
Innovation in the Use of GSM networks by International Students

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Abstract

Global System for Mobile communication (GSM) widely uses cell phone technology with its convenience to communicate using wireless devices. As a result of technological advances, a broad spectrum of mobile computers and devices has opened up some choices for users for competition, creativity and innovation. Despite nagging challenges to the deployment, acceptance and the use of GSM networks in the developing world, the services are popular among vast populations in most parts of Africa. In the emerging landscape of GSM networks research, there is over-concentration on technical challenges, need to improve coverage and strength of network or radio. Surprisingly, there is little focus on human and social contexts of GSM networks. The use of GSM networks is often regarded by many as a form of innovation. Consequently, the current research represented a distinct standpoint to view students' creativity and behaviour in the use of GSM networks. As a result, the overriding aim was to shed further light on the understanding of human behaviour, utilisation and choice of GSM network by users. Accordingly, the population comprised international students at the University of KwaZulu-Natal, UKZN, Pietermaritzburg Campus, South Africa. The study explored the social and behavioural factors that impact the students to introduce innovation in their use of GSM networks. The study adopted an interpretive paradigm and employed a dominant qualitative and less dominant quantitative method, using a survey research design with a sample of 50 students. The theoretical framework adopted was the Unified Theory of Acceptance and Use of Technology model (UTAUT) to inform the purpose of the research. Findings indicated factors that influence the innovative use of GSM networks to include: perceived usefulness and ease of use, among others. The significance of the study was the improvement in our understanding of the application of a model of technology adoption in the context of GSM networks. Finally, the research advanced new possibilities for the use of GSM networks.

Keywords: Innovation, Global System for Mobile communication (GSM), International Students, network providers, human and social contexts, the UTAUT model and Africa.

Introduction

The Global System for Mobile communication (GSM) networks has become the choice of many for diverse forms of communication services. These services include video, voice calls, Multimedia Message Service (MMS), Short Message Service (SMS), Voice Over Internet Protocol (VOIP), Internet surfing, M-banking, e-payment and other data services. Steenbruggen, Borzacchiello, Nijkamp and Scholten (2013) illustrated that GSM operates using a subscriber identity module (SIM) into a mobile station (GSM network). It is the SIM that transmits the personal number assigned to individual mobile users. Fortunately, Dahunsi and Dwolatzky (2012) highlighted the widely used GSM-enabled mobile networks in South Africa. The study revealed that GSM network services have covered e-government delivery, education, entertainment, industry, banking, health sector, transportation, traffic management, Global Positioning System (GPS), m-learning and e-learning to name a few. The future improvements of GSM networks at various stages of completion are being considered and deployed in North America and Europe. The allure to GSM networks for data services has been most prevalent in the developing world and particularly in Nigeria and South Africa in the past decade or so in the absence of other alternatives.

The Internet and wireless networks continue to lead new media, digital and interactive media and new opportunities. There is the transformational agenda of e-learning and m-learning that has resulted in higher data rates (Yang, 2012; Jacob and Issac, 2014). Thus, students and faculty now access learning resources and data services within the campuses and remotely. For instance, the e-learning system is home for module and learning tools for students at the UKZN. The online platform provides flexible access to teaching materials using mobile devices. Although the UKZN is a traditional institution that blends classroom instruction with e-learning systems, the “wireless possibilities,” affordable GSM network services continue to improve the quality of higher education and a “network society.”

Meanwhile, the digital and network infrastructure cannot function in isolation of the users. For instance, there are layers of GSM infrastructure that exist in the social and environmental contexts. In other words, for GSM networks to reach their full potentials there is the need to improve the understanding of human and behavioural factors in the context of GSM networks. Moreover, whereas many studies have highlighted several advances of wireless network infrastructure there are no corresponding improvements in the understanding of social and human settings of GSM networks (Liang and Yu, 2015; Osseiran *et al.*, 2013).

