Technology Affordances and Diffusion for Mobile Connectivity and Applications in Zimbabwe

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Technology Affordances and Diffusion for Mobile Connectivity and Applications in Zimbabwe

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Abstract— **The technology acceptance model (TAM) proposes that perceived ease of use and perceived usefulness predict applications usage. Affordances are the interactions between users and tool, i.e. properties of the world that are compatible with and relevant for people's interactions. Affordance offers a distinctive perspective on the use of ICT in education because of its focus on possibilities for action. The paper assesses the value-adding contribution of the concept of affordances, ascertains how its application provides new insights and enables innovation of mobile technology, and investigates how the notion of affordances can be used to assess the diffusion and explore possible applications of mobile technology into Zimbabwe. The main hypothesis being tested was: *"Technology affordances are related to the diffusion of mobile technology in Zimbabwe".* Examples of mobile phone applications used include WhatsApp, games and Ecocash, and potential applications to mobile learning.**

The quantitative methodology was used as the research paradigm and a survey conducted on 15 selected Zimbabwean schools to evaluate the application of TAM to mobile technology and e-learning. Data on infodensity on 18 countries in Eastern and Southern Africa was analysed to assess the relative progress on mobile technology diffusion in Zimbabwe in comparison with other neighbouring countries for the period 2000 to 2012. The FRAME model for mobile learning is adopted as a framework for implementation to manage the process resulting from the convergence of mobile technologies, human learning capacities and social interaction. TAM was partially supported, and the results showed that perceived usefulness is more important in determining intention to use the technology than attitude toward using. However, the high cost of internet bandwidth is a major prohibitive factor to the diffusion of mobile technology and e-learning in Zimbabwe.

Keywords— **ICTs, TAM, technology affordances, mobile learning, e-learning, connectivity, MOOCS.**

I. Introduction

The technology acceptance model (TAM) proposes that perceived ease of use and perceived usefulness predict applications usage. Emerging information technology cannot deliver improved organizational effectiveness if it is not accepted and used by potential users.

The most popular theory behind the diffusion of technology is premised on an acceptance model (Chuttur M. Y., 2009), and this is one of the most successful measurements for computer usage effectively among practitioners and academics. The Technology Acceptance Model (TAM) is an information systems theory that models how users come to accept and use a technology. Fred Davis proposed the Technology Acceptance Model (TAM) in which system use is a response that can be explained or predicted by user motivation, which in turn, is directly influenced by external stimulus consisting of the actual system's features and capabilities (Davis, 1986).

An **affordance** is often taken as a relation between an object, or an environment, and an organism that affords the opportunity for that organism to perform an action. Affordances are the interactions between users and tool. The tool prompts, guides, or constrains the users depending on their previous experiences (Salomon, 1990). As a relation, an affordance exhibits the possibility of some action, and is not a *property* of either an organism or its environment alone. Affordance offers a distinctive perspective on the use of ICT in education and e-business because of its focus on possibilities for action. In order to fully exploit and benefit tremendously from an affordance of the tool, the user must have prior experiences with similar tools (Carter, Westbrook & Thompkins, 1999), domain knowledge (Kozma & Russell, 1997), and must be at an age where they are able to understand or relate to the affordances (Carter, Westbrook & Thompkins, 1999). Norman (1998) says, 'affordance is not a property, it is a relationship that holds between the object and the organism that is acting on the object. The same object might have different affordances for different individuals' (p. 123).

The paper assesses the value-adding contribution of the concept of affordances, ascertains how its application provides new insights and enables innovation of mobile technology, and investigates how the notion of affordances can be used to assess the diffusion and explore possible applications of mobile technology into Zimbabwe.

Interface design is often faced with a tension between tasks and technologies because designs based primarily on the features of a new technology are often technically aesthetic but functionally awkward (Wijekumar K.J. *et al* , 2006). However, designs based primarily on users' current articulated needs and tasks can overlook potential innovations suggested by new technologies. The research paper seeks understanding of both the needs and abilities of prospective users, and equally, the capabilities and limitations of technologies in order to know the possibilities they offer. Examples of mobile phone applications considered include WhatsApp, games and Ecocash, and potential applications to mobile learning.

Statement of the Problem

The technology acceptance model (TAM) proposes that perceived ease of use and perceived usefulness predict applications usage. Affordances describe the interaction supported by the tool for each individual and is affected by their prior experiences. The insightful innovation associated with rapid diffusion of mobile connectivity and its applications in Zimbabwe cannot be explained exclusively by the technology gadgets or the people alone but by the affordances of the technology. This is evidenced by the phenomenal growth of mobile density and wide-scale use of mobile applications such as WhatsApp, games and Ecocash on mobile phones in Zimbabwe.

Purpose or Aim

To investigate on the use of technology affordances to the diffusion of mobile connectivity and applications in Zimbabwe.

