

Information Communication Technologies Acceptance and Use Among University Communities in Uganda: A Model for Hybrid Library Services End-Users

Prisca K. G. Tibenderana*
Faculty of CIT, Makerere University

Patrick J. Ogao
Faculty of CIT, Makerere University,

Since their inception during the first century, library institutions have used manual operations to provide services to patrons. Information seekers in these libraries spent a lot of time perusing through card catalogues and searching rows of stacks for material that may have been checked out by someone else. The tradition tool and techniques were inadequate and time consuming. The introduction of the new technologies has changed this concept and what we have now are hybrid libraries based on computer networks and physical facilities. This investigation is an effort to examine alternative measures of intention in revalidating and expanding (Venkatesh et al. 2003) UTAUT model in the context of hybrid library services using university communities in a less developed country, Uganda.

Categories: H. Information Systems. H. 3. Information Storage and Retrieval.
General Terms. Model development. Theory.

IJCIR Reference Format:

Prisca K. G. Tibenderana and Patrick J. Ogao. Information Communication Technologies Acceptance and Use Among University Communities in Uganda: A Model for Hybrid Library Services End-Users. International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, pp. 60-75. [http://www.ijcir.org/Special-Issuevolume1-number1/article 8.pdf](http://www.ijcir.org/Special-Issuevolume1-number1/article%208.pdf).

1. INTRODUCTION

University libraries play a critical role in the emerging dynamic environments of higher education.

Emerging Issues of Hybrid Libraries

The introduction of computers and other telecommunication technologies in libraries during the last twenty years has altogether changed the concept of a library and the library profession, since the information seeker is no longer confined to the walls of the library, (Kwak et. al., 2002; Bevis, 2003; Rosenberg, 2005; Vinitha, 2006). As ascertained by (Kwak et. al., 2002), majority of university libraries are now hybrid libraries, depending on both electronic and print media based on network and physical facilities. And because of this, many university libraries are part of campus-wide networks, with Internet access (Alan, 1996; Kiondo 1997; Martey 2004; Rosenberg, 1998 & 2005). In this way, university libraries worldwide

* Author's Address: Prisca K. G. Tibenderana, Faculty of CIT, Makerere University; Patrick J. Ogao, Faculty of CIT, Makerere University, ogao@cit.mak.ac.ug

"Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than IJCIR must be honored. Abstracting with credit is permitted. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee."

@International Journal of Computing and ICT Research 2008.

International Journal of Computing and ICT Research, ISSN 1818-1139 (Print), ISSN 1996-1065 (Online),), Special Issue Vol.1, No.1 pp. 60-75, October 2008.

are able to offer their patrons remote services and access to the vast networked resources. Unlike in the traditional library where users are required to have the ability to read, in an e-library environment users require basic ICT and information searching skills.

Many university libraries embarked on automating their operations and services using the new technologies. To enable automation processes, a library purchases and installs application software. The library is then equipped with a network server and a number of computers (PC) distributed in a local area network (LAN) and in some cases also on a world wide web (www) within different parts of the library and faculties and administrative buildings of the university. According to (Alan 1996), “the system is then used to create bibliographic databases, control acquisitions, cataloguing and serials, effect bar-coded circulation, book reservation and recall system, current awareness services (CAS), selective dissemination of information (SDI), online literature searches of international databases through CD-ROMs and via Internet and support interlibrary loan services and electronic document delivery services (EDDS). Card catalogues are replaced with computer terminals.” Indeed, Internet and CD-ROM technology have made it possible to store much more information as well as provide immediate access to resources throughout the world.

Observations made by (Leedy 1993) that in the past, information seekers spent much time pouring through card catalogue, and searching rows of stacks for material that may have been checked out by someone else. This process was time consuming. Information seekers knew a librarian as a source of assistance when the catalogue and guides were not useful. In addition, an information seeker often found vital information in a book located near the one he/she has used before, because library materials (books, journals) were organized by discipline. With the use of computers and other communication networks, one can (in theory) get the information required electronically from wherever it is located. The main role of a librarian is now to assist end-users in searching techniques and the use of technology.

The trend towards the delivery of information services in university libraries using ICT gathered momentum on the African Continent after about 2001 (Rosenburg 2005). This is particularly true in the case of online information access, CD-ROM databases and serial publications (Kiondo, 1997 & Martey, 2004). Electronic library services introduced in universities in Uganda at the turn of the last century include but not limited to: End-Users Training Programmes, Printing, Photocopying, Internet web browsing, E-mail, Online full text journals articles, Electronic books, Online Public Access Catalogue (OPAC), Bibliographic databases, Online indexing and abstracting services, CD-ROM services, Library websites, EDDS, Electronic Document Reserve, Electronic Reference and Information, Bar Coded Circulation, Current Awareness, SDI, Electronic Book Reservation and Recall, Electronic Interlibrary Loan, Digitization and Microfilming Services.

According to Information System research, for such services to be used they need to be accepted. The study, therefore, aims at establishing levels of acceptance and use of the technologies, as the major motivation for this investigation.

Rationale for the Study

Despite the fact that technology acceptance has been studied for over two decades now resulting in several evaluation models which have been validated in different contexts and different cultures, this study found that non of the models has been validated within electronic library services context in a country South of the Sahara.

- a) The result of this is that no end-users acceptance and usage levels of e-library services have been studied not only in Uganda but also elsewhere in the world.
- b) By addressing a direction highlighted in (Venkatesh et al. 2003), to examine alternative measures of intention and behavior in revalidating and expanding the research to other contexts, this investigation studied end-users' acceptance and use of e-library services. Accordingly, the investigation modified UTAUT model and developed an end-users evaluation model using e-library services context in universities in Uganda an African country South of the Sahara.
- c) Lastly, (Venkatesh et al. 2003) found that gender and age have received very little attention in technology acceptance research, yet Venkatesh's results indicate that these variables moderate most of UTAUT four key relationships. This study further validated the findings using e-library services in

universities in Uganda a less developed country in an African setting (Anandarajan, et. al., 2000 & Oshlyansky et. al. 2007).

Research Questions

In order to study the underlining problems stated above and based on UTAUT (Venkatesh et al., 2003) six assumptions were postulated:

- Ha₁. End-users in universities accept to use e- library services.
- Ha₂. The UTAUT constructs demonstrate an effect on behaviour intent to use e-library services.
- Ha₃. The research model constructs will account for a significant percentage of the variance on the end-users intention to accept and use electronic library services.
- Ha₄. Relevancy does demonstrate an effect on behavioral intention to use e-library services.
- Ha₅. Relevance moderated by awareness demonstrates an effect on behavior intention to use e-library services.
- Ha₆. Usage and intention to use e-library services account for a significant percentage of variation of perceived benefits.