Nevertheless, several researchers have often categorized the use of GSM networks as closed to innovation (Acker, 2013; Steenbruggen *et al.*, 2013; Sierpiński, Celiński, 2012). Also, there has been substantial research focus in Information Science (IS) literature on the use of smartphones, Personal Digital Assistants (PDAs) and other mobile devices by the youths, teenagers, the elderly, businesses, farmers, professionals, healthcare, governments, military and students across a broad spectrum of contexts. However, very little has been mentioned about the human and social factors that motivate users and innovations in GSM networks in the context of higher education in South Africa. The purpose of the study was to investigate innovation and creativity in the use of GSM networks by international postgraduate students in the School of Social

Sciences at the Pietermaritzburg Campus of the University of KwaZulu-Natal, South Africa. The choice of international graduate students was predicated on a need to obtain rich and diverse data for context-specific issues deemed fundamental to the research. After all, this category of students holds a potential for a much broader perspective based on the cross-cultural adaptation of the use of GSM networks (Lee, Trimi and Kim, 2013; Viberg, Grönlund, 2013). Besides, the aim of this approach was adequate to examine the contexts of a group of international postgraduate students as a pilot study ahead of a UKZN-wide survey. Whereas the diffusion of smartphones and GSM networks continues to be a global phenomenon, little is known about their affordances, impact and effect on the human and social context of users (Saramäki *et al.*, 2014). Also, the researchers reported users' innovation and creativity in the context of social media, e-learning, m-banking, e-medicine and other information systems but how users make use of GSM networks is not well understood (Steenbruggen, *et al.*, 2013; Liu *et al.*, 2013). Literature in this area of study is usually too broad. Thus, the present study provided a narrow focus on GSM networks and the human behaviour of users. The context of a developing country, South Africa was used to informing global knowledge in the field. The study employed the Theory of Acceptance and the Use of Technology (UTAUT) by Venkatesh, Morris, Davis and Davis (2003) as the study pragmatic lens. Innovation and GSM networks have emerged in recent years in the provision of fast, secure, flexible, affordable and reliable data services via GSM networks to a vast number of people. Some of these innovations in the context of education have included Learning Management Systems (LMS) and cutting edge technologies to students in higher education and the ample use of GSM network services by students for their social, communication, learning and other needs. There is a need to understand how these users adopt and use GSM networks in their learning environments by exploring human and social factors that may influence postgraduate students in their choices. The study addresses these issues; the research has identified the following research questions.

Research questions

The study covered two critical interrogations. These are:

1. How do students introduce innovation in the use of GSM networks to adapt to their learning environments?
2. What are the core human and behavioural factors that affect students' innovation and creativity in the use of GSM networks?

Literature Review

The guided framework for the review of the literature by the main themes emerged from the study's research questions. The scope of the review covers academic journals; peer-reviewed conference proceedings and research synthesis in international and African contexts.

GSM Networks

GSM network architecture is designed to initiate and receive wireless calls over a radio link within and outside a wide geographic area through connection to a cellular network provided by a mobile phone allowing access to the public telephone network through a service provider (Agarwal, Chandra, Wolman, Bahl, Chin and Gupta 2007). GSM networks have thrived as a result of the development of mobile phones as early as 1973 and with improvements in design,

capabilities and functionalities Over the years there has been an improvement in their diffusion to be fast when compared to other technologies (Leung, 2007). Acker and Mbiti (2010) opined that mobile telephony has brought a new lease of life across Africa traversing both urban and rural divides, cell phones connect individuals to individuals, information, markets, and educational services. Aiyedogbon and Obumneke (2014) described mobile phones as they connect people, information, markets, and services. ITU (2009) reported that telephony in sub-Saharan Africa had increased dramatically over the past decade showing that sixty percent of the population has a mobile phone and access to its coverage and bringing Africa, many possibilities. Tabbane (2014) described GSM (Global System for Mobile Communications) as a digital cellular standard used in over 100 countries for personal and official communication. The study further pointed to GSM as offering a data transmission service with an output that is limited to a maximum of 9.6 kbps. GPRS (General Packet Radio Service) when used. The study further indicated that GSM service also provides for efficient Internet service access with an output of up to 115 kbps, allowing faster communications with the potential to give access to teaching and learning remotely.