Objectives

The objectives of the research are to:

- investigate how the notion of affordances can be used to assess the diffusion and explore possible applications of mobile technology into Zimbabwe,
- assess the usage pattern of mobile technology connectivity and applications in Zimbabwe, and
- assess the value-adding contributions of the concept of affordances in providing new insightful innovation of mobile technology in Zimbabwe.

Research Questions

1. How valuable is the concept of affordances?
2. Does the application of affordances provide any insightful innovation of mobile technology in Zimbabwe?
3. What is the pattern of mobile technology adoption, connectivity and applications in Zimbabwe?
4. How valid is the taxonomic approach on affordances in making us understand the inherent properties of mobile technology?

Research Hypothesis

The main hypothesis being tested is:

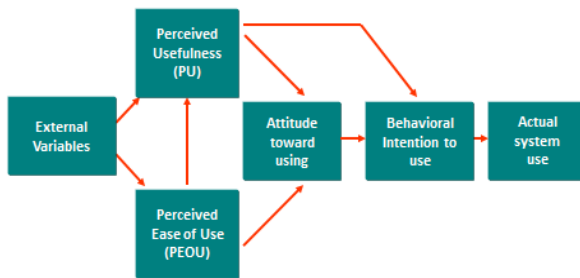*"Technology affordances are related to the diffusion of mobile technology in Zimbabwe".*

II. REVIEW OF RELATED LITERATURE

Fred Davis proposed the Technology Acceptance Model (TAM) in which system use is a response that can be explained or predicted by user motivation, which in turn, is directly influenced by external stimulus consisting of the actual system's features and capabilities (Davis, 1985). TAM is consistent with Everett Rogers (2003) theory on diffusion of innovation where technology adoption is a function of a variety of factors including *relative advantage* and *ease of use*. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it, notably:

- Perceived usefulness (PU) - This was defined by Fred Davis as "the degree to which a person believes that using a particular system would enhance his or her job performance".
- Perceived ease-of-use (PEOU) - Davis defined this as "the degree to which a person believes that using a particular system would be free from effort" (Davis, 1989).

TAM is an adaptation of the Theory of Reasoned Action (TRA), a widely studied model from social psychology which is concerned with the determinants of consciously intended behavior (more general theory) (Chuttur M. Y., 2009). According to TRA, a person's performance of a specific behavior is determined by his/her behavioral intention (BI) to perform the behavior and BI is jointly determined by the person's attitude (A) and subjective norm (SN) concerning the behavior in question (Figure 1).
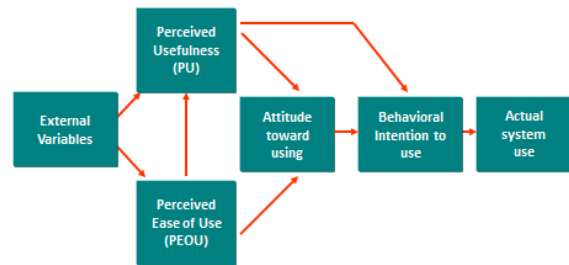
Figure 1: Theory of Reasoned Action (TRA) (Davis, 1986)

TAM attempts not only for prediction but also for explanation to help researchers and practitioners identify why a particular system may be unacceptable and pursue appropriate steps. Therefore, the purpose of TAM is to assess the user acceptance of emerging information technology, and so TAM is more specific and applies only to the use of computers (usage behavior), i.e. TAM addresses the human-computer interface (HCI). Perceived Usefulness (PU) of TAM includes how one can use technology to work more quickly, enhancing job performance, increased productivity, effectiveness and how useful the technology is. Perceived ease of use (PEOU) makes the technology clear and understandable, easy to become skillful, easy to use, controllable and easy to remember. The TAM model (Davis, 1986) is shown on Figure 2 below. According to the TAM, people's computer use can be predicted reasonably well from their intentions, perceived usefulness is a major determinant of people's intentions to use computers, and perceived ease of use is a significant secondary determinant of people's intentions to use computers.

Figure 2: Technology Acceptance Model (Davis, 1986)

Learning outcomes can be derived from noting the change from the gaming affordance to the learning affordance, and these should be addressed immediately. Our ability to distinguish between a future society that can innovate and produce from people who cannot think without a 'game' can be distilled by addressing the affordance issue. When constructing learning environments for primary school (K-12) and older student, designers, researchers, and teachers must look to balancing gaming and learning, engagement and distraction, and concentration and interruptions. The four major reasons of the role of affordances in educational technologies are as follows (Wijekumar K.J. *et al*, 2006):

1. Young learners' expectations of computers are that they will be entertaining and game-like, and so games can be constructed to promote their learning.
2. We can identify transitions to move learners from the game affordances to a learning affordance.
3. It is possible to change affordances of a computer tool for learners.
4. As the numbers of web-based distance learning environments increase and are actually being used by K-12 and older students, we can understand what is going on in learners' minds as they interact with the computer and do multitasking.