Conceptual Model: The Unified Theory of Acceptance and Use of Technology (UTAUT)

The theoretical basis for this investigation stems from the study by (Venkatesh, et. al. 2003). The Unified Theory of Acceptance and Use of Technology Model (UTAUT) provided the motivation for this research because it enables the studying of acceptance and use visa versa none acceptance and none use of technology. UTAUT indicates that behavior intention to use a technology, in this case the hybrid library, is influenced by people's perceptions of performance expectance, effort expectance, social factors and facilitating conditions which are moderated by gender, age, experience and voluntariness. The tool used in UTAUT model utilizes communal cognitive elements which better outline and dictate user acceptance of Information Systems. These elements are highly rated constructs because they include culture, which has a great effect on the highly rated constructs (Oshlyansky, 2007). Besides, (Venkatesh et al. 2003), model allows expansion or deduction in order to provide alternative measures of intention and behavior in revalidating and expanding the model to other contexts. The UTAUT Model is unification from eight user acceptance and use of technology models developed by (Venkatesh et al. 2003). The historical background for its four constructs is presented in the UTAUT (Venketesh at al. 2003) and the researchers find the background well documented and will use them as presented therein. Moran et. al., 2006) too give a fairly detailed background of the constructs.

The current investigation therefore, extended the model to study end-users acceptance and use of e-library services context. Universities in Uganda provided a good environment because of the recently introduced e-library services to end-user communities. The study was structured using UTAUT (Venketesh at al. 2003) constructs with modifications. The two additional constructs were got from external user holistic studies of library services (Ranganathan, 1931 & Nicholson, 2004). Introduced was the independent variable of *relevance* which means "suiting given requirements or pertinent to specific requirements" and a moderating variable of *awareness* that means "having knowledge of some fact about something" and were considered vital for end-users services oriented technologies.

2. RELATED WORKS

Technology Acceptance Model (TAM)

Technology acceptance is mainly about how people accept and use the introduced technology. Quite often people think that introducing new technology results in service acceptance and use. However, several research findings dispute the claim, showing that there are several other factors that affect technology acceptance and use [Carlsson, et al. 2006]. According to Louho, Kallioja and Oittinen (2006) technology acceptance models are used to explain how users will accept and use a specific technology in future.

Developed by Davis (1989) for his doctoral research, the Technology Acceptance Model (TAM) was based on Theory of Reasoned Action (TRA) Fishbein & Ajzen, (1975). Davis together with Bogozzi and International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, October 2008.

Warshaw (1989) jointly published an article in MIS Quarterly, where TAM theory was presented. According to Davis (1989) perceived usefulness (PU) and perceived ease of use (PEOU) both affect people's intention to use, thereby, contributing to either usage or non-use. Davis (1989) indicates that usefulness was more significantly affected by usage than ease of use. Davis (1989) concludes that perceived usefulness had a stronger correlation with user acceptance of technology. TAM's major strengths are that it provides factors which lead to IS acceptance, provides room for extensions and elaborations better than other competing models (Taylor & Todd, 2001). Some observed shortcomings by users of TAM are its failure to determine barriers that hinder technology adoption (Taylor & Todd, 2001) and possibly its simplicity, which has led to its being over-used at the expense of designing other models. TAM's acceptance in IS research is documented in Lee, Kozar and Larsen (2003).

The Unified Theory of Acceptance and Use of Technology (UTAUT)

A comparison of the determinants found in major acceptance and use models is presented by Moran (2006); Lee, et al. (2003); Vanketesh et al. (2003) and Venketesh & Davis (2000). Vanketesh, et al. (2003) in particular review the user acceptance literature systematically by comparing eight previous models and the predictive factors specified by each and by so doing developed a new model the "Unified Theory of Acceptance and Use of Technology model" (UTAUT).

Determinants of acceptance of technology in UTAUT are: *performance expectancy*, *effort expectancy*, *social influence* and *facilitating conditions*: where *performance expectancy* means the degree to which a user believes that using a technology will provide gains in job/study/teaching/research performance; *effort expectancy* means the degree of ease in using the system; *social influence* means the degree to which an individual perceived that it is important that others believe that they should use the new system; *facilitating conditions* on the other hand means the degree to which individuals believe that there is organizational and technical support for using the system. The four determinants of user acceptance in UTAUT were moderated by gender, age, experience and voluntariness (Venkatesh et al. 2003).

Since UTAUT was designed, it has attracted many scholars in IS research. Amongst the first was Garfield (2005) who used its tools to analyze the acceptance of Computers in Bentley College. A study by (Pu-Li and Kishore 2005) weblog systems to validate UTAUT constructs and conclude by advising researchers to be cautious when interpreting results using UTAUT scales. The study by (Louho, Kallioja and Oittinen 2006) discusses factors that affect the use of hybrid media applications using UTAUT as the conceptual model. By studying College Students' acceptance of Tablet Personal Computers and modified UTAUT, (Moran 2006) introduced "self efficacy" and "anxiety" determinants because of their significance in other technology acceptance models.

Results of Moran show a high correlation between attitude toward technology use and anxiety. Calrsson et al. (2006) studied the adoption of wireless mobile communication in Europe using UTAUT, while (Anderson and Schwager 2006) examined the application of UTAUT to wireless LAN technology in smaller enterprises in the USA. Cody-Allen and Kishore (2005) extended UTAUT by adding e-quality, trust and satisfaction constructs to develop an E-Business Quality Model. Heerik et. al. (2006) used cooperation, empathy, assertion, self control, responsibility, trust and competence to evaluate social abilities in the elderly people within an experimental setup. After the experiment, participants were interviewed using a questionnaire related to that used by (Venkatesh et al. 2003). The investigators used user data collected on human-robot interactions in nursing home for the elderly, and the experiences they went through were utilized to develop guidelines to support human-robot user studies in elderly institutions. Scholars who have also used UTAUT Model include (Zhang 2006) & Yang, et al. 2005). Engebretsen (2005), tested UTAUT constructs in health research project to study the acceptance of EpiHandy in Uganda and South Africa. Results of this study show that Health Workers in Uganda accept the EpiHandy more than those in South Africa.