In recent time, third generation GSM systems are being considered and are also known as universal personal communication networks (PCNs) (Lund *et al.*, 2014; Yap *et al.*, 2010). Additionally, PCNs will enhance personal mobility by employing lower power handsets. The emerging developments will support a single handset for cellular and cordless application leading to the improvements in quality of service.

Tiamiyu and Mejabi (2012) explained that number portability or operator portability allows telephone subscribers in their GSM network to hold on to their SIM numbers even when they migrate to other GSM network providers and subscribed services or move to new locations. Meanwhile, the functionality that enables a subscriber of a fixed service location to retain the SIM number even after changing positions is known as location portability. After all, portability allows for flexibility for users and provides seamless access to the users of GSM services irrespective of the home service provider. The current research used the lens of number portability to view user behaviour and evidence of innovation in the use of GSM network services. For instance, the present study investigated the influence of the portability feature on the innovative use of GSM networks.

Also, Wei and Lo (2014) indicated that GSM networks supplement the fixed telephone as a means of strengthening family bonds and expanding psychological relationship thereby facilitating the typical approach to the people they call and converse with the preceding from existing studies show the benefits of GSM networks as majorly focused on personal and business with little or no attention directed to the advantages that can accrue to improve education: The increased benefits of GSM particularly to higher education with a growing need for innovative adaptation of mobile technologies for teaching and learning with improved outcome to learners and lecturers. Valk, Rashid and Elder (2010) examined the extent to which the use of mobile phones helped to improve educational outcomes through improving access to education and in the promotion of new learning strategies in the contexts of Asia and particularly Bangladesh, India, Mongolia, Thailand, and the Philippines. Likewise, Valk *et al.* (2010) provided evidence in the developing world that mobile phones through GSM networks can innovatively impact on

educational outcomes by facilitating increased access to how mobiles phones affect educational outcomes by promoting new learning. The current study focused on the lesser known human and social factors that influence international students to use GSM networks to adapt to their learning environment and needs at UKZN in South Africa.

Finally, the emergence of GSM coverage in South African began in 1992 to enable mobile phone specifications to run on operating frequency bands (Mutula, 2002). The debut was soon followed by the emergence of 2G and 4G data services on GSM platform through features that include SMS text messaging with limited data transfer rates (Gupta, 2013). The study highlighted the 3G networks as offering faster data transfer rates and enabled video calls. The 3G network is thus suitable for use in modern smartphones that require a constant high-speed internet connection for many of their applications. Meanwhile, Yamao *et al.* (2000) described 4G as the fourth generation of mobile phone communications standards that provides ultra-broadband internet access for mobile devices. The high data transfer rates make 4G networks suitable for use with USB wireless modems for laptops, cell phones and home-based Internet access required for innovative use of learning by the international postgraduate students. The 3G and 4G platforms thus enable innovation technologies in the utilization of the networks. The traditional service providers in South Africa include Vodacom, MTN, and Cell C networks. Chigona *et al.* (2011) described mobile network operators in South Africa to include MTN, Cell C and Virgin Mobile with the following market share; MTN 11.4 million subscribers (32%, Cell C 8% (2.9 million) and Virgin Mobile having 21.6 million subscribers. Given the high rates of the adoption and the use of GSM providers and services in South Africa, it becomes critical to measure new user behaviour and strategies employed to improve the user experiences of GSM networks in the social contexts of students. The following section presents the review of existing literature on international students in the context of GSM networks.