Gibson (1977, 1979) developed the concept of affordance and argued for an ecological approach to understanding human perception. He argued that the environment and animals have co-evolved, and so there are features of the environment that afford (i.e. enable) perception and action in that environment. The features are not constructed by the person but exist independently in the environment, and are discovered rather than constructed by the human (or animal) actor. Gibson argues that 'The world of physical reality does not consist of meaningful things. The world of ecological reality … does' and 'their meanings can be discovered' (Gibson, 1979, p. 33).

Conole and Dyke argue that practitioners are often unclear about how to use the technology appropriately and present a taxonomy of ICT affordances as a contribution to solving this problem (Wijekumar K.J. *et al,* 2006). This taxonomy is grounded in the base of 'current social theory and critique' and lists the following affordances:

1. Accessibility - this is where the Internet 'affords' opportunities for accessing information and knowledge in a new way. This affordance faces a primary challenge from finding to selecting relevant information.
2. Speed of change - this refers to attempts to understand the question of how technology can 'be used to enable students to navigate their way through the myriad of changing information and make more informed decisions'.
3. Other affordances relevant to the learner include diversity, communication and collaboration, reflection, multi-modal and non-linear learning, etc. It is argued that 'Perhaps new forms of reflection and critique will emerge in response to more transitory and digital text.' (Wijekumar K.J. *et al,* 2006).

The slotting into a social constructivist approach ignores the quite different theoretical framework within which Gibson developed the concept of affordances. The concept of affordances arises from an ecological approach to human cognition and perception. It appears then that natural home for an approach based on Gibsonian affordances is not social theory, as the concept might have been used to challenge the limits of social theory rather than be simply being assimilated into it (Wijekumar K.J. *et al,* 2006). Gibson's (1979) theory of affordances was adapted to the design of everyday objects by Norman (1988) whose initial work confused the concept of affordances inherent in an object with the idea of perceived affordances. In later work, Norman (1998) clarified the distinction between "real" and "perceived" affordances.

While not making a separate category for affordances that could actually be used, Norman (1998) did note that "the perceived affordances are what determine usability" (p. 123). In contrast to Gibson (1979), Norman (1998) linked affordances closely with the mental and perceptual capabilities of the observer.

Affordance theories are a rich source of useful concepts for describing how attributes of online technologies interact with the other elements of a learning context, including learners, teachers and the physical environment. Affordances are what the environment offers an organism referring "to both the environment and the animal in a way that no existing term does" (Gibson, 1979, p. 127) and were thus seen as properties of the environment relative to a specific organism or group of organisms. The organism's capabilities for action were referred to as "effectivities" with action being a product of the interaction between properties of the environment and characteristics of the perceiver. Perception was seen as emerging from the mutual constraints on action determined by characteristics of both the perceiver and the environment. Affordances were "the attributes that provide potential for action" while constraints were "the conditions and relationships between attributes that provide structure and guidance for the course of actions" (Kennewell, 2001, p. 106). In this view, constraints are not seen as the opposite of affordances but rather as "complementary and equally necessary for activity to take place" (Kennewell, 2001, p. 106).

According to Boyle T. and Cook J. (2004), other theorists have developed different categorisations of affordances based on Gibson's original concepts (Gibson, 1979). Gaver (1991), working in the field of human-computer interfaces (HCI), extended the original definition to include the idea of complex affordances, namely nested, grouped in space, and sequential affordances where "acting on a perceptible affordance leads to information indicating new affordances" (Gaver, 1991, p. 82). Warren (1995) developed the idea of degrees of affordance, in response to a belief that Gibson's (1979) binary view of affordances, as existing or not existing, was too simplistic. Further to this, Turner (2005) argued that affordances should be classified into "simple" and complex affordances that embody such things as history and practice. The alternate view emphasises the impact of technological affordances within a context rather than as discrete from it, where context is seen from a constructivist viewpoint as being something that is "woven together with the act of learning, rather than around it (Boyle T. and Cook J. 2004) , as conveyed by the word 'environment'" (de Figueiredo & Afonso, 2006, p. 12).

The concept of context also refers to "the relationship between a setting and how participants interpret the setting, including the meaning of practices" (Moschkovich & Brenner, 2000, p. 463). Both ICT and other factors contribute to learners' capabilities for bridging the gap between potential and actual activity in a learning setting.

