EXPLORING MOBILE PHONE USAGE AND POTENTIALS FOR ENHANCING HIGHER EDUCATION GHANA, WEST AFRICA

A Thesis in

Information Sciences and Technology

by

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ABSTRACT

As a result of the high diffusion of mobile phones in Ghana, almost all students in high schools and colleges own and use them quite frequently in and outside classrooms. The Ghana Education Services in 2010 suggests that the use of mobile phones among high school students is destructive in their learning process; therefore, the use of mobile phones has been forbidden in all high school campuses [Imoro 2012]. It seems to be assumed that the prohibition of mobile phone usage in high school may help the students to focus on their studies instead of concentrating on their mobile phones. However, it could be presumed that this ban may limit students’ exposure to the modern technology, hence, limiting the learning experiences that could occur outside of the classroom setting. However, students are permitted to use mobile phones in the university environment.

Today, nearly all students in most universities have mobile phones and use them primarily for communicating with families and friends and for everyday business purposes. Mobile phones can be viewed as potential resource tools for learning rather than seen as a classroom distraction. In order for mobile phones to become useful as platforms for learning in the educational environment, it is imperative for educators and curriculum developers to know how students use mobile phones in their current educational settings. Also, given the high level of mobile phone usage among university students in Ghana, it can be assumed that some of the students may use their mobile phones for learning purposes. Hence, it is important to examine this phenomenon and to ascertain how mobile phones are currently used and to examine how mobile phones can be used to enhance the learning process among students in Ghana. In examining the current and possible use of mobile phones in the educational setting in Ghana, consideration was also given to Transactive Memory Theory and how the constructs of this
theory could be used to better understand and enhance the learning process of university students in Ghana.

This qualitatively driven mixed methods study investigates five specific questions: (1) Do students in universities in Ghana use their mobile phones for the purpose of learning? (2) If they do, what factors influence their use of mobile phones for learning, and if they do not, then why? (3) What kinds of mobile educational tools do they use and why? (4) How do students use their mobile phones to further enhance their learning process. (5) How and why do mobile phones relate to and support transactive memory in the context of learning in Ghana? In order to answer these questions, students are asked to complete a survey with some open-ended questions on their use of mobile phones, and how the phones impact their learning processes. The survey was conducted via crowdsourcing, on campus labs, and through the traditional printed copies.

These questions are addressed by using Transactive Memory Theory (TMT) and the concept of mobile learning as the bases for the interpretation and discussion of the student responses. While the survey analysis suggests that university students in Ghana use their mobile phones for learning purposes, this study also suggests ways in which mobile phones can be used as educational tools among higher education students in Ghana.
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Chapter 1

Introduction

The use of mobile devices such as mobile phones, tablet computers, e-readers and digital audio players such as MP3 has become quite popular among students all over the world. There are over 5 billion mobile phone users throughout the world [Kanhere 2013]. It is important to note that most of these users live in the developing parts of the world and that the use of mobile phones in these areas continues to increase yearly. For example, in Africa, mobile phone ownership increased from 10% in 1999 to more than 75% by 2010 [Komunte 2012], and has been projected to be 788 million by 2015 [Rao 2011].

With multiple mobile phone subscriptions by individuals, Ghana alone has over 24 million subscriptions [GSMA 2013]. This wide spread of mobile phones has made it possible for both elementary, high school, and university students to own and use mobile phones. The Ghana Education Services in 2010 suggests that the use of mobile phones among elementary and high school students, is destructive in their learning process; therefore, the use of mobile phones has been forbidden in all high school campuses [Imoro 2012]. However, as the students advance to the university environment, they are permitted to use mobile phones on campus. It seems to be assumed that the prohibition of mobile phone usage in high school may help the students to focus on their studies instead of concentrating on their mobile phones. However, it could be presumed that this ban may limit students’ exposure to the modern technology, hence, limiting the learning experiences that could occur outside of the classroom setting. Given that the use of mobile phones increases among students, it is important that educators learn as much as possible about the
possible use of mobile phone in the educational setting so that they can better understand and incorporate these devices into the teaching and learning process.

