford feature phones that cannot be used to access the PDF version of the brochure because of the cost implications of acquiring PCs, smartphones and tablets. Given that the majority of Nigerians own mobile phones as compared with PCs as compiled in [2] and given that just only 30% of Nigerians own smartphones and 70% owning feature phones [3], there is therefore a need to make the brochure accessible via this platform that is readily and widely available to the vast majority of the populace and take care of the needs of the disadvantaged Nigerians. In addition to the foregoing, since research work has shown that people prefer natural interfaces to search on digital devices [4,5], there is a compelling

need to explore a technology that can deliver the aforementioned. Fortunately, dialogue systems that can be accessed with all forms of telephone including feature phones which most Nigerians have, can be utilized to provide this service. It also provides a cost-effective means of accessing services[6].

Furthermore, very few research works to the best of our knowledge, probed into the use of technology to enhance access to admission requirements. In this work, a multi-platform eBrochure accessible via the Web, mobile Web and via dialogue system platforms was developed and its user satisfaction and acceptability evaluated.

## 2. Joint Admissions and Matriculation Board(JAMB)

JAMB was established by an act (no. 2 of 1978) of the Federal Military Government of Nigeria on the 13<sup>th</sup> of February, 1978. As at 1974, there were seven federal universities in Nigeria and every one of them conducted its own concessional examination and admitted its students. This system of admission was, however, beset with serious limitations and quite often a wastage of resources in its administration. Because the problems became more profound after the establishment of an additional six universities in 1976, the federal military government then had to set up a national committee to proffer a solution. The recommendations of the committee led to the establishment of the Joint Admissions and Matriculation Board which is saddled with the following responsibilities [1]:

1. Conduction of “matriculation examination for entry into all universities, polytechnics and colleges of education in Nigeria”.
2. Appointment of “examiners, moderators, invigilators, members of subject panels and committees and other persons with respect to matriculation examinations and other matters incidental thereto or connected with”.
3. Placement into these tertiary institutions, candidates that are suitably qualified.

JAMB provides the following electronic services through a mobile app downloadable from Google Play Store and Microsoft Windows Store [7]: checking of examination results, retrieval of registration number, result verification, checking of admission status, obtaining of examination centres locations and getting of directions to the examination centres. In addition to the above, the following services are also provided via PC:

- i. Printing of result slip
- ii. Printing of admission letter
- iii. Printing of direct entry acknowledge slip

## 3. Dialogue System

In [8], a dialogue system is described to be a discourse between two or more than two agents which could be human beings or a human being and a computer. According to Alan et al. in [9], it is a conversation between two or more parties, and according to Bui in [10], a dialogue involves a conversation between agents, either two or more who are humans or machines. Dialogue systems range from small systems to wide-scale applications that allow customers to interact to obtain information, services and goods [11]. These systems could be in textual form, graphical form, spoken-based and multimodal in nature. Respectively, the interfaces are: conversational user interface (CUI), graphical user interface (GUI), voice user interface (VUI) and multimodal user interface (MUI). When dialogue systems are classified based on the method used to control them, three groups are [12]:

- i. Finite State-based Systems: In these systems, there are predetermined states a caller must be taken through each time a call is placed on the system.
- ii. Frame-based Systems: In these systems, the dialogue flow is not predetermined, but depends on the kind of input supplied by the caller. This is achieved by asking the caller questions that will make the system fill the slots in a form in order to perform a task.
- iii. Agent-based Systems: These enable reasoning about the problems being solved by the caller and the application. The steps in the dialogue are not predetermined, but evolve dynamically.