The usefulness of affordance concepts is improved when affordances are seen as being products of a whole learning context, of which online technologies are an integral part, rather than being inherent properties of the technologies in isolation from the context in which they are used. Another way of explaining this context-based concept of affordances is to view technologies as having potential affordances. However, the actualisation of these potential affordances can be understood only with reference to all the contextual factors that act to promote or constrain them. The whole learning context, when examining the use of ICT in education, should consider the importance of the values and beliefs of the teacher with respect to the importance of ICT for learning, the teacher's understanding of the affordances of a range of ICT resources, and how they might best support students in making use of those affordances in learning interactions (Boyle T. and Cook J. , 2004). Knowledge of new affordances provided by the use of ICT in learning environments has increased the complexity of pedagogical reasoning that teachers need to carry out in their planning and teaching (Day et al, 2007). Once teachers have decided what affordances are likely to benefit their students, they can facilitate their students' learning in three ways (Webb & Cox, 2004, p. 239) by:

- providing them with the affordance;
- increasing the degree of an affordance provided by ICT, for example by prompting students to predict the results of a simulation; and
- giving students additional information about an affordance, for example by explaining and demonstrating a feature of software.

There has been a rapid growth in online learning environments and associated tools to support learning and research. These include communication systems (email, discussion boards, synchronous chat), authoring and assessment tools, as well as integrated learning environments such as Blackboard and WebCT (Conole, 2004). Coupled with this, there is now a range of tools to facilitate information management including commercial products and subject-specific information gateways.

Information overload, coupled with confusion of where to look, is increasingly problematic and, despite a growth in the range of searching tools and portals, it is not evident that the right information is being dispatched to the right users in a timely and quality assured fashion (Conole, 2002). Research into the use of ICT has increased significantly in the last decade and there is evidence that learning technology as a research discipline is now beginning to mature (Conole et al., 2003). However, research still tends to focus on particular case studies rather than the development of underpinning theories and approaches (Conole, 2004). Furthermore, little is understood about the 'affordances' of different technologies and, more specifically, how these properties might be exploited in particular learning and teaching contexts.

The best example of the increased use and importance of ICT is the now ubiquitous use of the PC as a work tool and the replacement of many traditional work modes of communication, such as memos, with online communication via email (Conole, 2004). There has been a commensurate growth in the use of technology to support learning, fueled by the increased use of all-in-one software such as virtual learning environments. There has also been a growth in the amount and variety of resources to support learning and research, through specialized gateways and portals, and niche resource providers. The types of software tools, hardware systems and online environments have also increased in variety and complexity, with tools now available to support everything from research publication management to online assessment and monitoring (Conole, 2004).

E-learning is learning supported or enhanced through the application of Information and Communications Technology (ICT), and has become an important pillar in open and distance learning. E-learning encompasses supported learning, blended learning and to learning that is delivered entirely online. E-learning is main driven by advances in mobile technologies, demand for ubiquitous services by learning providers, and mobile operators who are promoting new applications, services and markets.

Mobile learning (m-learning) is digital mobile learning that is facilitated and enhanced by the use of digital mobile devices that can be carried and used anywhere and anytime. ***Mobile and ubiquitous learning*** concept is different from e-Learning. It is of paramount importance, therefore, to develop a reference mobile-learning architecture that is attractive to key actors encompassing adaptive human interfaces, context-awareness tools, collaborative learning environment, and integration of mobile media delivery and learning content management systems.

Successful case studies on mobile learning assessed by Traxler J. (2009), include the following approaches:

1. Technology-driven mobile learning where specific technological innovation is deployed in an academic setting to demonstrate technical feasibility and pedagogic possibility;
2. Miniature but portable e-learning that uses mobile, wireless, and handheld technologies that re-enact approaches and solutions already used in conventional e-learning;
3. Connected classroom learning that support collaborative learning and may include interactive whiteboards;
4. Informal, personalized, situated mobile learning enhanced with additional functionality to deliver educational experiences;
5. Mobile training/ performance support to improve the productivity and efficiency of mobile workers; and
6. Remote/rural/development mobile learning that addresses environmental and infrastructural challenges of delivering and supporting education over w wider geographic dispersion.

M-learning standards are purposed to:

- Ensure resources are compatible with baseline delivery contexts and hardware platforms;
- Exploit the capabilities of specific devices to maximise quality and usability, and provide alternative formats for a range of devices; and
- Organize the architecture according to client platforms, mobile content development, mobile content delivery, and mobile content support.

