Perceived Attributes of Diffusion of Innovation Theory as a Theoretical Framework for understanding the Non-Use of Digital Library Services

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Abstract

Rogers's diffusion of innovation theory is one theoretical approach to understand how members of a social system can adopt an innovation. Certain attributes of the innovation itself may facilitate its adoption. This paper highlights the necessity of designing a Digital Library Service (DLS) in conformity with the attributes of Innovation. These attributes are: relative advantage, compatibility, complexity, trialability and observability. It further discussed previous studies that have used the theory of perceived attribute of innovation to conduct research on acceptance and rejection of an innovation in different fields and concluded that Digital Library Service designers who adopts the theory of the perceived attributes of innovation will understand why there is low or non-use of these services and help them in designing DLS that can easily be adopted by potential users.

Introduction

University libraries in Nigeria are losing huge sum of money due to the non-use of innovative services (e.g. Digital Library Services) (MCILP, University of Illinois, 2004; McCreadie, 2013). For innovative services to diffuse, adopted, and used it must conform to the attributes of innovation theory (Rogers, 2003). The critical role of the attributes of innovation theory in the acceptance and use of innovation has been documented (Almobarraz, 2007; Eljiz et al., 2010; Stachewicz, 2011; Neo and Calvert, 2012; Ntemana and Olatokun, 2012). Many successful innovative services in health, agriculture, and education are designed according to the attributes of innovation theory. This paper argued that to achieve enhanced acceptance and use of Digital Library Services in Nigerian Universities, the services must be considered as an innovation and the design of the services must be done according to Roger's theory of perceived attributes. According to Parisot (1995) and Medlin (2001), Rogers's diffusion of innovation is the most appropriate for investigating the adoption of technology in higher education environment. This paper reviewed literature on attributes of innovation theory and discussed the potentials of the theory for scholars and practitioners who are interested in understanding the non-use of Digital Library Services. The paper began with a discussion of Rogers's Diffusion of Innovation Theory,

Diffusion of Innovation Theory

Diffusion of innovation is a theory that have been widely tested and implemented. It has been used to explain individuals and social systems adoption of new ideas, inventions and practices. This is why a variety of disciplines has used the model as a framework. The theory states that innovation is communicated through certain channels over time among the members of a social system. This definition consists of four main elements namely: innovation, communication channel, time and social system.

Rogers (2003) defines innovation as any idea, object or practice that is perceived as new emergence. An innovation may have been invented a long time ago, but if a person perceives it as new, then it may still be an innovation for them.

Communication channels are medium used to exchange information between community members. In this context, Information regarding an innovation needs to be disseminated in order to introduce the innovation. Rogers (2003) identifies mass media and interpersonal communication as the two communication channels that are used to communicate an innovation from the source to the receiver.

Time defines both the pace at which progress occurs and the positions individuals occupy amid the evolution of such progress (Inman, 2000). Time involved in diffusion consists of (1) innovation diffusion process (time involved between the introduction of new idea, and the decision to accept/reject the new idea), (2) individual innovativeness (the degree to, and rate at which individual in a social system catch on to a new idea), and (3) an innovation's rate of adoption (the relative speed with which a new idea is adopted and is measured in terms of the number of members in a social system that adopt the new idea at a given time).

Social system, the fourth element, is a set of interrelated units such as individuals, groups, organizations, subsystems that are engaged in joint problem solving to accomplish a common goal. Rogers claimed that the nature of the social system affects individuals' innovativeness which is the main criterion for categorizing adopters.

According to Rogers (1995), the above four major elements of the diffusion of innovation theory are components from other theories about the innovation process. Rogers combine these elements so as to create a mid-range theory of diffusion. By synthesizing all the most significant findings related to diffusion from the

variety of disciplines, Rogers present a unified theory in his 1995 edition of the book of diffusion, he presents four of the most widely used theories of diffusion namely; innovation decision process theory; individual innovativeness theory; rate of adoption theory and perceived attributes theory.