The mobile learning phenomenon has gained the attention of researchers in many educational institutions, and has stimulated these researchers to devise new and innovative ways to enhance the potential of mobile phones as an important educational tool [Johnson 2012]. As a result, many researchers are focusing on the design of mobile friendly applications that will facilitate the learning process for students. Alcatel-Lucent [2010] indicated that for hundreds of years educators have relied on non-digital textbooks when distributing information to students. This focus on the design of mobile friendly applications is changing the educational landscape, while providing students with opportunities for dynamic individual learning experiences.

In March 2014, it was reported that, over 120 billion mobile applications downloaded. Over 7% of these downloads are educational applications and 5% are books. Many of these applications are available for college students using Apple’s iOS devices, Windows, Blackberry, and Android mobile devices [Statistics Brain 2014]. Some of these software applications are available free of charge to the public. For example, myHomework provides students with the opportunity to keep track of homework, classes, projects, and tests on their mobile phones [Neri 2014]. Documents to Go gives students the opportunity to upload and edit Microsoft Word and Excel files [DataViz Inc. 2014]. Whether students in Ghana make use of educational applications such as these is not known at this time. As a result of the availability of useful software that can assist students with their learning, important research questions can be raised, especially in relation to the use of mobile devices in the educational setting in developing countries. The importance of education has been realized as a catalyst for improving development. Given that education is the key to the progress of developing countries, if mobile phones can be used to
accelerate learning in higher education, it may be possible for developing countries to progress at a more rapid pace.

Therefore, research, which investigates how students make use of mobile phones, becomes a very relevant and practical area of inquiry in relation to developing countries. Using Ghana, West Africa as an example of a developing country, research questions in this instance can be framed as: (1) Do students in universities in Ghana use their mobile phones for the purpose of learning? (2) If they do, what factors influence their use of mobile phones for learning, and if they do not, then why? (3) What kinds of mobile educational tools do they use and why? (4) How do students use their mobile phones to further enhance their learning process? (5) How and why do mobile phones relate to and support transactive memory in the context of learning in Ghana? In order to answer these questions, students are asked to complete a survey with some open-ended questions on their use of mobile phones, and how the phones impact their learning process. The survey was conducted through crowdsourcing, on campus students’ computer labs, and by traditional printed copies. These questions are addressed by using Transactive Memory Theory (TMT) and the concept of mobile learning as the bases for the interpretation and discussion of the student responses.

The purpose of this study is to investigate these questions, and to examine ways in which mobile phones could better aid Ghanaian students in their learning process. Ghanaians place emphasis on personal interaction, direct communication with individuals, a respect for the past and the importance of the oral tradition in their culture. Based upon the emphasis on personal interaction, direct communication with individuals, a respect for the past and the importance of the oral tradition in Ghanaian culture, this study is conducted and analyzed through the lens of Transactive Memory Theory (TMT). This theory places emphasis on personal interaction and
group dynamics. “Transactive memory theory is a psychological hypothesis, first proposed by Daniel Wegner in 1985. It is a system by which groups collectively encode, store, and retrieve knowledge. It draws upon the memories within the individuals in the group to update information, create new ideas and solve problems. The theory focuses on the sharing of stored knowledge.” [Wegner 1985].

Lewis and Herndon [2011] note that there are three conditions that determine a well-developed transactive memory. These are: 1) community members’ differentiated knowledge, 2) members’ knowledge credibility, and 3) members’ ability to coordinate their knowledge with others. TMT consist of three components; (1) the individual memory, thus, a person’s independent memory. (2) External memory, which consists of record keeping tools such as books, and external storage devices like computers and mobile phones, and (3) transactive memory, (the interaction between two individuals and or the interaction between an individual and a computer or a mobile phone during learning process). Therefore, it can be said that transactive memory process is taking place when a person retrieves information from another individual, a group of people, and / or from an internal memory of a mobile phone and the Internet via the phone.

Transactive memory theory is used in this study because communication between individuals is important to developing and maintaining a well-integrated transactive memory, and mobile phones allow group members to maintain consistent and interactive communication with other individuals over a greater distance. Therefore, it seems that mobile phones ought to be enhancing the development of transactive memory systems, or promoting the creation of new ones. This study also considers the concept of mobile learning as it directly relates to mobile phone usage in the context of higher education in Ghana. Mobile learning (m-learning) refers to
the ability to learn at any time and place by the use of mobile device [Nyiri 2002, Sharples 2005, Fuxin 2012].