The Framework for the Rational Analysis of Mobile Education (FRAME) model describes mobile learning as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction. The researcher recommends the adoption of this model as it addresses contemporary pedagogical issues of information overload, knowledge navigation, and collaboration in learning. The FRAME model guides the development of future mobile devices, the development of learning materials, and the design of teaching and learning strategies for mobile education (Koole M. L., 2009). In the FRAME model, mobile learning experiences are viewed as existing within a context of information consumed and created by learners collectively and individually. Within this context of information, the FRAME model is represented by a Venn diagram in which three aspects intersect (Figure 3).
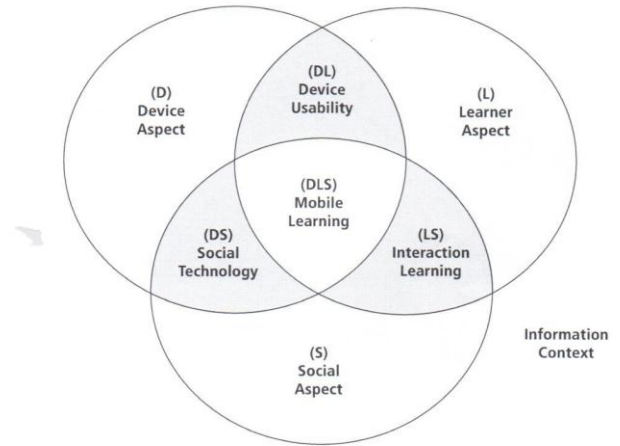
Figure 3: The FRAME model (Koole M.L., 2009)

The three circles represent the device (D), learner (L), and social (S) aspects and where the intersections contain attributes that belong to both aspects. The attributes of the device usability (DL) and social technology (DS) intersections describe the *affordances* of mobile technology. The intersection labelled interaction learning (LS) contains instructional and learning theories with an emphasis on social constructivism. All three aspects overlap at the primary intersection (DLS) in the centre of the Venn diagram, which defines an ideal mobile learning situation (Koole M.L., 2009) where more effective mobile learning experiences may be explored.

Learners can interact through wireless networks, but these may be constrained by low bandwidth and limited input/output capabilities of the devices. According to Koole M.L. (2009), the advantages of mobile learning include the following:

- ❑ Wireless, networked mobile devices can enable learners to access relevant information when and where it is needed at various locations.
- ❑ The ability to access a variety of materials from anywhere at anytime can provide multiple cues for comprehension and retention.
- ❑ Learning within specific contexts can provide authentic cultural and environmental cues for understanding the *uses* of information which may enhance encoding and recall.
- ❑ Well-implemented mobile education can assist in the reduction of cognitive load for learners. While it is difficult to determine how to chunk information, differing patterns of presentation and amounts of information can potentially help learners to retain, retrieve, and transfer information when needed.

There is a need to take advantage of rapid developments in ICT and rich sources of content, and invest in high quality learning, to remain globally competitive against the challenge from international and private providers. *Online learning* can be used to enhance student choice and meet learners' expectations; realignment of training and development to support academics to play a leading role in online provision; and the development and sharing of open educational resources to enhance efficiency and quality. *Massive open online educational courses (MOOCs)* are only a segment of the distance education and online course delivery landscape that has existed for years. Educational technology, such as MOOCs, requires fundamental items to be setup and implemented successfully and these are power, Internet connectivity and bandwidth, quality teacher training, respect and better pay for teachers, and the sustainability of implementations. MOOCs have been criticized for their low completion rates due to challenges of financial sustainability and accessibility to them by those who have limited or no access to reliable power, Internet connections, ICTs, and educational support (Wright C.R., 2014).

The quality assurance of post-traditional higher education has become more complicated due to the openness and flexibility dimensions. Openness is an increasing factor in mainstream education, with value being attached to concepts such as open content, open data, and open educational resources (OER), along with notions of transparency and easy access to data and information (Butcher N. and Wilson-Strydom M., 2013). The emergence of massive open online courses (MOOCs) has changed the landscape of quality assurance. The term MOOCs originated in 2008 from a web course based on an extensive and diverse set of content, contributed by a variety of experts, educators, and instructors, and aggregated into a central repository. All course materials and the course itself were open source and free, with the option of a paying a fee for those wishing to obtain university credit. However, the MOOC concept took a very different turn in 2012, when a number of top-notch universities offered informal learning on various topics to large global audiences using a very traditional instructional model. Students who passed the computerized tests could not obtain credit, and in most cases the study materials did not carry open licenses (Butcher N. and Wilson-Strydom M., 2013).

Existing institutional courses have often simply been translated into a web-based environment and made available to all (Butcher N. and Wilson-Strydom M., 2013).

Whilst the two types of courses, often called *cMOOCs and xMOOCs* respectively, have some common features, they clearly differ in the learning theory and pedagogical model they employ – in particular, the ways in which social interactions happen during the courses. Furthermore, the concept of openness behind each of the formats contrasts sharply.

- cMOOCs are based on a philosophy of connectivism and networking, where students learn from educators and from each other in online course environments that are largely community constructed and driven.
- xMOOCs tend to follow traditional behaviourist approaches to learning and the structure of existing educational practices. They typically have traditional course structures, content, and methods, with videotaped lectures, online quizzes, and weekly assignments. Their primary innovation is scaling.

