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Diffusion of Innovation Theory: An Effective Approach to Accelerate Adoption of Information and Communication Technology in Twenty-First Century Knowledge Society

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Abstract:

Purpose: The rapid technological advancement worldwide has precipitated the adoption of innovations by social systems to be abreast of development worldwide. The adoption of Information and Communication Technology in the twenty-first-century knowledge society has the potential to open the members of the social system to a limitless wealth of knowledge that would aid rapid human capital and infrastructural development. However, there seem to be issues that tend to determine the pace of adoption of such innovations. This paper examined the Diffusion of Innovation (DOI) theory, its four main determinants; communication channels, attributes of the innovation, the characteristics of the adopters and the social system. Knowledge society and its characteristics, as well as the adoption of Information and Communication Technology (ICT) by the twenty-first-century knowledge society in relationship with the DOI theory approach from empirical studies, were highlighted.

Design/Methodology & Approach: The methodology adopted was a contextual analysis that involved the review of materials ranging from publications, textbooks, and the relevant internet sources.

Implication: The successful and accelerated adoption of an innovation in a social system (21st Century Knowledge Society) require the thorough application of the determinants of diffusion of innovation in the DOI theory without which the adoption of an innovation may not be feasible in any social system.

Keywords: Knowledge, knowledge society, information and communication technology, adoptions diffusion of innovation (DOI) theory, adoption of ICT in the twenty-first century knowledge society

1. Introduction

Various theoretical frameworks have been postulated to investigate the adoption of Information and Communication Technology (ICT) in the twenty-first-century knowledge society. This study examined one of such theories namely the Diffusion of Innovation Theory approach in the adoption of ICT in the twenty-first-century knowledge society. The DOI theory describes the pattern of adoption, explains the mechanism and assist in predicting the success of a new technology (Rogers, 1999). The theory has been used as a theoretical basis for information and communication technology adoption and utilization research. The theory sees innovations as being communicated through certain channels over time and within a particular social system. It further portends that individuals possess varying degrees of willingness to adopt innovations. Thus, it is generally observed that the portion of the population adopting innovation is approximately normally distributed over time in any social system like the twenty-first-century knowledge society. For any innovation to be adopted, the knowledge of such innovation is required by members of the social system.

Knowledge is information and educational skills acquired through experience; information acceptable to individuals that could be put to use for profit or add value to the individuals. It can thus be said that information not accessible to people and profitable to the individual cannot be classified as knowledge. Meadows, D (1972), asserts that knowledge cannot exist in a void, people or groups of individuals must exist and interact with available information for knowledge to exist and be useful. Thus, society is crucial for knowledge to thrive. A society is the aggregate of people living together in a more or less ordered community. They share cultural beliefs and ideologies in common. Therefore, what is a knowledge society?

According to UNESCO, (2005) knowledge societies are about capabilities to identify, produce, process, transform, disseminate and use the information to build and apply knowledge for human development. Knowledge societies are nurtured by diversities and capacities. Certainly, every society has its knowledge assets. This knowledge asset must be disseminated to the members of the social system for profitable use. To disseminate the knowledge effectively and efficiently, the adoption of ICT in the twenty-first century is not negotiable.

According to Tinio, (2002) ICT such as the World Wide Web, e-mail, telephones, fiber optics and satellites are revolutionizing how societies interact and compete in international relations and politics. Information and Communication Technologies (ICTs) can enable social systems to produce, access, adapt and apply a greater amount of information and offer enormous opportunities for enhancing productivity. When used appropriately, ICT helps to expand access to education, strengthens the relevance of training to the increasingly digital workplace and raises the quality of education/training, helping to transform teaching and learning into an engaging, active process connected to real life (Tinio, 2002).

Tinio, (2002) also provided evidence that ICTs are potentially powerful tools for extending educational/training opportunities, for facilitating the acquisition and absorption of knowledge, improving policy formulation, execution and widening the range of opportunities because of its ability to transcend time and space. Therefore the need for the adoption of ICT through the DoI theory approach is imperative if the twenty-first-century knowledge society is to exhibit its attribute as a continually progressive and a living social system.

