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The Information-Seeking Behaviour of Students: A Case of University of Dubai

By Ali Amour El-Maamiry

University of Dubai

Abstract- The information seeking behaviour, is considered as a human behaviour to search for information in purposeful way to find the gap. This behaviour sometimes is very undefinable. The study investigated use of electronic resources by students of the College of Business Administration (CBA) and College of Information Technology (CIT). That is, it examined possible factors and problems in their searching habits, information seeking, use and retrieval in satisfying their needs. Therefore, the study focused on information seeking behaviour of students and barriers to utilizing online resources to execute academic tasks. Students of University of Dubai ultimately, due to cultural effects adopts different searching processes, use different phrases and mostly spend more time to search for information to satisfy their needs. It is assumed that poor information skills are preventing them from searching information effectively.

Keywords: digital library, electronic resources, information - seeking behaviour, information retrieval.

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The Information-Seeking Behaviour of Students: A Case of University of Dubai

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Keywords: digital library, electronic resources, information -seeking behaviour, information retrieval.

I. Introduction

Probably the increase of web-based information accessible via the Internet and the development in electronic publishing and related digital technology have induced abundance of electronic resources and services in the library. The dynamic change of library resources and swift change to electronic resources have brought about the significant challenges and opportunities to libraries. Perhaps the countless types of information as well as numerous search engines in different locations to be available in a single platform needs special searching skills to assist students to meet their needs. Many universities in UAE, including University of Dubai, are anonymously investing in electronic resources to increase access to their growing communities in various horizons. The library is providing thousands of scholarly journals through the subscriptions to number of academic databases along with web based resources. It is obvious that provision of those electronic resources will need some technical library settings for accommodating the growing information needs. Evaluation of plentifully available resources is highly important for designing, developing and maintaining effective information retrieval and information uses in a real-life operational environment [1].Perception into information seeking can be gained by understanding how users seek information sources and how they choose contents to meet their needs.

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In the digital environment, users' dilemma is on what is satisfactory and choosing what is best. In practice satisfactory translates into judgment that the information is good enough to achieve searcher's needs. Borlund [2] observed that "undergraduates employ a coping strategy in their search for information, often seeking to find enough information to fulfill assignment requirements with the least cost in terms of time or social efforts…" users are confronted with too much unevaluated information and select sources based on authors they already heard about or familiar with or even referred to. In universities regardless to their backgrounds tend to see themselves are capable of searching sources with less instruction. There is a need of changing library information delivery approach to get meaningful usage of information, at the meantime students learn more how to use digital information sources effectively.

Electronic resources are gaining prominence in GCC libraries which are trying their best to cope with the dynamic advancements in digital technologies. GCC libraries are witnessing a shift from emphasis upon holdings towards the importance of being gateways to networked information [3].University of Dubai Library is amongst those trying to follow the trends with eager. Recently University of Dubai Library has experienced extraordinary growth of electronic resources in its collection. It is necessary to conduct the study to investigate how students at the university library are seeking information to satisfy their needs. The study also attempts to explore the students' behaviour in information seeking and needs to understand problems they face while searching electronic resources in the library.

II. Literature Review

The literature review on studies of information seeking behaviour is widespread. Prabha [4] found that undergraduate students stop searching for information when they decide they have enough information for their assignments. These findings support those of Barrett's [1] who argued that students look for enough information to meet their course needs. Urquhart [5] studying information seeking behaviour with disciplinary differences conceded in this regard, that different disciplinary approaches are not necessarily monolithic in their information search patterns, but differ according to the discipline. A potential way of looking to information seeking behaviour may involve information seeking patterns

of an individual that includes searching pattern, internal processes regardless of discipline and its information needs.

There are a lot of surveys that point out abundance growth of business information on the internet and the impact of its seeking behaviour. In investigating information seeking behaviour, Nicholas et al. [6] has brought significant changes in information seeking patterns. Nicholas et al. [7] used a log data obtained from three different sources and analysed log transactions of students, faculty, researchers and librarians to determine their information seeking behaviour reported that students are among the highest users of online databases compared to other groups in academic community. A study conducted at the United Arab Emirates University, Abdulla [8] reported that the migration from print to electronic resources at UAEU library raised some concerns in seeking behaviour. Another study by Urquhart and Rowley [9] highlighted the factors that influence students' information seeking behaviour in two categories, Macro factors comprising information source design, technology infrastructure, accessibility and organisational culture. Micro factors category has its emphasis on information literacy, search strategy, role of academics in changing information behaviour of students, discipline and curriculum pedagogy and training support.

Wilson [10] generalizes a theoretical model of continuing information seeking cycle which recognises the episodic nature of information seeking. Although the model focuses on the information seeking process, it doesn't openly explore the conclusion stage. Therefore, the factors those individuals employ in deciding when to stop information seeking are not identified. In another study, Dutta [12] reviewed 56 scholarly articles from the developing countries focusing on two areas: i) Comparing information needs of urban and rural dwellers and ii) discussing their information seeking behaviour and where possible to draw similarities with their counter parts in the developed world. The key finding arising in this review ascertained that urbanites in developing countries show similar information seeking behaviour regardless to geographic location and the highly educated one perform fairly as their counterparts in developed countries. The study found evidence of the difference in the information needs between the urban and rural population in the developing countries. Therefore, it would be precisely correct to say that information needs and searching behaviour are affected by an individual's geographic location. This is why this study conducted in the Middle East to explore geographical differences. The technological advancements are changing the ways people communicate, methods of learning, teaching and research are becoming more varied and dynamic [14].

III. The Study

The study wasmainly quantitative and questionnaire was designed to study students' information-seeking behaviour. In particular, it investigated four sources of information seeking behaviour namely information see- king, information needs, use and retrieval.

A questionnaire was designed based on the previous literature to study students' information seeking behaviour at University of Dubai library. Five point Likert scale was used to measure how far students were using information resources in the library. SPSS package version 20.0 was used to analyse data. Ten students and a reference librarian were used to pre-test the questionnaire. Based on their feedback the questionnaire was revised to the final form. Respondents were asked to fill the questionnaire which includes 3 parts. Firstly, demographic information, secondly information resources use, and thirdly barriers to use electronic resources.

Participants of this study were randomly chosen amongst students of the University at the frame of n/n = above 10% of the population. A total of 200 questionnaires were personally delivered to the sample when they entered the library. It was self-administered questionnaire and students were given ample time to respond. Out of 200 questionnaires only 175 were returned to the researcher which made response rate 87.5% which is reasonable. All respondents were students of University of Dubai, College of Business Administration and few from College of Information Technology at the time of the survey.

IV. Results

This section presents findings relevant to information seeking behaviour. Findings from table 1 showed the descriptive statistics from the reliability analysis. The distribution of sources of information seeking behaviour variables are close to each other, the highest rating given to information needs (0.663). The results showed that students made significant use of electronic resources. However, it is interesting to report that 83% of students cited that the primary resources of information for their assignments were electronic resources to fulfill their daily information needs and execution of academic tasks. Respondents were asked to express their opinion regarding the difficulties they face in using electronic resources. They mentioned that barriers of information seeking, manly cited that they are facing difficulties in choosing databases (20%), lack of searching skills (18%), identifying reliable articles (12.8%) of search results and 4% cited lack of qualified staff. While 45.2% cited that they are not facing any problem at all. It seems that respondents were affected by their collective culture in searching electronic resources. Social pressure in Arab society is tremendous, and public opinion is the main drive force to moves, praises, or

condemns of the individual behaviour. So, respondents shy away to raise any problem which will reflect ignorance to their society. The individual Arab is, first and foremost, a part of an extended family.

While in the real sense they stated that they are getting some tips from faculty and friends to use electronic resources as the nearest sources. Students are using commercial websites to search for their needs instead of interacting with academic databases, which is really upsetting phenomenon. Due to students' exposure to internet in early stages of study, they are so weak in searching techniques of academic databases.

Table1: Descriptive statistics

	Mean	SD	N	α-alpha value
Information seeking	37.44	13.202	175	0.85
Information use	26.73	5.848	175	0.89
Information needs	60.63	11.985	175	0.88
Information retrieval	21.76	3.970	174	0.88

In order to understand participants' information seeking behaviour possible correlation between sources of information were examined through Pearson correlation coefficient (table 2). Each first order factor was measured by different items varied between 3 - 6 items, each item was assumed to lead only on the respective dimension. The four factors namely information seeking, information needs, information use and information retrieval were analysed. Analysis showed that there is significant coefficient between sources of information. The highest coefficients were found between information needs and information-seeking. Second highest coefficients were found between information use and information needs. Third highest was between retrieval and information seeking. A Mann-Whitney test was performed to test the sources of information-seeking behavior and socio-demographic that found no significant gender differences between participants regarding the information needs and information use although the women scored higher.

A Spearman coefficient performed to examine correlation between age and four sources of information-seeking. The results showed that, there is no significant correlation between age and four sources of information-seeking behaviour. This finding was expected as there were no much age differences amongst participants. Mean age of participants was 20.55, SD 1.23 and ranges between 19 - 24.

Table 2: Correlation between Sources of Information

Sources of information	Information seeking r(p)	Information user(p)	Information needs r(p)
Information seeking	1	0.79(<.001)	
Information use	0.54 (<.001)	1	
Information needs	0.60 (<.001	0.82 (<.001)	1
Information retrieval	0.62 (<.001)	0.54 (<.001)	0.57 (<.001)

The subsequent ANOVA test was performed and showed that there are differences between three of the sources of information.

V. Discussion

The present study examined the information seeking behaviour of the students. Findings of this study seems sufficient to measure information seeking behaviour of students in on going rapid development of communication systems (ICT). It is interesting to note that many respondents like to use electronic resources and visit the library frequently to improve their performances, but they only access the databases recommended by their instructors particularly. Students cited that in their searching for information, they face problems such as lack of quality of retrieved information, which might be due to poor search strategies, search terms (phrases), clear subject knowledge and using search engines rather than academic databases. It is perceived that students are having a high degree of self-efficacy to access electronic resources and are so confident, but are surprised by huge number of search results retrieved. At the same it is difficult to identify the

reliable sources of their needs. These problems are mainly due to students being exposed to personal computers, smart phones, laptops, gadgets in the early stage of their studies. Therefore, this exposure created another problem of accessing unevaluated resources. This means that students have easy access to information through various commercial websites (Google, Yahoo etc.), academic data bases and social networks. The libraries with their strong mediated search support are no longer the primary sources for students. Subsequently, existing information seeking behaviour models may not sufficiently describe their approach to satisfy their information needs as in[14].For instance, Wilson's [11] model provides some guidance on the search process but due to being developed prior widespread of the Internet as information source is not applied necessarily by students in the University of Dubai. Many students are executing search practice just by the tips from a friend or librarian. Many of them are not attending information literacy sessions while they are freshmen in the University.

The present day students mostly knew information as product and not as process, so young searchers of this generation tended to search horizontally rather than vertically, as in[16]. This creates difficulty to student in discerning valid information in a mediated search environment. Students are not following any searching model in satisfying their information needs. It is perceived that students' over confidence of their ability to use technology is the main cause of this searching behaviour. Students' self-efficacy of the use of technology was relatively found one of problems of getting quality information among them.

The study highlights that students of University of Dubai precisely have reached macro factors that influence students' information set by Urquhart & Rowley [9] of having well information sources designed, technology infrastructure and accessibility, but organizational culture is not met. Students are compelled to search for information resources only required by instructor or mentioned in course syllabi. Regarding to micro factors set by Urquhart and Rowley [9] emphasising on information literacy there is no any embedded course on information literacy and they are satisfied with library orientation of the use of information resources to freshmen. There is strong likelihood that students are not aware of e-tutorials, so there is a need of marketing this service that will partly solve the problem of instruction of the use of the library resources. Having access to databases off campus was preference of 88% of students at their own spare time. This means that conservative culture of the Arabs bound many students and specially women to access information at home in order to avoid male and female interaction in information seeking. Many women use online resources so that they can stay physically separated with male while electronically connected in order to be modest, respectful and

seldom engage in social interaction with male [15] or sensitive topics. These cultural norms are predicted strongly to affect information-seeking behaviour in the region and elevating towards information technology in their studies. It might be assumed that women prefer to use offline sources such as asking family, friend and instructor when come to specific personal information needs in order to comply with cultural norms. It is very strange to report that when students asked about their preference resources of information, they reported commercial websites (Google, yahoo etc.) followed by academic databases. This means that students' search is still traditional nature of getting tips from relatives, colleagues (92%) and few rely on librarian tips. Almost 98.2% of students in this study reported that they knew how to search through library website but still rely on Google scholar to connect them to their respected databases. Although one search (via summon etc.) service available, but still they found that Google is easier to interact with than academic databases. The strongest correlation was found between information seeking and information needs (r = 0.82) which might mean that students were heavily involved in seeking information and use electronic resources to satisfy their needs (table 2). This finding concurs with Nicolas et al. [6]. The second strong correlation was found between information use and information needs (r = 0.79) which might mean that almost all participants' needs were relatively the same to do research projects and assignments. The third strong correlation was found between information retrieval and information seeking (r = 0.62) which might mean that students' searching activities stopped when they feel they have enough information to execute the assigned academic tasks. This finding doesn't defer from that of Prabha [4].

It seems that students are more indulged in social networks where they get quick feedback from colleagues or friends. This is another problems to rely on unedited source of information. ICT nationally and internationally has changed information-seeking behavior of students, as they articulate their needs in social networks and commercial search engines [17].

These findings showed that the outcomes of information seeking behaviour can be influenced by different infor- mation structures such as information seeking, needs, retrieval and availability of information, experience of the web search, surrounding environment and culture. No significant gender-based differences were found in regard to information seeking behaviour, although fema- les scored higher than males. The dramatic changes in reference services data indicated that reference ser- vices are not utilized to the same extent in the past [16] and increasingly more students do not physically come to library or depend on social networks, friends' feedback and online chat with librarian. The online chat with librarian, has been used heavily by female students who were culturally forced to

be distantly segregated with male but electronically connected and share expertise in the subject or information seeking. Search strategies are still not to the extent as students rely on colleague's feedback and that might expose them to access peer reviewed journals, unedited publications and ultimately reduce the information quality.

VI. Conclusion

The main objective of this study was to explore the use of electronic resources by the University of Dubai focusing on information seeking behaviour. The results showed that students use electronic resources with limit of instructor's direction as knowledgeable persons along with tips from colleagues as nearest sources. There is a need of academics of playing pivotal role to enhance information seeking behaviour of students as knowledgeable persons consulted by students. Considering tremendous technology advancement in university education and teaching worldwide, there is some evidence that students' information seeking behaviour and use of electronic resources influenced by information literacy barriers. Therefore, information literacy skills are key focus so that students shouldn't suffer to navigate to authoritative and quality information sources. Having access to databases off campus was preference to students which means that would likely prefer to access at their own spare time, at their own convenient place rather than library. In other words, the library is no longer the only place to satisfy students' needs, but resources availability online is crucial. Considering the tremendous technology development in university education and teaching worldwide, it is expected that future students' information seeking behaviour will change tremendously as every level of their study will be online. Information literacy skills will be key focus from pre-university onwards. While the country is heading towards smart learning, students will no longer struggle with using software applications as will easily navigate electronic resources interfaces and fully utilize digital tools and none will struggle with basic electronic resources functionality.

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Determinants of Electronic Learning Adoption in Higher Institutions of Learning in Uganda: A Learners' Perspective

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Abstract- The introduction of electronic learning (EL) has been initiated in Higher Institutions of Learning (HIL) as an attempt to improve on education institutions' service delivery. By adopting the Technology-Organization-Environment (TOE) framework, this study was aimed at investigating the determinants of the e-learning adoption in HIL where eight TOE factors were examined. The study adopted a quantitative approach, a descriptive research and cross-sectional survey for the research design. A questionnaire was developed based on the eight identified TOE study constructs and administered to a population of 5438 students in three Faculties of Makerere University Business School (MUBS). In regard to data analysis, factor analysis and assessment of reliability and validity of the measurements items was done. Finally, a multiple regression analysis was carried out to evaluate the relationship between the predictor variables and e-learning adoption.

DETERMINANTSOFELECTRONICLEARNINGADOPTIONINHIGHERINSTITUTIONSOFLEARNINGINUGANDAALEARNERSPERSPECTIVE

Strictly as per the compliance and regulations of:

Determinants of Electronic Learning Adoption in Higher Institutions of Learning in Uganda: A Learners' Perspective

Juma Sonny Nyeko [α] & Cosmas Ogenmungu [σ]

Abstract- The introduction of electronic learning (EL) has been initiated in Higher Institutions of Learning (HIL) as an attempt to improve on education institutions' service delivery. By adopting the Technology-Organization-Environment (TOE) framework, this study was aimed at investigating the determinants of the e-learning adoption in HIL where eight TOE factors were examined. The study adopted a quantitative approach, a descriptive research and cross-sectional survey for the research design. A questionnaire was developed based on the eight identified TOE study constructs and administered to a population of 5438 students in three Faculties of Makerere University Business School (MUBS). In regard to data analysis, factor analysis and assessment of reliability and validity of the measurements items was done. Finally, a multiple regression analysis was carried out to evaluate the relationship between the predictor variables and e-learning adoption. The findings of this study imply that the TOE can be used to analyze E-Learning adoption in Universities and other HIL as relative advantage, complexity, compatibility, size, competitive intensity and regulatory environment were identified as significant predictors of EL adoption. Whereas top management support and IT/IS knowledge are insignificant predictors in the adoption of EL. The outcomes may provide insights to the education sector and stakeholders in developing countries when considering rollover of the technology.

Keywords: electronic learning adoption, higher institution of learning, TOE factors.

I. Introduction

Information systems (IS) projects, as a result of wide spread usage of the Internet, have been initiated in public Universities and other institutions of learning in developing countries over the past decade as an attempt to improve on public service delivery by investing million of United States (US) dollars in IT infrastructural development. Deng and Tavares (2013) also confirm this assertion that the latest development of Internet technologies has led to a lot of universities investing considerable resources in e-learning systems to support teaching and learning. Among them is the introduction of education information system (EIS) in higher institutions of learning (HIL), an electronic learning (e-learning) approach that support learning, research and administrative operations through the use of the Internet and computer facilities (Raymond, 2000; Roffe, 2002) in HIL. Henry (2001) defines e-learning as an appropriate application of the Internet that support the delivery of learning in a student-centered learning environment by delivering the required knowledge, skills and in a holistic approach not limited to any particular courses, technologies, or infrastructures. Whereas Koo-hang and Harman (2005) defined e-learning as the delivery of all educational activities relevant to instructing, teaching, and learning through various electronic media such as the Internet, intranets, extranets, satellite TV, video / audio tape, and/or CD ROM. According to *Yining et al.,* (2012) the specific learning objectives and applications that e-learning technologies are expected to support include:-instruction (lecture, demonstration, webinars, literature, ebooks); collaboration (virtual chat room, discussion board, study group, mentored exercise, instant message); practice (interactive tutorials, online labs, simulation, role playing schemes); and assessment (performance testing, proficiency evaluation, feedback mechanism). Thus e-learning is the attainment of knowledge facilitated and supported through the exploitation of information and communication technologies (ICTs).

Considering educational establishments across the globe, e-learning is becoming more widely adopted with the European Union Report (2014) observing that no less than 96% of the institutions surveyed in Europe use e-learning. Gaebel *et al.,* (2014) attribute the drivers to the adoption of e-learning (EL) in European Higher Institutions of Learning due: - to opportunity to gain employment while studying; flexible use of time and space, physical distance/residence in remote areas; professional development and continued education; family and other social obligations and socio-economic situations of students and the need for accessible and flexible access to education lifelong (Blin *et al.,* 2008). Globalization, aging society; growing competition between higher educational institutions both national and international, and rapid technological development are also drivers of educational technologies. In addition, other significant drivers to the adoption of EL include:- the reduction of overall cost (instructors' salaries, travel costs, and meeting room rentals), as well as access to quality education, the provision of convenience and a

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reduced environmental impact through lower paper use and energy consumption (Gill, 2000; Roy *et al.,* 2008).