International Students and GSM Networks

The characteristics of international education enjoyed by students are promoted in universities all over the world today by the support accruing from the telecommunication infrastructure. The support is channelled particularly through GSM networks that allow innovative use of technologies such as video calls, conference calls, MMS, graphics sharing and other social network features. For instance, Spencer-Oatey (2013) revealed that international collaborations are frequent in university strategies of teaching, research, and learning as a way of promoting internationalization, often about achieving greater connectivity among staff and students from different backgrounds. The achievement is on students' mobility interest and the implications of the dynamic patterns of cross-border study on a different meaning in developed and developing nations using the GSM innovatively to enhance scholarship. Bhandari and Blumenthal (2013) indicate that in the United States, international students have a growing impact on state economic development supporting ongoing efforts to internationalize campuses through academic activities on smartphone platforms. Lee (2013) reported that numerous studies focus on the general use of technology such as the use GSM networks for innovation in the delivery of course materials, learners' preparedness and usage of mobile learning with some research geared at examining the particular affordances of cell phones for learning. The examination is very similar to the current study that focused on related social reasons that inform the behaviour of international students in their choice of GSM network. However, this study uses the lens of the UTAUT model to

investigate the effect of human and social factors on the creative and innovative use of GSM networks by international students. The study approach is a departure from previous related studies that often were not underpinned by any methodological framework.

Meanwhile, Dzandu, Boateng, and Dzandu (2014) revealed that the most significant determinant of the students brand choice of GSM networks was perceived quality although price, prestige, and promotion also influenced their choice of mobile. Also, Yasin, Noor and Mohamad, (2007) reveal that the origin of the country also decides the selection of GSM brand preference by international students. Karjaluo, Töllinen, Pirttiniemi and Jayawardhena (2005) identified specific factors that have a significant impact on choosing particular service providers such as call rates, services and network coverage. While, Kalpana and Chinnadurai (2006) proposed that among all other influencing factors, advertisement plays a prominent role in deciding on choosing a particular brand of GSM network. The reviews mentioned above are limited to determining the factors that affect the choice of GSM networks by users. Meanwhile, the current research focused on context-specific issues to explain better the factors that are directly related to innovation in user experiences of GSM network services.

The location of the current study, the University of KwaZulu-Natal (UKZN) is a relatively new institution but a leader in African scholarship in the list of Academic Ranking of World Universities (ARWU). UKZN has been ranked among the top ten universities in continental Africa continuously in the last five years (ARWU, 2015) shows that the institution is a leader. The institution has a significant international postgraduate entry covering West, East and Central Africa. According to Zewotir, North and Murray (2015) graduates' international students come mostly from developing countries to study at the UKZN. Furthermore, most postgraduate students in the School of Social Sciences at the Pietermaritzburg Campus (PMB) come from countries where the capacity to educate students at the postsecondary level remains limited. In other words, the country of origin of most of the postgraduate students often lacks access to a wider range of options required for higher education (Wildavsky, 2012). The next section on theoretical framework demonstrates how the constructs of the UTAUT model underpinned and informed the study.

Theoretical Framework

The current study adopted the Unified Theory of Acceptance and Use of Technology model by Venkatesh, Morris, Davis and Davis (2003). The study found that a review of all the previous models of technology by the originators of the UTAUT model in the formulation of UTAUT. The core constructs of the UTAUT includes performance expectancy, effort expectancy, social influence, and facilitating conditions. There is little doubt that the UTAUT is a valid model to explain variables of technology adoption (Thomas, Singh and Gaffar, 2013; Abatan and Maharaj, 2013). Consequently, directly linked are the following core constructs of the UTAUT model to the two research questions of the present research. Performance expectancy, effort expectancy (their offshoots such as perceived usefulness (PU), relative advantage and outcome expectations. Also, perceived ease of use (PEOU), social influence and facilitating conditions (behaviour, attitude, intention, actual use, and technical support). Presented next is the choice of research approach for this study.

Research Approach

The study adopted a survey design approach for the research with convergent methods using both the qualitative and quantitative approaches. A Self-designed interview schedule and a survey questionnaire were employed to gather data from the respondent with the implementation of multi-sampling techniques for selection of those surveyed. Several previous studies have used a similar methodological approach (Groves *et al.*, 2013; Martins and Lambe, 2013) thus providing enough evidence to support the choice of the approach to this study.