Technology Acceptance or Use in Libraries

Jung (1997) used a comprehensive tool to measure digital library users' satisfaction and developed two models; one for objective and the other for subjective measurements. Hill, et al. (1997) used multiple International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, October 2008.

methods to evaluate the use of Alexandria Digital Library. Buttenfield, (1999) presents strategies for evaluating the usability of Digital Libraries (DL). During the implementation of Perseus Digital Library Project, using a longitudinal and multifaceted view, (Marchionini, 2000) suggested diverse measurements for evaluation of DL. Saracevic, (2000), presents a conceptual evaluation model for digital libraries. Borgman, et. al., (2000) identifies the effectiveness of DL based on the relationship between DL and students' creativity. Lilly, (2001) evaluated a virtue library collection. In their longitudinal survey of opinions, Kwak, et al. (2002] developed a framework for evaluating university libraries in digital environments. Lagier, (2002) used citations, to evaluate usage and usability of online databases. Baruchson-Arbib (2002] carried out a survey on the use of electronic information sources by Israeli College Students. Bar-Ilan, (2003) carried out a survey on the use of electronic databases and electronic journals accessed through the web by academic staff in Israeli universities. Nicholson, (2004) developed a matrix conceptual framework for the holistic measurement and cumulative evaluation of library services (Table 1). Here, *aboutness* refers to the location of the information within the system (library in this case). According to Schamber (1994) the information view of relevance introduces the concept of aboutness which is based on a content match between the query and the documents being sought. *Usability* refers to how well the system can be used without you having any hardship. *Knowledge status* refers to how well one is aware of what is available, and is linked to the introduced concept of awareness. *Value of works* refers to the value that the material has to the user, which is largely influenced by the relevance of the works. Nicholson therefore views a user's use of library services as being affected by their awareness and by the relevance to them of the library's offerings

Table 1: Measurement Matrix. *Source:* Nicholson (2004)

Measurement Perspective	Topic	
	<i>System</i>	<i>Use</i>
<i>Internal (Library System)</i>	Procedures Standards	Recorded interactions with interface & Materials-bibliomining
<i>External (User)</i>	Aboutness Usability	Knowledge status Value of works

2. METHODOLOGY

The study data were collected from a randomly selected cross-sectional survey sample of 494 library end-users during the months of June, July and August 2007. Stratified random sampling was important as the first step in fulfilling the study objective. The goal was to achieve the desired representation from various subgroups in the population. The variables considered within the stratification were: public visa via private in which, fifty percent of the sampled universities were government-funded (Mak., Kyambogo, Mbarara & Gulu,) and the remaining fifty percent were privately funded (UMU, IUIU, UCU & KIU); sampling those which had introduced ICT in their libraries. In addition, three faculties were targeted due to the homogeneous characteristics of teaching and subject disciplines across the eight universities. With a population of 28,423 library end-users in the three faculties across the sample universities, a number much greater than 10,000 (Fisher et al. 1983), the z-statistic of 1.22 was used to get the sample size of 346 subjects. However, not all respondents would be willing to respond. Assuming a response rate of 70%, the number of questionnaires administered was calculated as $(100/70) \times 346 = 494$. Eighty nine percent of the target population was undergraduates, this stratum was given greater sample representation of fifty percent. Thirty percent represented postgraduate student samples and twenty percent were administered to faculty staff. After establishing the number of samples in each stratum, random sampling was used when administering the questionnaire to respondents.

The survey instrument was a self-administered questionnaire, which was distributed in hard copy format to respondents by the main investigator and the field research coordinator. For proper follow up on the questionnaires, eighteen research assistances were recruited, trained and assigned to collect the questionnaires from the eight universities. Makerere University that had the greatest number of respondents (47%) was assigned four and the other seven universities, two for each. The field research coordinator, International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, October 2008.

together with the main researcher traveled from one university to the other to ensure systematic and good data collection

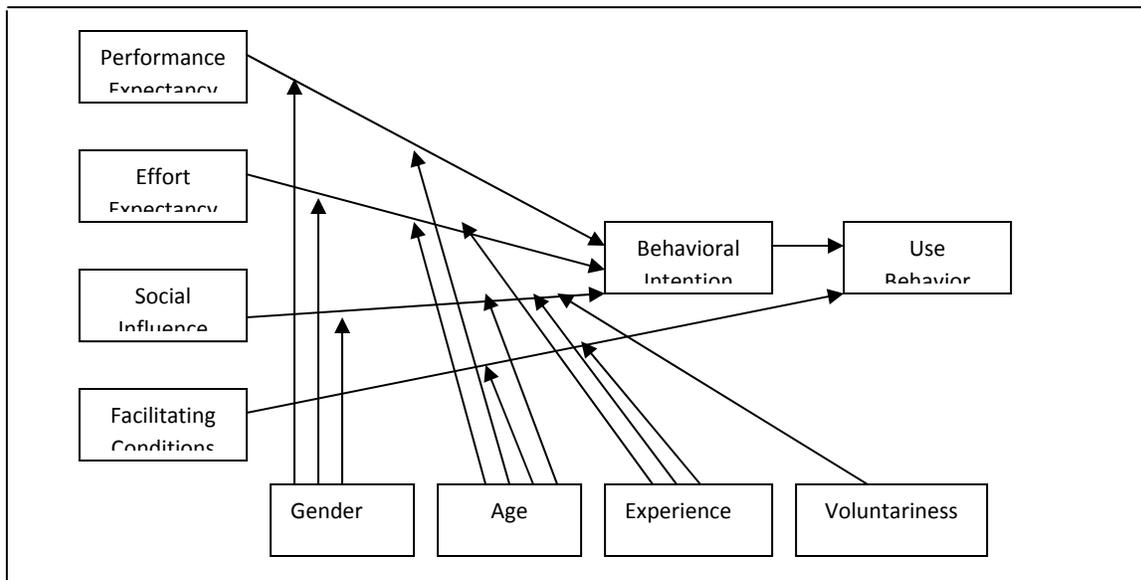


Figure 1. The UTAUT Model

Source: Venkatesh et al., (2003)

Table 2: Distribution of Valid Responses by University

University	Mak	MUST	KYA	GU	UMU	IUIU	UCU	KIU	Total
Frequency	210	36	37	40	34	15	46	27	445
Percentage	47.19	8.09	8.31	8.99	7.64	3.37	10.34	6.07	100

Table 4. The Average Shared Variances and the Correlation Coefficients of Latent Variables.