2. Literature Review

2.1. Knowledge

Knowledge could be perceived as a human facility resulting from interpreted information; understanding that germinates from a combination of data, information, experience, and individual interpretation. (www.businessdictionary.com) In the past, the control of knowledge goes hand in hand with serious inequality, exclusion, and social conflict. Knowledge was long the exclusive domain of the tight cycles of wise men and initiated few characterized by secrecy. However, there is now a change in the exclusiveness of knowledge in the present age of enlightenment, the demand for democracy, the concept of openness and the gradual emergence of public forum for knowledge: which fostered the spread of ideas of universality, liberty and equality Meadows, D (1972). Also, the diffusion of knowledge through books, printing press as well as education for all through schools and universities have changed the outlook of the present-day knowledge society (Kochen, (1971). Furthermore, the information age has brought about the idea of the present-day information society which is based on a technological breakthrough. Thus, today the concept of knowledge societies encompasses much broader social, ethical and political dimensions.

2.2. Knowledge Societies

Today's human society is described as embedding knowledge societies which are based on the need for knowledge distribution, access to information and capability to transform information to knowledge. Afgan and Carvalho, (2010) define knowledge society as a human structured organization based on contemporary developed knowledge and representing the new quality of life support systems. Lor P. J. and Britz J. J. (2006) further defined knowledge societies as societies that operate within the paradigm of the economics of information. It values human capital as the prime input to production and innovation.

Thus, the various forms of knowledge and culture are always used in building any society in the twenty-first century. It is, therefore, necessary to work towards connecting all forms of information technological development, acquisition and dissemination of knowledge to enhance the twenty-first-century knowledge societies. For the knowledge societies of the twenty-first century, it is imperative to foster knowledge sharing. It should be able to integrate all its members (information user) and promote new forms of solidarity both present and future generations where knowledge is a public good available to each individual (user) for development through the adoption of information technology.

Ochogwu, M. 2009, categorized information users into four in a society. The first category of information users are professionals such as medical practitioners, engineers, lawyers and agriculturist among others. The second categories of information users are along institutional lines such as tertiary institutions, secondary and primary schools. The third group constitutes users along geographical locations while the fourth category is referred to as disadvantaged information users. They are disadvantaged because their access to information centres are restricted. They include the physically challenged (the deaf, dumb, blind and cripple), and those in prisons, hospitals, and orphanage homes. However, with the adoption of Information and Communication Technology (ICT) such a disadvantage would be reduced to the barest minimum.

Besides, according to Dike, (2007), knowledge societies have the following characteristics:

- They are pluralistic and culturally diverse.
- Democratic societies by all and for all.
- They are learning societies.
- Knowledge societies foster full human development.
- They build better features.

Thus, to foster the dissemination of knowledge as a public good to those categories of information users in the twenty-first-century knowledge society, the importance of adoption of ICT usage cannot be overemphasized.

2.3. Information and Communication Technology (ICT)

The acronym ICT stands for Information and Communication Technology. It refers to technologies that provide access to information through telecommunications. Information and Communication Technology (ICT) is the concern of every nation and organization because it brings innovation into information seeking and knowledge acquisition as it plays an important role in information sourcing, generation, processing, storage/retrieval and dissemination (Obioha, 2005). Aldhmour and Shannak, (2009) suggest an integrated definition of ICT. They defined ICT as the integration of software,

hardware and people in a clear process to generate information that helps in decision making to facilitate the production of goods and services and enhance the efficient utilization of such products to promote better living standards.