Dialogue systems can be used in robots, automobiles, telephones, Web browsers and in personal digital assistants (PDA). A multimodal dialogue system makes use of a combination of two or more of the following: voice, touch, pen manual gestures, body and head movements, and gazing. These systems essentially make use of varying architectures, but have the same set of stages they employ. The stages are recognition of user input, natural language understanding, management of dialogue, generation of response and

rendering of output to the user[12]. There are a number of necessities for the adoption and introduction of dialogue systems as highlighted in [11]. These necessities are:

- The need to make available, market variations.
- To make an organization generate more income.
- To enhance the quality of existing services rendered by an organization.
- To increase access to services by making those who have hitherto been disadvantaged in one way or the other have access.
- To reduce the cost expended by an organization on services.
- To automate tasks that are tagged low-valued in a bid to let employees concentrate on high-valued ones.

There are essentially two approaches to the automation of services: the first approach is full automation which involves identifying a particular aspect of the business and completely automating it. The second approach christened progressive automation, combines the use of technology with skilled staffers to handle business aspects that current technology cannot handle. However, as technology improves, those aspects can also be automated [11].

#### 4. Related Works

In [13], a speech-based application that guides through voice, candidates wishing to write the Universities Matriculation Examination (UME) as to the requirements of the courses they intend to study, the universities offering the courses and the combinations of subjects for the examination was developed. However, the evaluation of the user satisfaction and acceptability of the system was not carried out. In addition, the application ran on only the voice platform.

Similar to the Joint Admissions and Matriculation Board of Nigeria is the Kenyan Joint Admissions Board (JAB), which is also saddled with the responsibility of selecting students for university courses in Kenya[14]. However, there is no evidence from literature that the board makes use of dialogue system in its operations let alone evaluating its acceptance and user satisfaction.

In the United States of America and the United Kingdom, there are no central bodies that conduct a common examination into the tertiary schools. As such, each school has its admission requirements and the criteria that must be met before admission is granted to a prospective student. Usually, information about the admission requirements is always found on each university's website as an HTML page or in PDF format that is downloadable. The requirements are peculiar to each school. A look at the following Ivy League universities' websites in the US and UK corroborates this assertion:

Harvard University[15], Princeton University [16], California Institute of Technology [17], Oxford University [18], Stanford University[19], and University of Cambridge [20].

In Brazil currently, a standardized university entry examination has been introduced by the government to replace individualized examinations by different universities. This examination is called ENEM (Exame Nacional do Ensino Médio – en/High School National Examination). Many universities now use this examination as a replacement for their individual examinations or in addition to [21]. This examination is taken throughout the country. However, it is not established in literature that the admission requirements are accessible via dialogue systems.

In China, admission to the colleges is handled by the placement office in each province by conducting standardized tests centrally. The office organizes a National College Entrance Examination for prospective students to the colleges and ranks the students based on their scores in the test. The students are allowed preferred choices of colleges as well as preferred courses in the faculties. There is, however, no evidence also that the placement office adopts the use of dialogue system for candidates to get the examination and admission requirements [22].

In Australia, the Australian Tertiary Admission Rank (ATAR) has replaced the tertiary entrance measures used in the different states and it is being used to compute the scores for admitting students into all universities in Australia[23]. Various universities normally provide the admission requirements on their websites in terms of the ATAR scores a student must have for the kind of certificate he holds. The requirements are always found on the websites in text form or in PDF form.

### 5. DeLone & Mclean Model

Among information system success models is the DeLone and Mclean Success Model. Available statistics show that it has been the most widely used model [24]. This model can be applied to determine the success or otherwise of an information system. The model has evolved to include dimensions of success of an information system such as “information quality”, “system quality”, “service quality” “use/intention to use”, “user satisfaction”, and “net benefits” [25, 26] as seen in Fig. 1 below.