Population and Sample

The University of KwaZulu-Natal (UKZN) currently has five colleges that include Humanities in five campuses at Howard, Edgewood, Medical School, Pietermaritzburg and Westville (Majyambere and Hoskins 2015). As a result of limited resources and proximity, the researchers in the current study have limited the survey to cover only the School of Social Sciences (in the College of Humanities) at the Pietermaritzburg Campus (PMB). In tandem with the suggestions of Merriam, and Tisdell (2015), the study is exploratory of a much wider project that will be conducted UKZN-wide in the future. The PMB Campus has a total number of 1,366 registered postgraduate students in the College of Humanities in 2015. The statistics from the International Students Office show that there are over 50 registered international graduate students in the School of Social Sciences at the College of Humanities at the PMB Campus. This group constitutes the focus of the survey. At the School of Social Sciences (PMB campus), a simple random sampling technique was applied to select 50 postgraduate students. The justification of small sample size was based on Crouch and McKenzie (2006) with an assumption that depth and reflexivity are evoked by studies requiring small sample sizes. After all, the research approach made use of both quantitative and qualitative methods for a purpose. For instance, one of the purposes was to penetrate the social life of the students under the survey beyond the ordinary manifest meanings and appearances. Thus, the research required immersion in a fruitful relationship with the study participants in a way to address the research questions. Consequently, the small sample size and the issue of representativeness have little effect on the overall purpose of the research. Consider that 50 participants were deemed adequate. Table 1 provides a breakdown of the sample based on the disciplines in the School of Social.

Table 1: Sample Distribution

S/N	Thematic Clusters/Disciplines in the School of Social Sciences	Sample size
1	Culture	10
2	Development	10
3	International and Public Affairs	20
4	Society and Social Change	10
	Total	50

Instrumentation

The research employed a survey questionnaire and an in-depth interview. The survey questionnaire was self-designed and had items adapted from various scales used in previous related literature (such as Park and Chen, 2007; Adeleke, Suraju, 2012; Biebuma and Esekhaigbe, 2016). Thus, this approach supported the reliability and validity of the instruments

since the previous studies had validated the tools. Also, the constructs of the survey questionnaire were measured to examine the human and behavioural factors that may affect students' decision for innovative use of GSM networks. The review of the literature and the constructs of the UTAUT model informed the study. The survey questionnaire maintained a five-point Likert scale in the collection of data, while, in the case of the interview, a schedule was made to guide the sessions. The research questions of the study and the constructs of the UTAUT model guided the items included in the interview plan. The next section indicates the data quality, validity, and reliability.

Validity and Reliability

The exploratory factor analysis examined the factor structure of the 12-item questionnaire. Before this time the analysis obtained a chi-square value of 6803.06 and a significant level of 0.05. The value suggested that the inter-correlation matrix contained sufficient common variance to make the factor analysis worthwhile. The analysis used the extraction of principal component factor analysis, and iterative sequence techniques. Also retained at this stage was nine predictor factors and no further deletions made. In summary, the factor analysis returned nine factors, and these were: personal innovativeness, result demonstrability, image, subjective norm, perceived behavioural control (PBC), perceived ease of use (PEOU), perceived usefulness (PU), behavioural intention (BI), social influence (SI). It also found that the nine factors explained 75% of the variance in the data set and no cross-loading. The nine factors tested for reliability using a Cronbach Alpha test. Sechrest (1984) suggested that the score for each construct should be greater than 0.6 to be considered reliable. The Cronbach Alpha (reliability) ranged from 0.8 to 0.9 and was found to be appropriate for further analysis. Meanwhile, interview data were subjected to trustworthiness criteria—transferability, consistency, credibility, dependability and bracketing based on Lowes and Prowse, 2001). Further analysis embarked on the whole conducted in the research upon the results of reliability and validity tests performed.

Data Analysis and Results

The ordered presentation style is the sequence of the research questions of the study. The first sub-section below presents the findings from the exploratory data collection. Meanwhile, strictly guided subsequent sub-sections follow the critical issues in the study.

The methodology adopted a dominant qualitative and less dominant quantitative approach. Accordingly, the findings from the preliminary exploratory study show that all the key GSM networks in South Africa are common among the international postgraduate students in the UKZN. There is evidence to suggest that the choice of network provider is country-dependent. In other words, depending on their country of origin as perceived reasons for selection include customer base and reliability cost, popularity and communication features. Table 2 below presents some of the main statements from respondents.

