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Applying an Extended Task-Technology Fit for Establishing Determinants of Mobile Learning: An Instant Messaging Initiative

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ABSTRACT

The high proliferation of mobile instant messaging (MIM) among university students creates opportunities for a new wave of mobile learning. However, correlational methods for assessing factors that influence student performance impacts on MIM platforms for learning are blurry. The task-technology fit theory has been widely used in the past in predicting performance impacts of users after using new technology. Despite the momentum gained by this framework in the information systems community, it lacks focus on user characteristics. The purpose of this study is to develop an extended model for task-technology fit through an integration of individual antecedent characteristics. Data were collected from 223 participants using a survey questionnaire. The analysis was performed using the partial least squares approach to structural equation modelling. The findings of the study confirmed the original task-technology fit hypotheses considered in this study. Study findings associated with individual antecedent characteristics indicate that perceived ease of use and perceived usefulness of the academic use of the MIM positively influence task-technology fit, while social influence was found to have no significant bearing on task-technology fit.

Keywords: Task technology fit (TTF), Instant messaging, Individual characteristics, Perceived performance impacts

1. INTRODUCTION

Accessibility of mobile wireless technologies influence the development of mobile learning substantially (So, 2016). Alrasheedi, Capretz, and Raza (2015) argue that mobile learning is among the fastest-growing learning phenomena. According to Kert (2011), mobile learning refers to pedagogical processes achieved through the use of mobile wireless technologies in academic support of students and facilitators operating in diverse geographical locations. The mobile learning phenomenon is capable of supporting ubiquitous, flexible, and distributable learning systems resulting in substantial positive effects to individualized learning (Kert, 2011). Kim, Lee, and Kim (2014) declare that emerging mobile learning technologies that utilize instant messaging applications are useful for promoting teamwork through collaborative learning.

The growing popularity of mobile instant messaging (MIM) applications among the youth in universities has been acknowledged in the literature (Bere and Rambe, 2016; Dlodlo, 2015). Bere and Rambe (2016) argue that high penetration of MIM services in people’s lives is attributed to these applications’ capacity to support interaction among several people at low-cost social networking facilities. Previous studies have reported positive pedagogical strategies supported by MIM (Bere and Rambe, 2016; Hrastinski et al., 2014; Kim, Lee, and Kim, 2014; So, 2016).

Based on the researcher’s professional practice, African students have demonstrated an interest in the use of mobile technologies to support learning activities. Some students have been seen taking pictures of the lecturer’s teaching material projected on the classroom teaching board, while others have been recording parts or the entire lecture for future reference. Although students have shown keen interest in mobile learning, there has been a lack of meaningful attempts to implement use of MIM in teaching and learning in African higher education institutions. Universities continue to encourage institutionally supplied learning management systems and traditional face-to-face instructional methods. Therefore, there is a need for the development of viable academic use of MIM initiatives.

Mobile learning initiatives in Africa that utilize MIM are lacking despite the high proliferation of smartphones among university students (Isaacs, Vosloo, and West, 2012). The potential to use MIM in education reported in the literature and students’ keen interest in embedding mobile technologies in their learning process (Bere and Rambe, 2016; Hrastinski et al., 2014; Kim, Lee, and Kim, 2014; So, 2016) require further investigation to boost adoption of these technologies in teaching and learning. Therefore, establishing the factors that may influence university students to adopt MIM for learning purposes could be helpful.

Task-technology fit is among the most widely used frameworks for predicting technology adoption and performance enhancement (D'Ambra, Wilson, and Akter, 2013; Gebauer, Shaw, and Gribbins, 2010; Lee, Hsieh, and Chen, 2013). Regardless of its influence in predicting technology adoption and performance enhancement, task-technology fit theory has been criticized for lack of focus on individual perceptions affecting users' choices concerning technology (Hong, Thong, and Wai-Man Wong, 2002; Strong, Dishaw, and Bandy, 2006). The aim of this study is to extend the task-technology fit theory in the mobile learning context. To address the concerns of the task-technology fit critics (Hong, Thong, and Wai-Man Wong, 2002; Strong, Dishaw, and Bandy, 2006), the theory will be extended via the individual antecedent characteristics facilitated by perceived ease of use, perceived usefulness, and social influence. The proposed model may contribute to the task-technology fit theory body of knowledge. Optimistically, it could provide insights that may influence higher utilization of mobile learning using MIM, resulting in enhanced instructional strategies.

The next section of this paper addresses existing literature for mobile learning and instant messaging. The paper then discusses the conceptual framework with respect to task-technology fit theory. The proposed model is established in the conceptual framework section. A discussion of the study population, procedure, and measurement items follows which leads to the results section of the study. The discussion of the results is provided followed by the conclusion.

2. LITERATURE REVIEW

The International Telecommunication Union (2015) reported that 7 billion mobile subscriptions were reached in 2015, resulting in a 97% diffusion rate up from 738 million subscriptions recorded in 2000. The International Telecommunication Union (2014) revealed that about three quarters of mobile phone subscriptions worldwide belong to developing countries. Africa was mentioned as the leading continent in mobile-broadband growth, and its penetration was estimated at about 20% in 2014, up from 2% in 2010 (International Telecommunication Union, 2015).

Roughly 84% of the world's population had access to mobile-broadband networks in 2016 (International Telecommunication Union, 2016). From 2012 to 2017, mobile-broadband subscriptions grew at a rate of at least 20% per annum and reached 4.3 billion globally at the end of 2017 (International Telecommunication Union, 2017). At least 70% of the world's young adults ranging from 15 to 24 years old were online in 2017 (International Telecommunication Union, 2017). These high mobile and Internet technology explosion rates created opportunities for the application of mobile technologies for social and economic development in areas that include but are not limited to banking, education, agriculture, and shopping (Hsu, 2013; Kert, 2011).

In the past, several attempts have been made to promote computer-based learning supported by Internet network protocols. These attempts remain inadequate, especially in Africa, where many people have limited access to the computer-based Internet (Hsu, 2013). Hsu (2013) argues that, in such contexts, mobile learning utilization may be a suitable option. Rambe and Bere (2013) supported Hsu's (2013) views; however, they recommended implementation of mobile learning using MIM. Despite the potential to support effective learning reported in Rambe and Bere's (2013) study, the literature acknowledges that MIM is still in its infancy stage (Jantjies and Joy, 2015; Kert, 2011; So, 2016); hence, more studies should be conducted in order to create a better understanding of this phenomenon (Hsu, 2013; Mohd Yusof et al., 2014) and its applications in education (Mac Callum and Jeffrey, 2014).