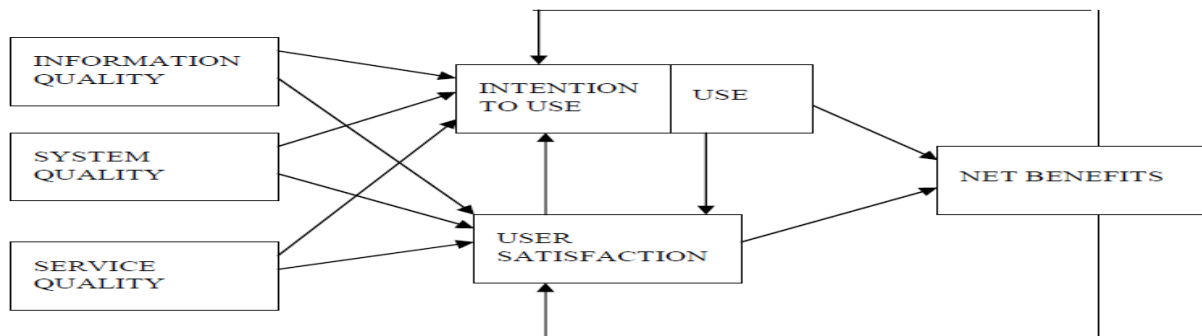


Fig. 1. DeLone & McLean Success Model [25]

There are different aspects of information success model as seen in Fig. 2 below. Using DeLone and McLean model, this work focuses on the “use/intention to use” and “user satisfaction” dimensions which fall under the effectiveness of influence of Shannon & Weaver 1949 model.

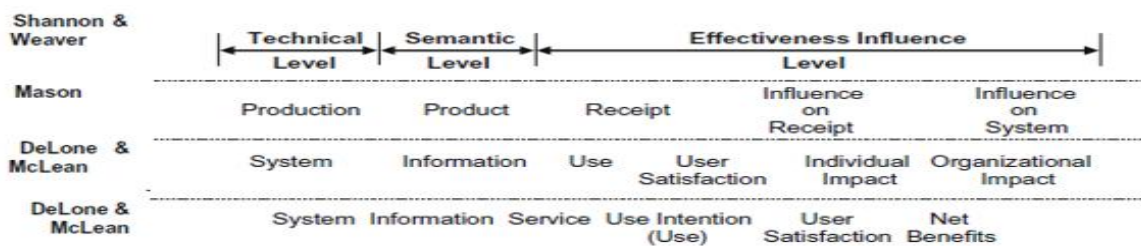


Fig. 2.The Categories of IS Success[24]

### 6. Methods

Web forms were created with HTML, CSS, JavaScript, Microsoft Ajax Scripting Library and ASP.NET with server-side scripting of C#. Web form enables users to interact with the application. C# was also used to speech-enable the application to provide audio capability. In addition to this, Microsoft SQL Server 2008 R2 was used as the RDBMS for the application. A database containing tables for the courses, their admission requirements and course-related information was set up for the application and was populated with the courses, admission requirements and other course-related information got from the JAMB brochure. Also, the application was connected to the database through a connection strings to provide the users results for the search. The system was tested on a laptop running Windows 8 operating system. The mobile portions (mobile Web and dialogue system) of the system were tested through the use of softphone embedded in Visual Studio; the tools used for the development of the system allow the testing of the application locally and getting the same feel as if deployed.

Towards determining user satisfaction and acceptability of the system, a questionnaire based on two dimensions of Delone & Mclean Model namely “user satisfaction” and “use/intention to use” as used in [27] was used to capture the feedbacks of the participants after each had tested the system. The questionnaire as reported, was based on similar studies conducted in [28] and [29]. The questionnaire was scaled 1 to 5 indicating “strongly disagree”, “disagree”, “undecided”, “agree” and “strongly agree” respectively. The

questionnaire contained sections that captured each participant’s experience with mobile computing device, user satisfaction with the system, demographic data, questions on if the user would support the use of mobile phone/PDA in accessing the contents of the JAMB brochure as well as if the user would recommend the use of the system tested for searching for courses, universities offering them and their admission requirements.