Despite their differences, MOOCs offer learning opportunities to millions of people and have the potential to reach and serve very large numbers of learners who would otherwise not have access to education. This provides learning close to zero cost, enabling students, lifelong learners, and professionals to acquire new skills and improve their knowledge and employability. The pedagogical styles of MOOCs have also diversified greatly with recent offerings having features of both cMOOCs and xMOOCs.

III. METHODOLOGY

The research used the quantitative methodology and research design is a survey. Diffusion of mobile technology is assessed mainly through the trends in usage patterns with respect to the major ICT indicators such as teledensity, mobile density and internet penetration levels. Data on infodensity was obtained from the International Telecommunications Union (ITU)

(http://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx).

Data on Infodensity covered 18 countries in East and Southern Africa for the period 2000 to 2012. The 18 countries covered by the qualitative study are South Africa, Angola, Bostwana, Burundi, D.R. Congo, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, Swaziland, Tanzania, Uganda, Zambia and Zimbabwe.

A survey was conducted on 15 selected Zimbabwean schools in May 2012 to evaluate the application of TAM to mobile technology and e-learning.

The main hypothesis being tested was: *"Technology affordances are related to the diffusion of mobile technology in Zimbabwe"*. The survey method used is good for comparative analysis, got lots of data in a relatively short space of time and was cost-effective. The questionnaire used solicited data on the following areas:

1. Progress on the implementation of the national e-learning programme and how the schools have responded to it
2. Computing facilities and networks currently available at the school
3. Internet bandwidth services, costs and management
4. Perceived use of ICT and the ICT tools in use
5. Progress on the diffusion and adoption of mobile technology and ICT
6. Value addition of ICT to the teaching and learning process.
7. The inter-linkages between technology diffusion and affordances of the interaction.

IV. RESULTS AND ANALYSIS

The ICT indicators are measured by penetration rates with respect to teledensity, internet, number of computers per 100 people and the mobile density. The ICT usage patterns in Zimbabwe were assessed through Infodensity for various ICT indicators for the period 2000 to 2012.