2.1 Mobile Instant Messaging

Lately, the universal eagerness for MIM applications adoption has been remarkable. According to Bardi and Brady (2010), the popularity of these applications is rising and hence their adoption has not yet reached saturation. The International Committee of the Red Cross, The Engine Room, and Block Party (2017) argue that MIM applications are the fastest-growing digital communication platforms ever. Henceforth, these applications are becoming the primary mode of communication for most mobile users globally. At present, over 2.5 billion users are active on various MIM applications and the number of subscriptions is forecasted to rise to 3.6 billion by 2018. Over one billion users were reportedly using the WhatsApp MIM application as of November 2016 (International Committee of the Red Cross, The Engine Room, and Block Party, 2017).

In South Africa, WhatsApp is arguably the leading app of choice, with over 10.6 million active users, while other common options embrace Facebook messenger, Skype, and Viber (BusinessTech, 2014). Such high popularity trends could influence acceptance and use of MIM in education because such technology would not be strange to students (Chen Wang and Morgan, 2008)

The MIM application is an emerging technology that allows two-way communication through the use of Internet protocols (Ogara, Koh, and Prybutok, 2014; Yoon, Jeong, and Rolland, 2015). These technologies' common characteristics include real-time text transmission, image exchanges, chatting, group meetings, and voice calls (Yoon, Jeong, and Rolland, 2015). They also permit users to observe the presence and status of their communication associates, set individual status and presence, and send and receive messages while handling numerous other chats at the same time (Ogara, Koh, and Prybutok, 2014). According to Zhou (2007), MIM is associated with casual communication style and quick message exchanges.

The majority of MIM applications are freely downloadable applications for a range of mobile devices. Once installed, users on the same platform obtain the liberty to send and receive messages for free via a mobile data plan or Wi-Fi connectivity (Ogara, Koh, and Prybutok, 2014). Ogara, Koh, and Prybutok (2014) argue that availability of these applications for free and their allowance for communication to take place for free significantly contributes to their high proliferation.

Chen Wang and Morgan (2008) argue that academic use of instant messaging is important because it promotes brainstorming, team work, community building, addressing technical issues, and extending classroom discussions. Their findings reveal that the use of instant messaging for academic synchronous engagement improved the levels of one-on-one interaction between students and the instructor (Chen Wang and Morgan, 2008). A learning community was reported among the students where they could share ideas and experiences as well as mentor each other (Rambe and Bere, 2013). Previous studies also report that students alluded to active learning since they could adequately prepare before engaging their ideas (Chen Wang and Morgan, 2008; Rambe and Bere, 2013). Furthermore, students significantly gained from feedback both from their peers and instructor (Chen Wang and Morgan, 2008; Rambe and Bere, 2013).

2.2 Mobile Learning in Africa Using Instant Messaging

Rambe and Bere (2013) advised researchers to explore the possibilities of utilizing MIM for academic purposes since it facilitates cost-effective interactions on smartphones, tablets, and iPads. Their study utilized a case study approach and the Framework for the Rational Analysis of Mobile Education (FRAME) model in order to investigate the potential of MIM to promote effective instructional objectives through collaborative learning techniques. The study was conducted at a South African University. The primary data analysis of this study was thematic analysis. Overall, Rambe and Bere's (2013) findings indicate that academic use of MIM promotes effective learning at low social networking costs while a small number of participants expressed concerns over the use of these applications for teaching and learning.

By the same token, Makoe (2010) conducted a qualitative study in South Africa to investigate the appropriateness of MIM application using mobile phones to promote pedagogy through social interaction in distance education. The study was underpinned by the Social Interaction Framework. Fourteen discussion threads provided the data used for content analysis. The findings of the study indicate that MIM has the potential to support collaborative learning contexts, because most South African student's cultures perceive interaction as a key factor in determining values and social interactions (Makoe, 2010).

Despite the limitations of qualitative studies, Rambe and Chipunza (2013) conducted a study to explore the suitability of MIM's ability to bridge information divides between educators and students. Their study was guided by the Sen's Capabilities Approach Framework. The content analysis revealed that the 72 participants perceived MIM as an enabler for bridging access to peer-generated resources, heightening on-task behaviour, and promoting meaningful context-free learning (Rambe and Chipunza, 2013).

According to Gupta and Mukhopadhyay (2014), qualitative research studies lack rigour, are characterised by practical difficulties, and offer a scant basis for generalization. Therefore, there is a need to conduct unbiased, reliable, and valid research studies that explore the academic use of MIM using quantitative techniques in the African context.

3. THEORETICAL FRAMEWORK: TASK-TECHNOLOGY FIT

The first dimension in the task-technology fit theory is the fit between the technology and the task (Wei and Liang, 2004). The theory holds that a high task-technology fit will result in better performance. Task-technology fit is a theory that refers to the ability of an information provider to support task-matching technology capabilities to task demands (Klaus, Gyires, and Joseph Wen, 2003).

The task-technology fit theory holds that new technology is more likely to have a positive impact on individual performance and be used if the capabilities of the new technology match the tasks that the user must perform (Goodhue and Thompson, 1995). Goodhue and Thompson (1995) developed a measure of task-technology fit that consists of eight factors: quality, locatability, authorization, compatibility, training, production timeliness, system reliability, and relationship with users. The task-technology fit has been applied in the context of a diverse range of information systems including but not limited to electronic learning, electronic commerce, and electronic health systems. Figure 1 presents the original task-technology fit theory.

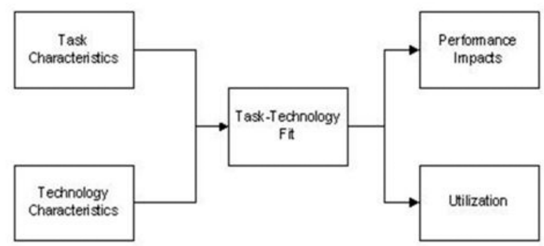

Figure 1. Task-Technology Fit Theory (Goodhue and Thompson, 1995)

Figure 2 presents the proposed model of the study. The model is an extension of the task-technology fit theory. Dotted lines with arrows represent the newly introduced hypotheses, while the continuous lines with arrows represent the original task-technology fit hypotheses. Perceived usefulness, perceived ease of use, and social influence are components of the individual antecedent characteristics. The constructs that constitute the proposed model are discussed individually.