Notwithstanding some lately promising initiatives, for the adoption of e-learning (EL), there are some concerns for slow e-learning adoption witnessed in higher institutions of learning in developing countries due to some noteworthy barriers hampering their efforts (Al-Fadhali, 2011) compared to developed countries. According to the Giga Information Group, nearly 75 percent of the 129 top US Universities use e-learning systems (Wang & Wang, 2009). Nevertheless, EL has recently become more popular in some developing countries (Alkhalaf *et al.,* 2012) as much as its upscale is low. However, there are limited studies done in the field of e-learning adoption in institutions of higher learning in developing countries, public Universities in particular and yet the Internet usage is on the rise. According to the Uganda Communications Commission (UCC), Inter- net penetration has in the last two decades exhibited tremendous growth by 79.3% by 2014. Therefore, app- lying technology, organization and environmental (TOE) framework, this study was aimed at examining the deter- minants of e-learning adoption in Ugandan University context.

II. Literature Review

E-Learning is becoming more popular as the most effective method of teaching and learning, while disseminating information and knowledge in institutions of higher learning and organizations in general (Noh *et al.,* 2012). In view of that, E-learning has relentlessly played an essential role to the advancement of the performance of teaching staff and learners, and the enhancement in the quality of teaching methods. E-learning engages the use of a computer or electronic device in some way to offer educational or learning materials, and e-manage data, information, and knowledge to improve student' performance (Agarwal *et al.,* 2004). E-learning has resulted in increased popularity of education in different educational institutions (Basheer and Ibrahim, 2011) and generally its pervasiveness in higher institu- tions of learning due to the accessibility of the Internet. Liu and Wang (2009) observe that the characteristic of e-learning process was mainly based on the Internet; information dissemination and knowledge flows in form of network courses among others. E-learning has provi- ded several benefits to both the academic and adminis- trative staff and students alike. E-learning enable students at a higher educational level to obtain their education in parallel with pursing their personal goals and maintaining their own careers, without a need to attend classes and be subjected to a rigid schedule (Borstorff and Lowe, 2007). This has resulted to an increase in the number of online courses due to attained benefits for both University and learners as also reported by (Kartha,

2006). This has also improved in the quality of education as it triggers competition amongst educational institutions.

E-learning systems can be categorized into two types; the Course Management Systems (CMS) and the Learning Management Systems (EMS). Course Management System is a set of tools that allow the instructor to create online course materials and post it on the Web without having to handle HTML or other programming languages (Janssen, 2015). It's also referred to as Content management systems available since the late 1990s and considered as an integral part of higher education in recent times. Its administrative components involve class rosters and student grade records. Whereas the teaching component of CMS include all aspects of teaching, student-teacher interaction; learning objects, quizzes, class exercises, tools for real-time chat, or asynchronous bulletin board type communications and tests (Technopedia, 2015).

On the other hand, Learning Management Systems (LMS) are software programs for the administration, documentation, tracking, reporting and delivery of electronic educational technology (also called e-learning) courses or training programs (Ellis, 2009) that handles all aspects of the learning process. Mindflash (2015) suggest that they are the infrastructure that distributes and manages instructional content, identifies and assesses individual and organizational learning and training goals as well as to automating, record keeping and supporting employee registration.

III. Research Model and Hypotheses

The TOE framework, developed by Tornatzky and Fleischer (1990), was the research model used to study cloud computing adoption by firms (Low *et al.,* 2011) and e-learning adoption *(*Shin-Yuan *et al.,* 2009). As indicated in Figure 1 below; Tornatzky and Fleischer (1990); Low *et al.,* (2011) and Shin-Yuan *et al.,* (2009) formed the basis of the conceptual framework of this study.
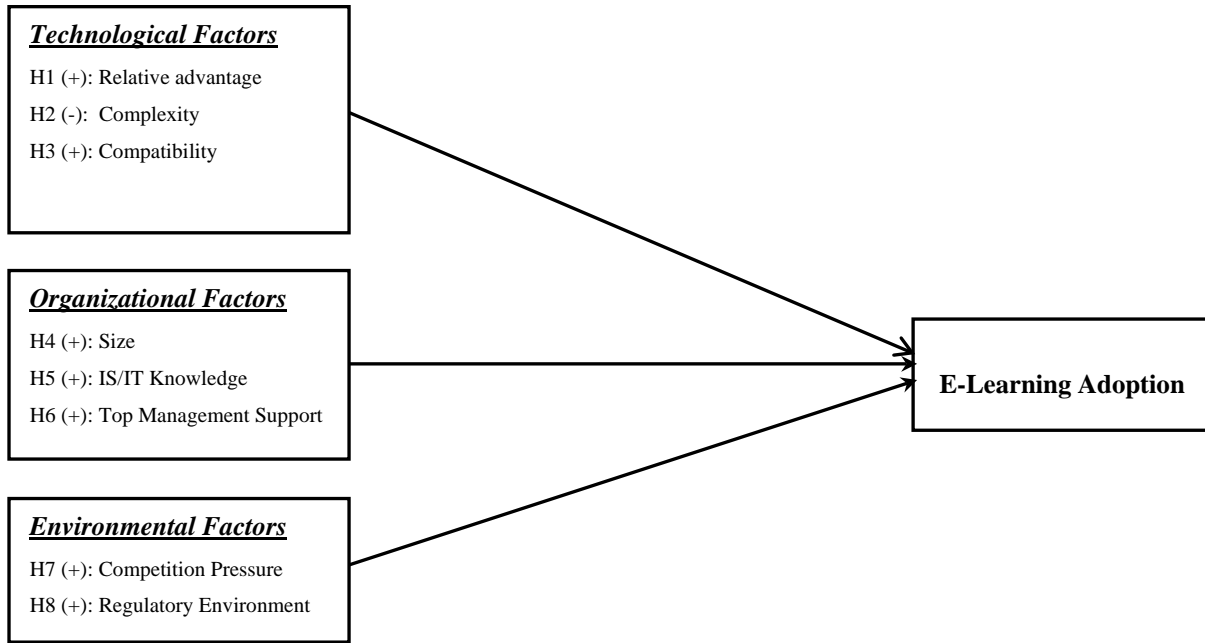
Figure 1: Proposed research model adopted and modified from (Tornatzky and Fleischer, 1990); Low et al., 2011 and *Shin-Yuan et al., 2009).*

The TOE framework has been used by other researchers to analyse the adoption of a variety of information systems (IS) and technical innovations, including e-commerce, online retailing, e-business, and ERP (Chong *et al.,* 2009; Lin and Lin, 2008; Oliveira and Martins, 2010; Zhu *et al.,* 2006). The TOE framework's *technology context* refers to internal and external technologies which are relevant for the firm. Frequently used constructs are relative advantage, complexity, and compatibility (Ramdani *et al.,* 2009), (Thong, 1999), (Grover, 1993) which have also been proposed in this study. Whereas, the TOE framework's *organizational context* comprises" the characteristics and resources of a firm including linking structures between employees, intra-firm communication processes, firm size, and the amount of slack resources" (Baker, 2012). Firm size, IT/IS knowledge and top management support have been proposed for the study. Lastly, the TOE framework's *environmental context* relates to the area "in which a firm conducts its business - its industry, competitors, access to resources supplied by others, and dealing with the government" (Tornatzky and Fleischer, 1990). Competition pressure or intensity and regulatory environment / policy have been proposed for the study.

a) Relative Advantage of Technology

In a technological context, Low and Chen (2011) define relative advantage as a degree to which a technological factor is perceived as providing great benefit to an organization and that the adopted

technology must assist the organizations to accomplish its goals. Rogers (2003) on the other hand defines relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes" and has been positively associated with the adoption of innovative technology in previous research [(Iacovou *et al.,* 1995); (Kuan and Chow, 2000); (Ramdani *et al.,* 2009), (Tornatzky and Klein, 1982)]. Relative advantage of the technology has been consistently identified as one of the most critical adoption factors (Iacovou *et al.,* 1995; Kuan and Chow, 2000). It's considered to be similar to what the Technology Acceptance Model (TAM) calls perceived usefulness. Comline (2008) refers to perceived usefulness as the benefits or the efficiencies that will be enabled through the use of the system. According to Heck and Ribbers (1999), organizations with management that recognizes the benefits of the new system proposed will be more likely to adopt the system and enjoy higher impacts compared with firms with management that do not recognize the benefits of the system (Heck and Ribbers, 1999); (Iacovou *et al.,* 1995). When perceived benefit or relative advantage of e-learning is high, there are higher chances that the organization will allocate more managerial, financial and technological resources to implement the innovation. Agarwal and Prasad (1998) demonstrate that the advantage an innovation has relative to another method is positively related to its rate of adoption. It is therefore possible to suggest that the advantages that e-learning offers would influence its rate of adoption. Therefore, the following hypothesis (H) was formulated on this basis:

- *H1:* Relative advantage is positively associated with e-learning adoption.

b) *Complexity of Technology*

Complexity refers to the degree of difficulty users' encounter in understanding or using an innovation (Rogers, 2003) and (Jianyuan and Zhaofang, 2009). The level of difficulty of using an innovation is inversely related to its adoption (Meuter *et al.,* 2005); (Jianyuan and Zhaofang, 2009); and (Taylor & Todd, 1995). Higher (perceived) complexity will create higher uncertainty related to a successful implementation (Grover, 1993), (Tornatzky and Klein, 1982). Jianyuan and Zhaofang (2009) in their study on adoption of B2B E-Marketplace in China, indicate that the complexity of an IT system has a negative correlation with the final adoption of the system. They further pointed out that, the more difficulty it is to use or train users on an IT system, the less likely it is for an organization to adopt the new system. Thus, the complexity of an IT system can be seen as having a negative impact in adopting innovation (Low and Cheng, 2011). Consequently, the greater the perceived complexity of using e-learning, the less likely its adoption will be. Thus, the study sought to verify:

- *H2:* Technical complexity is negatively associated with e-learning adoption.

c) *Compatibility of Technology*

Rogers (1995) defines compatibility as the degree to which innovation is consistent with the adopter's current culture, lifestyle, values, needs, processes and technological requirements. Previous research most frequently singles out compatibility's influence on the adoption of innovative technology; it correlates positively with the diffusion of innovations (Tornatzky and Klein, 1982). The lack of compatibility had led many organizations to doubt the potential of the innovation in relation to their current environment (Jianyuan and Zhaofang, 2009). Organizations are more likely to adopt a technology when it is compatible with their existing practices and values (Rogers, 2003). Prior studies such as Teo *et al.,* (2007) and Tan *et al.,* (2009) provide evidence suggesting organizations are more likely to adopt and use technology that is compatible with the organizations existing technology infrastructure, business processes and value systems. The study also intended to verify that:

- *H3:* Technical compatibility is positively associated with e-learning adoption.

d) *Organization Size/Firm Size*

Firm size refers to the number of employees, size of the target market and capital invested in an organization (Anand and Kulshreshtha, 2007) and has been recognized as an important facilitator for the adoption of technology innovations [(Tornatzky and Fleischer, 1990), (Thong, 1999)]. Anand and Kulshre- shtha (2007)

further point out that, large organizations have more resources that can be used to finance innovation and plays a key role in determining IT innovation (Pan and Jang, 2008). Consequently, large organizations stand to benefit greatly out of technology adoption due to greater flexibility and risk-taking ability (Liu, 2008; Oliveira and Martins, 2011; *Wang et al.,* 2010) and also often are more well-equipped with resources and infrastructure to facilitate innovation adoption (Thong, 1999; Levenburg *et al.*, 2006). Organizational and firm size is constantly found to be positive with regard to the organizational inclination to adopt an innovation (Rogers, 1995). Jeyaraj *et al.*, (2006) also revealed that organizational size is one of the best predictors of IT adoption by organizations. This is consistent with the study done by (Gibbs and Kraemer, 2004; Grover, 1993; Zhu *et al.,* 2003) who also suggested that organizational size positively influenced the organizational adoption of IT innovations. Montazemi (1988) also affirms that the probable reason for the significant positive relationship between organizational size and IT adoption is the greater size of the organizations as they generally have more slack in their resources and therefore assign more organizational resources (e.g., financial, technical, and human resources) for the adoption of any new IT innovation. Derived from the above theoretical arguments and empirical support, it can be argued that larger Universities with more students number is linked to a large sized University thus more likely to adopt e-learning. Thus, the following hypothesis was formulated on the basis of the above evidence:

- *H4:* University size is positively associated with e-learning adoption.

e) *Information System (IS) / IT Knowledge*

Information system (IS) expertise or knowledge also referred to as technological readiness and the IT/IS human resources and infrastructures of a particular firm. Knowledge about IS enables organisations to manage effectively the risks associated with investing in an innovation (Teo *et al.,* 2007). Those organizations that do not have much IT/IS expertise and experience may not be aware of new technologies and may not desire to take a risk by adopting them (Ramdani *et al.*, 2009). Relevant IS/IT experience variables have been investigated in many studies (Lee *et al.,* 2004; Lertwongsatien and Wongpinunwatana, 2003). Dholakia and Kshetri (2002) suggest that the experience of already available technologies in the organization will influence the adoption of similar technology in the future. Moreover, Kuan and Chou (2001) also found that prior IS experience influences the adoption of new technologies. Previous researchers identified their technology knowledge as a crucial factor influencing adoption decisions [(Grover, 1993), (Chau and Jim, 2002); (Fichman, 1992); (Zhu *et al.,* 2002). Considering that increasingly non-IT employyees - or at least their management – are involved in strategic IT decisions, their perception and under-

standing of the targeted technologies is important. Van Grembergen and De Haes (2008) also state that IT knowledge within business divisions contributes to a creative and innovative environment. There are also some empirical evidence that shows the positive relationship between employees' IS knowledge and the decision to adopt IS (Thong, 1999). Therefore, the following hypothesis can be formulated on this basis on technology readiness of the non-IT human resources:

- *H5:* IS/IT knowledge is positively associated with e-learning adoption.

f) Top Management Support

Top management support refers to the level of support extended by the higher management to adopting the technological innovations for use (Grover, 1993). The review of the IT adoption literature; Jeyaraj *et al.,* (2006) suggests, top management support as one of the three best predictors for IT innovation adoption at the organizational level and can contribute to the adoption of innovations by creating a fertile environment and by providing resources [(Ramdani *et al.,* 2009), (Grover, 1993), (Premkumar and Roberts, 1991)]. Indeed, it reduces barriers and resistance to change (Teo *et al.,* 2006). Previous studies on IT innovation adoption based on TOE framework have also suggested that top management support has a positive relationship to the organizational decision to adopt an innovation (Chong *et al.,* 2009; Grover, 1993; Lee *et al.,* 2009; Ramdani *et al.,* 2009; Teo *et al.,* (2006). Quinn (1985) argued that there happen to be two different grounds for justifying the positive relationship between top management support and technological innovation adoption. In the first instance, powerful top management support can make sure of the ample distribution of organizational resources (e.g., financial, technical, and human) for flawless adoption and implementation of an IT innovation (Oliveira and Martin, 2011) and also have the ability to send innovation importance and acceptance messages across the organization (Wang, Wang and Yang, 2010). Secondly, such support lessens organizational disagreement on adopting an IT innovation as top management can provide long-term vision, proposals, support, and the obligation to generate an affirmative environment for the IT innovation (Quinn, 1985). Innovations that receive management support are therefore easily adopted in organizations. Therefore, it would be highly likely that the organizations with stronger top management support for e-learning adoption would also be more likely to adopt such applications. Therefore, based on the previous theoretical arguments, the following hypothesis was formulated:

- *H6:* Top management support is positively associated with e-learning adoption.

g) Competitive Pressures

Competitive pressure refers to the degree of pressure experienced by organisations within the industry (Oliveira and Martin, 2011) and usually associated with environmental factors affecting technological adoption (Iacovou *et al.,* 1995). Organizations may adopt and use a technology to keep up with competing organizations (Joo and Kim, 2004). Competitive pressure forces organizations to be more innovative in order to stay in the business. Various studies have indicated that the intensity of competition in an industry is a major adoption determinant factor [(Wu and Subramaniam, 2009); (Jianyuan and Zhaofang, 2009); (Oliveira and Martins, 2011); (Kuan & Chou, 2001); (Low and Cheng, 2011) and (Chong and Ooi, 2008)]. Thus, competition increases the likelihood of innovation adoption (Thong, 1999) as organisations also allocate more resources to innovations (Grover, 1993). Hence, derived from the above theoretical arguments, the following hypothesis was devised:

- *H7:* Competition pressure is positively associated with e-learning adoption.

h) Regulatory Environment / Policy

Baker (2012) points out that government regulation can have a favorable or negative impact on organizations, depending on whether its policy encourages or discourages innovation. Organizational regulation tendencies are aimed at accommodating audit trails and legislative compliance. Firms operating in a well-regulated environment have to balance legal requirements with the adoption of technology innovations. Governments can support technology innovation by providing tax advantages by introducing regulation that force firms to adopt certain technology standards (Zhu, Xu, and Dedrick, 2003). In order to be well accepted the e-learning solutions need to meet some legal rules and security issues (Betts *et al.,* 2006). Adversely, governments can also pass constraining regulation and restrictions; for example restrictions for trading with specific countries, local legislations or disaster regula- tions (Quayle, 2005). Hence, derived from the above theoretical arguments, the following hypothesis was formulated:

- *H8:* Regulatory environment/policy is positively associated with e-learning adoption.

IV. Research Methodology

a) Research Design, Sampling and Research Instrument

The study examined the determinants of e-learning adoption in a higher institution of learning, specifically Makerere University Business School (MUBS). The study used a quantitative, descriptive and cross-sectional research designs. Cross-sectional research design collects and uses data for only a specific point in time. The study population included MUBS students from three (3) Faculties of Computing and Management Science (FCMS); Faculty of Graduate Studies and Research (FGSR) and in Faculty of Vocational and Distance Education (FVDE) with the number of respondents indicated in Table 1 below.

Table 1: Sample Size

Faculty	Sample Size
Faculty of Computing and Management Science (FCMS)	1671
Faculty of Graduate Studies and Research (FGSR)	663
Faculty of Vocational and Distance Education (FVDE)	3104
Total	5438

Out of the 5438 sample size in Table 1 above that was conveniently selected, 4743 questionnaires were returned, implying 87.2% response rate. However, some 95 questionnaires were found to be incomplete and others inconsistent in the way questions were answered. These were therefore removed from the analysis. Consequently, 4648 questionnaires representing 85.5% of the sample were analyzed. Even after the removal of 95 questionnaires, 85.5% representation of the study results was very adequate. The response rate was very good because the survey was conducted during exams period when most students are available at the Campus.

Table 2 below represents the social demographic characteristics of respondents about their gender, age and education level.

Table 2: Social Demographic Characteristics

			Frequency	Percentage
Gender	Male		2216	47.7
	Female		2432	52.3
		Total	4648	100
Age	19 years and below		56	1.20
	20 – 25 years		2928	63.0
	26 – 30 years		856	18.4
	31 – 35 years		584	12.6
	Above 35 years		224	4.80
		Total	4648	100
Education Level	Certificate		416	9.0
	Diploma		2848	61.3
	Bachelors		1120	24.1
	Masters		240	5.2
		Total	4648	100

The number of female and male respondents is almost even with the female representing a slightly higher percentage of 52.3% against 47.7% for male respondents. The gender composition reflects the student population trend in across all Universities in Uganda whereby female students constitute the majority of the student enrollments as indicated in Table 2 above. The numbers of respondents 19 years and below constitute 1.2%; 20 – 25 years constitute 63%; 26 – 30 years constitute 18.4%; 31 – 35 years constitute 12.6% and lastly, above 35 years constitute 4.8%. Considering the education background of respondents, Certificate constitute 9%; Diploma constitute 61.3%; Bachelors constitute 24.1% and finally Masters respondents constitute 5.2% as shown in Table 2 above.

b) Reliability and Validity of Measurement Instruments

A questionnaire was developed based on the study constructs of several information systems adoption studies in Table 3 below.