Therefore, the birth of ICT use is not unconnected with the revolution of Information Technology. The current trend in ICT has brought a phenomenon which can be termed the third revolution in IT. The first revolution comprised of films, radio, television, and satellite broadcasting, while the second comprised telecommunications and microcomputers. The integration of telecommunications and microelectronic technology in computing was termed the third revolution and came to be what is called Information and Communication Technology (ICT). The third revolution was said to promise not only a more productive person, a problem-solver and a life-long learner, but also a better informed, rational and participative citizen, a modern 'renaissance' person, living in the web and network of a worldwide electronic community (Kaino, 2004). Therefore, the need to accelerate (speed up) the adoption of ICT in the twenty-first-century knowledge society to enhance access to and utilization of information for development is imperative.

The concept of the adoption and use of ICT in the knowledge society of the twenty-first century is paramount to this study. According to Atinmo, (2000) use is the ability to make effective and independent utilization of the resources and services. This implies that the materials are in the appropriate format and language for use. It also extends to the frequency of usage of the materials and services and the concomitant utility derived from the resources as observed by Adebayo, (2007).

Addressing the issue of ICT use in education (knowledge society), Tinio, (2002) submits that the realization of the potential benefits of ICTs in education is not automatic because the process of integrating ICTs into the educational system is complex and multifaceted; it involves not just technology but also curriculum and pedagogy, institutional readiness, teacher competencies, and long-term financing among others. Tinio, (2002) asserts that the adoption of ICT is capable of accelerating development and growth in the twenty-first-century knowledge society when the four main elements and the five major determinants of adoption of innovation in the Diffusion of Innovation theory are considered in the social systems.

2.4. Diffusion of Innovation (DoI) Theory

According to Straub, (2009) adoption is when individuals integrate innovation into their lives and diffusion as collective adoption process over-time. Consequently, diffusion is the process through which an innovation is communicated through certain channels over-time among the members of a social system (Rogers, 2003). The Diffusion of Innovation (DoI) theory originates from a French sociologist, Gabriel Tarde in 1903, who carried out the pioneering research on the rate of spread or acceptance of innovations. He found that when plotted on a graph, the rate of diffusion of innovations gave an S-shaped curve. Also, two rural sociologists; Bryce Ryan and Neal Gross in 1943, carried further research into the DoI theory. However, the theory was made popular by Professor Everett Rogers in 1962. The diffusion theory is still very relevant today as it was, when propounded (Hornor, 1998). The only variation in the theory lies in the shape of the curve. Some innovations diffuse rapidly, creating a steep curve and others have a slower rate of diffusion giving a more gradual slope (See Figure 1).

Figure 1: The Diffusion Process of Innovation with the Percentage of Adoption Over-Time (Rogers, 2003, P.11).

Source: <https://ohiostate.pressbooks.pub/drivechange/chapter/chapter-1/>

According to Rogers (1999), the Diffusion of Innovation theory sees innovations as being communicated through certain channels over time and within a particular social system. It further portends that individuals possess varying degrees of willingness to adopt innovations. The beauty of the Diffusion of Innovation theory is that it is applicable to practically any type of innovation and it is widely used in different fields of human endeavour ranging from sociology, advertising, and marketing, agriculture, and healthcare to engineering and technology. Thus, it generally observed the portion of the population adopting innovation is approximately normally distributed over time (See figure 2).

Figure 2. Innovation Adoption Curves

Note: From Left to Right, the Blue Normal Distribution Curve Traces The Movement of Adoptions Through the Various Adopter Classes over Time (X-Axis Percentages); The Yellow 'S' Curve Represents The Accumulative Adoptions Until Saturation Is Reached (Y-Axis Percentages).

Source: <https://www.researchgate.net/publication/283546856>

It is hoped that this assertion would be confirmed at the end of this study in the adoption of ICT in a twenty-first-century knowledge society. In the Diffusion of Innovations theory, four main elements can be identified (Hornor, 1998). These are innovation, communication channel, time and social system.

2.4.1. Innovation

Innovation refers to the ideal, practice or object that is perceived as new by an individual or other unit of adoption. Rogers, (1999) itemized five characteristics that determine an innovation's rate of adoption; relative advantage, compatibility, complexity, trial-ability, and observability to people within the social system.

