

e-Infrastructure Acceptance in e-Health, e-Learning and e-Agriculture in Zimbabwe: The Quest for the User Acceptance Variable

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Abstract

One of the best ways to achieve global literacy is through communication, collaborative learning, research, and problem solving. Technology helps tremendously in these areas, so it is a great tool to use in this process. As e-infrastructures gain ground in many African countries and at the same time promises a new way of delivering health, education and agriculture. New technologies should be readily acceptable in order to deliver these essential services to the populace. However, against a background of previous studies pointing to e-learning as a monster under the bed (Chiome, Kurasha and Mupa, 2011) and after 98% of the students failed to voluntarily register for an e-learning blended programme, this research set out to find the factors affecting user acceptance of e- infrastructures in health, agriculture and education. This was a survey of institutions engaged in e-agriculture, e-health and e-learning in Zimbabwe. A purposive sample of 65 students who were exposed to e-infrastructures was interviewed in order to determine the user acceptance variable applicable in Zimbabwe. The study found out that e-infrastructure users made rational choices faced with alternatives, belief in the usefulness or lack of it of the system, too much effort put into using technology, content richness, e-infrastructure usefulness and update regularity of the e-infrastructure are some of the absolutely vital technology acceptance variables. The research argues that the ability to navigate the complex life and work environments in the globally competitive information age requires e-infrastructure developers to pay rigorous attention to technology acceptance to engage e-infrastructure users other than the “early adopters” with the opportunities in e-infrastructures.

Key terms: e-infrastructure, E-learning, e-agriculture, e-health, technology adoption, new technologies

1. Background to the Study

The importance of information and communication technology in executive decision-making has been extensively documented (Averweg, 2008). Information is critical for sustainable development especially in a country like Zimbabwe. Without concise and timely information, executives will not be able to determine whether their views of the environment and their organization’s position within it remain appropriate (Vandenbosch and Huff, cited in Averweg, 2008). Because of this, the use of e-infrastructures is gaining ground in many African countries. Zimbabwe has not been left behind. E-infrastructures in agriculture, health and other sectors are

the order of the day. What is missing though is contextualized research that will inform service providers to know what those using e-infrastructures prefer. This study was an attempt to fill this void.

This is also the same the world over that e-infrastructure is gaining ground. They are dictating the pace and depth of development. Tong (2010) appears to support this stance by arguing that online shopping is becoming increasingly popular in many countries of the world. To Tong (2010), online retail sales are estimated to grow from \$172 billion in 2005 to \$329 billion in 2010, representing a 14 percent compound annual growth rate (Johnson and Tesch, cited in Tong (2010)). The proliferation of e-infrastructures is a blessing in disguise for many African countries. For this reason, the use of e-infrastructures in many areas has stimulated widespread research aimed at understanding what drives e-infrastructure users to adopt technologies that are meant to advance their operations. This is useful for sustainable development in Africa considering that most e-infrastructure user behaviour constructs and theories have been developed and tested exclusively in a single country, typically the USA (Tong, 2010). As a consequence, the extent to which theories, models, constructs, and relationships among constructs are culturally bound is certainly unknown in many African countries and this Zimbabwean is one small attempt to correct this anomaly.

Technology acceptance is important if e-infrastructures in Africa are to make headway in sustainable development of the continent. The original Technology Acceptance Model (TAM) by Davis (1989) identified perceived usefulness and attitude as direct determinants of use of technology. On the other hand, what is now known as the parsimonious TAM which was advocated by (Davis, Bagozzi and Warshaw, 1989) showed that perceived usefulness and perceived ease of use were significant direct determinants of behavioural intention with perceived usefulness showing the strongest effect in that study. These authors argued that attitude did not fully mediate perceived usefulness and perceived ease of use and therefore should be excluded. The parsimonious TAM also continues to be used frequently in the literature (Tong, 2010) while perceived usefulness refers to the degree to which a person believes that using a new technology would enhance his performance or productivity.