Perceived attribute of innovation theory
Rogers's theory of perceived attributes of innovation defines five characteristics of an innovation which have been shown to affect the rate of its adoption in a society (Cullen, 2001). Rogers (2003) mentioned that the rate of adoption is partially influenced by perceived attributes namely: relative advantage, compatibility, complexity, trialabilty, and observabilty. Each of the elements of this theory is described as follows:
Relative advantage: the degree to which the innovation is perceived to be superior to current practice. In other words, the degree to which an innovation is perceived as better than the idea it supersedes by a particular group of users. According to Robinson (2009), it is measured in terms that matters to those users, like economic advantage, social prestige, convenience or satisfaction. The greater the perceived relative advantage, the more rapid its rate of adoption.
Compatibility: the degree to which the innovation is perceived to be consistent with socio-cultural values, previous ideas and /or perceived needs. An idea/innovation that is incompatible with a potential user's values, norms, or practices will not be adopted as rapidly as an innovation that is compatible.
Complexity: The degree to which an innovation is perceived as difficult to use and understand. It is hypothesized to be negatively related to the rate of adoption of an innovation (Rogers, 1995). Innovations that are simpler to understand and use is adopted more rapidly than innovations that require the adopter to develop new skills and understanding.
Trialability: The degree to which the innovation can be experienced on a limited basis. It is the fourth factor in promoting the adoptability of an innovation by providing the opportunity for a potential user to experience using the innovation itself. The user gets the chance to try a technology without having to fully commit to purchase or adopt it. During this period, re invention may occur. That is, the innovation may be changed or modified by the potential adopter.
Observability: The degree to which the results of an innovation are visible to potential adopters. The easier it is for individual to see the results of an innovation, the more likely they are to adopt it. Visible results lower uncertainty and also stimulate peer discussion of a new idea, as friends and neighbors of an adopter often request information about it.
According to Rogers, the above characteristics determine between 49 and 87 percent of the variation in the adoption of any new product. These characteristics have also been used by researchers in different fields and have been discovered to predict the adoption of an innovation among the affected social system. The following section reviews previous studies on the attribute of innovation in different disciplines.

Previous studies that adopted the attributes of innovation theory
Several scholars from variety of disciplines have used the theory of perceived attributes to investigate and explore why innovations are not adopted (Almobarraz, 2007; Eljiz et al., 2010; Stachewicz, 2011; Ntemana and Olatokun, 2012). This section discussed some of the previous studies that used Theory of Perceived Attributes of Innovation to explain how potential adopters judge an innovation based on their perceptions in regard to the characteristics of innovation.
A study by Minishi- Majanja and Kiplang'at, (2004) investigated the diffusion of ICTs in the communication of agricultural information among agricultural researchers and extension workers in Kenya. The study sought to map and audits ICT in the public agricultural sector in Kenya, establish their nature, types, distribution and extent of use in communication of agricultural information. It also assessed the demand and use of ICTs by agricultural researchers and extension workers in their knowledge acquisition and dissemination process. It examined government and institutional policies and their effect on diffusion of ICTs in the agricultural sector. It investigated funding, maintenance and sustainability of ICTs in the agricultural sector and established the knowledge gaps, constraints and challenges encountered in harnessing ICTs in agricultural sector. Using a quantitative approach, the study found that the relative advantage was low among the respondents and in particular the extension workers because of non-availability of ICTs to them thereby hindering them from acquiring necessary skills to use ICT. The study also found that the use of ICTs was affected by behavioral attitudes, social and economic factors of the respondents. The agricultural researcher also found ICT complex to use because they lack computer and internet literacy skills. The study also found out that information literacy programmes were better coordinated in the institute where such ICTs were tried often. Lastly, it was discovered that observation and peer discussions had facilitated the adoption and use of ICTs by agricultural researchers in Kenya.
In a study by Almobarraz (2007) on perceived attributes of diffusion of innovation theory as predictors of internet adoption among the faculty members of Imam Mohammed Bi Saud University, the following