- **Relative Advantage.** This is the degree to which an innovation is perceived as better than the idea or technology it supersedes. The yardstick for relative advantage measures are social prestige, convenience and user satisfaction which may be measured in economic terms. It does not matter so much if an innovation has a great deal of objective advantages, what predominantly determines its adoption is how users perceive the innovation as being advantageous. The greater the perceived relative advantage, the more rapid its rate of adoption would be. However, after the initial adoption of a technology because of its perceived relative advantage, it is not uncommon for the adopter to later reject or modify the utilization of such technology if they perceive advantage is less than its real advantage.
- **Compatibility.** This is the degree to which an innovation is perceived as consistent or compatible with existing values, past experiences, and needs of the potential adopters. An innovation that is incongruent with the norms of the social system will not be adopted easily, therefore its rate of diffusion will be slow. The adoption of an incompatible innovation often requires the prior adoption of a new value system.
- **Complexity.** This is the extent to which an innovation is perceived as difficult to understand and use. New ideas that are simpler to understand and user-friendly are adopted more rapidly than innovations that require the adopter to develop new skills and understanding.
- **Trial-ability.** This is the degree to which an innovation can be experimented with, on a limited basis. An innovation that is trial-able represents less uncertainty to the individual who is considering it for adoption and could learn by doing. New ideas that can be tried on the instalment plan will be generally adopted more quickly than innovations that are not divisible.
- **Observability.** This is the degree to which the results of an innovation are visible to others. The easier it is for people to see the results of an innovation, the more likely they are to adopt it because visibility stimulates peer discussion of a new idea.

2.4.2. Communication Channel

The communication channel is how messages about the innovation passes from one individual to another. Mass media channels are more effective in creating awareness of innovations whereas interpersonal channels are more effective in forming, changing opinions and attitudes to new ideas because most people evaluate innovations not based on scientific research by experts but through the subjective evaluations of people who have adopted the innovation.

2.4.3. Time

The time dimension involved in the DoI theory are in three ways:

- Time is involved in the innovations rate of adoption. The rate of adoption is the relative speed with which an innovation is adopted by members of a social system. The rate of adoption is usually measured as the number of members of a social system that adopt the innovation in a given period.
- Time is involved in the innovation-decision process. The innovation-decision process refers to the mental stages through which an individual or other decision-making unit such as a group, society, economy or country goes through before deciding to adopt innovations (Rogers, 1999). Three stages can be identified in the innovation-decision process; initial knowledge of innovation which entails seeking information about the innovation.

Information sort at this stage could be awareness information (information that such innovation exists), Know-how information (information necessary to use an innovation properly), principles information (information about the principles underlying how the innovation operates). Rogers, (2003) states that awareness, knowledge information and innovation can be disseminated and obtained most efficiently through mass media.

- Time is involved in the innovativeness of an individual or other unit of adoption. Innovativeness is the degree to which members of a social system is relatively early in adopting innovations.

2.4.4. The Social System

The social system is a set of interrelated units that are engaged in joint problem solving to accomplish a common goal. The members or units of a social system may be individuals, informal groups, organizations, and /or subsystems. The social system constitutes a boundary within which an innovation diffuses. Norms are the established behavioural patterns for the members of a social system. Research has proved that a social system structure and norms exert much influence on the rate of diffusion of innovation. For instance, if a batch trainees/learners are well-grounded on basic information and communication technology (ICT) skills, such will exert a positive influence on the next batch of trainees in the use of ICT for training.

In adopting innovations using the DoI theory, five types of adopters can be identified based on innovativeness (Honors, 1998, and Rogers 1999).