There are also issues of inconsistencies in research on technology acceptance. For instance, according to the study done by Gradon, Alshare and Kwan (Suki and Suki, 2007), subjective norm was found to be a significant factor in affecting university students' intention to use e-learning. In contrast, the study done by Ndubisi (Suki and Suki, 2007) showed that subjective norm had no significant effect on university students' intention to use e-learning. This kind of inconsistency may be resolved through similar research in a different context. Nonetheless, these studies still point out to the fact that user acceptance of technology is important otherwise technology will fail to make an impact on the African continent if appropriate research is not undertaken.

Some African countries appear to appreciate the usefulness of technology. They support this through research. A research done in the African context in Rwanda by Nsabimana & Masabo (2005) found out that 73% of the farmers had not adopted the technologies that they were exposed to. Only 25 of the respondents in that study adopted the technologies. An interesting finding though in that study is that of the 25 adopters of technology, 72% had been sensitised on

the advantages of the technologies, while 89% of the non-adopters of the technologies have not been sensitised. According to Nsabimana & Masabo (2005), sensitization is a critical element of technology adoption. In this Rwandese research, sensitisation on new technologies was done through visits by technical staff and discussions during sector meetings. These, appear to be related to promotion of adoption of technologies. Factors which promote adoption of agriculture technologies thus, to Nsabimana & Masabo (2005) include sensitisation on advantages of the technology, literacy, age, technical information and exposure to the technology. In addition, there is need for farmers to have access to credit. The creation and empowerment of a socioeconomic programme in ISAR with the aim of linking the Institute to farmers in order to adapt research to farmers' needs and aspirations and the consideration of farmers as important partner in a whole agricultural development process. Knowledge is very important for enhanced technology adoption. This serves to confirm the importance of this research.

2. Theoretical and Conceptual framework

2.1 Conceptual framework

According to European Communities (2010), e-Infrastructures can be defined as networked tools, data and resources that support a community of researchers. Broadly, this includes all those who participate in and benefit from research. Following this definition, the term e-Infrastructure comprises very heterogeneous projects and institutions within the scientific community. What this means is that e-Infrastructures include services as diverse as the physical supply of backbone connectivity, single- or multi-purpose grids, supercomputer infrastructure, data grids and repositories, tools for visualization, simulation, data management, storage, analysis and collection, tools for support in relation to methods or analysis, as well as remote access to research instruments and very large research facilities (European Communities, 2010). e-Infrastructure as a concept in this research is the term used for the technology and organisations that built upon an infrastructure of grid computing software that can provide users with benefits including shared access to large data collections, advanced ICT tools for data analysis, large-scale computing resources, and high-performance visualisation. It embraces networks; grids, data centres and collaborative environments, and can include supporting operations centres, service registries, single sign-on, certificate authorities, mobile technologies and help-desk services. Most importantly, it is the integration of these that defines e-infrastructure.

2.2 Theoretical Framework

Researchers in technology acceptance use many theories to explain behaviour. Some of the well known theories used by researchers include technology acceptance model (TAM), trust theory, social cognitive theory, social capital theory and social network theory. These have been used by different researchers to explore technology acceptance and user participation. One of the well-known of these models related to technology acceptance and use is the technology acceptance model (TAM), originally proposed by Davis (1989), as stated elsewhere in this paper. TAM argues that perceived usefulness and perceived ease of use are two main factors affecting user acceptance of an information technology (Davis, 1989). TAM has proven to be a theoretical model in helping to explain and predict user behavior of information technology (Legris, Ingham, & Colletette, cited in Park, 2009). Thus, this research was based on the need to

contextualize Davis' Technology Acceptance Model (TAM) that states that perceived usefulness and perceived ease of use are the two factors that govern the adoption and use of IT (Davis, 1989). TAM is considered an influential extension of *theory of reasoned action (TRA)*, according to Ajzen and Fishbein (1980). The **theory of reasoned action** is a model for the prediction of [behavioral intention](#), spanning predictions of [attitude](#) and predictions of behavior. TRA suggests that a person's behavioral intention depends on the person's attitude about the behavior and subjective norms ($BI = A + SN$). If a person intends to do a behavior then it is likely that the person will do it. Based on this, Davis' model specifically postulates that technology use is determined by behavioral intention to use the technology (Averweg, 2008). The TAM model asserts that two factors are primary determinants of system use. These are:

- **Perceived Usefulness (PU)**. PU is defined as the user's subjective probability that using a specific technology will increase his or her job performance within an organizational setting (Davis et al., 1989); and
- **Perceived Ease of Use (PEOU)**. PEOU is the user's assessment that the system will be easy to use and requires little effort.