3.1 Task Characteristics

In the task-technology fit theory, tasks refer to activities performed by individuals in transforming inputs to outputs for the purpose of satisfying their information needs (Goodhue, 1995). Task characteristics are the attributes of a task that can be executed using information communication technologies. Tasks can vary in a number of dimensions including task non-routineness, task interdependence, and time criticality (Goodhue, 1995, 1998). The task considered in this study is learning. The aspects of learning that can be achieved using mobile technologies are the task characteristics focus of this study. These include use of MIM for studying, academic engagements, and peer mentoring.

Gettinger and Seibert (2002) argue that studying involves systematic techniques that are vital to academic competence. Generally, effective study approaches are associated with higher performances for diverse students. Therefore, study techniques are regarded as academic enablers; they function as crucial learning tools (Gettinger and Seibert, 2002). Higher education students can utilize MIM applications for individual studying through reading learning material posted either by facilitators or peer students on these cyber spaces, while others

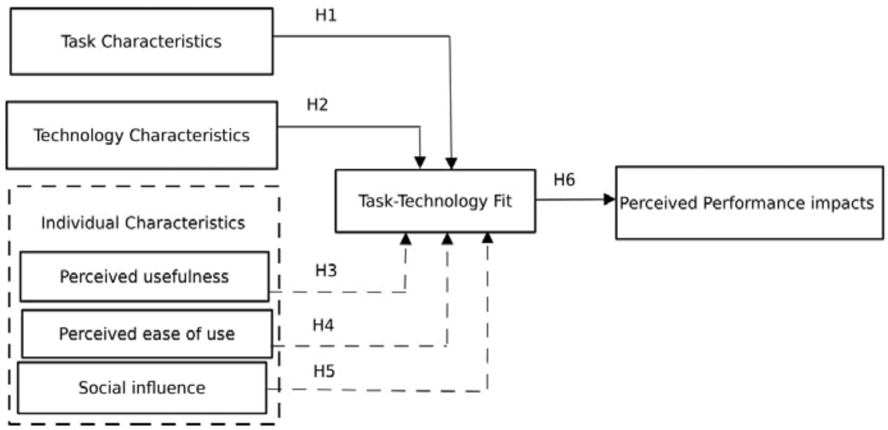

Figure 2. Proposed Task-Technology Fit Model

may benefit from academic interactions with their peers. The MIM applications support interactions among group members using various modes that include text, images, and audio. Some students that use MIM for academic purposes learn better through hearing or reading their peers' views, while others require step-by-step assistance from their classmates. Such students may benefit from their peers anytime and anywhere (Rambe and Bere, 2013).

The following hypothesis was developed based on this background information about task characteristics:

H1: Task characteristics have a positive influence on task-technology fit.

3.2 Technology Characteristics

Goodhue (1995) defined technology as the tool that is either hardware or software used by individuals in carrying out their tasks. The aspects of technology tools may influence technology utilization and users' perceptions (Goodhue, 1995, 1998). The task-technology fit model considers the importance of fitting the functionality and attributes of technology used to the demands imposed by individual needs. Within the context of this study, technology refers to mobile gadgets and MIM software. Mobile device characteristics include portability, touch screen, and facilities to enlarge images and texts. The MIM attributes include: cost effectiveness; ability to support interactions in various formats that include images, text, audio, and video; ability to support group interactions; ability to reply to a specific message within a group; ability to support synchronous and asynchronous communication; and data security using end-to-end encryption. The attributes of mobile devices and those of MIM applications constitute technology characteristics.

The following hypothesis was developed in relation to technology characteristics.

H2: Technology characteristics have a positive influence on task-technology fit.

3.3 Individual Characteristics

According to Aljukhadar, Senecal, and Nantel (2014) the original task-technology fit theory (Goodhue, 1995) was posited to predict organizational performance and utilization of technology while overlooking implications on individual users. However, user beliefs regarding new technology, such as perceived usefulness and perceived ease of use, are strongly associated with task-technology fit theory (Aljukhadar, Senecal, and Nantel, 2014; Mathieson and Keil, 1998). In this vein, Liu, Lee, and Chen (2011) argue that fit can be operationalized through a match between individual, task, and technology characteristics. On the other hand, Lu and Yang (2014) claim that studies focusing on performance enhancement of emerging technologies that include social networking (such as MIM) using the task-technology fit theory are lacking. Possible reasons could be that researchers have realized the challenges of using task-technology fit theory in these contexts without addressing the social construct as a perturbing limitation (Lu and Yang, 2014). Therefore, efforts should be made to integrate social construct to task-technology fit to enhance its capacity to address research that involves MIM performance enhancement (Lu and Yang, 2014). To this end, this study integrates individual antecedent characteristics as a facilitator of the task-technology fit construct. Individual characteristics in this study are defined in terms of three constructs, namely, perceived usefulness, perceived ease of use, and social influence. Within the context of this study, perceived usefulness and perceived ease of use were adapted from the technology acceptance model (Davis, 1989), while social influence is an adaptation of the unified theory of acceptance and use of technology (Venkatesh et al., 2003).

Perceived usefulness refers to "the degree to which a person believes that using a particular system would enhance his/her job performance" (Davis, 1989, p. 321). Perceived ease of use refers to the lack of mental and physical effort required in using new technology (Davis, 1989). Social influence occurs when one's emotions, opinions, or behaviors to adopt new technology are influenced by others (Venkatesh et al., 2003).

The following hypotheses have been developed in view of the individual characteristics construct:

H3: The technology user characteristics facilitated by perceived usefulness have a positive influence on task-technology fit.

H4: The technology user characteristics facilitated by perceived ease of use have a positive influence on task-technology fit.

H5: The technology user characteristics facilitated by social influence have a positive influence on task-technology fit.