The Southern African Development Community (SADC) fixed telephony, mobile cellular and internet penetration rates for the period 2000 to 2012 are shown below on Figures 4, 5, and 6, respectively using data obtained from the ITU. The fixed telephony penetration rates have not changed for the period 2000 to 2012. The mobile cellular penetration rate has grown significantly for the SADC countries, notably Botswana and Zimbabwe are on the leading edge. Botswana, Mauritius, South Africa and Zimbabwe now have a mobile density that is 100% and above, as shown on Figure 5. Individuals with access to internet are shown on Figure 6, where Mauritius and South Africa have 40% penetration rate and Zimbabwe is at 17.9%.
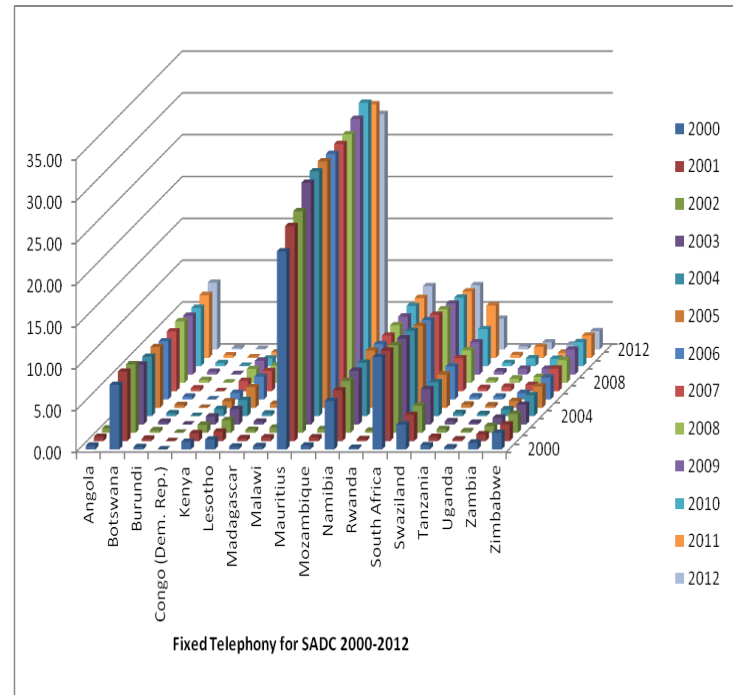
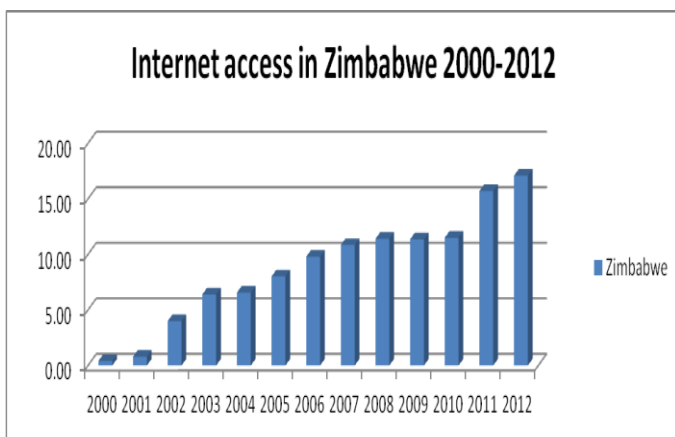**Figure 4: Fixed Telephony For Sadc Countries For 2000-2012.**
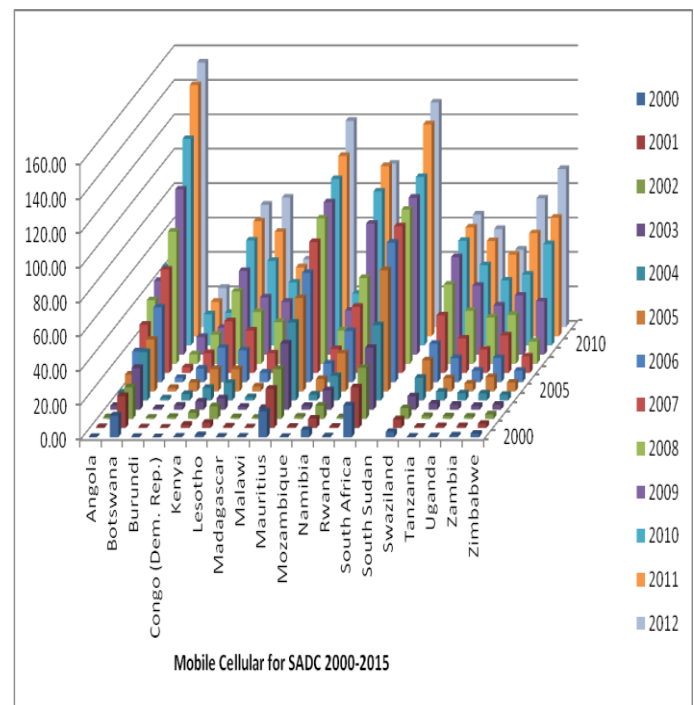
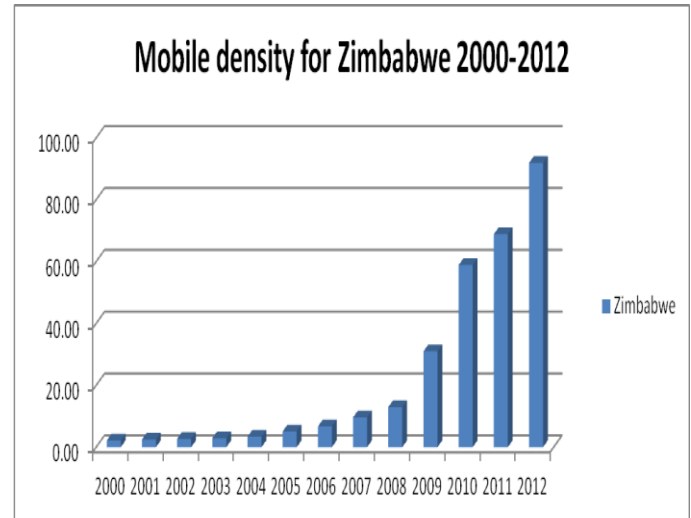**Figure 5: Mobile Cellular For Sadc 2000-2012**
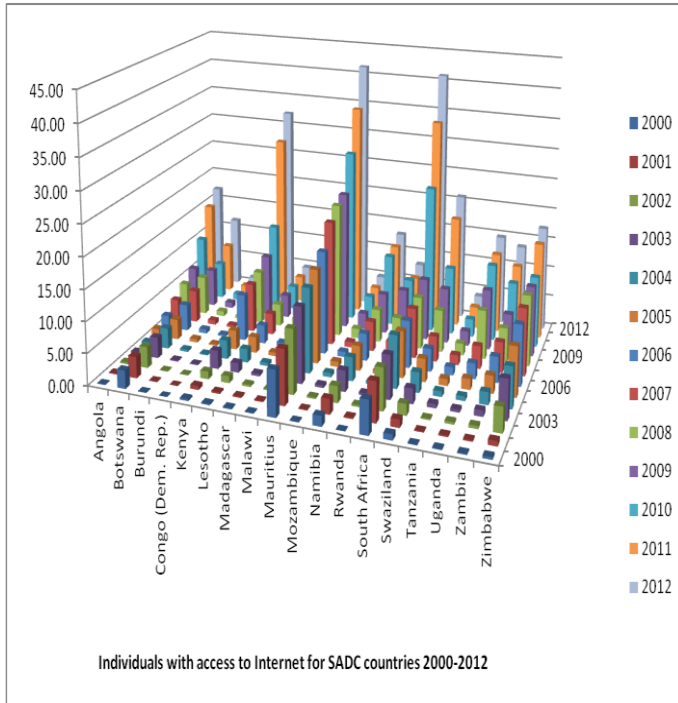
Figure 6: Individuals With Access To The Internet For Sadc For 2000-2015