- The Innovators. These are the first set of adopters of any innovation. One characteristic of this population of adopters is that their adoption decision process time is very short. They represent only about 2.5% of the populace. They are adventurous, daring and willing to take risk. Their willingness to take risk is probably due to their possession of substantial financial resources to absorb possible loss from an unprofitable innovation. They can understand and apply complex technical knowledge and can cope with a high degree of uncertainty any innovation may present.
- Early Adopters. Early adopters are less adventurous and daring than the innovators. They represent about 13.5 % of a social system. They are a more integrated part of the populace than the innovators. This category, more than any other has the greatest degree of opinion leadership in most social systems. They are generally sorted by change agents as a local missionary for speeding innovation diffusion because they are not too far ahead of the average individual in the populace. So they serve as good role-models for other members of the social system. Early adopters decrease uncertainty about innovations by adopting it and then conveying a subjective evaluation of the innovations to others through interpersonal networks.
- Early Majority. This represents about 34% of a social system. They adopt innovations just before the average member of the populace. They interact frequently with the majority, but they seldom hold positions of opinion leadership. They are an important link in the diffusion process because they provide interconnectedness in the system's interpersonal network. The early majority follow innovation with deliberate willingness, although they seldom lead in the adoption of new ideas.
- Late Majority. This represents another 34% of a social system. They adopt an innovation after the early majority out of necessity or pressure. They approach innovations with caution and skepticism. They only adopt innovation when the norm of the social system is in favour of it.
- Laggards. They represent 16% of a social system. They tend to be suspicious of innovation and they resist change. They decide innovations in terms of what has been done previously. Their resistance to change and innovation often stems from limited resources.

The final concept in understanding the nature of the diffusion process is the Critical Mass. Critical Mass occurs at the point which enough individuals have adopted an innovation such that the innovations further diffusion rate becomes self-sustaining. This concept implies that innovation awareness initiatives should be focussed on the early adopters because they are instrumental in getting an innovation to the point of Critical Mass.

It is however observed that the four main elements of the DoI theory and five characteristics which determine an innovation rate of adoption; relative advantage, compatibility, complexity, trial-ability, and observability to people within the social system and the five different innovation adopters described above, could be identified among the twenty-first-century knowledge society in the adoption of ICT.

Review of Related Empirical Studies on the Adoption of Information and Communication Technology Through Diffusion of Innovation Approach in the Twenty-First Century Knowledge Society

It is worthy of note to state in context, that the twenty-first century knowledge society is a social system characterized by global information explosion age having access to various information sources through the world wide web aided by ICT which has made the present-day world, a global village. There are many proponents of related empirical studies on the adoption of ICT in the twenty-first century knowledge society (organizations and learning institutions) through the DoI theory approach. In this section, the researcher will attempt to discuss several such studies.

The empirical study carried out by Usluel, Askar and Bas (2008) was titled: A Structural Equation Model for ICT Usage in Higher Education. The study focused on Information and Communication Technologies (ICTs) adoption and usage, which are the indicators of diffusion of ICT innovation. A model composed of the variables which can explain ICT usage in Turkish higher education was established and tested within the study. The two dimensions of ICT usage were considered: instructional and managerial. The data collected from 814 faculty members in Turkey were used to test the model by using LISREL 8.72; it explained 61% of the faculty members use ICT, with a good model fit.

The model supposes that the perceived attributes (relative advantage) of ICT and ICT facilities in the universities predict the ICT use. The faculty members made use of ICT mostly as a means of communication and for searching for

information about the course through the internet; for publishing their lecture notes and the announcements concerning the course assignments. The study was carried with a questionnaire administered on faculty members. The study was able to identify, within the Diffusion of Innovation Theory, the ICT diffusion rate in universities based on faculty members ICT adoption and usage. The result shows that 65.3% of faculty members in the study group have computers in their offices and 55.9% have access to the internet in offices. Also, the availability of computers and internet facilities in the laboratories were 38.7% and 28.2% respectively.

Furthermore, the majority of the respondents have personal access to the computer and internet facilities as they could be categorized under the early majority and late majority who according to the DoI theory, is knowledgeable, willing to take a risk to adopt an innovation because of the relative advantage and their financial capability. Respondents who own personal computers were 89.1% and 70.6% of them have internet connections and they form the Critical Mass. In summary, the study identified that the percentage of faculty members who have their computers and access to the internet is quite high (82.5% for computers and 81.2% for internet); these two categories of innovation adopters form over 64% populace of the twenty-first-century knowledge society in the study. The remaining 17.5% of faculty members who do not have personal computers stated that they easily have access to it in the department.