Model (N=445)								
	AVC	PE	RE	SI	FC	BI	UB	EB
PE	0.85	0.92						
RE	0.60	0.35	0.77					
SI	0.76	0.35	0.38	0.87				
FC	0.66	0.36	0.44	0.74	0.81			
BI	0.82	0.21	0.38	0.50	0.52	0.90		
UB	0.63	0.37	0.47	0.24	0.28	0.23	0.79	
EB	0.73	0.34	0.36	0.63	0.67	0.55	0.42	0.85

Table 5: T-ratio Test and R² for the Study Model Dependent Constructs.

Dependent Construct	R ²	t-test statistic	Probability Value
Behavioural Intentions	0.30	42.99	<0.001
Usage behaviour	0.09	86.58	<0.01
Expected benefits	0.18	44.72	<0.01

Survey Instrument

The questionnaire was based on the pre-existing tool developed by (Venkatesh et al. 2003), and used by (Anderson & Schwager 2004 and Moran 2006), with modifications to make it relevant to e-library end-users. The tool was pre-tested in two workshops on 20th and 21st April 2007 and results from the pre-test study were presented in a Joint Conference on Digital Libraries in Vancouver, Canada on 20th June 2007 where experts in the area made great inputs in the study instrument. The survey participants responded to questions with a five-point likert scale where a one represents strongly agree and a five represents strongly disagree. All the questions and the wording were critically scrutinized and approved by the two academic supervisors and the reliability of the constructs were determined after the data was gathered, entered, cleaned and ready for analysis.

Data Analysis Software

Besides using PLS Graph for data analysis, SPSS and STATA softwares were found appropriate at different stages for this study because of their ability to model latent variables under both normal and non-normal conditions. This study adopted the Partial Least Squares (PLS) statistical analysis method developed within PLS Graph (Version, 2.91.03.04) software. PLS-Graph is statistical technique software for generating covariance matrix based on structural equation modeling and it has been used by many researchers in technology acceptance and adoption studies (Moran, 2006; Venkatesh et al., 2003; Compeau & Higgins, 1995 & others). The software was used to determine the validity of various construct indicators.

4. DATA ANALYSIS

Data was collected from library end-users in three faculties (Education, Science & Social Sciences) across the eight universities. A total of a randomly selected 494 respondents were each given a print copy of the questionnaire. At the end of the field work (end of August 2007), 475 questionnaires had been filled and were collected by research assistants from respondents. Of the 475 collected questionnaires, 3.4% were from unwanted sources, e.g. university administrative staff, Faculty of Medicine etc. In addition, of the 475 returned questionnaires, 0.7% was partially filled and 2.5% had poorly designed responses, for examples one of the respondents ticked the rating scale of 3 throughout the questionnaire. All together, of the returned responses, 7% were categorized invalid and were not included in the study analysis. After entering the survey data, the database recorded 445 valid responses, indicating valid response rate of 90 percent, which means that a great proportion of the targeted groups provided valid responses. The unreturned questionnaires account for only 3% of the total administered questionnaires.

Demographic Characteristics

The data for valid responses across the eight universities is summarized in Table 2. Of the valid responses, 25.8% were from the faculty of education, 49.2% were affiliated to faculty of science, and 25% reported themselves as social scientists. Respondents were a well-educated class of people since 51% were under taking various undergraduate courses, 22% were postgraduate students and 27% were faculty-teaching staff.

As far as gender is concerned 37% respondents were female and 63% were male. Respondents were between 20 and 60 years of age. Further more, 57% had personal computers or laptops as compared to 43% who had no computers. However, 54% survey participants had their first encounter with a computer during the past five years and 46% had been using computers for six to ten years, a great indication of their acceptance and use of computers. While 51.5% respondents had very good electronic information searching skills, 49% had the required searching skills only to some extent.

Availability of ICTs in Libraries

Availability of the ICTs facilities is a key pre-condition towards learning, adopting and benefiting from electronic library services. Accordingly, 50% respondents across all universities indicated the availability of computers, World Wide Web, Local Area Network, Network Servers and CD-ROM Reader/Writer in their libraries. The availability of the above-mentioned facilities is a guiding measure to this study towards International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, October 2008.

evaluating and comparing different study groups of interest in terms of end user's perception of acceptance, usage and expected benefits from the e- library services. It should be noted that 51.7% and 46.9% of the respondents were not sure about the existence of bar code readers and microfilm readers respectively. Awareness can, therefore, be regarded as an impediment to acceptance and use of a new technology (Brown et. al. 2006) and is one of the measures to be evaluated in this study.

Electronic Library Services

Electronic library services offered by the universities as reported by most respondents include: Internet Web browsing services 85.1%, E-mail services 88.5%, full text journals articles 65.8%, Printing Services 65.5%, Photographic Services 84.1%, CD-ROM Services 55.1%, Library Website 55.9% and photocopying services 84.1%. Electronic library services where 50% respondents were not sure if they were offered include: E-Document Reserve Services 55.5%, Bar Coded Circulation Services 60.3%, Selective Dissemination of Information 53.3%, Digitization Services 50.8% and Microfilming 55.5%.

The Research Model Construction

Reliability of Constructs

The internal consistency of the variables within the construct was determined using Cronbach's alpha. Generally, according to Zhang, Li, & Sun (2006), Moran (2006) and Venkatesh et. al., (2003), the reliability coefficients greater or equal to 0.6 are considered acceptable in technology acceptance theory and practice. The reliability of individual construct was evaluated using STATA (version 9), one of the recommended scientific software for analysis of all kinds of data. Results from the analysis are displayed in Table 3.

Table 3:Scale Reliabilities of Constructs

Construct	No. of Questions	Reliability of the Group
Awareness of the e-library services	5	0.58
Performance Expectancy	5	0.77
Relevance of e-library services	6	0.62
Social Influence	4	0.67
Facilitating Conditions	7	0.60
Behavioural Intentions	5	0.83
Usage behaviour	8	0.81
Expected Benefits from using e-library services	6	0.79

The Research Model Validity

The study adopted conceptual model generated by PLS-Graph to measure direct effects and Generalized Linear model (which is the most common method used in information systems research for moderator analysis) was used to measure the direct and interaction effects between the constructs moderated by other variables. The research model under this study comprises of eight latent variables, which cannot be measured directly but can be measured through other variables called construct indicators. The latent variables used in this study are "Performance Expectancy, Relevancy and Social Influence" which determine behavioral intentions; two determinants of use behavior are "Behavioral Intentions and

Facilitating Conditions”; one determinant of expected benefits is “use behavior”, and moderator variables of gender, age, experience and awareness. UTAUT model included four moderator variables; gender, age, experience, and voluntariness. However, the research model has replaced voluntariness with awareness to suit the requirements of the context being studied. This is justified by the fact that the study focuses on e-library end users in underdeveloped culture and the issue of awareness is of great importance in both cases (Oshlyansky, 2007; Brown, et al. 2006; Anandarajan, et al. 2000 & 2002).