Figure 8: Mobile Density For Zimbabwe 2000-2012

The penetration rate for internet and mobile density for Zimbabwe for the period 2000-2012 are shown on Figures 7 and 8, respectively. Individuals with access to internet in Zimbabwe were 15% of the total population in 2012 and this has been rising steadily. The mobile density of Zimbabwe experienced a phenomenal growth between 2008 and 2012, now about 100% in 2014.

Zimbabwe, together with the rest of the SADC countries, has experienced a significant growth in mobile cellular subscriptions and internet penetration rates. The ICT development index has grown steadily from the year 2000 to 2012. However, Zimbabwe experienced one of the highest mobile density increases from 2007 to 2012 due to the enabling environment created by the Government of Zimbabwe. The introduction of mobile-broadband services coupled with the availability of smartphones and tablet computers, has contributed to the phenomenal increase in mobile broadband subscriptions. In Zimbabwe, we have seen the shift from the traditional mobile-cellular services, such as voice and SMS, towards mobile-web services, and thus shifting mobile traffic volumes from voice to data. Example mobile phone applications commonly used in Zimbabwe include WhatsApp, games and Ecocash, and potential applications to mobile learning.

The research paper examined TAM using school pupils' acceptance of mobile technology and e-learning. Generally, it was observed that TAM was partially supported based on data collected from 15 selected Zimbabwean schools. The utility of TAM for explaining acceptance of mobile technology and e-learning by learners was evaluated. Results showed that perceived usefulness is more important in determining intention to use the technology than attitude toward using. In agreement with what TAM postulates, perceived usefulness was found to have a significant influence on students' intention to use the technology in learning, i.e., it is in accordance with Davis (1989) who found attitude toward using was at best a partial mediator of the effect of perceived usefulness on intention to use, and that it added little causal explanatory power.

Figure 7: Internet Penetration Rate For Zimbabwe 2000-2012

However, the costs for bandwidth per month is a major obstacle to the fast diffusion of mobile technology and e-learning in Zimbabwe. Whilst the mobile density in Zimbabwe has risen astronomically to 100%, the internet penetration rate is still lagging behind at about 40% because of the prohibitive cost of internet bandwidth.

V. Conclusion

The technology acceptance model (TAM) proposes that perceived ease of use and perceived usefulness predict applications usage. Affordances are the interactions between users and tool, i.e. properties of the world that are compatible with and relevant for people's interactions. Affordances, when perceptible, offer a direct link between perception and action. Affordance offers a distinctive perspective on the use of ICT in education because of its focus on possibilities for action. The paper assessed the value-adding contribution of the concept of affordances, ascertained how its application provides new insights and enables innovation of mobile technology, and investigated how the notion of affordances can be used to assess the diffusion and explore possible applications of mobile technology into Zimbabwe. Examples of mobile phone applications observed and considered include WhatsApp, games and Ecocash, and potential applications to mobile learning.

The quantitative methodology was used as the research paradigm and a survey conducted on 15 selected Zimbabwean schools to evaluate the application of TAM to mobile technology and e-learning. The main hypothesis being tested was: *"Technology affordances are related to the diffusion of mobile technology in Zimbabwe".* Data on infodensity on 18 countries in Eastern and Southern Africa was analysed to assess the relative progress on mobile technology diffusion in Zimbabwe in comparison with other neighbouring countries for the period 2000 to 2012. The FRAME model for mobile learning is adopted as a framework for implementation to manage the process resulting from the convergence of mobile technologies, human learning capacities and social interaction.

A mobile strategy and mobile web framework is recommended for adoption. E-learning is learning supported or enhanced through the application of Information and Communications Technology (ICT), and has become an important pillar in open and distance learning. The Framework for the Rational Analysis of Mobile Education (FRAME) model describes mobile learning as a process resulting from the convergence of mobile technologies, human learning capacities, and social interaction.

The FRAME model guides the development of future mobile devices, the development of learning materials, and the design of teaching and learning strategies for mobile education (Koole M. L., 2009). Generally, TAM was partially supported based on data collected from 15 selected Zimbabwean schools. The results showed that perceived usefulness is more important in determining intention to use the technology than attitude toward using. However, the costs for bandwidth per month is a major obstacle to the fast diffusion of mobile technology and e-learning in Zimbabwe. Whilst the mobile density in Zimbabwe has risen astronomically to 100%, the internet penetration rate is still lagging behind at about 40% because of the prohibitive cost of internet bandwidth.

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