The use and efficacy of TAM was tested by Park (2009) in the Korean context arguing in that research that many universities implement e-learning for various reasons. It is obvious that the number of e-learning opportunities provided by higher educational institutes continues to grow in Korea. Yet little research has been done to verify the process of how university students adopt and use e-learning. In that research, Park (2009) uncovered that the general structural model, which included e-learning self efficacy, subjective norm, system accessibility, perceived usefulness, perceived ease of use, attitude, and behavioral intention to use e-learning, was developed based on the technology acceptance model (TAM). Thus, according to Park (2009), the result proved TAM to be a good theoretical tool to understand users' acceptance of e-learning.

Legris, Ingham and Collette (2003) suggest that while TAM is a useful model, it has to be integrated into a broader one which will include variables related to both human and social change processes and to the adoption of the innovation model. However, e-infrastructure acceptance in organizations is an important topic in scholarly discourse. This prompted this study.

3. Statement of the problem

Although there are glowing statistics and success stories of technology adoption elsewhere in the world, the Zimbabwean situation remains under-researched and many organisations in agriculture, health and education are apprehensive about technology adoption. Although there are some which are advanced, a study by Chiome (2013) indicated that technology is putting minorities, rural people and women at the margins. These appear to be lagging behind and tend to be afraid to venture into technology usage. This is plausibly because internet commerce is still relatively new and there are no hard and fast rules to follow, with no tried and tested business model to imitate in the Zimbabwean context.

3.1 Research Question

This research was directed by the following research question:

What are the factors that affect user acceptance of e- infrastructures in health, agriculture and education?

4. Methodology

The research was basically qualitative in nature. It was grounded in the interpretive paradigm where meaning is said to exist in our interpretations of the world. In such contexts, knowledge is interpretation. In this kind of research, the importance of the researcher's perspective and the interpretative nature of social reality is critical. Knowledge generated using this method provides suggestive interpretations by particular people at particular times. A purposive sample of 65 students who were exposed to e-infrastructures was interviewed in order to determine the user acceptance variable applicable in Zimbabwe at the time of study.

During the process of developing the instrument, it was pilot tested among ten users with perceived rich technology usage experience. Then as a result of their comments, some items were left out while others were revised in order to come out with the final instrument that was used in this study. The testing of instruments improved the clarity and understandability of the items in the interview instrument.

5. Results

5.1 Rational choices faced with alternatives

In line with the Theory of Reasoned Action that was discussed elsewhere in this paper, this research uncovered that e-infrastructure users made rational choices faced with alternatives. This was also confirmed by Park (2009). In that study, variables related to the behavioral intention to use information technology or to the actual use of information technology were grouped into four categories: individual context, system context, social context, and organizational context. While social context means social influence on personal acceptance of information technology use, organizational context emphasizes any organization's influence or support on one's information technology use. In all these contexts, the question of rational choices is explicit. Users make decisions based on their perception of the situation.

This kind of thinking, led Park (2009) to recommend that it is necessary that managers and developers of e-learning help students confirm or increase their perception positively through e-learning. To Park (2009), one possible solution is to develop more user-friendly and user-oriented e-learning content. This kind of system will add new perception to the previous attitude and thus bring about more satisfaction. This satisfaction in turn encourages students to optimistically make further use of e-learning. This appeared to have been confirmed in this study where respondents confirmed that they made rational choices faced with alternatives.