Table 3: Reliability and Validity Measures

Constructs & Sources	Construct Measurement Items	Cronbach's Alpha	Factor Loadings
Relative Advantage (Ali & Green, 2007); (De Haes & Van Grembergen, 2008); (Lee *et al.,* 2008a); (Nfuka & Rusu, 2010); (Nfuka & Rusu, 2011). (Wang *et al.,* 2010); Yen *et al.,* 2013; Alshamaila et al. 2012; Low *et al.,* 2011; Jang, 2010); Dublin, L. (2004)	• EL usage increases user satisfaction and leads to improved academic performance. • EL offer convenience in service provision. • EL usage is better than the use of previous manual systems in an institutions setting. • Using EL improves on operational efficiencies as a result of cost reduction in service delivery. • Using EL improves on effectiveness in performance through the provision of new opportunities.	0.675	1. 0.568 2. 0.636 3. 0.566 4. 0.673 5. 0.692

Complexity Matopoulos *et al.,* (2009); Ahmad and Agrawal (2012); Furneaux and Wade (2011).	• The skills needed to use EL are too complex for our institution. • Integrating EL in our current practices will be a challenge. • Overall, I believe that EL is easy to use.	0.769	1. 2. 3.	0.745 0.901 0.834
Compatibility Matopoulos *et al.,* (2009); Ahmad and Agrawal (2012); Furneaux and Wade (2011).	• Using EL service is compatible with the institution's goals and objectives. • The use of EL technologies is compatible with all aspects of our institution's operation. • EL is compatible with the institutions' existing culture and values. • EL is compatible with the institution's existing information technology (IT) infrastructure such as hardware and software.	0.748	1. 2. 3. 4.	0.638 0.705 0.618 0.662
Size (Ramdani, Kawalek & Lorenzo 2009; Al-Somali, Gholami & Clegg 2010); (Hung *et al.,* 2010)	• Large institutions effectively use EL due to their greater risk-taking ability. • Large institutions are well-equipped with resources to make possible EL acquisition and usage. • Small institutions that have invested in technology before approve the use of EL more rapidly compared to larger institutions that have not. • Large institutions effectively use EL due to their greater flexibility in usage.	0.543	1. 2. 3. 4.	0.655 0.612 0.695 0.709
IT/IS Knowledge (Van Huy *et al.*, 2012); (Rahayu & Day 2013; Wang, Vogel & Ran 2011).	• The institution has an extensive EL technical knowledge. • EL is a familiar type of technology to use. • I have the knowledge to use EL services. • I have the understanding to use EL services.	0.585	1. 2. 3. 4.	0.655 0.612 0.695 0.709
Top Management Support (Ali & Green, 2007); (De Haes & Van Grembergen, 2008); (Lee *et al.,* 2008a); (Nfuka & Rusu, 2010); (Nfuka & Rusu, 2011). (Wang *et al.,* 2010); Yen *et al.,* 2013; Alshamaila et al. 2012; Low *et al.,* 2011; Jang, 2010)	• Top managers are interested in the use of EL services. • Top managers are willing to invest the necessary resources for improving EL usage in the institution. • Top managers are willing to take risks involved with EL usage.	0.723	1. 2. 3.	0.643 0.717 0.783
Competition Intensity (Wang *et al.,* 2010); (Alghamdi et al. 2012; Ayyagari et al. 2012; Sohail 2012; Swilley et al. 2012). Nasseef (2013); Ahmed *et al.,* (2014)	• The institution experiences competitive pressure to improve on the existing EL services. • Institutions that readily implement new technologies will be competitive. • Neighboring institutions are also using the EL. • There is pressure from the education sector to use EL as a standard practice in all institutions. • I think it is necessary to use EL in order to compete with other institutions regionally and internationally.	0.641	1. 2. 3. 4. 5.	0.538 0.514 0.543 0.675 0.688

Regulatory Environment (Buchwald & Urbach, 2013; Baker, 2012; Zhu, Xu, and Dedrick, 2003; Betts et al., 2006; Quayle, 2005).	• There is adequate legal protection for EL usage in institutions. • There is knowledge about the availability of information regarding information system laws and regulations from government. • It has always been a regulatory requirement by government to use EL.	0.523	1. 0.643 2. 0.717 3. 0.783
E-Learning Adoption (Agarwal et al., 2004; Basheer and Ibrahim, 2011; Liu and Wang, 2009; Borstorff and Lowe, 2007; Kartha, 2006).	• Users always ready to utilize EL services. • Users more than ready to apply EL services whenever it's applicable. • Readiness to use EL is very high among users. • E-learning leads to increased popularity in education due to improve student performance.	0.676	1. 0.722 2. 0.578 3. 0.716 4. 0.641

The instrument for this survey comprised of items that provided indicators as a yardstick for EL adoption. The instrument was anchored on a multi-item five-point Likert scale with statements to which respondents gave the degree to which they were in agreement/disagreement with five options offered as:- Strongly Agree "5", Generally Agree "4", Neutral "3", Generally Disagree "2"or Strongly Disagree "1". The questionnaire was pre-tested through solicited views from MUBS staff to ensure validity of the items within the instrument.

In order to have robust findings, the scales used to measure the variable constructs has to be reliable. Thus, an assessment of the items used for every variable was conducted using Cronbach alpha to determine the internal consistency of the measurement model. Consequently, the Cronbach alpha coefficient and factor loadings for the variables were extracted to ensure the internal validity and consistency of the items. The construct validity of the measurement items was determined by conducting a principal component analysis (PCA) with varimax rotation where a minimum loading value of 0.5 was used for all primary factor loadings. Other items were eliminated because of cross-loadings or their factor loadings were below the 0.5 threshold value.

Hair et al., (1998) recommended Cronbach alpha of more than 0.7 as appropriate for a reliable mea-surement instrument. However, the generally accepted Cronbach value of 0.60 and above and factor loadings for each of the variable items of over 0.5 are also consi-dered reliable. Therefore, since the Cronbach alpha for all the combined construct was 0.815 coupled with an acceptable Cronbach alpha of the individual constructs and factor loadings as indicated in Table 3 above, the results demonstrates that the internal consistency in the survey items demonstrate a reliable measurement instrument in terms of reliability and validity.

Prior to proceeding with factor analysis, Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTOS) was measured to ascertain whether the adequacy of sampling was appropriate to proceed with factor analysis. A small KMO value indicates the factor ana-lysis may not be an excellent alternative. Kaiser (1974) suggests that a KMO measure in the 0.90's is consi-dered as 'marvellous', in the 0.80's as 'meritorious', in the 0.70's as 'middling', in the 0.60's as 'mediocre', in the 0.50's as 'miserable', and below 0.50's as 'unacceptable' for sample adequacy for factor analysis purposes. Further Blaikie (2003) suggest that KMO should be at least 0.60 and BTOS should indicate test for the overall significant correlation among all items at ($p < .05$). The result for the KMO and BTOS are shown in the Table 4 below.

Table 4: Kmo And Bartletts's Test

Kaiser- Meyer -Olkin (KMO) and Bartlett Test of Sphericity		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.795
Bartlett's Test of Sphericity	Approx. Chi-Square	15499.325
	Df	36
	Sig.	.000

As indicated in Table 4 above, the KMO measure for the determinants of e-learning adoption show a value of 0795, which is almost meritorious. The observed value of the Bartlett test of sphericity was also large (15499.325) and its associated significance level was very low (0.000). Combining the results of KMO measure and Bartlett test of sphericity, the items used to indicate the determinants of e-learning adoption evidently met the conditions for subsequent tests of factor analysis. The result of this factor analysis also will affect the hypotheses that were suggested earlier.

V. Analysis of Results

In this study, the technological, organisation and environmental (TOE) factors were used to predict e-learning adoption in a University context. A multiple regression analysis was run to determine the predictors. Prior to interpretation of the regression results, issues of multicollinearity and multivariate outliers were checked. Consequently, possible problems of multicollinearity were found not to be of concern as each predictor had a tolerance value of more than 0.5 (Tabachnick & Fidell,

2001) and a variance inflation factor (VIF) less than three (Stevens, 2012) as seen in Table 7 below. On the other hand, as a rule of thumb, if VIF>5.0, one suffers from the problem of multicollinearity (Pallant, 2001). The maximum Mahalanobis distance (19.8) did not go beyond the critical $\chi2$ (22.5), showing that the multivariate outliers were purged. Consequently, specific focus in the analysis was on the model summary, ANOVA and coefficients in Tables 5, 6 and 7 respectively as indicated below.

Table 5: Model Summary

Model Summary[b]				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.870[a]	0.756	0.756	0.27207
a. Predictors: (Constant), Regulatory Environment, Relative Advantage, Competitive Intensity, Complexity, Size, Top Management Support, Compatibility, IT Knowledge				
b. Dependent Variable: E-Learning Adoption				

In the model, R Square is 0.756 (75.6%), taken as a set indicates that the predictors: - RA, CX, CT, S, IT, TM, CI and RI account for 75.6% of the variance in e-learning adoption. It's the measure of the amount of variance in the dependent variance (DV) that the independent variable (IV) account for when taken as a group. Therefore, the overall model predicts 75.6% of the variance, which is pretty good indicating that 76

percent of the changes in behavioral intention to adopt e-learning can be explained by the changes in the eight (8) independent variables. The analysis of variance (ANOVA) Table 6 below is the test of whether R Square is significantly greater than zero (o) such that when the P value is less than 0.05 (<0.05) then the regression output is deemed significant.

Table 6: Analysis Of Variance (Anova)

ANOVA[a]						
	Model	Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	1050.425	8	131.303	1773.778	0.000 [b]
	Residual	338.810	4577	0.074		
	Total	1389.235	4585			
a. Dependent Variable: E-Learning Adoption						
b. Predictors: (Constant), Regulatory Environment, Relative Advantage, Competitive Intensity, Complexity, Size, Top Management Support, Compatibility, IT Knowledge.						

As a result, at P<0.05, the overall regression model was significant where F (8, 4577) = 1773.8, p<0.001, R Square = 76% thus showing the fitness of the model. Thus, the predictor taken as a group predicts e-learning adoption and also indicates that the

combination of the e-learning (EL) predictors can significantly predict the EL adoption.

Table 7 below show the coefficients that is used to assess the predictors individually whether they are significant in their own right and P<0.05.

Table 7: Coefficients

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	.487	.041		11.784	0.000		
Relative Advantage	.974	.009	.889	103.286	0.000	0.719	1.390
Complexity	-.044	.007	-.053	-6.336	0.000	0.767	1.304
Compatibility	.017	.008	.020	2.257	0.024	0.649	1.541
Size	-.020	.007	-.026	-3.031	0.002	0.714	1.401
IT Knowledge	-.003	.007	-.004	-.473	0.636	0.617	1.620
Top Management Support	.002	.007	.003	.339	0.735	0.628	1.593
Competitive Intensity	-.032	.008	-.035	-4.207	0.000	0.775	1.290
Regulatory Environment	-.015	.006	-.024	-2.592	0.010	0.637	1.570

a) Dependent Variable: E-Learning Adoption

Considering the coefficient Table 7 above, the P value for Relative Advantage (RA) as one of the e-learning (EL) adoption predictors is 0.000. This is less than 0.05 hence RA is a significant predictor of e-learning adoption. Similarly, complexity with a P value of 0.000 is also a significant predictor of e-learning adoption since the P value is less than 0.05. Furthermore, Compatibility (0.024), Size (0.002), Competitive Intensity (0.000) and Regulatory Environment (0.010) all with P values less than 0.05 are also all significant predictors of e-learning adoption. However, IT knowledge (P=0.636) and Top Management Support (P=0.735) are not significant predictors of e-learning adoption since their P values are all greater than 0.05.

VI. Discussion on the Findings

Set of hypotheses H1 to H8 was derived from a review of the literature on e-learning adoption numbered to correspond to the labels shown in Figure 1 in Section 3 (on page 5) indicating the anticipated effect each predictor variable would have on the criterion variable is shown as a plus sign (positive effect) or minus sign (negative effect). The hypotheses were used to test the research model involving both the independent and dependent variables. The independent variables of this study are relative advantage (RA); technical complexity (CX); technical compatibility (CT); size (S); IT/IS knowledge (IT); top management support (TM), competition intensity (CI) and regulatory environment (RI). These independent variables may be the determinants that influence the dependent variable (represented by REL), that is, the intention to adopt e-learning among students respondents of MUBS in Uganda.

Hypothesis H1, Relative Advantage was found to have the most significant positive influence (t = 103.3, p-value <0.01) on the students' intention to adopt e-learning services in the University. The finding was consistent with past studies conducted related to adoption of e-learning services (Ansong *et al.,* 2016; Yen *et al.,* 2013; Alshamaila *et al.,* 2012; Low *et al.,* 2011; Jang, 2010) due to benefits derived from EL adoption. It also matches the results of Islam (2013) and Motaghian *et al.,* (2013) who found a significant relationship between expected benefits and e-learning adoption. Raouf *et al.,* (2012) affirm that Universities that adopt e-learning provide better services in their functions consequently, opening up new opportunities in the fields of teaching and transferring knowledge to the learners. This result implied that e-learning services will be embraced provided it leads to improved student performance thus increases user satisfaction; being very convenient; improves operational efficiencies and effectively through the provision of new opportunities.

Hypothesis H2, complexity was found to have significant negative impact (t = -6.336, p-value <0.01) on the students' intention to adopt e-learning services in the University. It shows an inverse relationship with e-learning adoption. Complexity in EL implies that as technology becomes more complex in a University it will lead to EL being less adopted. Other studies suggest that integrating EL in University practices is a challenge and the skills needed to use EL are also complex as demonstrated in previous studies (Matopoulos *et al.,*2009; Ansong *et al.,* 2016; Ahmad and Agrawal, 2012; Furneaux and Wade, 2011). Nevertheless, they agree that it's easy to use EL. This is so because they are already users of EL services.

Hypothesis H3, compatibility was found to have significant positive influence (t = 2.257, p-value <0.01) on the students' intention to adopt e-learning services in the University. The result was also consistent with past studies by (Matopoulos *et al.,* 2009; Ahmad and Agrawal, 2012; Furneaux and Wade, 2011). This is also complements the findings of several studies that IT infrastructure has a significant impact on the adoption of e-learning (Namisiko et *al.,* 2014; Eze *et al.,* 2013). They argue that IT infrastructure in the Universities is a necessity in promoting the adoption of e-learning systems as they are viewed as key constituents of technological advancement of a University. The research results highlighted that EL adoption can be influenced by the compatibility of the EL technology with the University's operations, goals, objectives, existing culture and values and also the existing information technology (IT) infrastructure such as hardware and software.

Hypothesis H4, size was found to have significant negative impact (t = -3.031, p-value <0.01) on the students' intention to adopt e-learning services in the University which supported the hypothesis. The result was consistent with several past studies by (Ramdani *et al.,* 2009; Al-Somali, *et al.,* 2010; Hung *et al.,* 2010). Thus, the study also implies that large institutions are well-equipped with resources to make possible EL acquisition and usage. Furthermore, adoption of EL services is possible by large Universities, because they have more students and programmes, due to their greater risk-taking ability and greater flexibility in usage.

Hypothesis H5, IT knowledge was found to have insignificant negative impact (t = -0.473, p-value >0.01) on the students' intention to adopt e-learning services in the University thus the hypothesis was not supported. Previous studies had the hypothesis supported (Van Huy *et al.*, 2012); Rahayu & Day 2013; Wang *et al.,* 2011). It means that the students were technologically prepared to use the EL platform. Technology readiness in this study refers to the degree to which technological infrastructure and human resources are ready to support technology adoption. It can be assumed that organizations whose non-IT

students are ready to use a technological innovation are more prepared to adopt technology innovation.

Similarly, hypothesis H6, top management support was also found to be have insignificant positive impact (t = 0.339, p-value >0.01) on the students' intention to adopt e-learning services in the University thus the hypothesis also was not supported. Previous studies had the hypothesis supported (Wang *et al.,* 2010; Yen *et al.,* 2013; Alshamaila *et al.,* 2012; Low *et al.,* 2011; Jang, 2010). Both H5 and H6 are not very strange findings in regard to this research because the students had some prior training in the use of IT integrated in their year one curricular; therefore there was no need of top management support as far as the use of EL platform was concerned. They also see no need of having any IT expert to take them through the usage of the platform.

Hypothesis H7, competition intensity was found to have significant negative impact (t = -4.207, p-value <0.01) on the students' intention to adopt e-learning services in the University which supported the hypothesis. The result was consistent with several past studies by (Ansong *et al.,* 2016; Wang *et al.,* 2010; Alghamdi *et al.,* 2012; Ayyagari *et al.,* 2012; Sohail, 2012; Swilley *et al.,* 2012; Nasseef, 2013; Ahmed *et al.,*2014). Thus, the study also implies that Universities that adopt EL do so due to improve on the existing EL services and implement new technologies as a result of competition in the education sector. Universities are in effect in a competition for supremacy, esteem, popularity, recognition and for the best products in the market. Furthermore, the Universities embrace the usage of EL due to global changes and standard practice pressure.

Hypothesis H8, regulatory environment was also found to have significant negative impact (t = -4.592, p-value <0.01) on the students' intention to adopt e-learning services in the University which supported the hypothesis. The result was demonstrated with previous studies by (Buchwald & Urbach, 2013; Baker, 2012; Zhu, Xu, and Dedrick, 2003; Betts *et al.,* 2006; Quayle, 2005). Thus, the study also implies that Universities that adopt EL do so due to existence of adequate legal protection for EL usage and knowledge about the availability of information regarding information system laws and regulatory requirement from government.

VII. Conclusion and Recommendations

The aim of the study was to examine the determinants of EL adoption in Universities in a developing country context. The eight technology, organization and environmental (TOE) factors and predictor variables examined in this study are relative advantage, complexity, compatibility, top management support, size, IT/IS knowledge, competitive pressure or intensity and regulatory environment. The results point to six (6) factors,

that is; relative advantage, complexity, compatibility, size, competitive pressure or intensity and regulatory environment identified as significant predictors of EL adoption. Whereas top management support and IT/IS knowledge are insignificant predictors in the adoption of EL in HIL. The factor having the strongest relationship on the adoption and usage of EL is relative advantage because students are more interested in their academic performance.

The implication of the top management support and IT/IS knowledge results being insignificant shows that there is need to have the same study in a University that does not have IT based course units in year one of their curriculum for sake of comparison. Perhaps, the scope of the study was also limited, so a comprehensive study should be done at MUBS to include all the six (6) Faculties instead of only three (3) before generalizing results.

As a recommendation, since E-Learning is still at its infant stage in Universities in developing countries, in order to promote its usage, Universities have to encourage both staff and students to positively embrace the EL system. Furthermore, based on the result of IT knowledge and top management support as insignificant to the adoption of EL, Universities should incorporate IT related course units in all their study programmmes during First year of study. The findings are envisioned to present government, education stakeholders and educational institutions better understanding of the e-learning adoption determinants before rolling the E-Learning system to other institutions of higher learning, perhaps including supporting private Universities. Therefore, the study will ignite the process of the formulation of national policies and strategies to enhance and support e-learning initiatives to counter and address the existing and future e-learning challenges given the foreseen potential of e-learning in higher education. The study will also contribute to the gaps in educational information systems adoption literature.

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Historical College Scorecard Big Data Analysis using in-Memory Processing

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Abstract- Data set is collected for colleges of United States. We would like to analyze different dimensions like SAT scores, ear- ning after graduation, net price and grant financial aids which is a great analyzation for the students. Big Data platform and BI tool such as Spark and tableau are adopted for data analy- zation and visualization. It is found that the top colleges for mean earnings are from medical field, mean earnings with respect to states, detailed comparison of average net price of California and New York, SAT scores for different colleges and also average undergraduates receiving Pell Grant in each colle- ges which will help students to select a college which meets their requirement.

Keywords: big data, spark, hadoop, college scorecard analysis, mean earnings, in-memory.