3.4 Task-Technology Fit

Goodhue (1995) reported that "individuals' interactions with an information system are often intertwined with their task-technology and individual-adoption behaviours." The task-technology fit may be assessed by considering the individual's satisfaction level of the extent to which a system's operational activities meet his/her task needs as an individual (Goodhue, 1998; Mpekoa and Bere, 2015). The task-technology fit entails the association between task requirements, individual abilities, and the functionality of the mobile technology system (Mpekoa and Bere, 2015). Furthermore, task-technology fit has been linked to the criterion of personal performance, which can be used in the larger context of considering the impact of information technology on individual performance (Goodhue, 1998; Mpekoa and Bere, 2015).

The following hypothesis has been formulated based on the task-technology fit construct's relationship with performance.

H6: Task-technology fit has a positive influence on student performance.

3.5 Perceived Performance Impacts

Perceived performance impacts refer to an individual's belief that his or her task execution capabilities change after using information communication technology (ICT) interventions. High task-technology fit increases users' perceptions of their performance impacts (Goodhue, 1995). University students utilized MIM for the successful accomplishment of academic activities such as collaborative learning, peer consultation, and examination preparation. A high perceived performance impact implies a high level of task-technology fit and satisfaction with adopting the MIM for academic use (Goodhue, 1998).

4. METHODOLOGY

The methodology for this study concerns the study population, research procedure, and measurement items.

4.1 Study Population

The study was conducted in South Africa at a University of Technology. A survey was conducted on Bachelor of Technology (BTech) students registered for an Internet Programming course and third-year diploma students registered for an Information Systems course. All the students enrolled in these courses were considered for the study. The target population consisted of 35 BTech and 263 third-year students. Among this population, 279 consented to participate in the study comprising 246 diploma and 33 BTech students. All the participants that consented to participate in the study possessed web-enabled mobile devices capable of downloading and installing WhatsApp. Mobile devices used in the study ranged from smart phones, PDAs, iPhones, iPads, and tablets.

4.2 Research Procedure

The research site has a tradition of utilizing the last few weeks before the start of the semester final examinations for revision purposes. The majority of the lecturers rely on traditional face-to-face classroom revision methods; however, in the past these approaches have been characterised by high student absenteeism. In pursuit of improving students' participation in these revision exercises, the researcher proposed implementation of the academic use of MIM since it supports anywhere and anytime learning.

The instant messaging application used for learning purposes in this study was WhatsApp. It was chosen on the basis that it is the most popular instant messaging application in South Africa (BusinessTech, 2014).

The researcher uploaded a manual on the institutional Blackboard learning management system which guided students on how to download and install the WhatsApp application on their mobile devices. The manual also detailed basic WhatsApp features and functionalities to enlighten those with limited prior exposure and knowledge of the application. The lecturer offered open-door consultations to provide extra training to the less technologically adept students on WhatsApp usage.

The lecturer used students' mobile numbers to randomly place them into virtual discussion forum groups comprising at most ten participants per cluster, including the lecturer. The development of random clusters afforded anonymous group interactions, which helped overcome perceived knowledge differentials among peers.

The study was conducted for a period of six weeks from 19 September to 29 October 2016; participants were encouraged to participate anytime and anywhere. Participation was voluntary and it was not assessed. The lecturer regularly posted quizzes on these learning platforms. The lecturer reinforced effective learning by exhorting participants to research and think critically before responding. Participants would take these quizzes and post their responses to the group discussion space. Additionally, participants were encouraged to provide constructive criticism against their peers' posts. Participants were also encouraged to post quizzes from any section of the syllabus and discuss them with their peers. Some participants simply provided problem-solving techniques to their peers.

Since the academic engagement platforms were open throughout the day for the six weeks, participants responded to quizzes in a synchronous and asynchronous manner depending on their preferences. Other students gained from this learning initiative by reading their peers' posts and asking for clarification if needed.

Students who were reluctant to participate on WhatsApp were encouraged to create similar clusters on the Blackboard learning management system. A total of 279 students consented to participate in the study using WhatsApp MIM, while 19 did not give consent. However, seven participants withdrew and exited the groups before the end of the study. Out of the 19 who did not give consent, 6 did not possess mobile devices that supported WhatsApp.

Constructs		Items	Adapted from
Individual Characteristics (ICPU)	ICPU1	Academic use of MIM empowers me to attain my learning goals	(Davis, 1989; Louw, Swart, and Bere, 2016)
	ICPU2	Academic use of MIM meets my learning styles through synchronous and asynchronous communication	(Davis, 1989; Louw, Swart, and Bere, 2016)
	ICPU3	Academic use of MIM meets my learning preferences through options to interact using video, audio, images or text	(Davis, 1989; Louw, Swart, and Bere, 2016)
	ICPU4	Academic use of MIM promotes collaborative learning	(Davis, 1989; Rambe and Bere, 2013; So, 2016)
	ICPU5	I often get timely feedback whenever I seek academic assistance using MIM	(Davis, 1989; So, 2016)
	ICPU6	Overall, academic use of MIM is useful for my learning process	(Davis, 1989; Rambe and Bere, 2013; So, 2016)
	ICPEOU1	I often use MIM for social networking; hence, I am familiar with its functionalities	(Chen Wang and Morgan, 2008)
	ICPEOU2	Learning to use MIM for academic purposes is easy	(Bere and Rambe, 2016; Louw, Swart, and Bere, 2016)
	ICPEOU3	It would be easy for me to become skilful at using MIM for learning	(Bere and Rambe, 2016; Louw, Swart, and Bere, 2016)
	ICPEOU4	Using MIM for academic purposes is clear and understandable	(Bere and Rambe, 2016; Suki and Suki, 2011)
	ICPEOU5	Overall, using MIM for academic purposes would not require much mental effort	(Bere and Rambe, 2016; Suki and Suki, 2011)
	ICSI1	People who influence my behaviour will think that I should use of MIM for academic gains	(Mtebe and Raisamo, 2014; Venkatesh et al., 2003)
	ICSI2	People who are important to me will think that I should use of MIM for academic gains	(Mtebe and Raisamo, 2014; Venkatesh et al., 2003)
	ICSI3	My classmates will be helpful in the use of MIM for academic gains	(Mtebe and Raisamo, 2014; Venkatesh et al., 2003)
	ICSI4	My lecturers will be helpful in the use of MIM for academic gains	(Mtebe and Raisamo, 2014; Venkatesh et al., 2003)

Table 1. Measurement Items for Individual Characteristics

Also, these 19 students were not keen to do their revision using Blackboard either.