5.2 Perceived usefulness and e-infrastructure acceptance

One of the results that constantly came out vivid in this study is that of conceived usefulness of e-infrastructures, be they in e-agriculture, e-health or e-education. This appears consistent with what is in the literature. In Tong (2010)'s study, consumers' perceived usefulness of a virtual store consistently had a positive impact on their future purchase intentions in both US and Chinese sample. In both the current study and Tong (2010)'s study, results appear to confirm that perceived usefulness is the primary determinant of the use of a new technology that was

uncovered way back by (Davis et al., 1989). According to Ha and Stoel (2009) usefulness is important determinant of e-infrastructure acceptance. This appears to affect Africans most because most of the e-infrastructures they use have been developed in other countries for use in very different contexts than those in Africa. What this means is that developers of e-infrastructures should heed the call of contextualizing technology so that it will be readily accepted by users who will see added value in adopting it. This result is precisely consistent with Brashear, Kashyap, Musante and Donthu (2009)'s study, which explored the profile of internet shoppers in six countries that included the USA and China among others and found that online shoppers in the USA and China are similar with regard to seeking convenience and usefulness through online shopping, although they might differ in other aspects of their profile.

5.3 Effort put into using technology

An interesting finding to come out of this study was the fact that users are concerned with the effort that they put in using technology. The more the effort, the less they are likely to adopt that technology. What this means for technology developers is that they need to simplify technologies if they are to be readily adopted. According to O'Brien (2005), this entails harnessing the capacity of information and communication technology (ICT) systems, particularly the power of high-capacity distributed computing, and the vast distributed storage capacity fuelled by the reducing cost of memory, to study complex problems across the research landscape. Effort put into technology usage appears to have been confirmed in Malaysia. According to Lee, Eze and Ndubisi (2011) in this country, despite the phenomenal growth in online retailing, a clear understanding of the facilitators of online purchase intention of customers is still lacking due largely to little research done within the Malaysia context. They went further to recommend that it is important for researchers and practitioners especially those who run/manage online businesses to be aware of the factors that encourage customers to repurchase from an online store

5.4 Content richness

The idea of content richness was uncovered in this study. Respondents were of the opinion that it was easier for them to use technology that was rich in content. Farmers said if technology can change the yields then it will easily be adopted. Students argued that if they can pass their exams because of technology then they will adopt it. On the other hand, nurses in this study were also of the same opinion. What this may imply for technology developers is that in addition to information technology adoption theories, other theories such as perceived value, perceived justice and personality traits are also important for technology adoption. Content richness will undoubtedly enhance perceived value of technology. Pura (2005) examined the effect of perceived value on the continuance intention of location-based services (LBS). Typical LBS includes mobile navigation, location-based advertisements, emergency evacuation and check-in services of mobile social network. LBS will create value for users and improve their loyalty (Pura, 2005). In that study, Pura (2005) appears to confirm the importance of content richness by saying that perceived value includes social value, emotional value, conditional value, monetary value, convenience value and epistemic value.

5.5 Informational efficiency

The findings from Rwanda by Nsabimana & Masabo, (2005) that sensitization is critical to technology adoption was confirmed in this study where respondents were of the opinion that

information efficiency was a critical determinant of technology adoption. For one to adopt any kind of technology, one requires several types of information. Some of the information that is critical includes knowledge about the existence of technology, whether that existing technology will be of any benefit to the individual concerned and knowledge about how to use that technology. Efficiency in the supply of that critical information will see many people adopting technology.

The information about technology in the context of Zimbabwe can be obtained from technology providers, teachers, health officials, from colleagues and peers and from the media. Other sources of useful information may be particularly important for the adoption of new technologies. In this study, technology providers, peers and in some cases extension workers were seen as potential and important sources of information about agricultural, health and education technologies that are being used in the vicinity. Studies on technology adoption in fields other than agriculture show that individuals learn from others within their social network (Lee, Eze and Ndubisi, 2011). Owing to cultural, economic, societal and political factors, e-commerce development will not be identical across countries (Yu, cited in Zhou, 2011). Learning from others can result in a less rapid spread of technology if social networks are small or if the benefits of a technology are hard to observe. Examples include technologies for slow growing crops that take multiple seasons to mature or technologies that require considerable customization for a farmer's particular growing conditions.