GJCST-H Classification: H.3.4

HISTORICALCOLLEGESCORECARDBIGDATAANALYSISUSINGINMEMORYPROCESSING

Strictly as per the compliance and regulations of:

Historical College Scorecard Big Data Analysis using in-Memory Processing

Kunal Pritwani [α], Atinder Singh [σ], Dharmesh Soni [ρ], Mounika Vallabhaneni [ω] & Jongwook Woo[¥]

Abstract- Data set is collected for colleges of United States. We would like to analyze different dimensions like SAT scores, ear- ning after graduation, net price and grant financial aids which is a great analyzation for the students. Big Data platform and BI tool such as Spark and tableau are adopted for data analy- zation and visualization. It is found that the top colleges for mean earnings are from medical field, mean earnings with respect to states, detailed comparison of average net price of California and New York, SAT scores for different colleges and also average undergraduates receiving Pell Grant in each colle- ges which will help students to select a college which meets their requirement.

Keywords: big data, spark, hadoop, college scorecard analysis, mean earnings, in-memory.

I. Introduction

We are to analyze the basic fundamentals of college which are important factors in big data analytics. This kind of data is analyzed by big name analyst for big money as this kind of analysis provides insight on differ- rent aspects of college. The outcomes by this analysis will help students to compare between different colleges and can select college according to their own needs and education goals.

Big Data is defined as non-expensive frame-works that can store a large scale data and process it in parallel [7, 8]. A large scale data means really a big data, this data cannot be processed using traditional computing techniques. Data is getting generated every-day through social media, websites, mobile applications etc. To analyze and store data we use Hadoop, which is an open source framework which provides distributed storage on the commodity hardware. Hadoop has two major components which are MapReduce and HDFS (Hadoop Distributed File System).

Apache spark is popular for processing big data using Hadoop architecture. As it's the updated version for map reduce. Apache Spark runs 100 times faster than Hadoop but it doesn't have its own HDFS. So it uses HDFS as its filesystem and runs on top of Hadoop by using memory. Spark uses RDD (Resilient Distributed Datasets) which replaces the MapReduce functionality to write the data to physical storage every time.

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II. Related Works

Nick does the data analysis using statistical techniques to find the correlation between different colu- mns. But, we have used spark to manipulate and visua-lize the data to get useful insights [10]. Student Respon-siveness by Hurwitz et al is analyzed by selecting the earnings using statistical techniques to find the corre-lation and by using scatter plots for visualization [11]. We simply used geographical visualization to show top earning states. Besides, Spark computation is less time consuming to process the results.

We have used Big Data Spark platform to store and analyze the data and BI tool such as tableau for visualizations. By analyzing the 100,000 colleges data of 14 years, we have different results as we analyzed a very huge dataset. We have the detailed analysis for 100,000 colleges and they have analysis for around 600 colleges. We found the top major which has high paid jobs is in medical field [9]. Spark helps to process the queries and gives the results fast.

III. Methods

First, we collected the data from an online community dedicated to data scientists where the dataset comprises of historical data of 100,000 colleges in the US spanning over 14 years to compare and ana-lyze. Further, by using the Spark technique to find diffe-rent terminologies like Mean and Median Earnings of the College, Average Net Price of a College, Verbal and Math Sat Score Analysis and Percent of Undergraduates Receiving PELL GRANT. Detailed Analysis of college score card has been performed using data visualization tools.

a) Specification of Data Set

The data is collected from an online community. We have historical data of about 100,000 colleges within United States spanning of 14 years. The data size is 1.33 GB and file is in CSV (Comma Separated Values) format [1].

b) Tools

Data Analysis tools used are Apache Spark cluster on Databricks cloud platform, and visualization tool Tableau 9.2 is used for detailed data analysis for daily and yearly records.

c) Terminology

i. *Mean and Median earnings of the College*

Mean earnings are for the institutional total of all governmentally helped understudies who select in an

organization every year and who are working but not taking any classes.

ii. *Average Net Price of a College*

There are a few components in the Average Net Price that are gotten from the full cost of participation (counting educational cost and charges, books and supplies, and everyday costs) less government, state, and institutional guide, for undergrad understudy.

iii. *Verbal and Math Sat Score Analysis*

Test scores of enrolled students are not reported for all institutions, but rather may help students to discover a school that is a decent scholastic match. The query incorporates 75th percentiles of SAT Verbal (SATVR75), SAT Math (SATMT75).

iv. *Percent of Undergraduates Receiving PELL GRANT*

This column (PCTPELL), reflects the share of undergraduate students who have got Pell Grants in a given year. This has an important measure of the access a school provides to low-income students.

IV. Detail Data Analysis Results

a) *Mean and Median earnings of the College*

This formula selects columns the institute name (INSTNM), Mean and Median Earnings of the college (mn_earn_wne_p10) and state name(STABBR). Results are stored in 'results' RDD and then displayed using Spark Display command. Spark SQL commands are used for fast processing of SQL context queries. It shortens the query length and gives faster results than SQL.

->results = sqlContext.sql('SELECT INSTNM, mn_earn_wne_p10, STABBR FROM Scorecard_Project order by (mn_earn_wne_p10) desc')
-> display(results)

Figure 1. shows the top colleges with mean earnings, In this case its Medical college of Wisconsin with mean earnings as 250K.

Figure 2. shows the states with highest(Blue - California), medium(Gray - Texas) and lowest(Red - Oregon) mean earnings as for CA it's more than 60 million. The results are listed in Figure 1 and Figure 2 below.

b) *Comparing Average Net Price of Two States*

This formula selects columns the institute name(INSTNM), Average Net price of state (NPT4_PUB) and CITY(CITY). Results are stored in 'results' RDD and then displayed using Spark Display command. Spark SQL commands are used for fast processing of SQL context queries. It shortens the query length and gives faster results than SQL. Refer the code at Github [5], [6].

Figure 3. shows the average net price with comparison of two states. UCLA has 13,817 and Cal State La has 4,37.

Figure 4. shows the top net prices for public universities like Blue Hills Regional Technical School has 26, 475.

Figure 5 shows the top net prices for private universities like Aerosim Flight Academy has around 87K.Figure 3, Figure 4 and Figure 5 display the results below.

c) *SAT Scores in Different Colleges*

This formula selects the top institutes where SAT verbal and Mathematics score is maximum. Refer the code at Github [5], [6].

Figure 6. shows the SAT scores and mean earnings like California Institute of Technology has Math's score(Blue) as 800, Verbal score(Orange) as 778.9 and Mean earning(Purple) as 98,700. Figure 6 display the result below.

d) *Comparing Average Undergraduates Receiving PELL GRANT*

Amounts can change yearly. For the 2016–17 award year (July 1, 2016, to June 30, 2017), the maximum award is $5,815. The amount you get, though, will depend on:

• your financial need
• your cost of attendance
• your status as a full-time or part-time student
• your plans to attend school for a full academic year or less.

You may not receive Federal Pell Grant funds from more than one school at a time.

This formula will select the columns from the database, institute name(INSTNM), Mean, state name (STABBR), Average Undergraduate Students(UGDS) and percentage of Pell grant(PCTPELL) which has UGDS > 1000. Results are stored in 'results' RDD and then displayed using Spark Display command. Spark SQL commands are used for fast processing of SQL context queries. It shortens the query length and gives faster results than SQL. Refer the code at Github [5, 6].

Figure 7. shows Universal Career Community College has the full PELL grant like 1.0 which means 100% scholarship

Figure 8. shows that East Georgia State College has 2,854 Avg. no undergraduate students and also PELL grant percentage is 97.285%. Figure 7 and 8 shows the result below.

Colleges/Institutions

Colleges/Institutions	Max. Mean Earnings
Medical College of Wisconsin	250,000
Philadelphia College of Osteopathic Medicine	241,200
West Virginia School of Osteopathic Medicine	227,000
New York Medical College	205,600
Rosalind Franklin University of Medicine and Science	195,700
University of Massachusetts Medical School Worcester	191,400
Baylor College of Medicine	168,100
University of Medicine and Dentistry of New Jersey	166,200
Meharry Medical College	155,000
Upstate Medical University	152,700
Harvard University	148,400
University of California-San Francisco	139,200
Princeton University	128,900
Massachusetts Institute of Technology	128,400
Brooklyn Law School	123,800
Stanford University	123,400
University of Pennsylvania	114,700
Duke University	107,600
Dartmouth College	104,900
Columbia University in the City of New York	104,300
California Institute of Technology	103,600
Yale University	102,400
Washington and Lee University	100,100

Max. Mean Earnings in $

Figure 1: Top Mean and Median earnings of the College in USD.
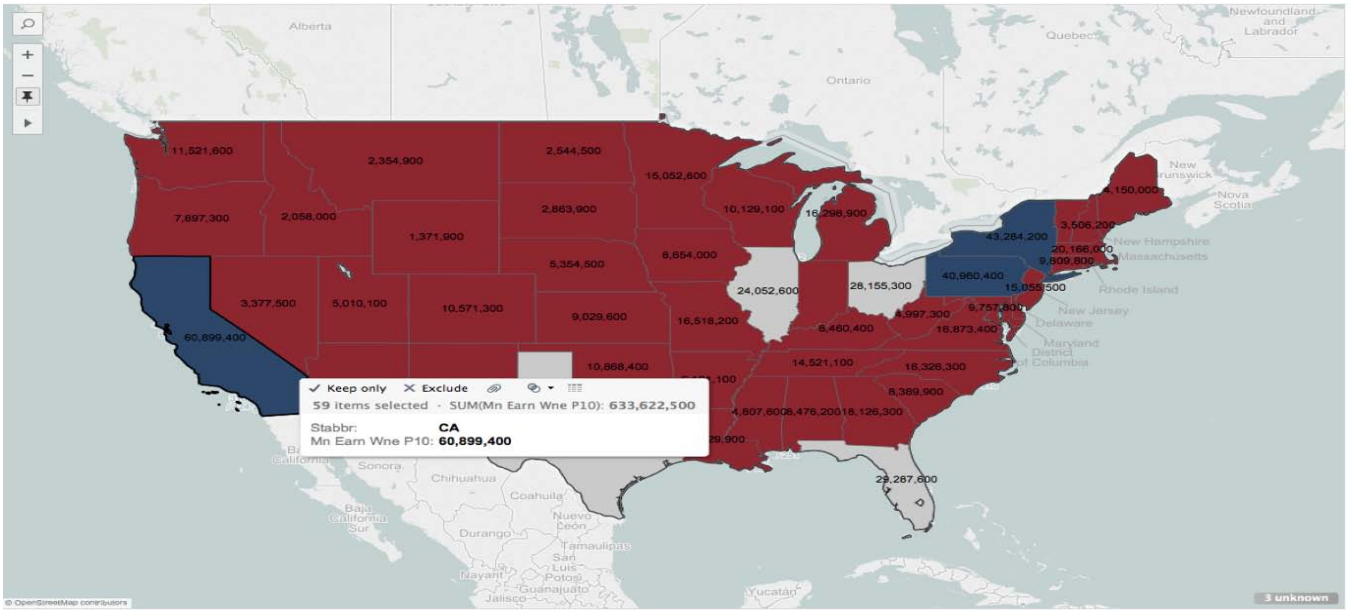
Figure 2: Top Mean Earnings with Respect to states (Blue – High, Gray – medium, Red- less) in USD.

Figure 3: Comparing Average Net Price of Two States in USD.

Public Universities

Figure 4: Net Price comparison of Public Institutions in USD.

Private Universities
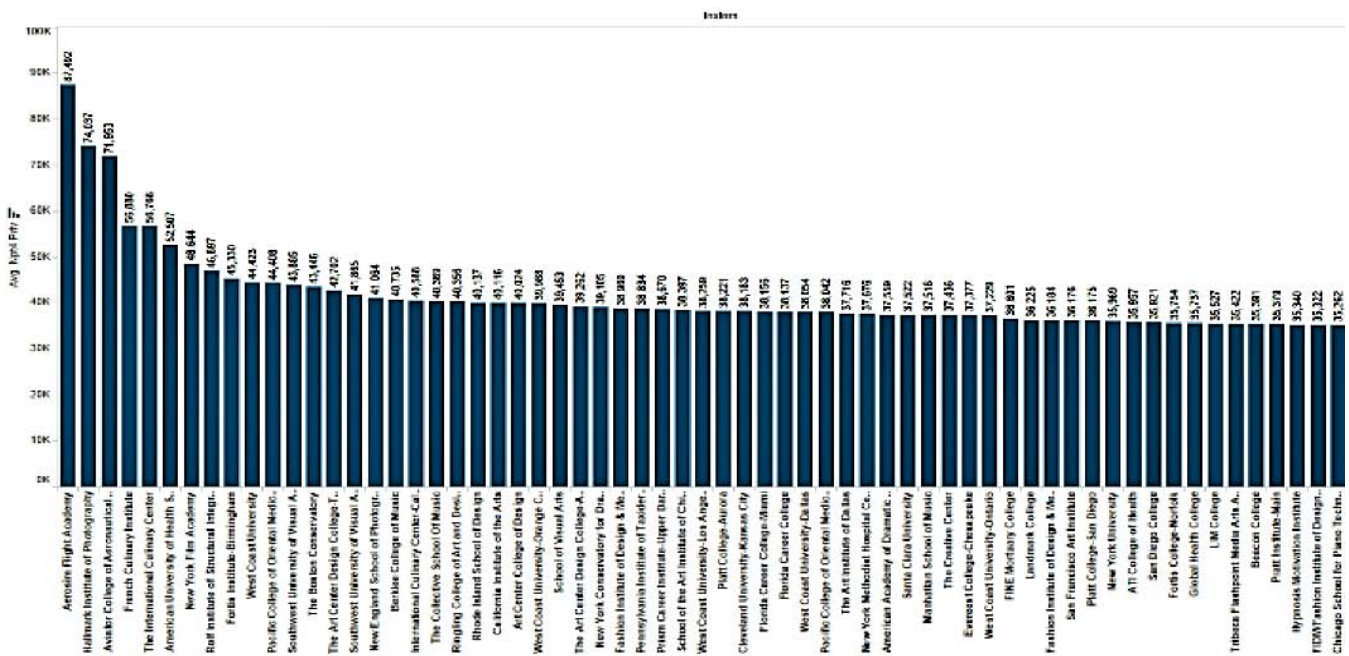
Figure 5: Net Price comparison of Private Institutions in USD.
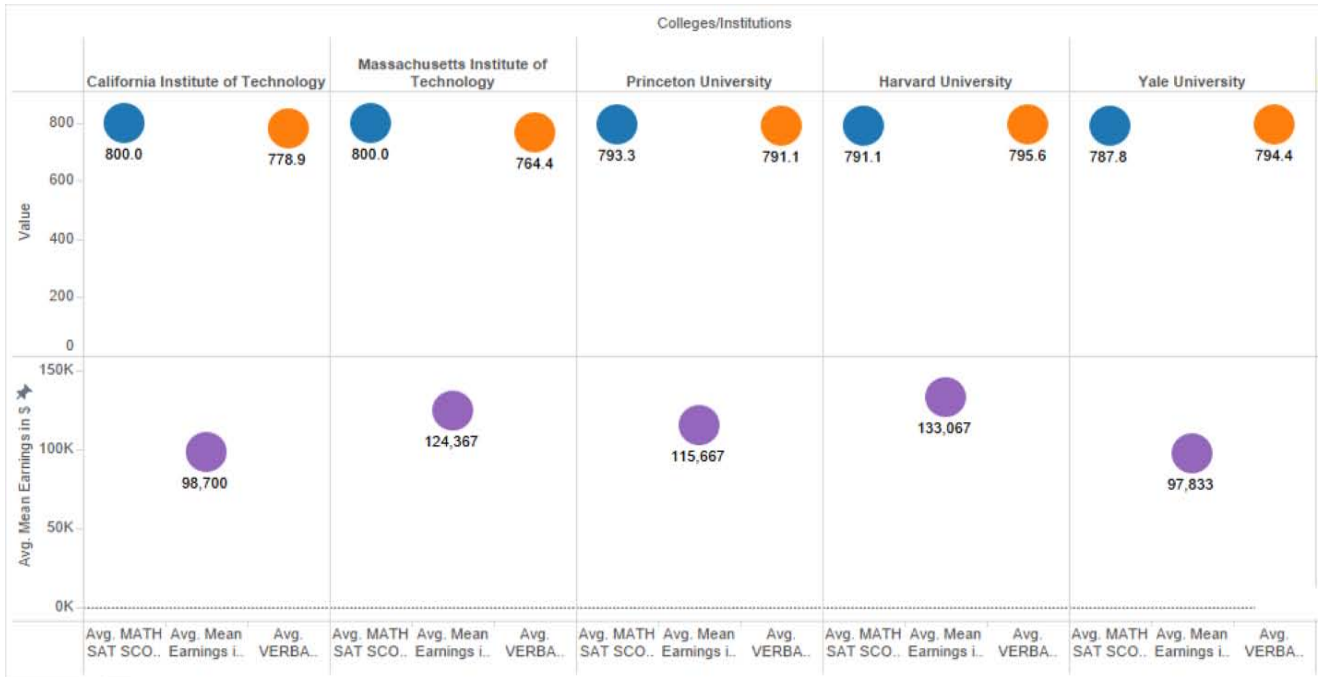
Figure 6: SAT Scores in Different Colleges on the scale of 800
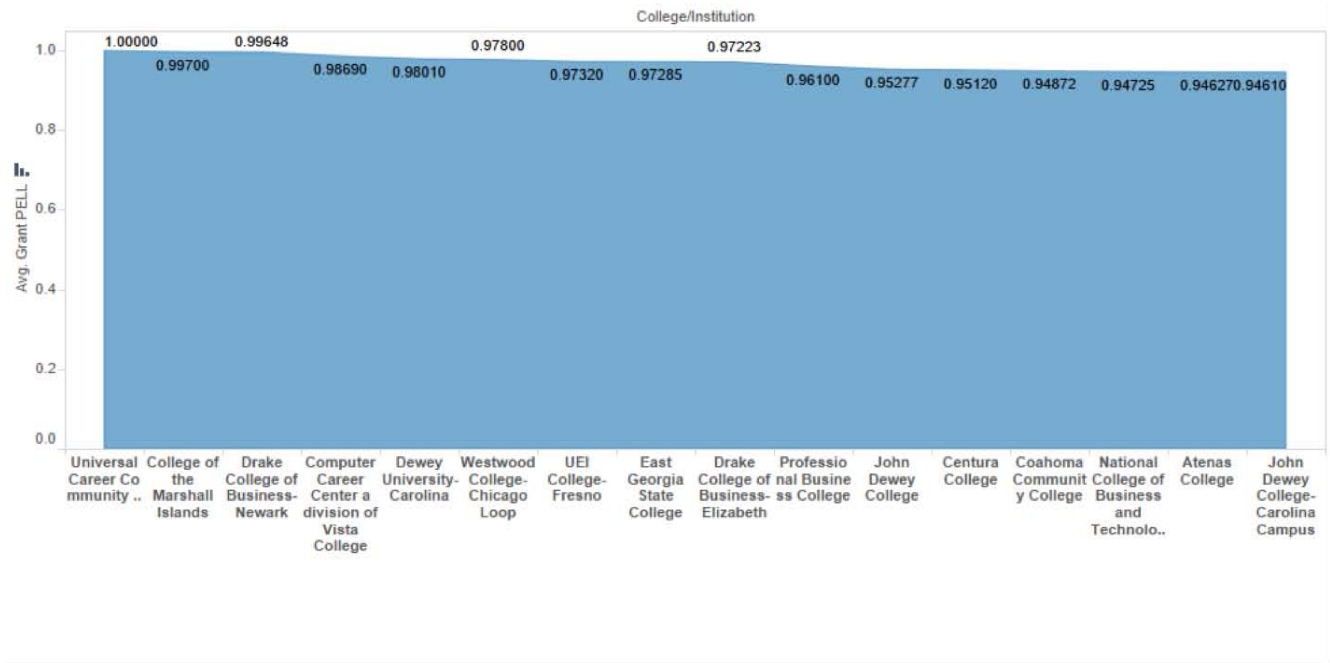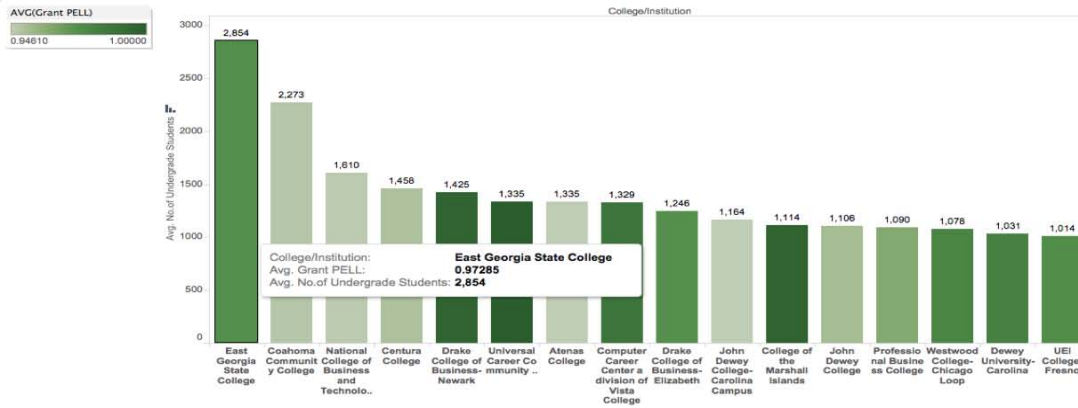
Figure 8: Average Undergraduates Receiving PELLGRANT in Each College in USD.