4.3 Measurement Items

The survey research instrument comprising 38 measurement items was initially developed based on task-technology fit (Goodhue, 1995, 1998; Goodhue and Thompson, 1995), the technology acceptance model (Adwan and Smedley, 2013; Louw, Swart, and Bere, 2016; Tam and Oliveira, 2016), and the unified theory of acceptance and use of technology (Mtebe and Raisamo, 2014; Venkatesh et al., 2003). Constructs authenticated in previous studies were modified to meet the requirements of this study. Additionally, the survey instrument collected demographic information such as course, gender, and age. A 7-point Likert scale ranging from “strongly agree” to “strongly disagree” was utilized for measuring the questionnaire items. The researcher conducted a pilot study that comprised of 20 randomly selected respondents from the study population. The pilot study was meant to ensure the validity and reliability of the measurement items that formed the basis of the study questionnaire. In completing the questionnaire, participants were asked to identify vague measurement items and make some recommendations to enhance them. The culmination of the pilot study was the compilation of 35 measurement items from the pilot data, elimination of three items, and rephrasing of some items. Measurement items for the study are presented in two tables: Table 1 above presents measurement items for individual characteristics, and Table 2 below shows measurement items for original task-technology fit constructs including task characteristics, technology characteristics, task-technology fit, and perceived performance impacts.

Constructs		Items	Adapted from
Task Characteristics (TC)	TC1	I need to learn anytime and anywhere	(Goodhue and Thompson, 1995; So, 2016; Tam and Oliveira, 2016)
	TC2	I often need advice from someone else about easier methods to solve academic problems	(Goodhue and Thompson, 1995; Lu and Yang, 2014)
	TC3	I often learn by gathering information from others	(Goodhue and Thompson, 1995; Lu and Yang, 2014)
	TC4	I often require interaction during learning process	(Goodhue and Thompson, 1995; So, 2016)
	TC5	I often require timely feedback during learning process	(Goodhue and Thompson, 1995; So, 2016)
	TC6	Overall, MIM can support learning tasks	(Goodhue and Thompson, 1995; Rambe and Chipunza, 2013)
Technology Characteristics (TECC)	TECC1	Learning using MIM encourages active engagements with both peers and instructors	(Bere and Rambe, 2016; Goodhue and Thompson, 1995; So, 2016)
	TECC2	I constantly study at my convenience at anytime and anywhere using mobile learning supported by MIM	(Chen Wang and Morgan, 2008; Rambe and Bere, 2013)
	TECC3	I constantly have a choice to interact synchronously or asynchronously in a mobile learning context using MIM	(Goodhue and Thompson, 1995; Rambe and Bere, 2013)
	TECC4	I constantly have a choice to interact using video, audio, images or text in a mobile learning context using MIM	(Goodhue and Thompson, 1995; Rambe and Bere, 2013)
	TECC5	Overall, MIM technology characteristics are suitable for promoting effective learning	(Goodhue and Thompson, 1995; Rambe and Bere, 2013)
Task-Technology Fit (TTF)	TTF1	Within mobile learning using MIM, I would like to solve academic tasks through active engagement with peer students and facilitators	(Goodhue and Thompson, 1995; Rambe and Bere, 2013; Rambe and Chipunza, 2013)
	TTF2	Within mobile learning using MIM, I would like to gain critical thinking skills	(Goodhue and Thompson, 1995; Rambe and Bere, 2013)
	TTF3	Within mobile learning using MIM, I would like to get timely feedback	(Goodhue and Thompson, 1995; Rambe and Bere, 2013; So, 2016)
	TTF4	Within mobile learning using MIM, I would like to learn anytime and anywhere	(Goodhue and Thompson, 1995; So, 2016; Tam and Oliveira, 2016)
	TTF5	Overall, I would like to gain new knowledge through the academic use of MIM	(Bere and Rambe, 2016; Goodhue and Thompson, 1995; Rambe and Bere, 2013; So, 2016)
Perceived Performance Impacts (PPI)	PPI1	Through academic use of MIM, I improved knowledge sharing skills	(Goodhue and Thompson, 1995)
	PPI 2	Through academic use of MIM, I improved my assessment grades	(Goodhue and Thompson, 1995)
	PPI 3	Through academic use of MIM, I improved communication with peers and facilitators	(Goodhue and Thompson, 1995)
	PPI 4	Overall, through academic use of MIM, I improved knowledge acquisition skills.	(Goodhue and Thompson, 1995)

Table 2. Measurement Items for Original Task-Technology Fit Theory Constructs

4.4 Data Collection

On the last day of the study (29 October 2016), the lecturers added and introduced the researcher to all the research cohorts. Furthermore, the researcher was also introduced to participants who did not complete the study processes, and their consent for data collection was obtained. The explanation of the data collection processes and the invitation to participate in the data collection were conducted by the researcher using a short audio clip that was broadcast to the participants, and written copies of the same information were circulated. Once again, participants were reminded that participation in the data collection process is voluntary. On 30 October 2016, the researcher used the WhatsApp broadcast facility to send the link of the online questionnaire to participants. The link was valid for seven days. Instructions concerning the opening and completions of the questionnaire were provided. The link for the online questionnaire was administered to 279 participants. A total of 231 questionnaires were returned, but 8 were discarded due to incomplete data. The remaining 223 questionnaires, which constituted about an 80% response rate, surpassed the minimum recommended sample size. A sample of at least 175 participants would be ideal for achieving 95% confidence (El-Gayar, Moran, and Hawkes, 2011). Table 3 shows the participants' demographics of the 223 completed questionnaires.

Variables	Variable Category	Frequency	Percentage
Course	Diploma IT	192	86.10%
	BTech IT	31	13.90%
Gender	Male	98	43.95%
	Female	125	56.05%
Age	< 21	8	3.59%
	21-25	168	75.34%
	26-30	45	20.18%
	> 30	2	0.90%

Table 3. Demographics

5. RESULTS

This section of the study presents the results.