Table 2: Summary of significant statements by respondents (exploratory)

<i>"My friends told me that MTN is the most popular with free call allowances, and you can call the same network free at dedicated hours, and I just have to accept this service."</i>
<i>"The Association of Congolese Students at UKZN arranged for me to be picked up at the airport and had made pre arrangements to buy my Cell C SIM cards and airtime to use on arrival. It took me several months to realize there were other GSM networks."</i>
<i>"I am from Nigeria, and MTN is a major player in my home country. I made enquiries and was told that I could roam MTN services in a list of countries that includes South Africa. As a result, I continued to use my MTN Nigeria SIM card for calls, data and SMS services when I arrived here at UKZN (PMB Campus). When I could not bear the high costs of international roaming, that I settled for the MTN South Africa SIM card."</i>
<i>"Initially when I arrived at the local PMB airport from Tanzania, I bought the South African MTN SIM card only to be urged by my compatriots here at UKZN to buy Vodacom SIM. Vodacom South Africa is a major player here. Ultimately, I swapped my MTN SIM for Vodacom. Currently, I use this alongside Telekom data service on my MODEM and IPad."</i>
<i>"At the moment I have SIM cards for all the major players in the South African GSM landscape. In my case, my husband had been living in South Africa before the rest of the family joined him. Over the years he used local MTN SIM card but later changed to another service provider because the new service was cheaper. It is hard for me to catch up with his trail of changing service providers. The often changes seem to depend on network quality, access to air time, affordability and network coverage."</i>
<i>"Mobile Office comes to my mind as a handy tool that comes in handy."</i>

The analysis of the results in Table 2 shows that affordability, social environment, previous experience of GSM network providers, social influence factors, network quality and coverage impact the choice of service by the students. The following subsections present further results of the analysis.

Research question 1

The research question one aimed at measuring how GSM networks are used with innovation to deal with changing academic environments of international postgraduate students. Considering the fact that previous studies reported innovations regarding GSM technology use. Thus, the current research emphasises context-specific issues that foster innovation. The qualitative data regarding the research question 1 indicate that GSM networks are used for trustworthy research data collection in the field, mapping, navigation on campus and city-wide in Pietermaritzburg. Some of the notable statements from respondents are below:

"I never knew that my social contacts on my GSM could be of help for my learning as it can connect with my ex-lecturers and mates to share with them my new experience and their contributions, in particular on the blogs, there are valuable to my academic success."

"Once my handset got lost and I was able to recover quite a lot of data saved on my GSM network, the recovery was a big relief."

Meanwhile, Table 3 provides samples of emerging themes based on formulated meanings drawn from the critical responses from the participants.

Table 3: Emerging themes

Formulated meanings	Emergent theme
The GSM provider subscribed to alert users whenever they are out of GSM network coverage. This knowledge is very crucial when the students are mobile. Over time the users are aware of places where the network coverage is weak/unavailable on campus and likewise in town. As a result, this allows seizing the best opportunities the GSM services offer users where a network is stable. Also, users make use of the GSM services due to limited access to PCs in the computer LANs and absence of personal desktops/laptops.	Location-based services GSM coverage dependence Activity-awareness delays Adaptability to network instability.
Course/class pages on social media such as Facebook, Whatsapp, and other social media are commonly accessed to keep up to date. It occurs when classes/group assignments are missed. Access is via GSM networks. The use of SMS to enhance contact with peers/colleagues, new friends, supervisors, mentors, tutors and sparingly with close family members overseas.	Use-based on social contexts Class monitoring Group assignment monitoring Awareness of backgrounds such as academic and family Real-time activity awareness Student SupervisorManagement.
The GSM networks support smartphone features that enable recognition of the names of places where incoming calls are made.	Location awareness.
Research data are collected using Skype-based interviews; Whatsapp based calls to respondents and evaluation of active logs on Facebook and other social media.	Research Real-time data collection
Students rely on Internet-based communication tools via their smartphones and mobile devices. There is evidence that many of the social media tools are not supported by Wi-Fi services of the institution. The alternative is to access media tools using GSM networks. GSM service providers have products targeted at students (low tariff regime, data and free Whatsapp access).	Service awareness Complimentary to institutional Wi-Fi facility
The availability of mechanisms to automatically send SMS on a GSM network to alert students of class activities using the e-learning platform. The online registration platform sends SMS to students to inform them of their registration status. The various student groups/associations that students belong to use SMS to communicate with their members	Student registration management
Evidence that students send SMS to colleagues in the contexts of learning activities.	SMS based collaborative learning