V. Conclusion

We adopt Spark Big Data platform to analyze college score card and display the insights. Choosing a college for your undergrad right after high school is every child's nightmare and insights like these give you a clear picture of the where about of the college. This kind of insight will be charged huge sum by data analyst for what we just presented. We have found out different colleges have different values in terms of earnings after degree. Two states have California and New York has the maximum average earnings after graduation. Also PELL grant is high in community colleges. These analysis is helpful for students to select the colleges based on their interest.

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Sustainable Producing Process using 3D Printing

By Kim Kyung A

Hongik

Abstract- This study is Sustainable producing process using the 3D Printing based on sustainable design. Generally, an approach of sustainability is strong to environmental aspects. 3D Printing technology has been in the spotlight of fabrication field as the new sustainable producing system. Additional, the progress of 3d printing will bring results to the personalizing producing system. It means that it can be produced from necessity. Also, it enables to producing part of discontinued models. The power of these advancements prevents over producing and reduces the lifecycle of product. Namely it reduces the term of works and saves the cost curtails the product lunching period. Therefore, it is the solution to the energy problem and resource saving. The guides line for sustainable producing is required to be controlled the problem of environment and social constraints. This research walks you through a few guidelines. And it offers the practical ways of doing sustainable system centered at the 3Dprinting producing system.

Keywords: sustainability; 3 d prinitng; production system; sustainable design.

GJCST-H Classification: B.4.2,D.2.3

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Keywords: sustainability; 3d prinitng; production system; sustainable design.

I. Introduction

Over-consumption and over-producing is caused Social Problem such as environmental Problem and industrial pollution. It becomes a menace to survival of human and society. Accordingly, Society faces a plethora of problems and Design should be conscious sustainable issue. 3D Printing is additive manufacturing skill. 3D printing needs to 3D design digital file for producing product. So It enables more rapid producing and any figuration. Also, It means that it is possible to personal manufacturing. It means that it is possible to reduce the producing and waste of sources of production. Thus, it requires to guidelines of sustainable design for personal manufacturing using 3d printer.

II. Sustainable Issue and Sustainable Producing System using 3d Printing

Generally, the sustainable design issue is used in various terms such as green design, ecological design, green design, and ecosystem. But The fundamental aim is to provide solutions to the possibility that we can preserve and pass the current environment. Sustainable design should include the environment issue and society and include fairness, stability, and viability. This should exceed the limits of the economic

aspects stemming from industrial factors and the economic structure of the market. the substantiality of design guidelines is extracted through existing research, Key-factors of sustainable design and the substantiality for definition of sustainable design. New sustainable design strategy for a time of changes will be suggested based on the understanding of new manufacturing process. New sustainable design strategy was focused on the role of producer and Technology in supporting of the government and the technology. This sturdy is expected to be applied to as one of the methods in solving the substantiality, design issues in Digital Fabrication. Digital fabrication period and 3D printing technology This time is Digital Fabrication period with the rapid growth of internet and computer. 3D printer technique development and Rapid prototyping system contribute to Digital Fabrication and shifted production base to personal and flexible small quantity production base. 3D Printing producing system can be easily design by using 3D scanner and 3D Program development. It is possible to produce a product at one go in any shape. It means to be possible to be in low cost without manufacture by several moldings or using many kinds of equipment. The This matters mean that the Person can various participate in all steps such as plan, design, manufacture, production, and sales as well as production industry's new arrangement, supported by progressive. 3D Printing 3D printing process needs basic technology in the modeling, printing, post-processing. First Modeling process is to compose object's shape in 3D computer design programs like CAD programs Also it requires a technology to convert the object into data for 3D printing by scanning or designing the object. It is the process to analyze data into so many thin layers and forms by brining digitalized files. The process improves resolution and production time, shoots the jet of raw materials to be suitable for location, according to data analysis and additives raw materials.
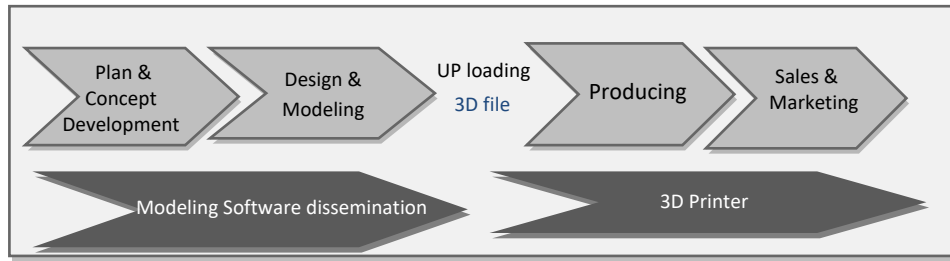
Author: email: 770k@naver.com

Figure 1: Producing system using 3D printing.

This changes will give individuals empowerment in overall manufacturing system, and this will lead changes throughout the manufacturing process. it means that area of design is expanded to personal manufacturing from designer and it needs to guidelines of sustainable design for personal manufacturing.

a) Sustainable issue In Digital fabrication period.

Sustainable approach of design and industrial field has been studied during and after a generation by Victor Papanek, William McDonough, Ezio Manzini and so on. It confined conception of social, economy, and environment. Nowadays Sustainable design include meaning of Eco design, Environmental design, and ecology design. It is aimed to maintain the nature and provided a new value to the environment issue. Also, focus on the influence on next generation. Sustainable design should include the macro concept of thinking about ecological systems, including organizational systems, human beings and society with the relationship between human beings and society and interdisciplinary services. To extract detailed elements for sustainable design, the three main issues presented above were identified as economic, environment, and social.

Main factor		Practical Factor
Economy area	Use of efficient resources	The minimization of resources Use of single Materials Recycling/ reuse
	EfficientDesign	Modularity Light weight Unification of package contents
Environment area	Decrease of Environmental pollution	The Minimization of Waste Reducing Environmental pollution and Environmental Compliance Dispose of waste disposal regulations Use of natural materials Use of non-toxic Materials
Social area	Social	Extension of product life Ergonomics design Universal design

Figure 2: The macro concept of thinking about sustainable issue

In the economic arena, it is able to choose the use of efficient resources through the use of minimal resources and the minimize use of energy. Environmental considerations enabled us to minimize environmental impact and extract ecological designs. From social point of view, it was compressed as a main factor for human beings and designer social responsibility.
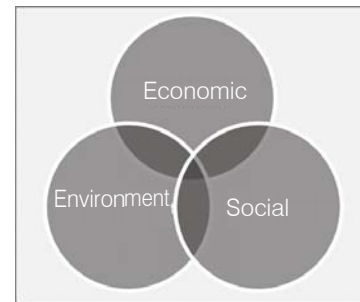
Figure 3: Practical factor of sustainable issue

Namely, the conception of sustainability comprises economic meaning, environmental issue and social meaning. Therefore, producing system using 3D printing Producing system is to take care of several factor of sustainable Producing.

In terms of technological aspects, the producing using 3D printing has already been cost- Efficiency and resource - Efficiency. Realization of 3d printing Producing resolves low cost for raw material. Also, it can reduce industrial waste. 3D Printing can produce by 3D digital file. So, this technique enabled the production based on needs and simply parts' producing. Thus, the system can extend the lifecycle of the product and can be realized by parts-producing. Also, it can be predicted and suggested the problem on excessive manufacture of products based on simple and easy way. Consequently, it can be reduced of wasted energy and energy consumption problem.

However, problems such as the use of materials with environmental pollution (plastics, etc.) have not been solved. 3D printing producing may be caused by harmless gas from machine in manufactural area. It causes a serious problem in human survival and environmental pollution. In personalized manufacturing era, with the aim of approaching strategy for each sustainable design. Each person's role will be extended as the practical part of sustainability. The most important

element can be addressed by an approach that encourages personal recognition and social awareness. In other words, a person must produce a sense of responsibility to achieve the sustainability of their sustainability with maintain attitude to concern the social issue. It needs something that is both educational system and educational center systematically.
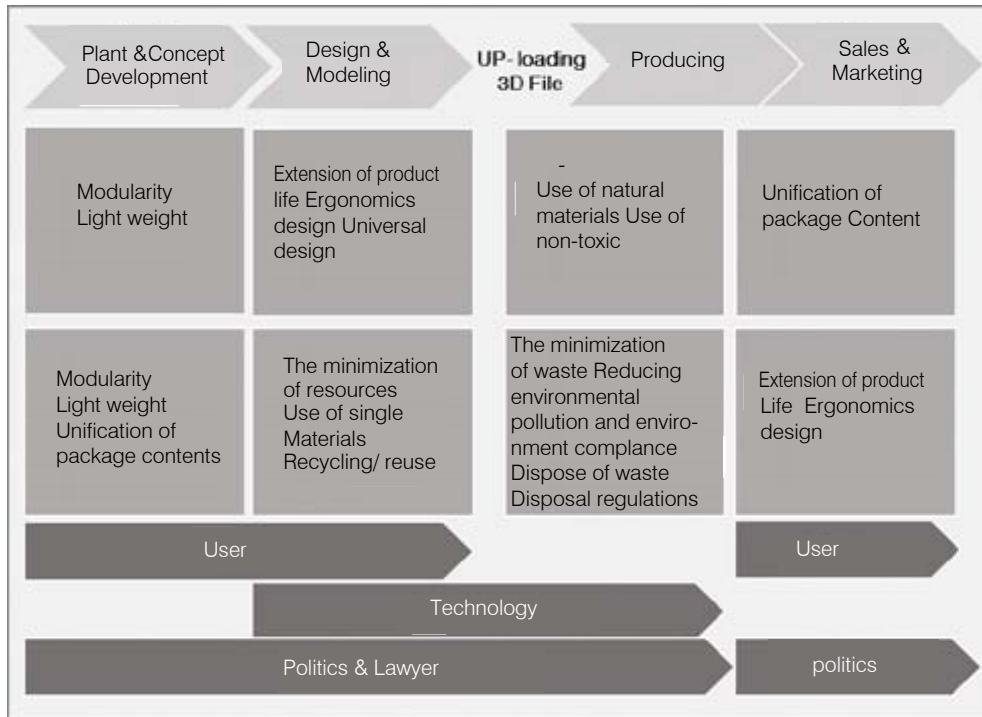
Figure 4: Practical factor in 3dproducing process

Technically speaking, it should be to be supported by technical development about air pollution system. Also, it should be obliged to control the air pollution. Also, research and use of eco-friendly materials should be studied. Not only technical research, but also legal policy constraints are required. Such as Politics and Laws is in regard to environmental problem, obligation duty for using environmental material, restrictions of bad gas exhaust.

ness and consumer, consumers and consumers. Sustainability has led to sustainability growth in sustainable design. Moreover, it is a competitive approach to sustainable corporate sustainability. However, the actual entity of the digital manufacturing era of the digital manufacturing era will be producers. Namely, in digital manufacturing system the role of an existing firm has been played, and the role of designers for sustainable designs has been extended to individuals. Such phenomena should be mutually complementary and complementary under the policy support, institutions and regulations.

Figure 5: Roll of practical factor

III. Conclusion

In existing manufacturing systems, sustainable design has been highlighted by sustainable management by economic logic Under the prevailing system of economic logic. This is based on mutual relationships and complementary arrangements in the areas of busi-

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Ecawsoft: A Web based Climate and Weather Data Visualization for Big Data Analysis

By Fue, Kadeghe G., Sanga, Camilius A. & Tumbo, Siza D.

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Abstract- *Purpose:* In Tanzania, data for climate and weather are normally analyzed by Meteorological Agency and then are published through TV, website and radio. Different stakeholders normally obtain the weather and climate data / information in a generalized way. This calls for a need of a system which allows data to be shared openly to different stakeholders so that they can analyze those data as per their specific needs.

Design/methodology/approach: The paper presents the overview of the developed system, ECAWsoft. Also, it gives some few interfaces showing different outputs from the system.

Findings: The goal of this paper has been attained by developing a working data visualization tool for climate and weather called ECAWsoft. The system is current operational and is providing open data for different stakeholders.

Keywords: *climate, weather, visualization, system, big data.*

GJCST-H Classification: *H.3.5, H.3.4*

ECAWSOFTAWEBBASEDCLIMATEANDWEATHERDATAVISUALIZATIONFORBIGDATAANALYSIS

Strictly as per the compliance and regulations of:

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Findings: The goal of this paper has been attained by developing a working data visualization tool for climate and weather called ECAWsoft. The system is current operational and is providing open data for different stakeholders. It is user friendly and interactive with capability of displaying visualization of data as per fine granularity required by user. Development of open data system for data visualization has lead to a transparency system which is helping farmers, researchers, policy makers (etc.) to make informed decision on weather and climate.

Practical implications: The system presented in this paper need to be scaled up so that more data from all weather stations in Tanzania can be populated in real time.

Originality/value: The development and adoption of open systems for visualizing weather and climate data remains seriously lacking in many countries including Tanzania. This paper provides an overview of some initiative to fill such a research gap.

Keywords: climate, weather, visualization, system, big data.

I. Introduction

Never before in history has data been generated at such high volumes as it is today. Exploring and analyzing the vast volumes of data (i.e. big data) is becoming increasingly difficult. Information visualization and visual data mining can help to deal with the flood of information (Keim, 2002). Visualizations of subspaces on the World Wide Web can provide users the ability to identify relevant information from a set of Web pages, while gaining new insights or understanding of the space (Heo and Hirtle, 2001). Brodlie (1997) looked at the different players involved in the creation of a Web-based visualization service, and hence, build a reference model for Web-based visualization. Ondov et al. (2011) presented krona which is a powerful metagenomic visualization tool and a demonstration of the potential of HTML5 for highly accessible bioinformatics visualizations. Its interactive displays facilitate more informed interpretations of metagenomic analyses, while its implementation as a browser-based application makes it extremely portable and easily adopted into existing analysis packages.

Murray (2013) presented a 3D JavaScript-based tool for loading data into a web page and generating visuals from data. Murray's study provides a better understanding to novice programmers who have little programming experience or no at all. It is a tool for non programmers in many fields including those dealing with climate and weather.

We are in the era where the effect of climate change is very noticeable. This call for a tool to analyze voluminous data generated from weather stations in real time in order to look for a pattern of effects of climate change. Climate change extremes such as flooding and seasonal drought are already undermining the economies of countries in the Horn of Africa[1], with agriculture and water resources being the most affected sectors (Rosenzweig et al., 2013).

Buja et al. (1991) presented two principles used to design interactive system to visualize different ecanerios. Two basic principles for interactive visualization of high-dimensional data-focusing and linking were discussed. Focusing techniques may involve selecting subsets, dimension reduction, or some more general manipulation of the layout information on the page or screen. A consequent of focusing is that each view only conveys partial information about the data and needs to be linked so that the information contained in individual views can be integrated into a coherent image of the data as a whole. Ladstadter et al. (2010) reported that interactive system facilitates iterative and interactive browsing of the parameter space to quickly understand the data characteristics, to identify deficiencies, to easily focus on interesting features, and to come up with new

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1 (retrieved from http://africanclimate.net/en/node/6080 on 2016/09/24)

hypotheses about the data. These properties extend the common statistical treatment of data, and provide a fundamentally different approach. Tomiscki et al. (2011) reported on a survey that they conducted to evaluate the application of interactive visualization methods and to identify the problems related to establishing such methods in scientific practice. The feedback from 76 participants showed clearly that state-of-the-art techniques are rarely applied and that integrating existing solutions smoothly into the scientists' workflow is problematic. They tried to illustrate how interactive visualization tools can be successfully applied to accomplish climate research tasks. They showed some examples to support that interactive sys- tems were really required. Lu et al. (2011) demonstrated the framework that has great flexibility and simplicity for end users intending to perform data analysis by aiding the integration of data and tools and enabling interactive visualization on-the-fly. The system was coupled with effective utilization of computational resources and data storage systems.

Therefore, this paper presents a technology developed to allow easy visualization and interaction with the Agricultural Model Inter-comparison and Improvement Project (AgMIP) output data that contain climatic information of several locations in Tanzania. AgMIP is a major international effort linking the climate, crop, and economic modeling communities with cutting-edge information technology to produce improved crop and economic models and the next generation of climate impact projections for the agricultural sector (Rosenzweig et al., 2013; Sanga et al., 2013). The technology

that was developed for visualization of AgMIP output is known as ECAWsoft. This is the short form of Enhancing Climate Change Adaptation in Agri- culture and Water Resources in the Greater Horn of Africa (ECAW) Software. The data sets obtained from the ECAW project that have been generated using models were used in the development of this system. The coding was done mainly using PHP, HTML5 and JavaScript. The famous JavaScript libraries like jquery and bootstrap were used to integrate interactive features of the visualization system. The system is web based and uses open source tools that cost almost nothing because of the free license behind their innovations. The interaction system is user friendly. The code integrated in this system might seem to be complex but it was made so to achieve the best human to machine interaction and experiences. The system is designed for visual presentation of the data based on the region-oriented metaphor that includes visualization levels and aggregation or fusion features of the graphs. The system is able to present comparison of up to six locations of the information in the interactive manner that allows the user to granulate or aggregate the data presented.

II. Materials and Methods

This system used the Unified Modeling Language (UML) for analysis and design of the system components. The system was designed to get text files from the folder and then process the data dynamically and draw the dynamic graphs (Figure 1).

a) ECAWsoft flowchart

Figure 1: ECAWsoft flowchart

Figure 1 presents the logic flowchart of the ECAWsoft. The system reads input and creates a dynamic back end database then loads the information to the frontend which processes and present it output to the users. The information is presented as interactive information that allows front end database to be upda- ted with information from the database as requested by the user while navigating the system.

b) Characteristics of the Input data

The data sets are provided in the form of text files with extensions "agMIP" (Mourice et al., 2017). The datasets were collected from the weather stations located in Tanzania and other missing data were generated automatically using weather modeling algorithms and software. The data sets include a form that text fields are separated by space. The algorithm goes through the data set to establish database that can be visualized using HTML5 capable browser. In Figure 2, the focus is on 7 types of data: Solar Radiation (SRAD), Maximum Temperature (TMAX), Minimum Temperature (TMIN), Rainfall (RAIN), Relative Humidity (RHUM), Wind (WIND) and Dew Point (DEWP) (Wambura et al., 2015). All the given data sets are presented using interactive line graphs except rainfall datasets which are presented using bar charts. The data axis is presented against time -series. Time series is the first column with @DATE as name. The file has important information such as LAT for Latitude and LONG for Longitude of the weather station.