5.6 Update regularity of the e-infrastructure

The role of e-infrastructures was seen as important in this study. For that reason, the respondents in this study opined that it is important that these infrastructures are updated regularly. They appeared not willing to work with obsolete equipment and technologies. This stance appears to be supported by a research undertaken by the European Communities (2010) which among other sought to understand better the organizational, collaborative and technological developments in e-Infrastructures which are effective in supporting virtual research organizations in different fields. E-Infrastructures represent a very heterogeneous subject of investigation, they span continents, scientific and professional practices, functions and technologies (European Communities, 2010). The findings of the European Communities (2010) study revealed that More than 85% of e-Infrastructure users classify e-Infrastructure as important or very important for their work. Most would also see their research or work programmes impaired if the e-Infrastructure did not exist. Early adopters more often report relying on the availability of the e-Infrastructure than those who became involved later. It apparently takes some time for benefits of e-Infrastructure to materialize, and benefits are often over-shadowed by costs at the outset. The main benefits relate to the speed of doing research or work: accomplish tasks more quickly, access resources faster or better, produce processes or analyse data faster or better (European Communities, 2010). Equally important is the ability to work on new problems which could not be addressed with previously available technology. This is the reason why respondents in this study were of the opinion that update regularity is important.

5.7 Expanding opportunities

An interesting finding from this study was that the respondents appreciated technology if it was in a position to expand opportunities for them. To them this was important because it meant they

will get most of the things they want when they engage in technology. This idea is supported elsewhere in the literature (European Communities, 2010). For instance, O'Really (2005) argues that the possibilities also offered by Web 2.0 to modern libraries expand the opportunities for implementing digital scholarship projects. On the other hand, Zhou (2011) is of the opinion that the proliferation of web 2.0 technologies has triggered the rapid development of online community. For example, Facebook, the largest global online community, holds million users around the world. This meant to say web 2.0, by expanding opportunities for technology users, it also has the effect of luring them to use technology. Web 2.0 refers to second generation internet-based services such as social networking sites, wikis, communication tools and folkosonomies that emphasise online collaboration and sharing among users (O'Really, 2005).

5.8 Morals, values and ethics in digital scholarship

A surprising finding from this study was that of morals, values and ethics that was brought up in this study. Despite differences in culture of the various respondents in this study, they agreed that the use of e-infrastructures should not in any way derail their moral principles, values and ethics as human beings. Literature appears to support these findings. Ethics is a subject of study that is concerned with moral principle or framework (Hawker, cited in Mutula, 2010). Mutula (2010), then went further to consolidate these claims by arguing that ethics issues pervade all environments where information or any other form of content is generated, stored, communicated, applied and owned. On the other hand, Ocholla (2008) believes environments in which information is generated, stored or retrieved should uphold ethics. In this regard, Ocholla (2008) highlights the assumptions underlying the subject of ethics namely, that:

- The distinction of right actions from wrong actions is that they [actions] have better consequences (Fallis, cited in Ocholla, 2008).
- There are ethical duties that human beings must obey . . . regardless of the consequences.
- The right thing to do is determined by the rights that human beings have.
- Ethics is concerned with the universal or commonly held values of persons, despite – different . . . moral or cultural values.
- Ethics . . . focuses on the norms and standards of behaviour of individuals or groups within a society based on normative conduct and moral judgment, principles of wrong or right.

An interesting point to note is the assertion by Mutula (2010) that the role and purpose of ethics in society is to promote what is good in people . . . and provide norms and standards of behaviour . . . The ethical values which all human beings are expected to enjoy were formalised when the UN General Assembly endorsed the Universal Declaration of Human Rights charter on 10 December, 1948 (United Nations, 1998). Mutula (2010) believes that the key components of the charter are the recognition of the inherent dignity of the equal and inalienable rights of all members of the human family as the *foundation of freedom, justice and peace in the world*. The respondents in this study agreed with this assertion. This is because Mutula (2010) explained that the charter was conceived and motivated by the disregard and contempt for human rights across the world. There are 30 articles in the Universal Declaration of Human Rights charter with each defining a particular right. Article 19 for example, declares that everyone has the right to freedom of opinion and expression. This right includes freedom to hold opinions without

interference and to seek, receive and impart information and ideas through any media regardless of frontiers.