The finding of the study shows that ICT usage is getting more widespread in higher education. This study has investigated the underlying relationship between ICT facilities, perceived attributes (relative advantage), and ICT usage for higher education. The empirical examination of the usage of ICT using a structural model based on the Diffusion of Innovation (DoI) has been tested and validated. The study provides evidence of the appropriateness of the DoI theory to measure the ICT usage in Higher Education in Turkey. Also, it further provides evidence that the availability of ICT facilities have a strong positive effect on ICT adoption and usage due to characteristics simplified complexity, compatibility with the norms of the social system in the knowledge society and the observability of the relative advantage of the innovation (ICT).

Kiptalam and Rodrigues, (2010) studied accessibility and utilization of ICTs among secondary school teachers in Kenya. This work investigated the level of access and the extent of use of ICT among teachers in selected Kenyan secondary schools. The study provided evidence to support the fact that the use of ICT in education has the potential to enhance the quality of teaching and learning, the research productivity of teachers, students, management and effectiveness of institutions. The study, which was a cross-sectional descriptive survey, used a quantitative technique using the questionnaire method for data collection and analysis. The sample for the survey was drawn from 11 secondary schools with internet access. The findings show that the use of ICTs and its integration in the teaching and learning process in secondary education is getting more widespread and its use more pervasive among teachers as a means of communication and information searching. Access rates for teachers were observed to be much higher in educational institutions that have made effective ICT investments in education, translating into better utilization of ICT related technologies with assumed positive impacts. This was because such educational institutions were made up of three categories of adopters namely the innovators, early adopters and the early majority described in the DoI theory.

The study further revealed that the majority of the teachers did not receive ICT training at the teachers' training colleges or universities where they trained, with 55% getting into the teaching profession with no experience of computers and its related technologies. Nevertheless, it is reassuring to note that there seems to be a reversal of trends with 51% of them indicating that they have undergone ICT training in the past three years due to observable relative advantage of the innovation (ICT) with some schools supporting the training programs.

In more recent survey by Global Information Technology (GIT), in 2005–2006 on ICT utilization in training using Networked Readiness Index (NRI), Nigeria was ranked 90th out of the 115 countries surveyed as a result of the lack of will power of the government to lavishly invest in ICT in the higher institutions of learning. These members of the Nigerian government then, fall under the category of adopters known as laggard according to the DoI theory. United States of America topped the list, followed by Singapore, Denmark, Iceland, Finland, Canada, Taiwan, Sweden, Switzerland, and the United Kingdom, (Global Information Technology, 2006). This shows a decline in Nigeria's preparedness to participate in the utilization of ICT in education and training development because the innovation (ICT usage in training) was not compatible with the norms of the social system then.

Dankaro, Jude, Inibehe, and Terumbur, (2012) did an empirical study on ICT Resources Utilization, Availability and Accessibility by Teacher Educators for Instructional Development in College of Education, (CoE) Katsina-Ala, Benue State Nigeria, the purpose of the study was to examine the availability and accessibility of ICT resources for teacher educators in College of Education (CoE). A total of forty (40) College of Education Katsina-Ala teacher educators from five schools randomly selected formed the sample size from a population of 287. The researchers adopted the Ex post-Facto research design and formulated two research questions to guide in the study. A researcher-made instrument tagged Information and Communication Technology Research Questionnaire (ICTRQ) which was used for data collection. The reliability coefficient of the instrument was 0.7.

The data was analyzed and the findings revealed that ICT resources were not available and for that reason, teacher educators could not access them for instructional development purposes. ICT resources were not available in CoE Katsina-Ala for teacher educators' instructional development as the institution did not supply computers/laptops to its teacher educators. The reason for this was not farfetched from the DoI Theory which buttressed this finding by explaining that complexity is the extent to which an innovation is perceived as difficult to understand and use. New ideas that are simpler to understand and user-friendly are adopted more rapidly than innovations that require the adopter to develop new skills and understanding.