5.1 Main Survey

All six items for task characteristics received positive responses from the respondents. Item TC1 was ranked the most favorable in the task technology characteristics category with around 42% respondents strongly agreeing, 28% agreeing, and 13% somewhat agreeing that they would like to learn anytime and anywhere. Item TC4 received significant support with 31% respondents strongly agreeing, 19% agreeing, and 27% somewhat agreeing that they often require interaction during the learning process. However, item TC3 was the least favorable in the task characteristics category with 14% respondents strongly agreeing, 18% agreeing, 12% somewhat agreeing, 6% neutral, 20% somewhat disagreeing, 23% disagreeing, and 7% strongly disagreeing that they often learn by gathering information from others. Figure 3 presents a more detailed account of the technology characteristics results.

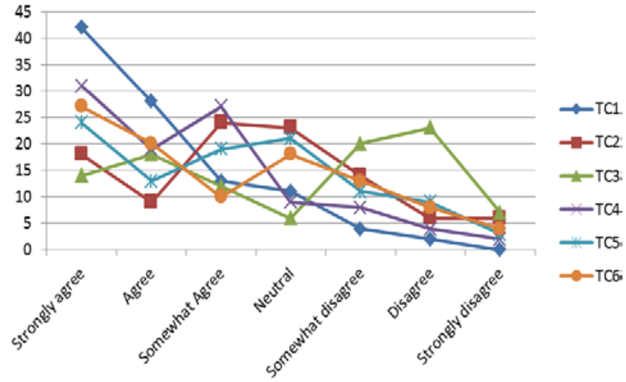

Figure 3. Task Characteristics Presentation of the Results

Among the technology characteristics constructs, item TECC2 had the most favorable responses with 44% participants strongly agreeing, 22% agreeing, and 17% somewhat agreeing that the technology's ability to support ubiquitous learning provides opportunities in learning. Items TECC3 and TECC4 were also highly ranked by respondents. Students' responses show that technology's ability to support learning material in different formats and its capacity to support interactions synchronously and asynchronously influence their decision to use MIM for academic gains.

The MIM for learning attained positive responses regarding its perceived usefulness and perceived ease of use. About 33% of respondents strongly agreed, 19% agreed, and 23% somewhat agreed that academic use of MIM empowers learning goals attainment. About 78% of respondents at least somewhat agreed that academic use of MIM is useful for their learning, while a significant population indicated that learning using MIM was easy. This claim can be attributed to the fact that around 16% strongly agreed that they were familiar with MIM functionalities. Additionally, 26% somewhat agreed and 24% agreed to the sentiments that their prior use of MIM for social networking purposes familiarized them with these technologies' functionalities. However, social influence's contribution to individual characteristics was minor. About 3% of respondents strongly agreed, 4% agreed, 5% somewhat agreed, 22% remained neutral, 15% somewhat agreed, 34% disagreed, and 17% strongly disagreed to item ICSI1. With regards to ICSI2, approximately 51% of respondents disagreed and 19% of respondents strongly disagreed.

The results of the study reveal a task-technology fit in the use of MIM for learning because all five items received positive responses from the respondents. Almost 31% of respondents strongly agreed, 12% agreed, and 28% somewhat agreed that they would like to learn anytime and anywhere using MIM in a mobile learning context. About 34% of respondents strongly agreed, 9% agreed, and 20% somewhat agreed that they desire to interact with peers and instructors during academic problem-solving exercises.

Four items were used to test performance enhancement of academic use of MIM and they all received positive ratings from the respondents. Approximately 27% of respondents strongly agreed, 22% agreed, and 26% somewhat agreed that the initiative helped them improve their assessment grades. Also, almost 36% of respondents strongly agreed, 24% agreed, and 18% somewhat agreed that academic use of MIM helped them improve their knowledge acquisition skills.

5.2 Overall Model Assessment

The measurement model for this study was assessed using confirmatory factor analysis (CFA). A total of 10 model-fit indices were employed for the purposes of examining the model's overall goodness of fit. Table 4 below shows that all the model-fit indices exceeded their respective generally acceptable levels as recommended in Gefen, Straub, and Boudreau (2000) and (Bao et al., 2013), which demonstrated a good fit between the model and data.

Goodness-of-fit Measures	Recommended Value	Measurement Model	Structural Model
χ^2/df	≤ 3	2.519	1.945
GFI	≥ 0.8	0.985	0.989
RMSR	≤ 0.05	0.032	0.035
SRMR	≤ 0.08	0.066	0.043
RMSEA	≤ 0.08	0.071	0.067
NFI	≥ 0.9	0.998	1.094
CFI	≥ 0.9	1.101	0.959
AGFI	≥ 0.8	0.959	0.873
PNFI	≥ 0.5	0.829	0.696
PGFI	≥ 0.5	0.675	0.678

Table 4. Fit Indices for Measurement and Structural Models

Variable	Item	Mean	Standard Deviation	Factor Loading	Cronbach's Alpha	Composite Reliability	AVE
	TC1	5.362	1.139	0.862	0.766	0.892	0.623
TC	TC2			0.926			
	TC3			0.886			
	TC4			0.852			
	TC5			0.866			
	TC6			0.836			
TECC	TECC1	5.661	1.033	0.884	0.794	0.798	0.785
	TEEC2			0.872			
	TECC3			0.792			
	TECC4			0.812			
	TECC5			0.803			
IC	ICPU1	5.212	1.201	0.836	0.817	0.782	0.655
	ICPU2			0.823			
	ICPU3			0.818			
	ICPU4			0.832			
	ICPU5			0.821			
	ICPU6			0.848			
	ICPEOU1			0.892			
	ICPEOU2			0.833			
	ICPEOU3			0.833			
	ICPEOU4			0.842			
	ICPEOU5			0.856			
	ICSI1			0.752			
	ICSI2			0.829			
	ICSI3			0.792			
	ICSI4			0.786			
TTF	TTF1	5.462	1.103	0.823	0.836	0.854	0.711
	TTF2			0.874			
	TTF3			0.829			
	TTF4			0.844			
	TTF5			0.835			
PPI	PE1	5.169	0.315	0.779	0.788	0.832	0.801
	PE2			0.842			
	PE3			0.822			
	PE4			0.837			