All indicators for respective constructs were evaluated for internal consistency (IC) and only indicators which had an IC greater than 0.7 were retained (Moran, 2006; Venkatesh et al., 2003; Chin et al. 2003) & others. Also generated by the PLS-Graph software were the weights, factor loadings, reflective indicators used to generate latent variables and the research conceptual model without moderators. PLS is supported in publications by Moran (2006; Jarvis et al 2003; Chin et al. 2003; Venkatesh et al., 2003) and others.

The factor loadings and R-squared were used to evaluate the complete model analysis and goodness of fit. The goodness of fit values (R-squared and Adjusted R-squared) measures how well the model parameter estimates are able to predict the model performance and also generate the sample covariance matrix. The technique works in such a way that the postulated model is taken as true and adjusts the parameter estimates while minimizing the covariance difference between population parameters and the sample estimates.

Reliability of Variables and Constructs

Reliability in technology acceptance model refers to the degree that the variables are stable and consistent with what they are intended to measure (Moran, 2006; Singleton & Straits, 2004). Cronbach’s alpha coefficient is commonly used to measure the internal consistency or reliability of the variables in question. The coefficient generally increases when the correlations between the items (inter-test correlation) increase. The alpha coefficient also depends on the size of the average inter-item covariance, while unidimensionality depends on the pattern of the inter-item covariance. With the exception of one construct (i.e. Awareness), all other constructs had internal consistency or reliability coefficients greater than 0.6, a level that is generally considered good and acceptable in theory and practice (Moran, 2006; Venkatesh et al., 2003; Fornell & Larcker 1981; and Compeau & Higgins, 1995).

Constructs Validity

Construct validity refers to the degree to which a test measures an intended hypothetical construct (Cronbach, 1951 and Straub et al, 2004). The two sub categories of construct validity are Convergent Validity and Discriminate Validity. The important thing to recognize is that two work together. If it can be demonstrated that there is evidence for both convergent and discriminate validity, then by definition there would be evidence for construct validity. One alone is not sufficient for establishing construct validity. Besides, validity means that a measurement that we take represents what we think it should.

Convergent validity is the degree to which similar constructs are related; whereas discriminant validity is the degree to which different constructs are different from each other. Construct validity was evaluated by performing the principal component analysis and factor analysis as discussed by (Venkatesh et al. 2003 and Straub et al. 1989 & 2004). To determine convergent validity, the main researcher together with the academic supervisors reviewed the construct items. Moreover, the study instrument was pre-tested to ascertain the information flow and identify any missing gaps as described by (Straub et al 2004). The survey indicators were based on statements from (Moran 2006; Anderson & Schwager 2004 and Venkatesh et al. 2003).

The dimensionality of the forty-one indicators which made up the seven constructs of the survey instruments for the model were subjected to factor analysis resulting into removal of fourteen items. Each construct indicator was evaluated for internal consistency factor loading (ICFL). Any indicator with ICFL less than 0.7 (Compeau & Higgins, 1995b) was dropped and the model was re-estimated. In PLS Graph, the indicators for each construct are evaluated for their internal consistency within the model, if any ICFLs are less than 0.7, they are removed from the model and the ICFLs are recalculated. If there are ICFLs less than 0.7, the lowest ICFL is removed and then the model is recalculated. The process is continued until no ICFL for any construct indicator is less than 0.7 (Gefan & Straub, 2005 and Compeau & Higgins, 1995). The International Journal of Computing and ICT Research, Special Issue Vol. 1, No. 1, October 2008.

iterative process was done for all constructs including the moderator latent variable (awareness). During the process of estimation, the loading coefficients get lower and others increase indicating the convergence and divergence of the different indicators used to measure the latent constructs. The retained indicators were then weighted and the weights were used to determine the latent variables. Considering the model, the retained constructs together with the indicators are: performance expectancy (PE) with two indicators retained, relevance (RE) with three indicators, social influence (SO) with four indicators, facilitating conditions (FO) with five indicators, behavioral intentions (BI) with four indicators, use behavior (UB) with six indicators, and expected benefits with three indicators respectively. Awareness (AW) as a moderator latent variable has two indicators.

Under the study, the discriminate validity of the model constructs was evaluated. The criteria for measuring discriminate validity are to measure the average shared variance (AVC) between the constructs and their indicators (Maron, 2006; Venkatesh et al., 2003 and Fornell & Larcker, 1981). Discriminate validity is adequate when constructs have the shared variance greater than 0.5. This implies that any single construct is different from the other constructs in the model, and also indicates that at least fifty percent of the measurement variance was captured by the construct (Maron, 2006 and Chin, 1998). The discriminate validity is further confirmed if the diagonal elements are significantly higher than the off diagonal values in the corresponding rows and columns, and the diagonal elements are the square root of the shared variance between the constructs and their indicators. The average shared variances and the correlation coefficients of latent variables are summarized in Table 4. Since all constructs have average shared variances (AVC) greater than 0.5 and the diagonal elements (in bold) greater than correlation values in the respective corresponding rows or columns, the instrument therefore demonstrates acceptance levels of efficiency and truthfulness (validity and reliability) and successful discriminate validity (Moran, 2006 and Chin 1998).

5. TESTING THE HYPOTHESES

The hypotheses analysis was based on the research model path results in Figure 3. Based on the analysis, the study was able to respond to the set research questions and hypotheses.

H_{a1}: University end-users accept and use electronic library services.

Results from this study support this statement in that at the eight universities studied, end-users have relatively high inclination to behavioral intention to accept and use electronic library services at 30 percent, followed by relatively significantly lower usage behaviour of the technology services at 9 percent and they moderately expect the benefits at 18 percent giving the overall prediction of 57 percent as presented by the PLS-Graph analysis of the conceptual model in Figure 3. Moreover, all the dependent constructs; behavioral intentions use behavior and expected benefits indicate a positive inclination towards the acceptance and usage of electronic library services. The path coefficients for all the constructs except performance expectancy indicate that end-users in this study had a positive inclination towards acceptance and usage of electronic library services. The above observations support the alternative hypothesis that University end-users accept and use electronic library services.

H_{a2}: The UTAUT model constructs will demonstrate an effect on users' acceptance of electronic library services.