Despite the negative perception of the government of the day on the complexity of the use of computers and ICT facilities, a number of the teacher educators owned personal laptops/computers which were not connected to the internet

and as such could not access internet services in their offices for instructional development purposes. They mostly relied on personal mobile devices to access the internet. This finding corroborates with the findings of Ezeoba, 2007 and Fakeye, 2010; who also found that ICT resources were not available in primary and secondary schools due to the ignorance of the relative advantage. This is also attributed to the failure of teacher training institutions whose products go through the programs without the training to interact with technology in the classroom due to fear of complexity to operate the ICT facilities and as such are not ICT compliant; that is they lack the know-how to teach these programs in the primary and secondary schools where they are trained to teach.

Hence, there is an absence of ICT resources in primary and secondary schools as well as personnel to use them. The level of accessibility of ICT resources depends on their availability. The poor availability level of ICT resources in CoE Katsina-Ala also meant that accessibility will be hindered for instructional development purposes.

Thus, it can be deduced from this study that, integrating ICT in the teacher training program in Colleges of Education through the DoI theory approach, would go a long way in raising the fallen standard of education, making learning real and no longer abstract. This also would motivate learners, who deserve an improved approach to their daily educational growth. As all stakeholders clamour for improved quality of education through the integration of ICT in learning, the need to equip teacher training institutions with adequate ICT infrastructure and skills after carefully considering the five characteristics which determine an innovation's rate of adoption (relative advantage, compatibility, complexity, trial-ability, and observability to people within the social system) becomes imperative. Based on these, it was recommended that the college authority should avail teacher educators in the institution with ICT resources and sponsor them for training and retraining programs to produce ICT compliant teachers.

Alazzam, Bakar, Hamzah and Asimiran, (2012) also conducted a study to examine ICT readiness and the effects of demographic characteristics, educational background, and support factors on the ICT readiness of technical and vocational teachers in Malaysia. The study was conducted using a questionnaire administered on technical and vocational teachers who are teaching engineering subjects in Malaysian technical and vocational schools. The questionnaire consisted of items related to ICT knowledge, ICT skills, and attitudes toward ICT. The findings in this study indicated that the teachers' ICT knowledge was above average, the teachers' ICT skills were at a moderate level, and their attitudes toward ICT were positive.

A total of 329 teachers participated in this study. Almost 63% of them were male teachers and the other 37% were female teachers. They were between 27 and 57 years old and more than one-third (37.1%) were between the age of 42 to 49 years old. Concerning teaching experience, about 32% have been in the teaching profession for less than 10 years, approximately 31% were between 11 and 18 years and about 11% had been in the teaching profession between 27 and 34 years.

The respondents were asked if they attended any ICT related courses. Forty-one percent (41%) of them indicated that they have attended ICT basic course. A little bit more than 39% attended courses related to world-wide-web design, multimedia, and programming. Ten percent of the respondents attended courses related to ICT integration in teaching and learning and 9.7% of the respondents never attended any ICT related training. The success of ICT integration in teaching and learning process is very much dependent on the administrative support and the availability of the ICT facilities. The majority (75%) of the respondents who form the Critical Mass, indicated that they have the support from the administration in the integration of ICT in teaching. Concerning the ICT facilities, 62.9% of the respondents felt that there were highly adequate ICT facilities in their schools, 27.7% thought that the ICT facilities in their schools were adequate and 9.4% thought that ICT facilities in their schools were inadequate.

The findings of this study also indicated that there was no significant effect related to age and years of teaching experiences on teachers' overall ICT readiness. However, there was a significant effect of teachers' gender on their readiness, specifically teachers' ICT skills. It also failed to discover the effect of educational background and support factors on teachers' overall readiness to integrate ICT in teaching. Therefore it could be deduced from the findings of the study, that three of the five determinants of diffusion of innovation; relative advantage, compatibility of ICT with the twenty-first-century technology compliant knowledge society and the perceived ease of ICT use (complexity) as postulated by Rogers, (1999) in his DoI theory were responsible the ease of acceptance and use of ICT by the respondents (teachers).