research questions were raised: To what extent do faculty members at IMSU adopt the Internet for academic purposes?, Are there any significant differences in demographic characteristics among Internet adopters and non-adopters in IMSU?, How does the university administration impact faculty member's desire to adopt the Internet?, Does all the attributes of innovation (relative advantage, compatibility, complexity, trialability, observability as perceived by faculty members predict their Internet adoption? Using a quantitative research method, the study revealed 54.7% of IMSU faculty members used the Internet for research and academic activities twice a month or less, indicating a low Internet adoption rate. Statistically, significant differences were noted among adopters and non-adopters relative to income level and English proficiency. Multiple regression analysis showed that all attributes of innovation individually predicted Internet adoption. The combination of all attributes indicated the model could predict Internet adoption among faculty.

Research carried out by Eljiz et al. (2010) on the Individual Factors Influencing the Diffusion of Process Innovations from Manufacturing to Health Services Settings was based on Greenhalgh et al. (2004) who identified eleven factors that influence the spread and sustainability of innovation in health settings the factors were relative advantage, compatibility, complexity, trialabilty, and observability, potential for re-invention, fuzzy boundaries, minimal risk, relevance, the nature of knowledge required and support. The aim of the study was to determine if these factors help to understand DOI from manufacturing to health setting. A qualitative research method was used. Semi- structured interviews were conducted with eight hospital personnel who helped identify and implement strategies to improve patient flow within the imaging department. The general finding was that computer simulation eased the implementation of process because it: helped to assess relative advantage, presented information in a manner that corresponded with individual preferences, was simple and user friendly allowed for experimentation, was visual, could be adapted to the department, could accommodate the dynamic nature of departmental processes, offered minimal risk, was relevant to the research participant and offered information that could be transferred from one context to another. In essence, the major findings from Eljiz et al (2010) was that observabitity, trialability combined with low risk appeared to be most influential for individual DOI decisions for the hospital and innovation examined.

A research by Stachewicz (2011) on measuring the perceived attribute of Innovation: a study of capacitive switch Technology in Industrially Designed User Interface Controls. The purpose of the research was to test the applicability of Rogers' theory of innovation diffusion as it relates to measuring the perceived attributes of innovations of capacity switch technology in user interface controls. Quantitative research method was adopted by using a Likert scale to collect data on the following perceived attributes of innovation- relative advantage, compatibility, trialability, demonstrability, visibility, ease of use, image, voluntariness, perceived risk, and perceived resources as outlined by Rogers (1995), Moore and Benbasat (1991), and Dupagne and Driscoll (2005). The study found out that the results for relative advantage, compatibility, ease of use, image, and perceived risk were statistically significant enough to indicate that a consumer is willing to accept capacitive switch innovation in industrially designed user interface controls. The results indicated that for voluntariness, trialability, demonstrability, visibility, and perceived resources did not indicate the same. However, all of the attributes of relative advantage, compatibility, trialability, demonstrability, visibility, ease of use, image, voluntariness, perceived risk, and perceived resources combined would also end up being statistically significant enough to indicate that a consumer is willing to accept capacitive switch innovation.

Using a quantitative research method, Ntemana and Olatokun (2012) examined the influence of the five attributes of diffusion innovation theory on lecturers' use of ICTs. The hypotheses tested was that the five attributes of innovation- relative advantage, compatibility, complexity, trialability, and obserabilty of using ICT will not positively affect the lectures attitude towards using the technology: A structured questionnaire was used to collect data using multiple regressions to test the five hypotheses formulated. The findings revealed that relative advantage, complexity and observability were found to have a positive influence on the attitude of lecturers towards using ICTs with observability having the highest influence.

The study by Neo and Calvert (2012) on face book and the diffusion of innovation in New Zealand public libraries was based on how New Zealand public libraries assessed and evaluate facebook and the motivating factors that cause New Zealand public libraries to adopt or not to adopt facebook. Using a qualitative method, interview was used to gather data, the study found out that all the five characteristics were important in explaining the decision to adopt face book. Specifically, it found that relative advantage, compatibility and complexity were the most important factors to explain adoption because they have important implications for the rate of adoption as well as being motivating factors in the adoption/non-adoption of Facebook. Meanwhile, trialability and observability were found to be less important factors in the decision to adopt Facebook.