The user is given an opportunity to decide when to display the information and which data sets to include and which places of that data set is desired for comparisons. In fact, the user can choose up to six places to display. The user may decide to add new dataset that can be displayed automatically by the system. These datasets are categorized in two parts; baseline simple-scenario data and Coupled Model Inter-comparison Project phase 5 (CIMP5) generated data (Msongaleli et al., 2015).

*WEATHER DATA : USAMCAXA - baseline dates maintained for leap year consistency

@ INSI	LAT	LONG	ELEV	TAV	AMP	REFHT	WNDHT				
USAM	42.017	-93.750	329	11.2	14.6	-99.0	-99.0				
@DATE	YYYY	MM	DD	SRAD	TMAX	TMIN	RAIN	WIND	DEWP	VPRS	RHUM
1980001	1980	1	1	1.2	1.3	-1.5	0.0	3.1	-0.3	6.0	89
1980002	1980	1	2	4.7	-0.3	-2.6	0.0	4.9	-7.6	3.5	58
1980003	1980	1	3	1.9	-0.3	-4.8	0.0	4.3	-9.0	3.1	52
1980004	1980	1	4	3.8	0.2	-2.6	0.0	4.1	-5.2	4.2	67
1980005	1980	1	5	1.0	0.2	-3.2	1.5	3.4	-2.5	5.1	82
1980006	1980	1	6	8.5	1.9	-7.0	2.1	9.1	-0.8	5.7	82
1980007	1980	1	7	6.7	-6.4	-15.9	0.0	8.2	-13.4	2.2	58
1980008	1980	1	8	6.7	-8.7	-16.5	0.0	2.9	-17.1	1.6	51
1980009	1980	1	9	2.2	-11.4	-20.4	1.5	3.7	-16.2	1.8	68
1980010	1980	1	10	8.0	6.3	-13.7	0.0	8.0	5.3	8.9	93
1980011	1980	1	11	4.0	11.3	-9.8	0.0	11.9	7.3	10.2	76
1980012	1980	1	12	8.6	0.8	-13.7	0.0	6.1	-10.4	2.8	43
1980013	1980	1	13	8.6	12.5	1.3	0.0	6.7	2.4	7.3	50
1980014	1980	1	14	2.1	6.9	-3.2	0.0	4.1	-1.0	5.7	57
1980015	1980	1	15	1.0	8.6	4.6	0.0	4.1	7.2	10.2	91
1980016	1980	1	16	1.9	7.5	2.4	24.4	5.6	7.4	10.3	99
1980017	1980	1	17	3.7	2.5	-2.6	1.2	5.6	-0.6	5.9	80

Figure 2: agMIP output file which is the ECAWsoft input file

c) Implementation of the data sets and system

The visualization tool has integrated HTML5 features, PHP programming language version 5.6 and JavaScript scripting language to achieve a web-based visualization and interaction system. The system can easily be installed in Apache 2 web server. The system has been maximized to use google-chrome browser and in fact, it works very fine with other famous browsers like Firefox and Internet explorer. The on-line tool has been made easier for any user to install it even in a local machine with Apache 2 and PHP version 5 installed.
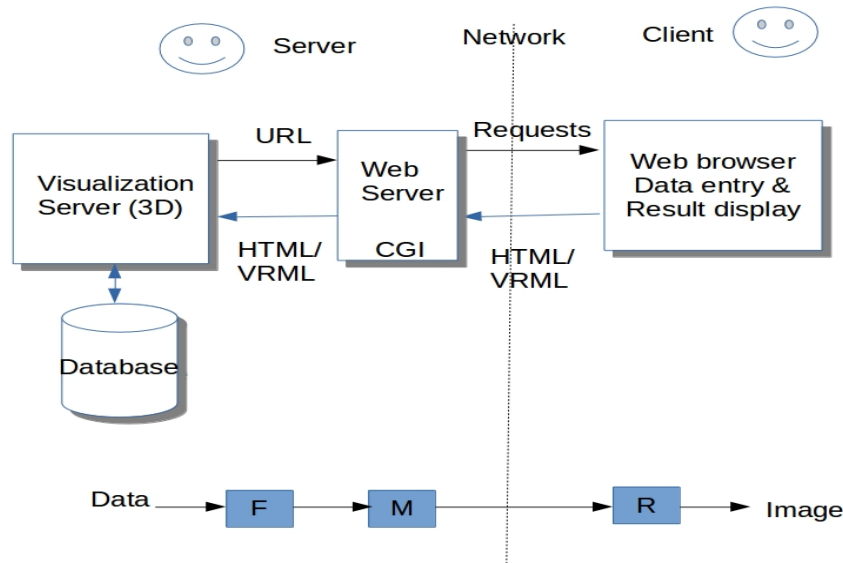
Figure 3: Server-side visualization using CGI and VRML. Note: the happy face means light load and the unhappy face means heavy load. F, M and R stand for Filter, Map and Render, respectively. (Huang, B., 2003)

In a server-side application, a web browser is used to generate requests, send them to the application server, and display the results. The application server, connected with the web server via the Common Gateway Interface (CGI), processes the requests and delivers the result in a standard Web format (e.g. HTML) back to the client. In such an application, the client is usually an HTML page containing forms connected with the application server, while all the software as well as the databases resides on the server that is administrated by the deploying organisation (Huang, 2003).

III. RESULTS AND DISCUSSIONS

a) Visualization and interaction system

In this section, the discussion is on the visual parts of the system used for visualization and interaction approaches for visual analysis of the input datasets against time-series.

The main view of the visualization tool has two sidebars; left and right sidebars. The left sidebar show Home, Baseline data, Present Stations (These are Tanzania regions specific data) and help as presented in Figure 5 and Figure 6.
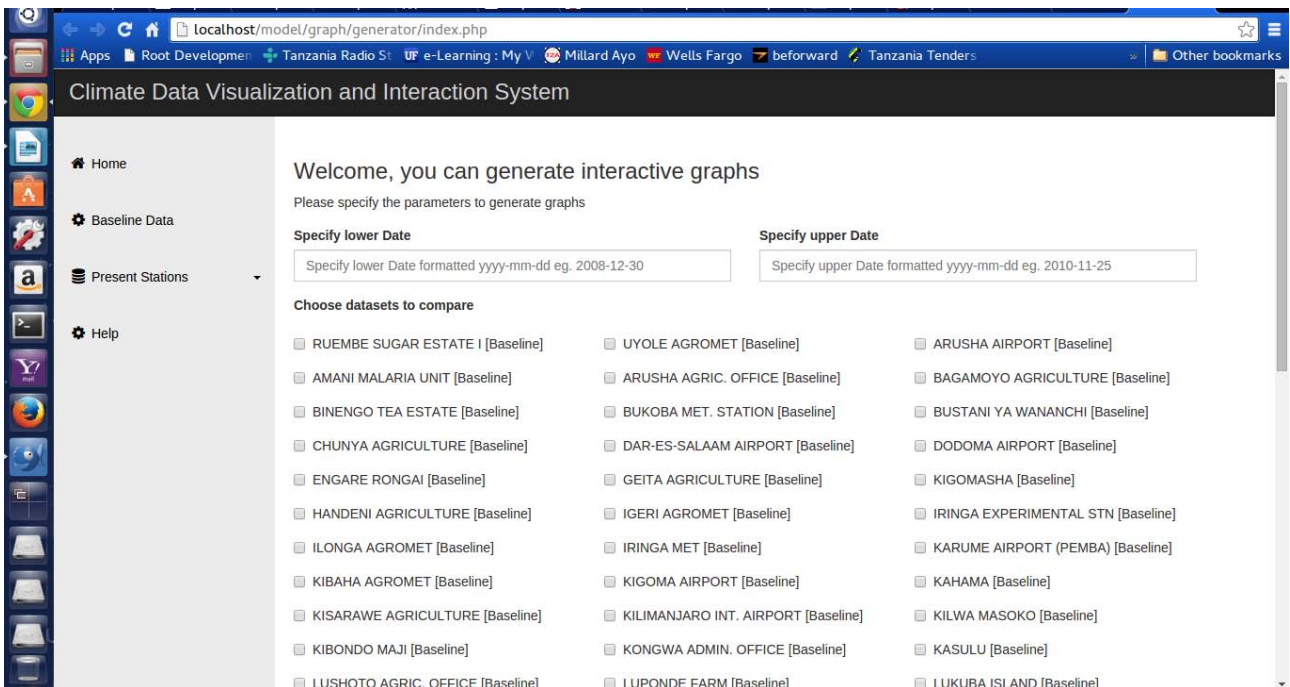
Figure 4: The Main view of the visualization Tool

The right side shows all the climate baseline dataset stations that have been read from the climate database. The user is able to choose the dates desired to be generated by this tool.

The user can then choose desired dates and places for comparison as in Figure 5, Figure 6 and Figure 7. The date panel allows user to go back years using << or monthly using < and also g forward by using the opposite signs.
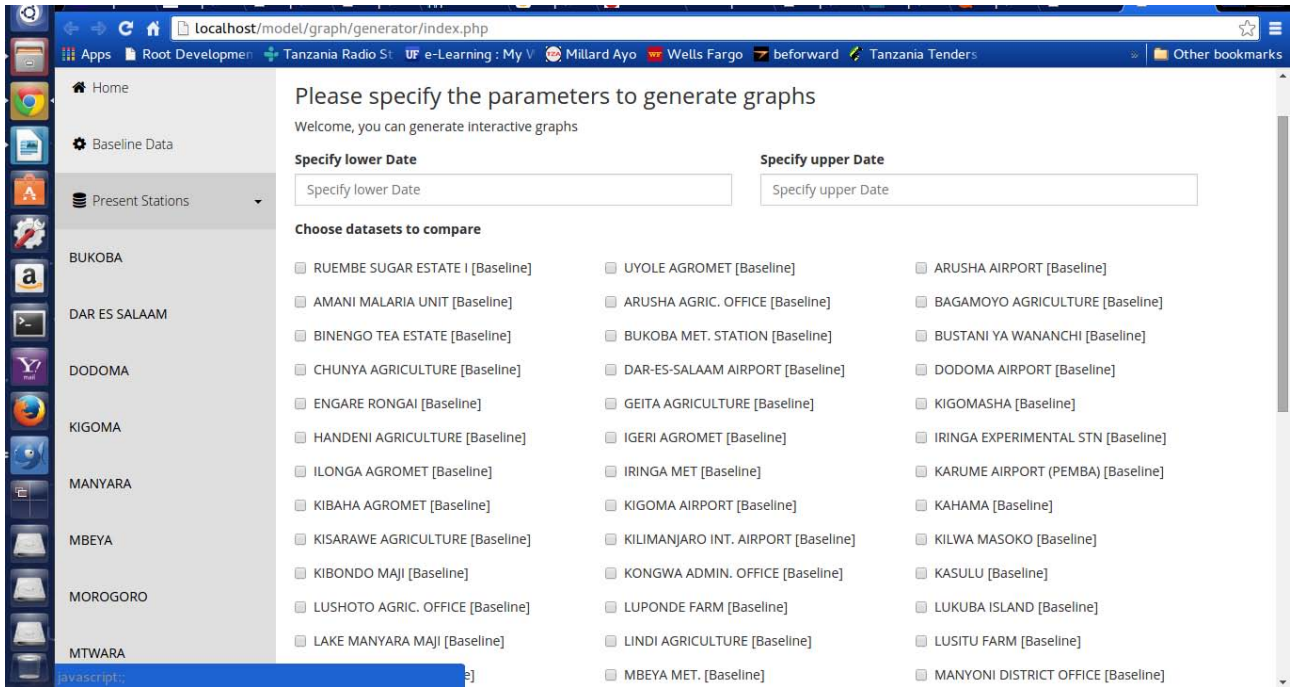
Figure 5: The Main view with present stations show on the left sidebar
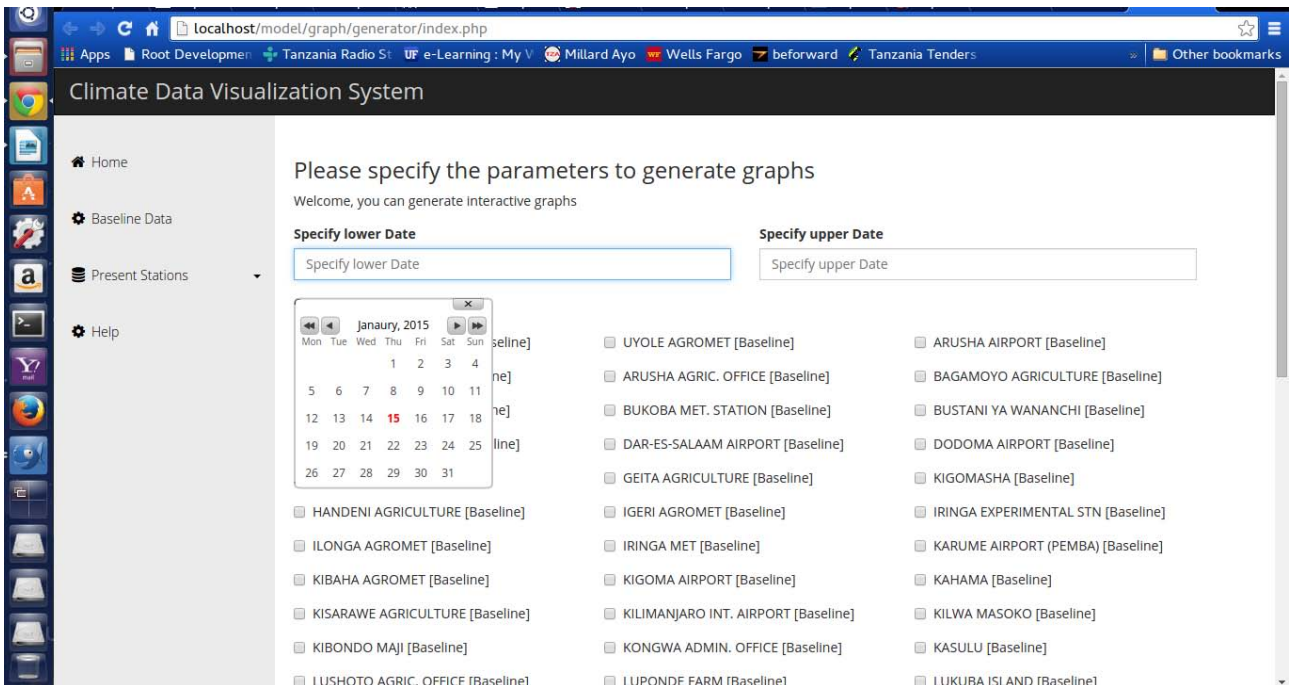
Figure 6: The desired dates and places choose by the user
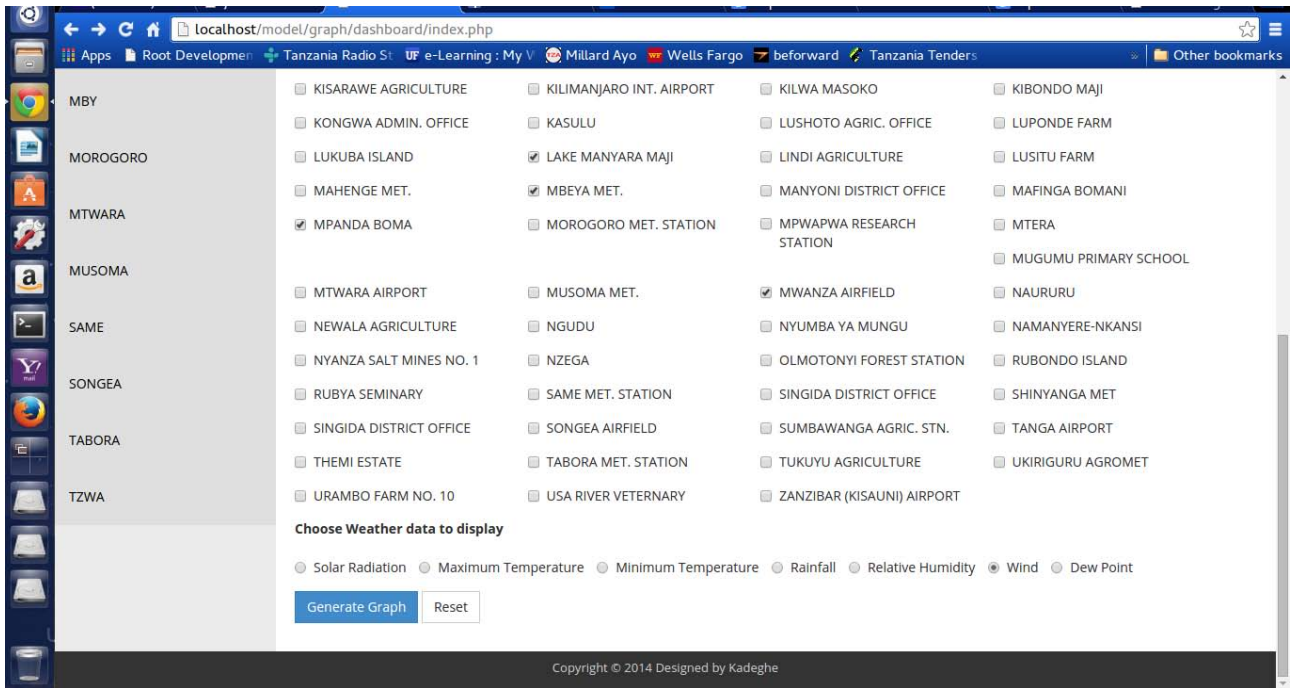
Figure 7: The user specifies the weather data type to be generated
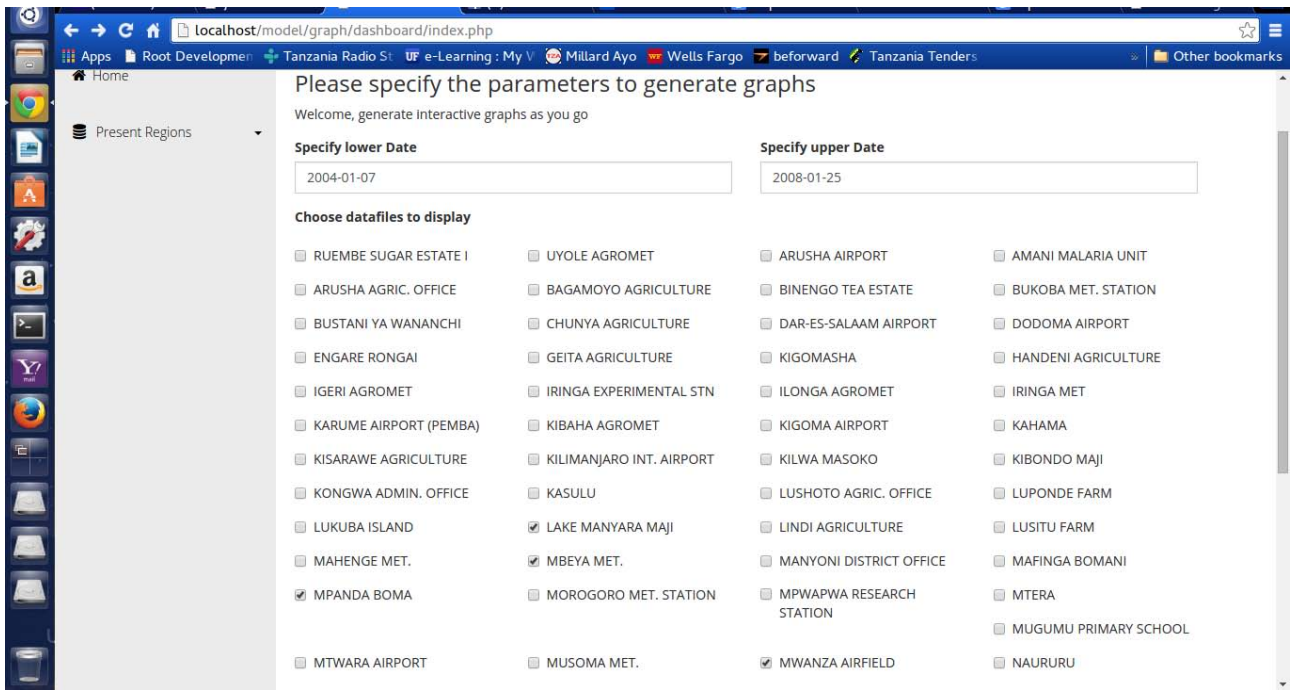
Figure 8: The Main view just before the user presses generate button to generate interactive graphs

The user can now press GENERATE button to instruct the visualization tool to generate the interactive graphs.