Table 3 presents a summary of the key themes that emerge from the significant statements of the respondents. Before, the researchers grouped the formulated meanings into categories there was a construction of the articulated meanings. The categorizations allowed for the demonstration of a distinctive framework of themes. After that, the emerging themes such as location awareness, activity awareness, class and group monitoring, registration management and SMS based collaborative behaviour emerged (See Table 3).

Research question 2

The research question 2 investigated how the human and behavioural factors inform innovative behaviour in the use of GSM networks? The quantitative analysis using multiple regression analysis addressed the question, considering that a factor analysis was conducted, and the results support the viability of the statistical conclusions reached (See section 4.3 for the details). Table 4 below presents the results of the analysis of how human and social factors predict the innovative use of GSM networks.

Table 4: Multiple regression analysis n=50

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	3.981	1.431		2.781	.007
Personal innovativeness	-.058	.128	-.442	-5.958	.655
Results demonstrability	-.212	.112	.364	-.621	.067
Image	-.403	.171	.164	2.355	.022
Subjective norm	.401	.083	.516	5.958	.000
PBC	-.098	.069	-.125	-1.426	.159
PEOU	.472	.060	.782	8.706	.000
PU	-.474	.079	.719	6.863	.000
BI	.237	.177	.097	1.337	.187
SI	-.331	.137	.342	4.701	.004

The Table shows that PEOU (B = .782, t = 8.706), PU (B = .719, t = 6.863), subjective norm (B = .516, t = 5.958), personal innovativeness (B = -.442 t = 5.958), result demonstrability (B = .364, t = 2.961), and Social Influence factors (B = .342, t = 4.701) as the important human and social factors that predict innovative behaviour in the use of GSM networks. However, the prediction relationship of perceived usefulness (PU) on the innovative use of GSM networks by the students is found to be negative. Also, the results suggest that social influence affects innovative behaviour in the use of GSM networks by international postgraduate students at UKZN. Thus, the indication is that factors like the subjective norm, social elements, image, and attitude relate directly to innovation and creativity in the ways GSM networks used. Also, the

last research question was addressed by the qualitative aspects. Presented in Table 5 are some of the significant statements.

Table 5: Significant statements

<i>“I believe SMS is useful and easy to use.”</i>
<i>“The cost of using SMS in formal and informal learning contexts is not so expensive for me when compared with its benefits.”</i>
<i>“I expect that my use of GSM services on my devices will complement my communication with my peers, advisors, mentors and supervisors in new ways – such as getting prompt feedback from faculty.”</i>
<i>“GSM networks hold values for me to help manage and share data (capture materials, video/audio from interviewers) with my data analyst and supervisors.”</i>
<i>“If GSM network services improve regarding the speed of uploads, downloads and their overall services, I will increase how I use them.”</i>
<i>“Should my grades improve in school as a result of content I share and have access to via SMS, I will put GSM services to more use in the future.”</i>
<i>“For my group assignments, I typically encourage that we use a conference chat for our deliberations.”</i>
<i>“GSM networks complement my social activities to stay connected.”</i>
<i>“I do not see myself as any technology enthusiast, and I do not brandish around smartphones and digital devices, but my simple ‘old school’ GSM handset suffices for my needs.”</i>
<i>“An irritating thing is that some networks SIM lock and bundle to specific handsets by operators thus shortchanging the users.”</i>
<i>“Mobile number portability and cheaper voice services across networks attract me to use GSM services.”</i>

The analysis of the results in Table 5 suggests that perceptions of the value, ease of use and usefulness affect the use of GSM network services. The findings indicate that perceptions influence user behaviour based on the individual’s assessments of value. In a nutshell, the data in Table 5 support the essentiality of social factors, outcome expectations and perceptions in the users’ approaches to GSM network services. Also, additional new data show that cost-effectiveness impacts user perceptions. The central conclusions discussed and presented in the next section.