Despite the fact that many researchers have carried out investigation in different fields and have agreed that the attributes of innovation are associated with innovation adoption, there is little research to examine the adoption of theory of attribute of innovation in the design of digital library services. The last section of this paper discusses the attributes of innovation and its potential benefits for the design of Digital Library Services.

Perceived Attributes of Innovation Theory and Digital Library Services (DLS)

A digital library also referred to as electronic library or digital repository is a focused collection of digital objects that can include text, visual material, audio material, video material, stored as electronic media formats (as opposed to print, micro form, or other media), along with means for organizing, storing, and retrieving the files and media contained in the library collection. Digital libraries can vary immensely in size and scope, and can be maintained by individuals, organizations, or affiliated with established physical library buildings or institutions, or with academic institutions. The electronic content may be stored locally, or accessed remotely via computer networks. A digital library is a type of Information Retrieval System. Digital Library Services (DSL) provides a kind of service that does not require the user to be physically present and may be continents away. Examples of these services are: library website, online library catalog, on-line reference materials, online databases, electronic magazine and journals, electronic books, online librarian question services e.t.c.

Studies have found out that there is generally low or nonuse of DLS, most reasons being attributed to lack of awareness (Osinulu, 1998; Torina & Vakkari, 2004; OCLC, 2005; Brown and Swan, 2007; Harle, 2010; Ifijeh 2011, Creaser and Spezi, 2012; McCreadie, 2013)) and design factor (Lesk, 2005; Harle, 2010). However several studies as discussed in the previous section has identified the process of enhancing the acceptance of products and services (Almobarraz, 2007; Eljiz et al., 2010; Stachewicz, 2011; Neo and Calvert, 2012; Ntemana and Olatokun, 2012). They have advocated that, for innovations to be adopted and used, it must conform to the attribute of innovation theory (Rogers, 2003), hence the need to consider DLS as an innovation. The five attributes of innovation can help in project evaluations and identify weaknesses to be addressed when improving products or services. As observed by Bussey, Dormody and Vanleeuwen, (2000) in Ntemana and Olatokun (2012), the theory of perceived attribute could be a valuable tool for librarians and information professionals working to increase the utilization of product and services. Therefore, Librarians and Information professionals should consider the need of it potential user in designing and promoting DLS using the construct of attributes of innovation. The five constructs are discussed below in the context of the present study:

The attribute of relative advantage symbolize the necessity of system designer to design a DLS that will be superior in benefit in terms of increased value, low cost, low risk e.t.c. According to Cain and Mittman (2002), the decision to adopt a technology is influenced by two factors; (1) the ability of a potential adopter to judge whether the benefits of using the innovation will outweigh the risks of using it and (2) whether the innovation improves upon the existing technology. The more benefit people foresee from adopting the innovation relative to what they presently use, the more rapidly it will diffuse. Likewise, individuals are more likely to adopt an innovation if they think it can help them (Berwick, 2003). DLS librarians interested in designing new services or evaluating existing one can apply the construct of relative advantage to ask the following question: what advantage does the proposed DLS have over the existing service in terms of cost, risk, convenience, satisfaction e,t.c. if this question is answered, it will help the DLS designer. Relative advantage is therefore a factor that DLS librarians should consider in designing a DLS. Another characteristic in the attribute of innovation is the compatibility attribute.