5.9 Group influence

An interesting finding in this study was group influence. Farmers, health personnel and students in educational institutions were greatly influenced by their groups in technology adoption. While the TAM model was fairly successful in explaining perceived usefulness, trust and self-efficacy as having significant effects on user acceptance behavior, it fell short of explaining group influence as was uncovered in this study. In fact, Zhou (2011) is of the opinion that the group influence of online community on user behavior has seldom been examined. To Zhou (2011), online community is composed of members sharing common interests. They interact with each other to discuss topics, exchange ideas and seek support. What this means for farmers, health workers and students in the context of Zimbabwe may be influenced not only by their own motivations such as perceived usefulness, but also by other members and the community at large. This stance appears to be supported by Bagozzi and Lee (2002) who, in their study noted that “social processes are important determinants of decision making for people”.

According to Toral, Martí'nez-Torres and Barrero, (2010) social network theory proposes that online community can be described as a social network composed of nodes and edges, representing individuals and relationships, respectively. Network cohesion, structure and centrality are found to affect community success (Toral et al., cited in Zhou, 2011). These previous studies have found that factors such as perceived usefulness, commitment, trust, self-efficacy and outcome expectation significantly affect online community user participation and knowledge contribution (Zhou, 2011 and Toral et al., 2010). Zhang (2010) reported that sense of community, which includes membership, emotional connection and influence, has an effect on social networking usage. This will also influence affective identity which is known to reflect the senses of membership, belongingness and attachment to the community as was the case in this study. According to Zhou (2011), group norm reflects the congruence of a user's values and goals with those of other members. Group norm is similar to shared vision, which has been found to affect online community users' knowledge sharing (Chiu et al., cited in Zhou, 2011).

6. Conclusions and recommendations

From a theoretical perspective, this research adopted the technology acceptance model (TAM), originally proposed by Davis which is itself informed by the theory of reasoned action to identify the factors affecting user adoption of e-infrastructures in e-health, e-agriculture and e-education. As noted earlier, previous research has used multiple theories including social influence theory, trust theory, commitment theory, social cognition theory, social capital theory and social network theory to explore adoption of technology with some relative success but fell short of a model that addresses the Zimbabwean context. This research, takes a position that the ability to navigate the complex life and work environments in the globally competitive information age requires e-infrastructure developers to pay rigorous attention to technology acceptance. In view of the need to engage e-infrastructure users other than the “early adopters” with the opportunities in e-infrastructures, the study considered it important to recommend a relook into **attitudinal variables as they affect the individual's positive or negative feeling about performing the target**

behavior; the **behavioral intentional variables as they affect** the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior; e-infrastructure **anxieties particularly group influence as far as they affect** the degree of an individual's apprehension, or even fear, when she/he is faced with the possibility of using e-infrastructures. This study appear to point out that e-infrastructure **self-efficacy in so far as it affects** the degree to which an individual beliefs that he or she has the ability to perform specific task/job using e-infrastructure; **effort expectancies in as far as they affect** the degree of ease associated with the use of the system; **facilitating conditions in as far as they affect** the degree to which an individual believes that an organisational and technical infrastructure exists to support use of the system and to provide a point of entry pitched at a level most will not find too difficult coupled with e-learning ease of use tactics so that more users will adopt e-infrastructures as a necessity in their everyday work for sustainable development in Africa. This research appears to enrich previous findings by explaining some of the user acceptance variables in the context of the Zimbabwean culture and context. This may also advances our understanding of user acceptance of e-infrastructures as prior research has mainly focused on the motivations affecting technology adoption in other context or sectors without going multi-sectoral as was the case in this study.

7. Limitations and future research

Some of the limitations of this study are opening up gaps for future research on e-infrastructures in Africa. For instance, it is acknowledged in this research that this study is limited to one African country Zimbabwe. It is hoped that extending the study to other African countries would contribute greatly to our understanding of the user acceptance variable in the African context. This will possibly add external validity to the findings. It can also be argued that within one national culture, we assume the cultural value to be uniform across the population. Yet it is well known that individual differences in cultural orientation are a reality. This may compromise results in that country and future researchers may want to put this into consideration. Other variables not captured in this study may be included in future studies as well to broaden the results and validity of the results.

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