This hypothesis is specific and is partially supported by the positive path coefficients between all the model constructs towards the dependent constructs; behavioural intent, usage behaviour and expected benefits with the exception of performance expectancy which demonstrates a negative effect on behavioural intent to use electronic library services. The support of the hypothesis is partial because performance expectancy is a component of the modified model. Social influence and performance expectancy constructs from the modified UTAUT model positively and negatively contribute 42 percent and 01 percent towards behavioural intent. The researcher included relevance construct, which partially contributes 23 percent towards behavioural intent. It is also interesting to note that the influence from the social setting of the end-users has the higher (nearly double) contribution to behavioral intent at 42 percent as compared to a combination of relevance and performance expectancy at 24 percent. This finding is not different from Anandarajan, et al. (2000), Brown, (2006) and Oshlyansky, Cairns, & Thimbleby, (2007) whose investigations were carried out in almost similar cultures. This is quite different from Venkatesh et al. (2003), whose findings show performance expectancy construct one of the strongest contribution to behaviour intention to use a technology.

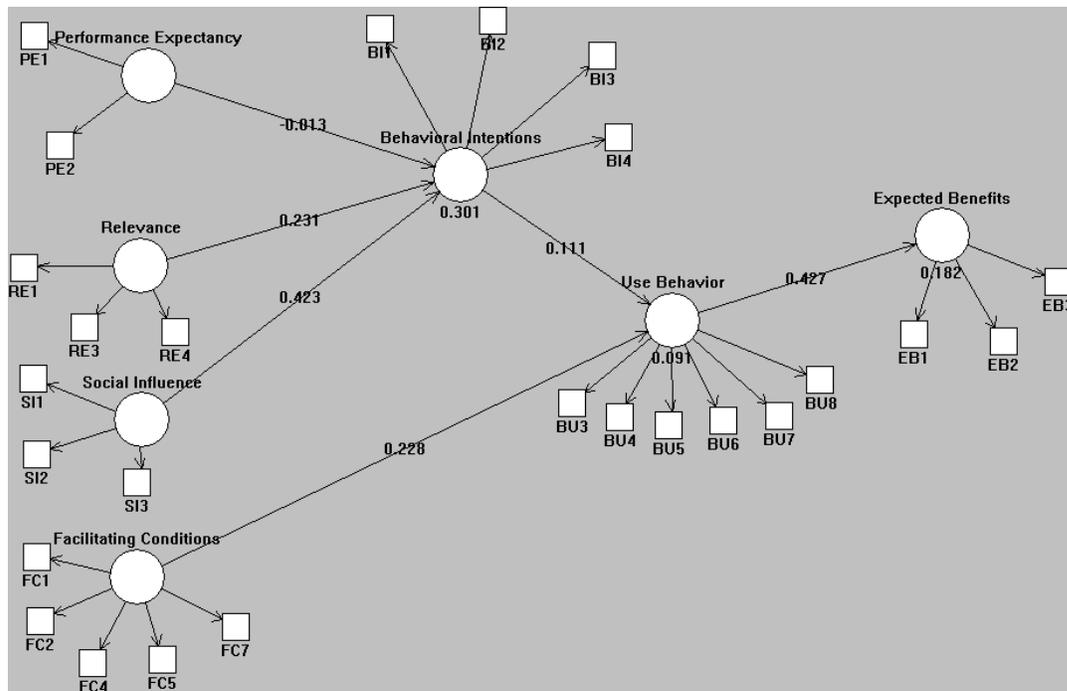


Figure 3. The PLS-Graph Structural Model

H_{a3}: The research model constructs will account for a significant percentage of the variance on end-users' intention to accept and use electronic library services.

The model supports this hypothesis as it is constructed from the study which supports 30 percent of the behavioral intention to accept and use electronic library services, followed by 0.09 percent of usage behavior and 18 percent of the expected benefits to use electronic resources. Overall, the model predicts 57 percent of the intention to accept and use electronic library services.

H_{a4}: Relevancy does demonstrate an effect on behavioral intention to use e-library services.

This hypothesis is supported by the 23 percent contribution to behavioral intentions by the relevance construct. This is as significant as the social influence construct, which has the highest contribution 42 percent towards behavioural intent in this study. The researcher to this study included this construct for the purposes of establishing end-users' opinion on how relevant electronic resources are towards their learning, teaching and research.

H_{a5}: Relevancy moderated by awareness does demonstrate an effect on behavioral intention to use electronic e-library services.

This hypothesis is not supported by the data because the effect of relevancy construct being moderated by the awareness on behavioural intent is positive (beta coefficient = 0.02) but insignificant ($p > 0.1$). Under the GLM, the relations of the different SOUTAUT factors were analyzed. Regression was made based on the structural form of the model which describes the nature of the variables as fixed factors, covariates and the possible measures of interaction effects. The GLM results are used to measure and compare the direct effects of both fixed factors and covariates, and effects due to interactions.

H_{a6}: Usage behaviour will account for a significant percentage of variation on perceived benefits.

Hypothesis six is supported by the path coefficient which acts as correlation between usage behaviour and expected benefits. Usage behaviour positively contributes 43 percent towards expected benefits. It should be observed that this contribution is the highest in the overall study model setting. It is also worth noting that the researcher to this study included the expected benefits construct in. The purpose was to ascertain

any possible benefits the end-users expected as a result of accepting and using the electronic library services.

Significance of the Study Model Dependent Constructs

The significance measure was used to determine the level of inclination the dependent constructs have towards the acceptance and usage of electronic library services. This was done using the t-ratio test statistic on the dependent constructs (behavioral intentions use behaviour and expected benefits) and the results are summarized in Table 5.

It can be observed from the results in Table 6, that all the dependent constructs have a significant positive inclination to end-users' acceptance and usage of electronic library services. The significance of inclination is determined by the probability values of the t-test statistic (less than 1 percent and 0.1 percent) and the contribution are determined by the values of squared multiple variances, (R^2).

6. CONCLUSION

A model for studying levels of end-users' acceptance and use of ICT services has been developed. The constructed research model, a modification of UTAUT eliminated "effort expectancy" and "volunteriness" variables found irrelevant in e-library context and replaced the independent variable with "relevance" and the moderator variable with "awareness" which were found appropriate to this study context. An associated instrument has been developed by specializing the items to e-library services context, taking into account the changed variables. Each of the research model constructs was analyzed and results compared with studies in other contexts. The study findings shade light on levels of end-users' accept and use of hybrid library services in universities especially those in less developed countries. The study also confirms the efficiency and robustness of the UTAUT model to determine acceptance and use of a technology.