The compatibility of the innovation with user's life and practice is very important. An adopted technology should be integrated into one's life and therefore must mesh well (University of Washington, n.d). If an innovation is incompatible with an individual's needs, then uncertainty will increase and rate of adoption of the innovation will decrease (Sahin, 2006). According to Sherry (1997) and McKenzie (2001), lack of compatibility in Information Technology (IT) with individual needs may negatively affect the individual's IT use. To increase the probability of adoption of DLS, it must address an issue that the institution, librarians, information professionals, potential users or others perceive to be a challenge. For example, there must be a collective agreement that there is need for a DLS that if when designed will not be in contrast with the organizational goals and objectives of the institution and will not totally change the users existing values. Hence, DLS librarian applying the construct of compatibility can ask the following question: will the proposed service be consistent with the users existing values, past experiences and their needs? If this question is answered, it will help DSL designer to develop DLS that will be readily accepted by the potential user. The adoption of this DLS will be most convenient if it is designed to be simple to use which leads to the next attribute.

Complexity is the sense of difficulty that the user has in using and understanding an innovation. New ideas that are simpler and easy to understand are adopted more rapidly than innovations that require the adopter to develop new skills and understandings. Hence, excessive complexity of any innovation is seen as an obstacle in its adoption. To apply the construct of complexity, the question is: Will the proposed DLS be simpler to use and understand than the existing services? In designing a DLS, the designer should consider making the innovation as simple as possible to use and understand than the existing one. In essence it should be user friendly. Martin, (2003) noted that if hardware and software are user friendly, then they might be adopted successfully. An example is an Information Retrieval System (IRS) that requires special language or special procedure to make it accessible to users. This IRS may require special training for users. Most of the time, these IRSs attracts low patronage because user termed it as too difficult to use and understand. A DLS that is designed to be easy to

use and understand will attract enough patronage than the one that is difficult to use and understand.

Another factor in promoting the adoptability of an innovation is the opportunity for a potential user to experience using the innovation itself. The more an innovation is tried, the faster it rate of adoption which means trialability is positively connected with the rate of adoption. During this stage, re-invention can take place. That is, an innovation may be changed and modified by the potential adopter and increased re-innovation may create faster adoption of the innovation (Sahin, 2006). According to (university of Washington, n.d), trials can be great source of information searched for and needed during the persuasion and implementation stages. In particular, trials directly limit or prevent forming inaccurate assumptions about a technology. Trying out an innovation allows potential adopters to reduce their uncertainty about the risks and benefits (Cain and Mittman, 2002). A DLS designer using the construct of trialability should be ask this question: Can the proposed services be trialed on a limited basis i.e without fully being committed to buying or adopting it, so as to give room for modification or re invention? If this question is answered, then DSL designer can apply this construct. A trialable DSL can make a user overcome the evidence that argues for or against the benefits of adopting it because he has a personal experience with it. It is therefore important for a system designer designing a DLS to adopt this quality of the attribute of innovation so as to give room for modification to suit potential users' requirements.

The last and most critical factor that shapes innovation diffusion is observability. That is, watching someone else use it and then acknowledging that the innovation is safe and/or beneficial. Observability attribute symbolizes the necessity of designing of DLS that potential users will be able to see its benefits from others who have used and benefited from it. Therefore, applying the construct of observability to design a DSL should answer the question: will the benefits of proposed DLS be easily visible to those that have not adopted or use it? Observing a technology stimulates awareness of the innovation and conservation among peers. For a person to adopt a technology, seeing, hearing about, or otherwise knowing that other individuals are using that technology dramatically encourages adoption (University of Washington, n.d). For Rogers, the power of observability encouraged research on what makes an innovation more readily notice. Therefore, it is important for librarians and information professional to design a DLS that will be observable.

Conclusion

This paper has discussed the innovation diffusion theory and particularly emphasized on Theory of Perceived Attributes of innovation. Studies that used this theory discovered that all the variables were an important factor in the adoption of any innovation. Though getting a new idea or innovation to be adopted by a social system can be difficult even if the advantages that can be derived from adopting it are visible. This paper has succeeded in discussing the usefulness of the Theory of Perceived Attribute of innovation to explain the issues related to non-use of DLS and some questions DLS librarians can ask to have a better understanding of use or non use of DLS. However, all things being equal, the more profitable, understandable, personally compatible, observable, and testable the participant considers an innovation, the higher the potential for adoption.

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