Also, Tella, (2012) investigated the level of availability and use of ICT in some South-Western Nigeria Colleges of Education. The data for the study were gathered through a two-page questionnaire administered to 200 respondents who were accessible in all the Colleges of Education in the South-Western part of Nigeria. In all a total, 180 questionnaires were retrieved which represents a 90% return rate. The data were analyzed quantitatively using Statistical Package for Social Scientists (SPSS). The study revealed a low level of usage of ICT gadgets and the non-availability of some ICT equipment. Colleges use computers for research/educational purposes. All the Colleges use computers for administrative purposes and these computers are usually found in the Provost, Registrar, Deputy-Provost offices. Not a single one could be found in any of the Heads of Department's offices except the offices of the Departmental heads of Mathematics/Computers.

The results of the survey on College of Education staff on the level of availability, use of and perception of the impact of ICT on teacher education in Nigeria revealed and suggested a low level of usage of ICT gadgets; non-availability of ICT equipment and that the respondents were disgruntled with the sluggish use and integration of ICT. The perception of the impact of ICT on teacher education in the South - Western Nigeria, could be explained by the DoI theory, Rogers, (1999). The theory confirms that for easy diffusion of an innovation like ICT from the survey on colleges of education in southwestern Nigeria, there must be an interplay of observable relative advantage, compatibility with the norms of the social system and ease of use (complexity).

Moswetsi, Renken and Neethling, (2006) researched to investigate the attitudes of students in the South Africa (SA) Military Academy towards ICT because they believed that a realistic perception of the worth of ICT/Computers needs

to be established among officers and students at the SA Military Academy for the academy, students and instructors to benefit maximally from the widespread use of ICT. The objective was to determine whether there exists any difference in the attitudes of students towards ICT utilization based on gender, prior experience with computers, rank, arm of service (Navy, Army, Air-force and others) and academic year. The result indicated that there is no significant difference in perception towards ICT based on gender, prior knowledge of computer and arm of service.

However, the study indicated a significant difference in perception based on rank and academic year. Officers of lower rank than a Lieutenant had a negative perception of ICTs and officers in the first year were more afraid to use ICTs resources than others. The research also provided evidence that ICT utilization is dependent on computer experience, access to computers/ICTs and the number of ICT related courses attended. This finding supports the fact that the complexity (the ease of use) of diffusion of an innovation impacts on the perception of adoption and use of ICTs by the officers of lower rank than Lieutenant. These results highlight the importance of influencing the perceptions of officers under training to optimize their preparedness for the operational environment. Thus, the research also emphasizes the importance of providing contextualized information systems training to military personnel in a purposeful way which is aptly captured in the DoI theory.

3. Conclusion

In summary, salient issues relevant to the research topic have been explored. The concept of knowledge and knowledge society generally reviewed and different definitions of ICT have been explained in the context of this study. The review of the information sources employed in this research also highlighted the Diffusion of Innovation (DoI) theory that provided an adequate framework for the research. The DoI theory describes the pattern of adoption/acceptance, explains the mechanism and assists in predicting the success of a new technology especially in the context of the twenty-first-century knowledge society in this study. The theory has been used as a theoretical basis for information and communication technology acceptance and utilization research. The theory perceives innovations as being communicated through certain channels over time and within a particular social system. It further portends that individuals possess varying degrees of willingness to adopt innovations. The DoI theory itemized five characteristics that determine an innovation's rate of adoption; relative advantage, compatibility, complexity, trial-ability, and observability to people within the social system which is evidenced in the adoption of ICT usage by the various twenty-first-century knowledge societies examined in this study. Thus, the DoI theory approach has the propensity to accelerate the adoption of ICT in the twenty-first-century knowledge society.

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