Table 5. Factor Loading and Reliability

Partial Least Square (PLS) was employed for the overall model assessment. Construct validity was tested using Cronbach's alpha and composite reliability. The values acceptable for both Cronbach's alpha and composite reliability must be at least 0.7 (Fornell and Larcker, 1981). The Cronbach's alpha values ranged from 0.766 to 0.836, and the composite reliability values ranged from 0.798 to 0.892 indicating satisfactory Cronbach's alpha and sufficient composite reliability in this study. Average Variance Extracted (AVE) evaluates convergent validity and acceptable values for AVE should be greater than 0.5 (El-Gayar, Moran, and Hawkes, 2011; Fornell and Larcker, 1981). Satisfactory convergent validity was achieved in this study since AVE values ranged from 0.6253 to 0.8010. The mean values greater than 5 obtained in this study reveal that participants had a positive evaluation of the academic use of MIM. Table 5 shows the factor loading and reliability values for this study

Discriminant validity has been widely used for testing construct validity in studies involving structural equation modelling (Chang, Yan, and Tseng, 2012; D'Ambra, Wilson, and Akter, 2013; Gebauer, Shaw, and Gribbins, 2010; Gefen, Straub, and Boudreau, 2000). "Discriminant validity tests whether concepts or measurements that are not supposed to be related are actually unrelated" (Campbell and Fiske, 1959, p. 81). The notion confirms that the non-overlapping factors do not overlap (task characteristics, technology characteristics, individual characteristics, task-technology fit, and perceived performance impacts).

Discriminant validity was examined by comparing the AVE square root values and factor correlation coefficients. Drawing on a previous study which claims that if the square root of AVE is significantly larger than its correlation coefficients indicates a scale has good discriminant validity (Fornell and Larcker, 1981), the researcher inferred that the scale adopted in the current study had good discriminant validity. For each factor shown in Table 6, the square root of AVE is significantly larger than its correlation coefficients with other factors. The square root of the AVE is shown in bold and italics in Table 6.

	TC	TECC	IC	TTF	PPI
TC	***0.789***				
TECC	0.739	***0.886***			
IC	0.694	0.725	***0.809***		
TTF	0.721	0.798	0.793	***0.843***	
PPI	0.699	0.883	0.778	0.814	***0.895***

Table 6. Discriminant Validity

5.3 Structural Model Testing

The structural model analysis was adopted to establish the path coefficients (β) and R^2 among antecedents of the research model. Path coefficients and R^2 signify the common ground between the structural model and experimental data (Chang, Yan, and Tseng, 2012). A statistically acceptable path coefficient should be at least 0.05 (Suki and Suki, 2011).

Task characteristics, technology characteristics, and individual characteristics (perceived usefulness, perceived ease of use, and social influence) explained almost 50% total variance in task-technology fit. Task-technology fit explained almost 56% total variance in perceived performance impacts.

All the path coefficients were found to be statistically significant, except for H5 (individual characteristics facilitated by social influence has positive influence on task technology fit). The path coefficient for H5 is 0.039; hence the path was rejected. Paths H1 to H4 and H6 had path coefficients that ranged from 0.249 to 0.492. The β values obtained for these paths indicate that the constructs are significant; hence, the paths were accepted. Figure 4 shows the structural model of the study.

6. DISCUSSION

The results of the study reveal that when students feel that there is a fit between learning tasks and academic use of MIM, adoption of these technologies occurs resulting in effective learning. A student who believes in ubiquitous learning is more likely to realize the fit presented in this study.

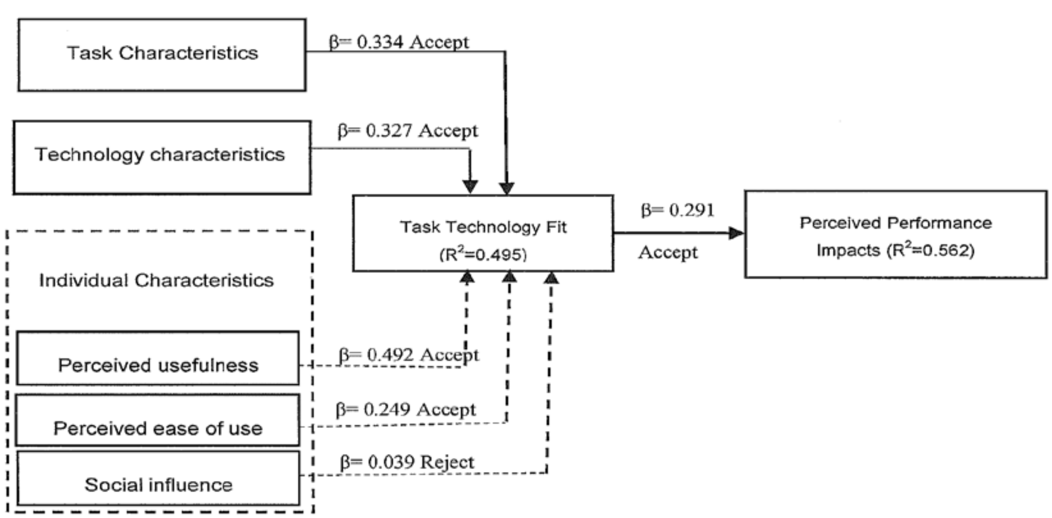

Figure 4. Structural Model

6.1 Task Characteristics-Learning Task

Mobile technologies facilitated students in fulfilling learning tasks. Students actively participated in the mobile, academic virtual platforms. Instruction took place through one-on-one interaction among peers and their facilitator. Furthermore, students gained from group interactions. Questions were addressed in a short period of time, resulting in the provision of immediate feedback. The facilitator provided scaffolding techniques to support needy students, while these students could also access their peers' posts resulting in knowledge sharing. These outcomes are in line with Chen Wang and Morgan's (2008) findings that academic use of MIM promotes one-on-one interaction between students as well as students learning from one another. Also, these findings are consistent with Rambe and Bere's (2013) findings that MIM can help students share ideas and experiences as well as provide instant feedback to their peers.