For instance, if the user chooses four stations to visualize the information, then the system is going to show years only as shown in Figure 8 and Figure 9.

Now, the user may decide to drag between the dates by holding left click and moving the cursor to visualize the information in detail as shown in Figure 10. Figure 11 visualize the chosen date from Figure 10.
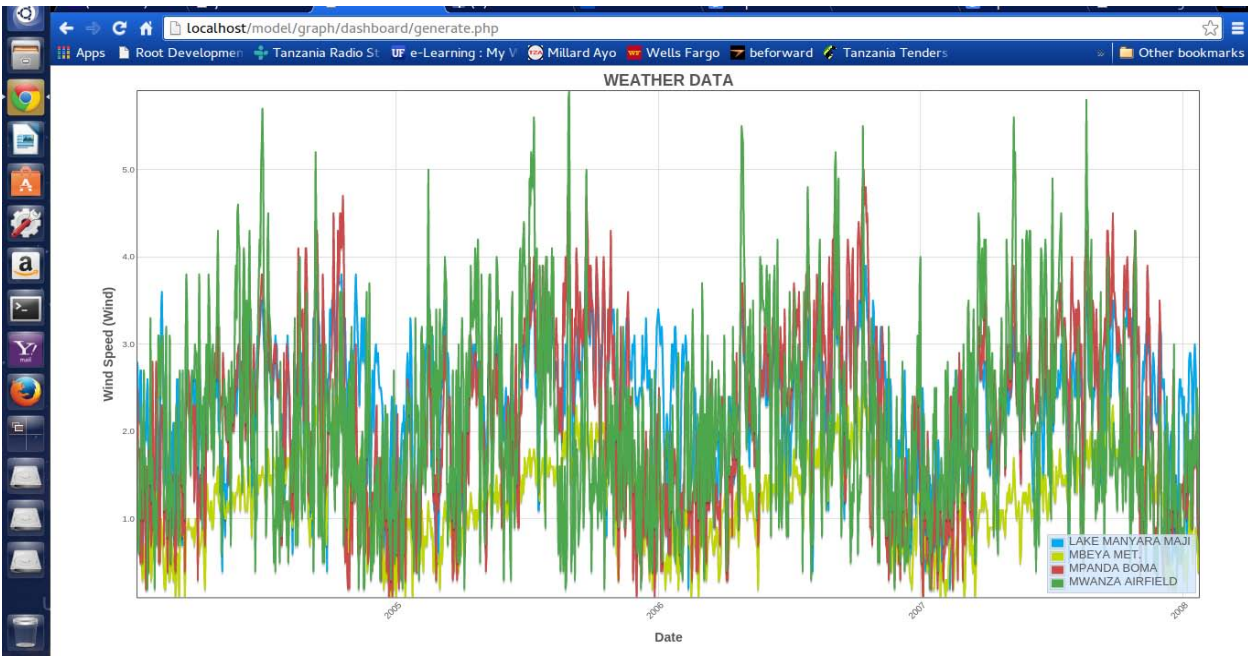
Figure 9: Weather data generator has generated the dataset between 2005-01-04 to 2009-01-23

Figure 11 includes more detailed information that is why the time series now show month with year instead of the years only. If you go further it will show date and then time as shown in Figure 12.
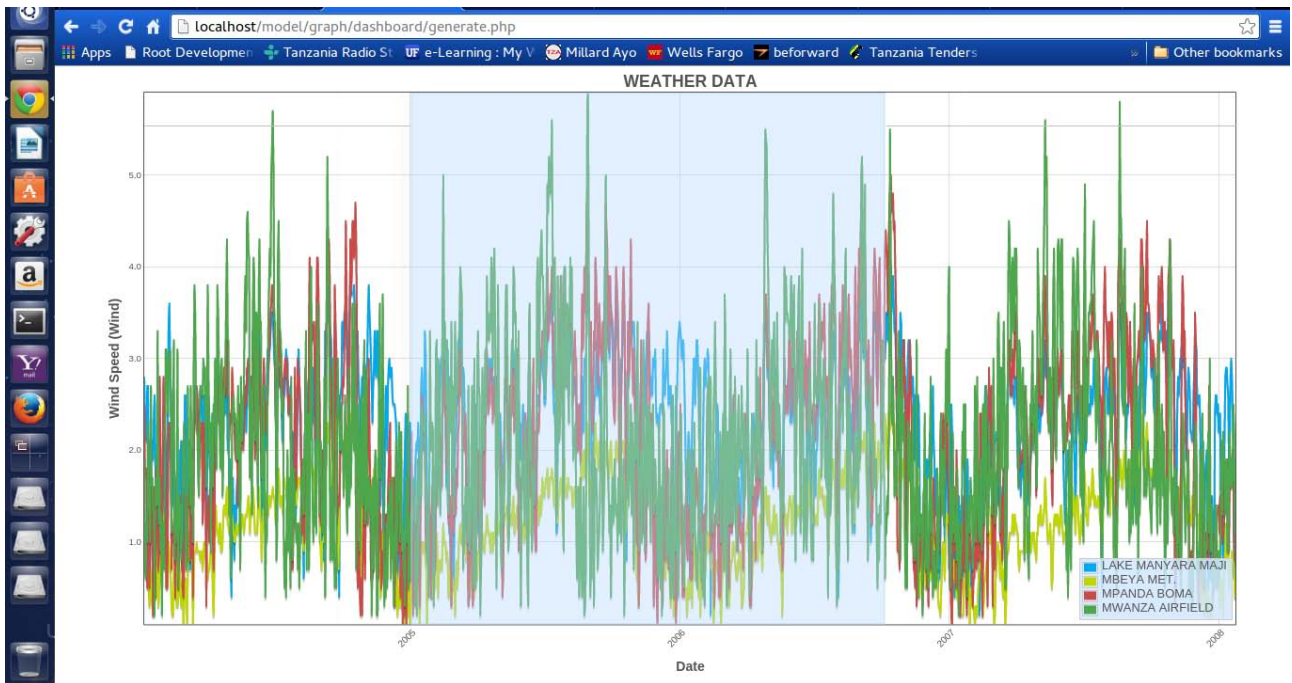
Figure 10: The weather data visualized in detail by dragging between the time-series

39
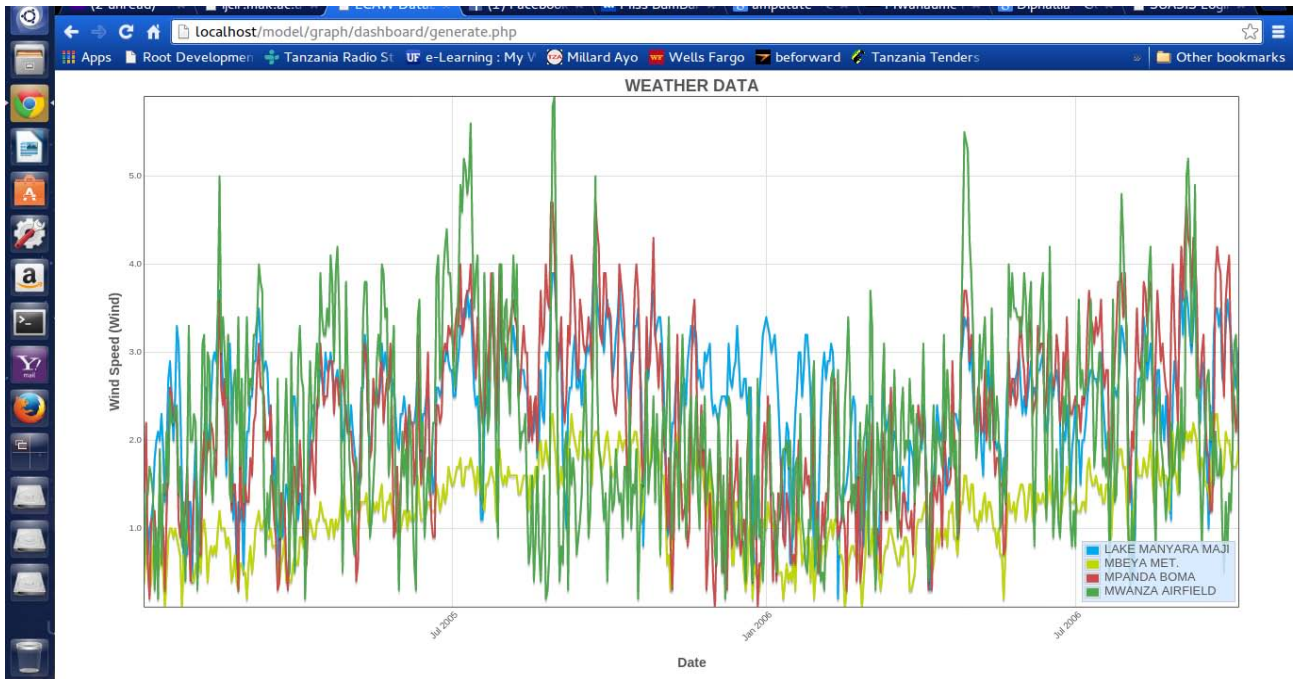
Figure 11: The weather data for the year 2006
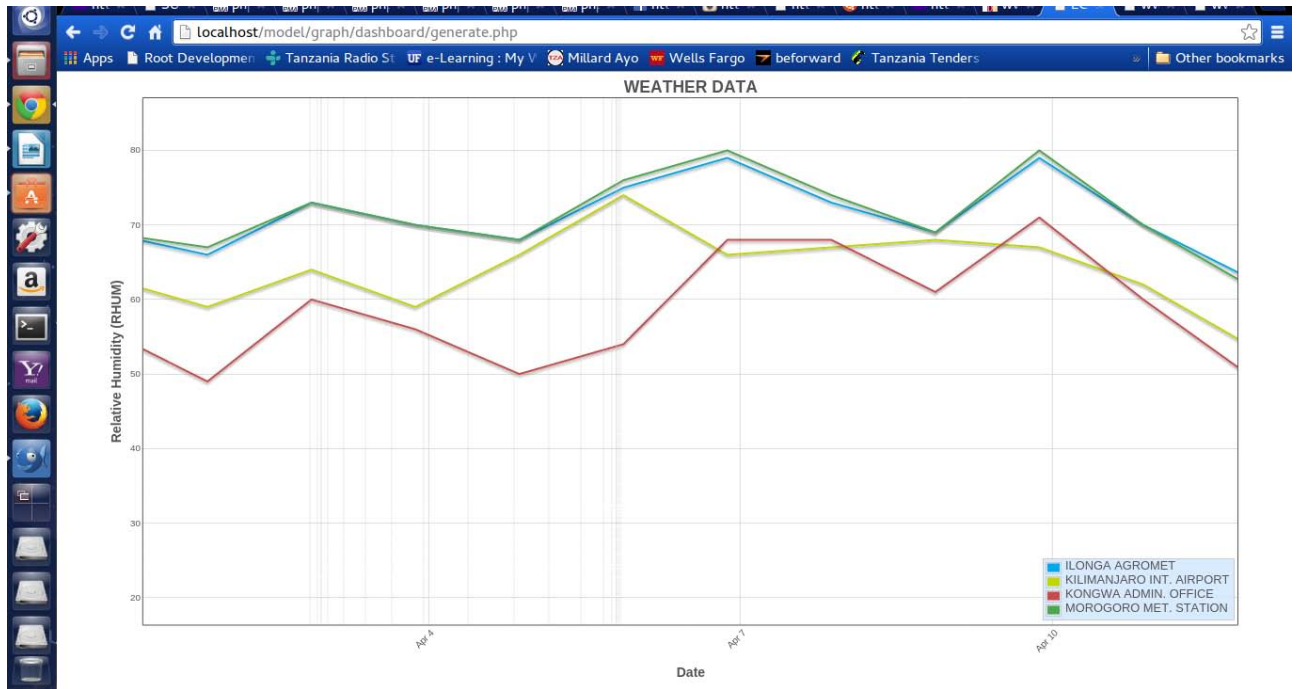
Figure 12: The weather data for specific month of April, 2006

Rainfall information is visualized using bar graphs as shown in Figure 13.
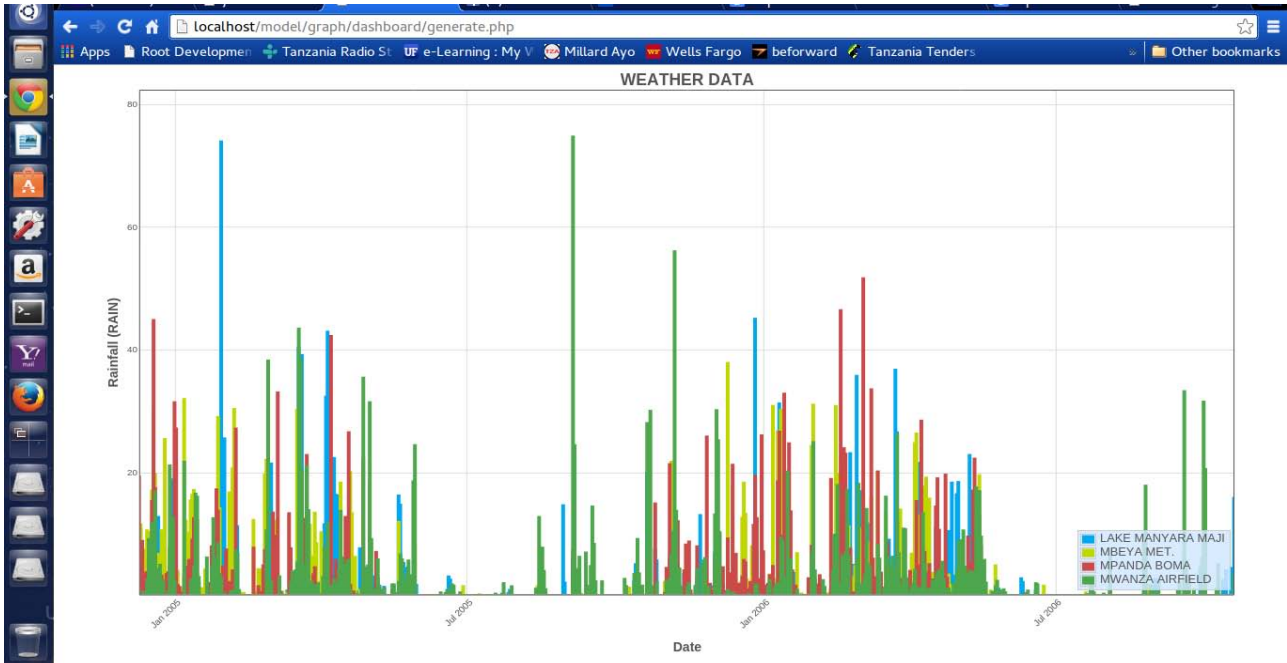
Figure 13: Rainfall data visualization

The rainfall data can be seen in each time, the rainfall was recorded. The detailed data will separate the information so that the differences of rainfall data of the same day can easily be visualized by the user as shown in Figure 14.
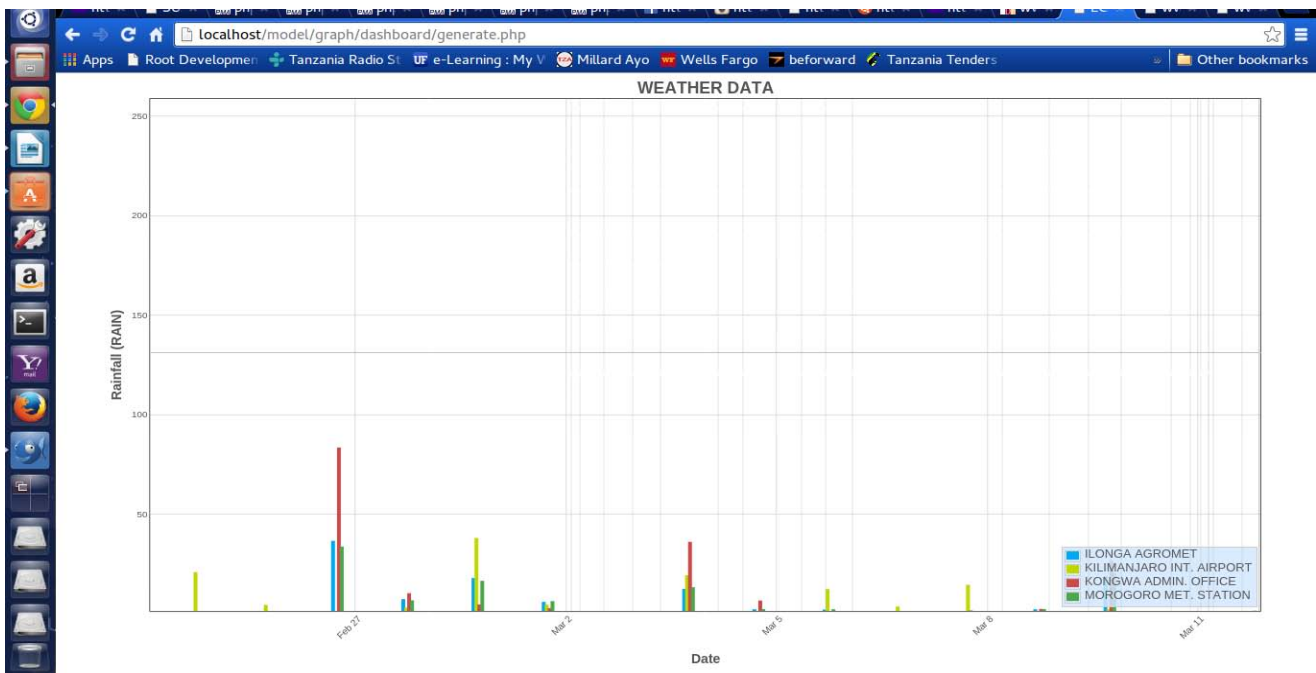
Figure 14: Very detailed rainfall data visualized as bar graph