Discussion of Results

The first research question investigated how users introduced innovation in the use of GSM networks to adapt to their learning environments. The principal findings show that activity and location awareness of GSM networks’ services by the users were crucial to class activities’ monitoring, registration management processes and collaborative learning using SMS functions. The implications of these results reveal a transformative role of GSM network services as educational tools. For instance, Lu and Global (2012) asserted that learning is about being able to learn wherever and whenever you have a need or curiosity and to integrate that knowledge with other learning experiences. They further pointed out that learning occurs through GSM tools like cellular phones or smartphones, MP3, MP4 players and handheld gaming devices. The assertion

indicated that the changing environment of international postgraduate students at UKZN and their previous experience elsewhere were added advantage for their academic success using the GSM and mobile networks tools to adapt to their new learning environment. Contrarily, (Ajagbe, Eluwa, Duncan, Ramliy, Long and Mkomange, 2011; Basaran, Cetinkaya and Bagdadioglu, 2014) reported that most commonly used educational wireless phone application services are information queries and deliveries via SMS. The others are the use of a blog, Twitter, Facebook and electronic mails that are now popular among international postgraduate students for ease of learning and performing personal communication using current and prior contacts.

The second critical question attempted to find out the core human and behavioural factors that affect students' innovation and creativity in the use of GSM networks. Resultantly, the significant findings highlight human contexts such as perceived ease of use, subjective norms, personal innovativeness, results from demonstrability and social influence factors in the creativity of users to adopt GSM networks to meet their needs. Zorn, Flanagin, and Shoham (2011) provided evidence of human resources like the social determinant of innovation use GSM network. Further, Venkatesh, Thong, and Xu (2012) indicated that social influence is the extent to which consumers perceive that technology is necessary for others (e.g., family and friends). In contrast, Yang et al. (2012) argued that beliefs, social influences and personal traits are significant features of adoption and use of technology. The researchers stated that cost does not affect behavioral intention in the post-adoption stage, but social influences no longer have an indirect impact on behavioral intention in the post-adoption stage. Thus, the current study provided a narrower focus on GSM networks' services from the perspective of users in a developing country context. The research provided benchmark data on user adaptation behaviour and underlined the centrality of beliefs, social influences and individual traits in the adoption of GSM networks by the international postgraduate students at UKZN.

Conclusion and recommendations

The study, therefore, revealed the categorizations of a pattern of GSM use of network services in formal and informal learning and social spaces. Some of the emergent themes include deliberate behaviour, social influence, collaborative behaviour, passive ease of use, users' backgrounds, subscription cost and social contract on the part of network subscribers and providers. The important themes highlight the contexts in which international students introduce innovations. The adoption of the GSM network was found to be innovatively premised on the following core human and behavioural elements: perceptions, subjective norms and social influence factors, personal innovativeness and result demonstrability. The research shed further light on the understanding of GSM networks in the context of human and social behaviour in a developing country landscape.

Accordingly, the study recommends that GSM network providers should strive to provide more affordable and user friendly GSM that can assist international postgraduate students in deploring GSM networks innovatively for personal and academic engagements while studying in South Africa. UKZN as a destination and particular institution for international postgraduate students should additionally provide support for this category of students to enable them to maximise potentials therein for their study and other benefits of GSM networks. Moreover, international postgraduate students are encouraged to use GSM networks innovatively in ways to enhance

academic achievement and to make their stay in South Africa rewarding. This study is limited to international students in an institution, further studies may obtain data from more diverse populations and academic disciplines to improve on generalisations of findings. Future studies may employ multiple data collection tools to add to the scope, texture and depth of this study.

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