6.2 Technology Characteristics

Students that value learning at their convenience due to mobile technology characteristics such as support for synchronous and asynchronous communication, the ability to form virtual discussion groups, and the ability to communicate in various formats were more likely to realize a positive association between MIM technology's characteristics and academic use of MIM. Mobile technologies made students' desire to connect with their peers anywhere and anytime a reality. Technology characteristics allowed students to interact at their convenience. Unlike impromptu participation that occurs during traditional classroom participation, MIM technologies created opportunities for students to prepare themselves before responding to questions. To this end, some students chose to participate asynchronously after gathering their facts, while those that preferred interacting in real time did so. Furthermore, mobile technologies provided characteristics that accommodated various learning preferences. For instance, students who learn better through listening requested their peers and facilitators to interact using audio clips, while those that prefer reading received their learning material in text format. This group of students interacted mainly through typing. The MIM academic discussion forums also supported images as a communication option.

6.3 Hypotheses Validation

The study validated the following task-technology fit hypotheses: a) task characteristics have a positive influence on task-technology fit, b) technology characteristics have a positive influence on task-technology fit, and c) task-technology fit has a positive influence on performance impacts. Hence, the findings of this study are consistent with Goodhue (1995, 1998).

6.4 Individual Characteristics

For the individual characteristics construct, the results reveal that perceived usefulness positively influences task-technology fit. These findings are similar to findings (Davis, 1989; Mac Callum and Jeffrey, 2014) that reveal that perceived usefulness has a positive influence on technology utilization. The findings of this study suggest that students who find academic use of MIM useful are more likely to find it meeting their fit requirements and are then also more likely to use MIM in their learning activities.

The findings also suggest that mobile learning's ability to meet students' leaning needs contributes to its usefulness in learning. Learning needs in this study where met through allowing one-on-one discussions or group discussion, students' ability to engage academically in communication formats of choice (text, audio, images, or videos), and anywhere and anytime learning.

Another hypothesis for individual characteristics that was statistically significant is that perceived ease of use has a positive influence on task-technology fit. This finding suggests that mobile technologies and instant messaging are not strange phenomena to students; hence, using them for academic gains is like letting students learn in their comfort zones. The researcher further inferred from the findings that instant messaging affordances such as easy navigation and easy downloading of the software contribute to a fit between individual perceived ease of use and academic use of MIM. The findings suggest that students should focus on learning activities rather than trying to understand how technology should be operated. Since the majority of students use MIM for social networking and communication in general in their everyday life, using them for learning was an effort-free process. Furthermore, interfaces of MIM are simple and easy to navigate.

The hypothesis that social influence has a positive impact on task-technology fit has been rejected in this study. These findings suggest that students' use of MIM for learning in this study is their personal choice driven by the advantages associated with this form of instructional delivery. In that vein, students are more likely not to be influenced by others to use MIM for academic gains. These findings contradicts Ismail's (2010) outcomes that students are likely to utilize social networking platforms for academic reasons if their acquaintances do the same. Possible causes for Ismail's (2010) findings could be that during that period social media was not as popular as it is nowadays; therefore, some students lacked confidence in the use of these emerging technologies for academic gain. Instead, they preferred using them in the company of their peers or someone they trust.

The findings of the study reveal that technology-based learning platforms that are easy to use are likely to meet students' learning needs. Additionally, motivated students may not require social influences to learn because they inherently have the desire to learn.

6.5 Performance Impacts

Finally, the study findings reveal a positive association between task-technology fit and perceived performance impacts. This finding suggests that students who believe that a fit exists on the antecedents presented in this study are more likely to utilize MIM for learning, resulting in better achievement of their learning goals.

6.6 Contribution of the Study

The study's contribution to the information systems research community involves the extension of the task-technology fit theory through the integration of the individual antecedent characteristics. A large number of previous studies that utilized task-technology fit theory (Gebauer, Shaw, and

Gribbins, 2010; Goodhue, 1995, 1998) overlooked the impact of individual characteristics in determining technology adoption, hence, reporting on findings that lack user's attitudes.

An assumption is made that once a fit occurs in the task-technology fit theory, utilization will automatically occur. This study has confirmed that perceived performance impacts can be assessed directly from the task-technology fit construct. This reduced the complexity of the original task-technology fit theory by eliminating the utilization construct.

7. RESEARCH IMPLICATIONS

The implications of this study are beneficial to many university personnel: instructional designers, lecturers, and university management. The findings of the study revealed that mobile learning systems present competitive avenues for conducting learning activities. Their potential should be further explored rather than viewing them as destructive to the learning process. In pursuit of this implication, instructional designers should develop instructional strategies suitable for supporting MIM pedagogical delivery. Lecturers should encourage students to participate in mobile learning using their most preferred learning inclinations. Also, lecturers should encourage students' instructional participation using platforms they are familiar with or those that are easy to use. In line with this implication, lecturers should continually work with students and identify popular emerging technologies and investigate how best they can be implemented to support effective teaching and learning. University management and lecturers should not impose new learning platforms on students; instead, they should continuously explore systems that have the potential to stimulate students' learning. Therefore, lecturers should refrain from using marks as an incentive for adopting a newly implemented learning system because students may utilize these imposed learning tools for the purposes of gaining marks – which may not result in effective learning.

On the other hand, MIM application developers should consider utilization of cloud storage. Such initiatives could reduce data losses when a mobile phone malfunctions or is lost. Also, cloud storage could help with data back-ups for students with mobile phones that have limited storage capacity. In addition, mobile developers should consider improving the potential of MIM in learning through the integration of important functionalities such as assessment facilities.

8. CONCLUSION

The study challenged the original task-technology fit theory and contended that user traits (perceived ease of use and perceived usefulness) including social considerations (social influence) also significantly shape students' successful performance of academic tasks. The study extended the task-technology fit model through the incorporation of the user psycho-social variable. The correlational approach was used to determine the existing relationships between variables. The findings of the study reveal that perceived usefulness and perceived ease of use are the facilitators for the technology user characteristics construct, but social influence proved to be a weak driver of successful task-technology fit performance impact. The task-technology fit theory hypotheses tested in this study were all reported to be statistically significant.

9. RESEARCH LIMITATIONS

Although this study provides several interesting findings, three limitations must be recognized. First, the study was conducted at one institution and in one department; therefore, generalizability of results could be difficult. Second, the implementation of MIM learning initiatives could impact lecturers' workloads since their facilitation services are required even after hours. Third, mobile learning initiatives proposed in this study may not benefit students who do not possess smartphones.

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