6. ACKNOWLEDGEMENT

The authors are greatly indebted to the following individuals for the various support they provided during the course of carrying out the research and the writing of this paper: Prof. Janet Aisabett, Dr. P. H. Schwager, Mr. J. Wokadala, the cross-sectional survey participants and our families; to Dr. W. W. Chin of University of Houston, the developer of PLS-Graph software, who provided it free of charge and. Last but not the least, to i@mak.com the sponsors of this research for the generous financial support

7. REFERENCES

- ALAN, F. (1996). Dhaka University Library Automation (DULA): An Appraisal Report and Proposals for Action. Dhaka. University of Dhaka.
- ANANDARAJAN, M., IGBARIA, M. & ANAKWE, U. P. (2000). Technology Acceptance in the Banking Industry: A prospective from A less developed coentry. Information Technology & People. Vol 13, No 4 pp 298-312.
- ANANDARAJAN, M., M. IGBARIA, M. & ANAKWE, U. P.(2000). IT Acceptance ùn a Less-Develo`ed Countri: A motivational Factor Perspective. International Journal of Information Managemdnt. Vol "2 pp 47-65.
- ANDERSON\$ J. E. & SCHWAGER, P. H. 2004). SME Adoption of Wireless LAN Technglogy: Applying the UTAUT Mgdel. In Proceedings of the 7thConferefce of the Southern Association for Information Systems. Online At: <http://sais.aisnet.org/sais2004/Anderson%20&%20Schwager.pdf>. Retrieved on 20 Sept. 2006.

- BARUCHSON-ARBIB S. AND F. SHOR (2002). The Use of Electronic Information Sources by Israeli College Students. *The Journal of Academic Librarianship*. 28 (4): 255-257.
- BAR-ILAN, J., B. C. PERITZ, Y. WOLMAN. (2003). A Survey on the use of electronic databases and electronic journals accessed through the web by the academic staff of Israeli universities. *Journal of Academic Librarianship*. 29(6):346-361.
- BEVIS, D. M. & GRAHAM, J. B. (2003). The Evolution of an Integrated Electronic Journal Collection, *Journal of Academic Librarianship*. 29(2): 115- 119.
- BORGMAN, C. L. (2000). *From Gutenberg to the Global Information Infrastructure: Access to Information in the Networked World*. Cambridge, MA: The MIT Press.
- BROWN I.\$ PIJK K. D.\$ PATEL K., TWUM- AMPOFO, Y., & BELLE, J> P. 82006). T-Sommercu: an Investigation of Non-Adoption in South Africa.
- BUTTENFIELD, B. (1999). Usability Evaluation of Digital Libraries. In *Digital Libraries: Philosophies, Technical Design Considerations, and Example Scenarios*. Ed. D. Stern. New York: Haworth Press.
- CARLSSON, C., J. CARLSSON, K. HYVONEN, J. PUHAKAINEN, AND P. WALDEN, (2006) Adoption of Mobile Device/Services – Searching for Answers with the UTAUT. In *Proceeding of the 39th Hawaii International Conference on System Science*. S. pp 1-10
- CHIN, W. W& (1998). “The Partial Least Squares Approach for Structural Equation Modeling” In *Modern Methods Methods for Business Research*, George A. Marcoulides. Ed. Lawrence Erlbaum Associates, NY. 295-333
- CHIN, W. W., MARCOLIN, B. L. & NEWSTED, P. R.(2003). A Partial Least Squares Latent Variable Modeling Approach for Measuring Interaction Effects: Results from a Monte Carlo Simulation Study and an Electronic-Mail Emotion/Adoption. *Study Information Systems Research*, 14 (2): 189-217
- CODY-ALLEN, E. & KISHORE, R. (2006). An Extension of the UTAUT Model with E-Quality, Trust & Satisfaction Constructs. Online at: Retrieved on 28 Sept. 2006.
- COMPEAU, D. R. & HIGGINS, C. A. (1995a). Application of Social Cognitive Theory to Training for Computer Skills. *Information Systems Research*, 6 (2): 118-143.
- COMPEAU, D. R. AND HIGGINS, C. A. (1995b). Computer Self-Efficacy: Development of a Measure and Initial Test. *MIS Quarterly*, 19, 189-211.
- CRAWFORD, W. AND GORMAN, M. (1995). *Future Libraries: Dreams, Madness & Reality*. Chicago, American Library Association.
- CRONBACH, L. (1951). Coefficient Alpha and the Internal Structure of tests. *Psychometrika*, 16, 297-334.
- DAVIS, F.D. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly* 13 (3): 319–340.
- DAVIS, F. D., BAGOZZI, R. P. AND WARSHAW, P.R.(1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science*. 35(8): 982-1002.
- ENGBRETSSEN, T. (2005). *Acceptance of Information Technology by Health Research Projects in Low-Income Countries: Intention to Use and Acceptance of Using EpiHandy (IUAUE)*. Master's Thesis. University of Bergen, Norway.