Also, the system can be used to compare current weather conditions to modeled weather conditions as shown in Figure 15. It means it is possible to compare baseline information to the near-term conditions (2010-2039), Mid-Century (2040-2069) or End-of-Century (2070-2099) using four Representative Concentration Pathways (RCP2.6, RCP4.5, RCP6.0 or RCP8.5) as shown in Figure 16. The left sidebar has present stations which present data for different regions. As the matter of fact, the years are maintained 1980-2009 for compatibility reasons. Near-term means plus 30 years, Mid-century means plus 60 years while End-of_Century means plus 90 years. All the months correspond to each month across years.
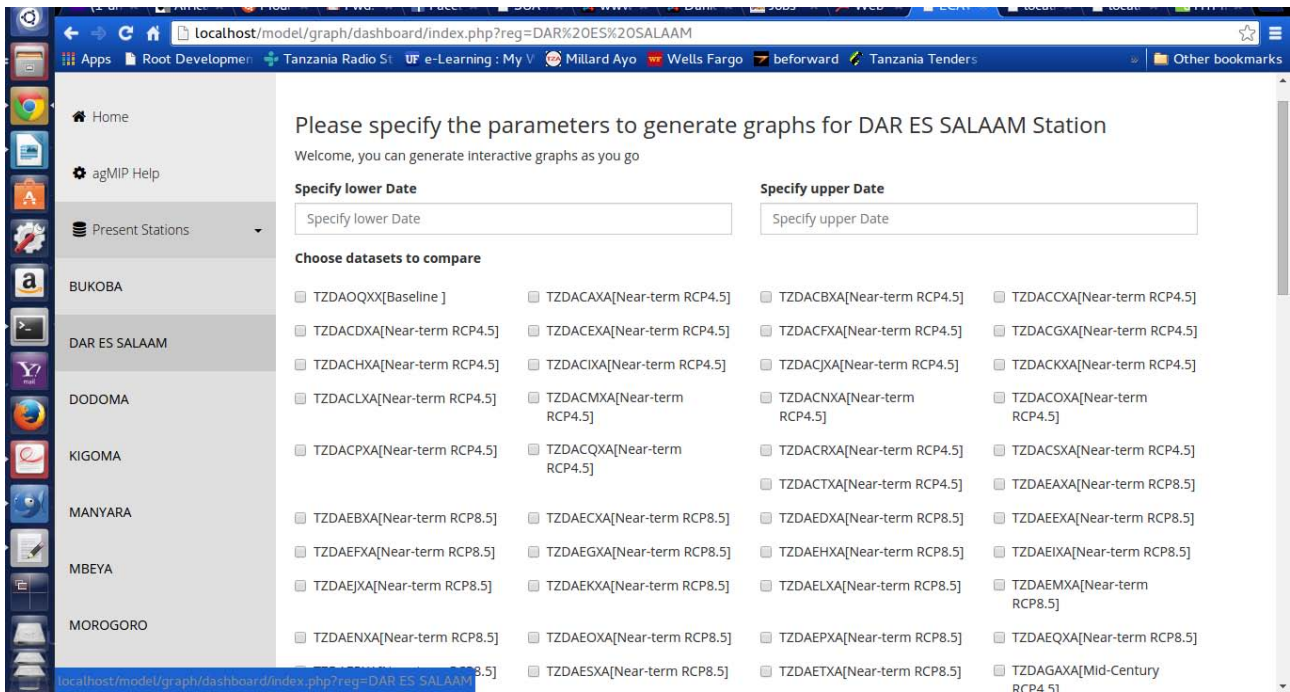
Figure 15: Choosing station to compare the baseline with the predicted weather conditions
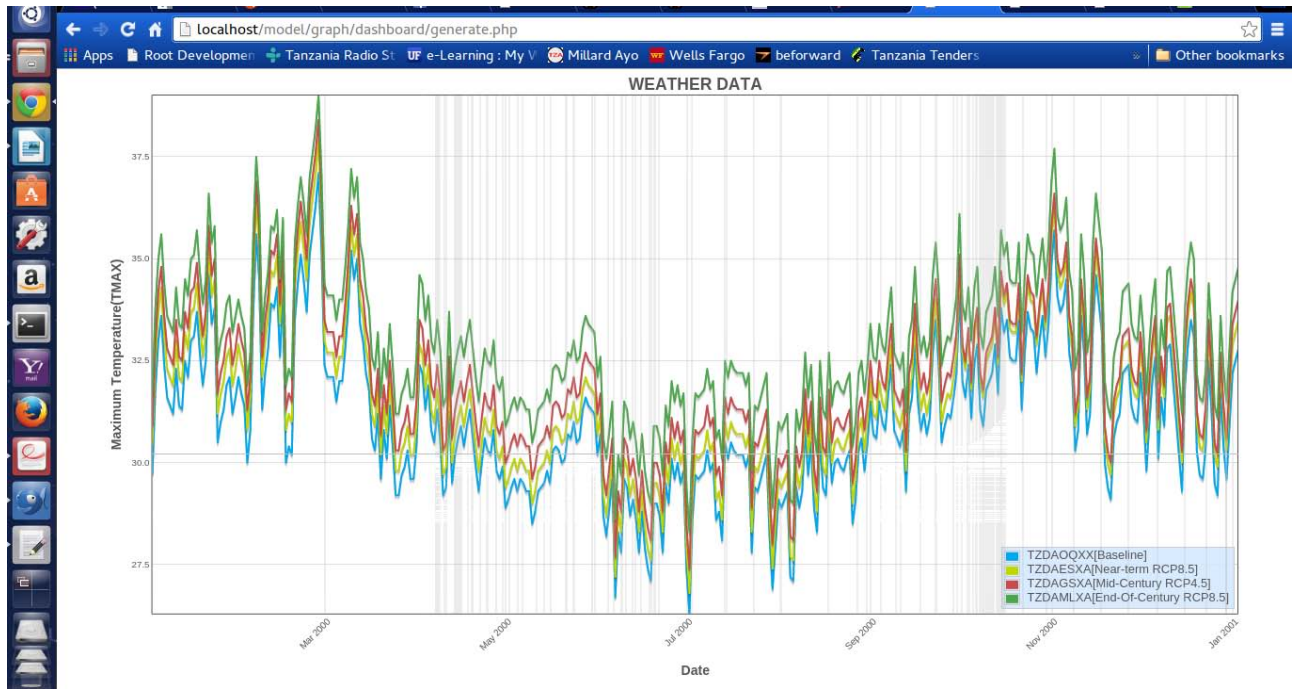
Figure 16: Generated graph for all year 2000, 2030[near-term], 2060[Mid-Century], 2090[End-of-Century]

The results from this paper are better compared to that from Luhunga and Chang'a (2016) who presented a decision supports system for determining effects of climate change. Their system was not interactive and hence, not adapted to rural farmers. On the other hand, ECAWSoft[2] is an open system (Sanga et al., 2016) for open data for the climate and weather visualization. It is in use online. Future[3] data visualization system needs to embed data warehousing, data mining and artificial intelligence algorithms (Woodard, 2016).

IV. Conclusion

This paper has presented a technique that can easily be loaded using a flash disc and manipulates data for easy visualization and interaction. The future

[2] http://41.73.194.138/model/graph/generator/index.php

work will involve integration with the web mapping system that will allow the users to visualize the information just in upper layer of the maps dynamically so as to make a feel and understanding of spatial information.

ECAWsoft has used simple but somehow complicated scripting to give state of art interaction of the dynamic graphs for large dataset of climate information (i.e. big data analysis)

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³ https://www.ag-analytics.org/AgRiskManagement/Home

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Arabic Question Answering with Dialogue Support

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Abstract- Question Answering (QA) system is a combination of Information Retrieval(IR) and Natural Language Processing (NLP) techniques. It returns a specific answer in response to user question. However, a system that can interact with the user to clarify and refine the answer is required. We propose QA system that adopts a user model for adaptation and a dialogue interface for interaction with the user combined with information retrieval and natural language techniques for Arabic Language. Our system will be able to handle users' questions in natural language and to present answers in in respect to the user's preferences and expected needs. The system achieved a precision of 82.05% and a dialogue success rate of 71.6%. The result is highly promising. As an extension for the present work, we need to make the system more adaptive and capable to learn and evolve with every new interactive scenario.

Keywords: question answering, information retrieval, user modeling, dialogue interfaces, natural language processing.

GJCST-H Classification: J.4, K.4.2

ARABICQUESTIONANSWERINGWITHDIALOGUESUPPORT

Strictly as per the compliance and regulations of:

Arabic Question Answering with Dialogue Support

Waheeb Ahmed [α] & Babu Anto P [σ]

Abstract- Question Answering (QA) system is a combination of Information Retrieval(IR) and Natural Language Processing (NLP) techniques. It returns a specific answer in response to user question. However, a system that can interact with the user to clarify and refine the answer is required. We propose QA system that adopts a user model for adaptation and a dialogue interface for interaction with the user combined with information retrieval and natural language techniques for Arabic Language. Our system will be able to handle users' questions in natural language and to present answers in in respect to the user's preferences and expected needs. The system achieved a precision of 82.05% and a dialogue success rate of 71.6%. The result is highly promising. As an extension for the present work, we need to make the system more adaptive and capable to learn and evolve with every new interactive scenario.

Keywords: question answering, information retrieval, user modeling, dialogue interfaces, natural language processing.

I. Introduction

The vast amount of available information on the web is usually accessed using classical search engines. However, the user gets a list of links to documents and it should spend some time searching for the answer in the documents referred by this links. To save users' time QA systems have emerged. The QA system will return a precise/concise answer as a response to the question given by the user instead of a list of links. There are some works which have been introduced in the field of Arabic language. In [1][2] systems which are based on knowledgebase and web are proposed. The systems depend on web as external source of data. A QA system based on big data is proposed in [3]. It finds answers to complex questions from various data sources including structured/unstructured. The system generates variety of semantic structures from these data resources and converts the knowledge extracted into an RDF format. In [4] the issue of question answering in community question answering (CQA) which gathers information from community sites is addressed. In [5] ontology-driven framework is proposed for natural language question answering using user models that are gathered with the help ontology design patterns. Social

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Question answering is proposed in [6]. It uses a collaborative paradigm to fulfill complex information needs. JAWEB [7]is a stand-alone a web-based application that receives a question from user and pass it as a query to a search engine to return the answer from the web. Most state-of-the-art question answering systems has the drawback that their output is independent of the user's characteristics, goals and needs. Secondly, most systems are only able to process *factual* questions, i.e. questions regarding dates, quantities, people, numerical, etc. However, there exist some complex/*non-factual* questions which may have multiple answers (e.g. different points of view) or complex answers (e.g. an articulated explanation). Such answers should be generated efficiently, enabling the user to understand and clearly differentiate among the different perspectives, portions of an explanation, and so on. Besides, state-of-the-art QA systems lack the interactivity with the user. The traditional question answering session involves the user submitting a question and the system retrieving a result; the session is then ended. In order to overcome these drawbacks of existing QA systems, we propose a question answering system supported with a dialogue interface. The main feature of such system is that it provides output adapted using of a user model and the answer type to be generated, and thus modifies/adjusts both content and presentation of the final answer(s). To the best of our knowledge, this work will be the first on dialogue question answering for open domain.

II. Architecture of QA System

A question is submitted to the dialogue interface, which passes it to the QA system. The question answering module will generate a query from the question terms and pass the expanded query to a search engine and interacts with the user model. The user model gives information on how to adjust the query conditions and how to rank and re-rank the search engine results in accordance with the user level. It is created during the dialogue using information provided by the user and is updated by the dialogue history module. This model supplies information to the dialogue system on the way of interaction and presentation of results to the user.

a) QA Component

The system should be able to differentiate between questions with simple/factual answers and ques-

tions with multiple answers. Each modules per- forms one analysis stage and described in the following sections (Figure 1 shows the architecture)
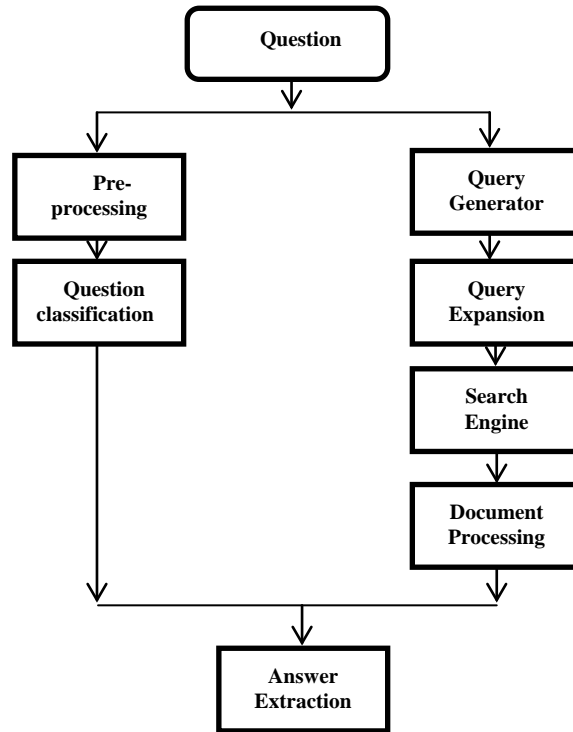
Figure 1: QA component

Figure 1: Architecture of the QA System

i. *Pre-processing*

The question sentence is processed in order to remove diacritics (special Arabic signs on letters) and remove stop words. The stop-words are words that occurs very frequently and does not add any importance to the search process [8][9].

ii. *Question Classification*

The given question is classified to identify the question according to its expected answer type. We used Support Vector Machines from our previous work [10], to help in answer extraction at later stage.

iii. *Query Generation*

A query is generated from the question terms. The query consists of the question terms after removing the stop-words.

iv. *Query Expansion*

The generated query is expanded by adding more terms to it(i.e., synonyms or hypernyms) to improve the search results and stemming can also be used for query expansion[11][12].

v. *Search Engine*

The expanded query is passed to a search engine. In our case, we use Google [13]. The search engine will produce/retrieve a collection of documents. The top ten documents will be extracted.

vi. *Document Processing*

The search results—a list of documents retrieved by their relevance to the generated query— are ranked based on their similarities and to the user model. The documents are divided into passages.

vii. *Answer Extractor*

The analyzed question is compared with the retrieved passages based on similarity metric. A list of answer candidates/sentences is generated which we derive from the relevant passages. In this stage, the ranked passages are filtered based on the user model and answer candidate/sentences are located and prepared for presentation. The passages in the collection are filtered according to their reading difficulty: only those in accordance with the UM's reading level are selected for further analysis.

b) *Dialogue Interface*

The dialogue interface help contribute to the building of a model of the user's interests, goals and level of comprehension/understanding. This consists of

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[1] All examples are translated into English for this paper.

analyzing the dialogue history which would help the user modeling component to build such a model.

The main aim of the dialogue interface is to provide users with a friendly interface to make their requests. For example, consider the following scenario:

—System: Hi, how may I assist you? 11

—User: I would like to know who is the author of the novel "Treasure Island".

The dialogue component reads the submitted sentence by the user and extracts the following question :"who is the author of the novel Treasure Island?", which will be passed to the question answering module. The dialogue component also help the user disambiguate its queries. For example, assume the user's query is instead:

—User: I would like to know about the novel "Treasure Island".

This question is somehow ambiguous: it is not specified what know about the novel "Treasure Island" in particular the user is intending. In such case, the dialogue component should give a reply like:

—System: Excuse me, did you want to know information about the novel summary or about its author?

—User: Actually, I would like to know about the author of the novel.

In a second stage, the dialogue module has to provide the answer to the user once the question answering component has produced it. The dialogue manager must get consultation of the user model to decide on the most suitable presentation of the answer (i.e. level of readability) and produce the final answer accordingly,

In addition, the dialogue interface should verify if the answer generated was satisfactory and, if not, to carry on the interaction necessary to further clarification/refine or modify the question.

c) User Model

The reason for using user model is that it is an important prerequisites which help the system to adapt to a large range of dialog behavior . The system should consider the user's goals , needs and plans, and also what he/she knows about a domain. Hence, the task to build model of the function of the system in mind is no longer related to the user only. Instead, the system should also to make some inference about what the user needs, believes, and plans. Ideally, the user-system interaction task should not be different from person-to-person communication.

For the purpose of responding in an interactive way to the user, a system must identify the plans formulated in the question provided by the user, store all of these in its knowledge base, test them for embedded hurdles, and generate information to help the user to overcome these hurdles. Thus, a user model is an important requirement for these complex inference procedures.

Another reason for the need of user modeling is that it forms an important prerequisite for intelligent dialog behavior. So, the user modeling is required to identify the elements which the partner of the dialog is talking about, for analysis of the meaning and indirect text indicators in his/her contributions to the dialog.

A User Model contains information that the system uses to identify the knowledge that the user has on the domain, referred as the domain based/dependent data. The domain based/dependent data are associated with three level functionality namely: Task, Logical and Physical Level. The first level includes the the domain objectives that the user will have to be professional in. In this way, the objectives can be modified based on the progress of the learning process. The second level identifies the user knowledge of the domain and evolves during the user's interaction process. The third level maintains and derives the user knowledge profile. The other type of data is the domain independent data. It consists of two parts: the psychological and the generic models of the user profile. The psychological data are associated with the affective and cognitive aspects of the user. They are more permanent which enable the system to know the features that it must adapt to. The data associated with the user interests, common knowledge and background are saved in the generic model of the user profile. The domain independent data include following elements: Elementary user knowledge, objective and plans, cognitive capacities, references, Learning styles, type and age of user, cognitive style, personality aspects Some of these features are relevant for a specific type of user models and not for others[14].
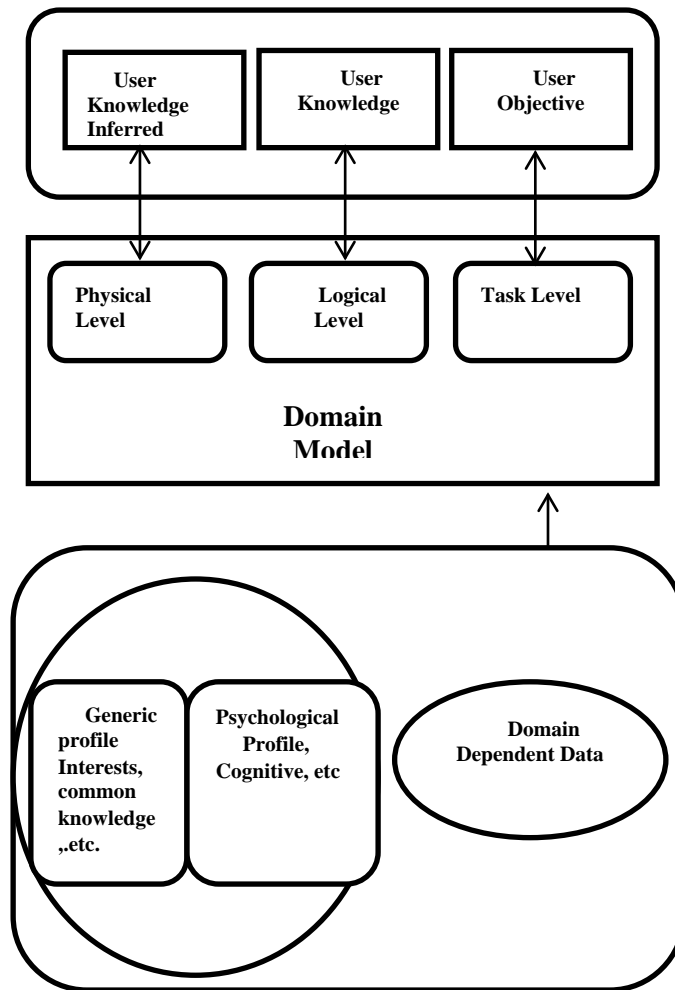
Figure 2: Architecture of the user Model

III. RESULTS AND DISCUSSION

For evaluating our system we have used general knowledge questions. we adopt two metrics for evaluating our system: *Precision* and *Dialogue success rate.* The QA system was evaluated by giving 10 sets of dialogue with a total of 50 natural language questions. The two evaluation metrics are defined as follows:

For each set the dialogue success rate =No. of Answers/Responses produced by the system /No. of turns initiated by the user.

Dialogue success rate = (Total of Dialogue success rate for each set / No. of dialogues' sets)*100.

Precision= (No. of correct answers provided by the system/No. of responses generated by the system)*100.

The number of turns issued by the user in a dialogue is the total of the number of questions submitted to the system and the number of responses provided by the user to the system. Each set of dialogue consisted of around 2 to 3 questions. The total dialogue success rate for the 10 sets was obtained as 28.16. The dialogue success rate for the system is calculated as Dialogue success rate= (7.16/10)*100= 71.6%.

Out of 50 questions, system produced answers for 39 questions of which 32 were correct answers. Therefore, the precision of the system is calculated as Precision= (32/39)*100= 82.05%.

The low dialogue success rate is because that the system coverage of the domain is not enough. Another problem is misinterpretation of the dialogue history.

IV. CONCLUSION

In this paper, we presented a question answering system with dialogue support and a user model component. This system enables the adaptation and clarification of the answer based on the user's level and needs. It scored a precision of 82.05% and a dialogue success rate of 71.6%. The results of the system are promising. As a future direction, the user model needs to be supported with the learning capability to be more flexible.

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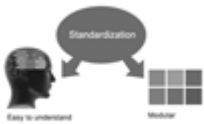
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TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

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9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

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16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

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The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

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Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including <u>definite statistics</u> - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
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- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.

- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

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The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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