**7. Participants**

The study was carried out in Lagos, south west of Nigeria. Lagos is a microcosm of Nigeria because all Nigerian tribes can be found in the city, being the commercial nerve centre of the country and that of West Africa. Twenty two participants took part in the evaluation. This is higher than 20 recommended in[30] as an ideal number to participate in a usability study for the evaluation to be acceptable. 59% of the participants are male while 18% are female. 23% did not specify their sex. 4% of the participants rated their skill in the usage of software as novice, 41% as average, 32% as good while 23% rated theirs as expert. 27% use tablets to enhance their work, 18% use desktop computers, 46% use laptop/notebook and 9% use PDA/cell phone. 77% responded that they owned PDA/mobile phone while 23% did not respond. 18% have used PDA/mobile phone for one year, 5% for one and a half year, 9% for two years and 68% for more than two. 4% make calls 1-2 times a week, 14% make calls 3-4 times a week, 9% make calls 5-6 times a week and 73% make calls more than seven times a week.

**8. Some Snapshots of the Multimodal Ebrochure System**

Fig. 3 is the text format page for the eBrochure. It provides the users with the text format of the selected course such as accountancy, institutions that offer a selected course, the requirements and UTME subjects on the mobile platform. Accountancy/accounting is selected in Fig. 3. Fig. 4 shows the mobile audio format brochure page. On this page, the users can select the audio information they want to get from the eBrochure and listen to the selected information on a mobile platform.

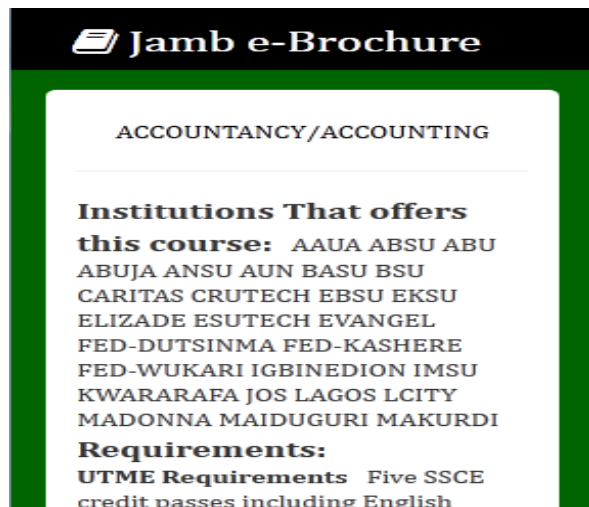


Fig.3. Mobile Text Format Brochure Page



Fig. 4. Mobile Audio Format Brochure Page

**9. Results**

96% supported the use of mobile phone for accessing JAMB brochure contents via dialogue system while 4% did not. Those that did not support gave reasons like: “A lot of persons do not know how to operate some devices” and “It is too bulky for the cell phone and one may not grab its necessary information”. It has been suggested that a good usability study has a mean value of 4 using a questionnaire that is scaled 1-5 and 5.6 using a questionnaire scaled 1-7 [31]. In this study, the questionnaire was scaled 1-5 and the mean value obtained was 3.6, which is approximately 4 suggested for a good usability study. This shows that the users were satisfied with the system.

## 10. Conclusion

In this work, a multimodal admission requirements search system was developed to allow access to the JAMB brochure in electronic form via Web, mobile Web and in audio formats, all from a single source. The study also carried out acceptability and user satisfaction evaluation of the developed prototype system. With the results from the evaluation of the dialogue system, if introduced, the system will find acceptability in the Nigerian society and would be suitable for users who need eyes-free and/or hand-free access to the brochure in addition to all the other benefits that have been highlighted. Furthermore, the main goals of the different research works carried out on admission to tertiary institutions of learning are to increase access to education at this level by all categories of applicants and to ensure positive outcomes are realized from the exercise ultimately. This work has further presented another perspective from which these goals can be realized. In future work, the other services provided by the JAMB mobile app like checking of results, retrieval of registration number, verification of result, checking of admission status, finding out of the locations of centres where the Unified Tertiary Matriculation Examination will be written and getting of the directions to locations of examination will be speech-enabled and their user satisfaction and acceptability tested.

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