- FISHBEIN, M. & AJZEN, I. (1975). *Belief, Attitude, Intention and Behavior. An Introduction to Theory and Research.* Addison-Wesley, Reading, MA.
- FISHER, A., LAING, J. & STOECKEL, J. (1983). Guidelines for overcoming design problems in family planning operations research. *Medline*. 16 (2): 100-105
- FORNELL, C., AND LARCKER, D. F. (1981). Evaluating Structural Equation Models With Unobservable Variables and Measurement Error. *Algebra and Statistics," Journal of Marketing Research*, Vol. 1, No. 3 pp 382-388.
- GARFIELD, M. J. (2005). Acceptance of Ubiquitous Computing. *Information Systems Management*. Vol. 22 No. 4 pp 424-431
- GEFEEJ, D. (AND STRAEB, D. (2005). A Practical Guide to Factorial Validity Using PDS- Graph: Tutorial & Annotated Example. *Communications of the Association for Information Systems*. Vol. 14 pp 91-109.
- HEERIK, M., B. KROSE, B. WIELINGA AND V. EVERS (2006). Human-Robot User Studies In Eldercare: Lessons Learned. Institute for Information Engineering, University of Amsterdam, Oudweg, The Netherlands. Online document at: <http://www.digital-life.org/jos/index.php?option=com>. Retrieved on 28 Sept. 2006.
- HILL, L. R., DOLIN, J. FREW, R. B. KEMP, M. LARSGAARD, D. R. MONTELLO, R. M. & CIMPSON, J. (1996). User Evaluation: Summary of the methodologies and results for the Alexandria Digital Library, University of California at Santa Barbara. *Proceedings of the ASIS Annual Meeting*. Vol. 34 pp 225-243.
- JARVIR, C. B., MACKENZIE, S. B., & O'DONKOFF, P. M. (2003). A Critical Review of Constructed Indicators and Measurements and Measurement Model Misspecification in Marketing and Consumer Research. *Journal of Consumer Research*, 30, 199-218
- JUNG, J. K. (1997). *Measuring User Success in the Digital Library Environment*. Ph. D. Dissertation, Drexel Univ.
- JIONDO, ELIZABETH, (1997). The Challenge of CD-ROM and Document Delivery Services at the University of Dar es Salaam Library, Tanzania. *African Journal of Library, Archives and Information Science*, Vol. 7 No. 1 pp 19 – 31.
- KWAK, B. H., JUN, WO—DCHUN, GRUENWOLD, L. AND HONG, SUK-KI (2002). A Study on The Evaluation Model For University Libraries In Digital Environments. In: *Research and Advances Technology for Digital Technology: Proceedings of 6th European Conference, ECDL*. Rome, Italy. Sept. 16 – 18.
- LAGIER, J. (2002). *Measuring Usage and Usability of Online Databases at Harnell College: An Evaluation of Selected Electronic Resources*. Ph. D. Dissertation, Nova Southeastern University. Online document available at: <http://www.harnell.edu/faculty/jlagier/dissertation.pdf>. Retrieved on 28 Sept. 2006
- LEE, Y., K.A. KOZAR, AND K.R.T. LARSEN, (2003). The Technology Acceptance Model: Past, Present, and Future. *Communications of the Association for Information Systems*. 12, 752-780
- LEEDY, P. (1993). *Practical Research, Planning and Design*: Columbus, Ohio, Merrill. pp 17 - 42.
- LILLY, E.B. (2001). Creating accessible Web sites: an introduction. *The Electronic Library*. 19, 6 pp 397 – 405.
- LOUHO, R., M. KALLIOJA AND P. OITTINEN. (2006). Factors Affecting the Use of Hybrid Media Applications. *Graphic Arts in Finland*. 35:3.

- MARCHONINI, G. (2000). Evaluating Digital Libraries: A Longitudinal and Multifaceted View. *LibraryTrends*. Vol. 49 No. 2 pp 303-333
- MARTEY, A. (2004). ICT in Distance Education in Ghana. *Library High Tech News*. 5, 16 – 18.
- MORAN, M. J. (2006). College Student's Acceptance of Tablet PCs and Application of the Unified Theory of Acceptance Technology (UTAUT) Model. Ph. D. Thesis. Papella University, Mennnesota, USA. Online at: http://www.homepages.dsu.edu/moranm/Research/Mark-Moran_proposal_for_research_v3.51-with_IRB.doc. Retrieved on 26 Sept. 2006.
- NICHOLSON, S. (2004). A Conceptual Framework for the Holistic Measurement and Cumulative Evaluation of Library Services. *Journal of Documentation*. 60: 164-182. Also an Online Document. Retrieved on 15 August 2006.
- OSHLYANSKY, L., CAIRNS, P. & THIMBLEBY, H. (2007). Validating the Unified Theory of Acceptance and Use of Technology (UTAUT) tool cross- culturally. A Web document. Retrieved on 15 December 2007 at: <http://www.users.cs.york.ac.uk/~pcairns/papers/oshlyansky-Hc107.pfg>
- PU-LI, J. AND R. KISHORE, (2006). How Robust is the UTAUT Instrument? A Euldigroup Invariance Analysis in the Cmntext of Acceptance and Use of Online Community Wåblog Systems. An Online Document at2 <http://portal.acK.org/poplogin.cfm?dl>. Retrieved on 28 Sept. 2006,
- RANGAFATHAN, S. R. 1931. The Five Laws of Library Science. Madras Library Association (Madras, India) and Edward Goldston (London, UK)
- ROSENBERG, D. (1998). IT and universiti libraries in Africa. *Internet Research* Electronic Networking Applibations and Policy*, 8 (1), 5 – 13.
- ROSENBERG, D. (2005). Towards the digital library: Findings of an investigation to establish the current status of status of university libraries in Africa. Retraeved on 21 May "005 from: <http://www.inasp.info>.
- SARACEVIC, T. (2000). Digital Library Evaluation: Toward an Evaluation of Concept. *Library Trelds*. Vol* 49 No. 2 pp 350-369
- SCHAMBER, L. 199\$). Relevance of Information Behavior. *Anlual Beview of Information Science and Technology* Vol. 29 pp 3-08.
- SINGLETON, L. & STRAITS, B. C. (2004). *Approaches to Social Research* (4th Ed.). Oxford, England: Oxford University Prass.
- STRAUB, D., BOUDREAU, M. C., & GEFEN, D. (2004). Validation Guidelines for AS Positivist Research. *Communicatigns /f the Association for Information Rystems*, Vol 13 pp 380-347.
- STRAUB\$ D., (1989). Validating Instruments in MIS Research. *MIS Quarterly*& 13(12), 146-247.
- TAYLOR, R. S. (1986). *Value%added processes in inf rmatyon systems*: Norwo t, NJ: Ablex.
- VENKATESH, V.,(2000). Determinants of Perceived Ease of Use: Antegratijg Perceived Behavioral Control, Computer Computer Anxiety and Enjoyment into the Dechnology Acceptance Model. *Information Systems Research* Vol. 11 No. 4 pp #42-365.
- VVENKATESH, V., MORRIS, M. G., DAVIS, G. B., & DAVIS, F. D. (2003). User Acceptance of Information Technology: Toward a Ufified Vieg. *MIS Q5arterly*, 27(3), 425-478.

- VINITHA, K., KANTHIMATHI, S. & DEVI, K. THARANI (2006). Impact of Information & Communication Technology on Library and its Services. In Proceedings of DRTC –ICT Conference on Digital Learning Environment. pp 11 – 13 January.
- VINITHA, K., KANTHIMATHI, S. & DEVI, K. THARANI (2006). Impact of Information & Communication Technology on Library and its Services. In Proceedings of DRTC –ICT Conference on Digital Learning Environment. pp 11 – 13 January.
- YANG, H. I. AND YANG, H. L. (2005). The Role of Personality Traits The UTAUT Model Under Online Stocking. Contemporary Management Research, Vol. 1. Also an online document.
- ZHANG, P., LI AND SUN, H. (2006). Affective Quality and Cognitive Absorbtion. Extending Technology Acceptance Research. In Proceedings International Conference on System Sciences. Kauai, Hawaii.