In addition, it has been observed that with the increasing usage of mobile phones, the people of Ghana still maintain the oral tradition of learning. Therefore, they have the tendency of relying on each other’s memories and they also have a great admiration for individuals that have good retentive memory. It is assumed that this behavior would increase by the use of mobile phones. Based on this observation, the research questions are as follows:

**Research Questions**

*I.* Do students in universities in Ghana use their mobile phones for the purpose of learning?

*II.* What factors influence their use of mobile phones for learning?

*III.* What kinds of mobile educational tools do they use and why?

*IV.* How do students use their mobile phones to further enhance their learning process?

*V.* How and why do mobile phones relate to and support transactive memory in the context of learning in Ghana?

**Rationale for this study**

The ubiquitous nature of mobile phone technology has made it possible for individuals to stay connected wherever they are. As a result of the increasing mobile phone technology, more and more people use mobile phones in a variety of contexts. This raises the question; to what extent is the usage of mobile phones beneficial in college education? The purpose of this study is to investigate this question by examining ways in which mobile phones could better support
students with their learning processes. There are currently several educational mobile applications available. Whether students in the universities in Ghana make good use of these resources is undefined at this time.

As stated earlier in this chapter, there are over a 120 billion mobile application downloaded worldwide. Approximately 7% of the 120 billion apps are educational applications and 5% include books [Statistics Brain 2014]. Some of these applications are available free of charge to the user. A few examples include myHomework, which provides students the opportunity to keep track of homework, classes, projects, and tests [Neri 2014]. Google Mobile app allows students to search Google using voice input [Google Inc. 2014]. Documents to Go gives students the opportunity to upload Microsoft Word and Excel files and edit the files on their phones wherever they may be [DataViz Inc. 2014]. It is imperative to find out whether students in Ghana make use of these mobile applications for learning purposes, and to find out how they can better use the applications to enhance their education.

**Objectives and Contributions**

The use of mobile phones is highly personal, and qualitative and quantitative methods are better for understanding the reasons behind the phenomena observed in this case. Therefore, this study is conducted using a limited mix-method to explore the use of mobile phones as tools for learning and for encouraging the learning process among students. As Creswell [2003] indicated, this method is used because the use of both qualitative and quantitative data helps to provide the best understanding of research problem [p.12]. In an investigation of this nature, a contemporary phenomenon within its real-life context is examined. The goal of this study is to explore how and why students use their mobile phones in higher education in Ghana. Through this process, the
ways in which college students use their mobile phones for the purpose of facilitating their learning processes is examined.

The outcome of this study may serve as a way to increase awareness among college students and educational communities on how to make good use of their mobile phones in the teaching and learning process. This search may also promote the development of software for mobile phones that is useful for college students. Although there are extensive studies done in this domain, none has examined mobile phone usage as it relates to college education in Ghana through the lenses of Transactive Memory Theory. Therefore this study adds to the existing pool of Knowledge and literature in the areas of teaching and learning relative to how this phenomenon occurs in developing countries.

This study will also make both theoretical and methodological contributions to the field of Information and Communication Technology research. The theoretical contribution is the use of two different constructs (Transactive Memory Theory and Mobile Learning) at the same time in this study. From a theoretical standpoint, this will be the first time the theory of transactive memory and the concept of m-learning are used together in the analysis of mobile phone usage among college students in Ghana. This study also contributes to the practical understanding of how mobile phones are used in the learning process of college students in Ghana and adds to the existing literature in the field of learning by the use of technology.

The methodological contribution is the combination of three different ways of data collection. (1) the use of crowdsourcing to capture participating subjects around the world; particularly, individuals who had college education experiences in Ghana, but did not reside in Ghana at the time of this study; (2) the use of an auto pop-up of the survey in the computer labs
to gain the attention participants who may not be familiar with crowdsourcing; (3) the use of print-copy survey as a result of the lack of stable electricity power supply.
Chapter 2

Literature Review

As the telecommunication technology increases and more software applications are developed for educational use, more students will become involved in the use of mobile phones in the educational arena. Meanwhile, with the third and fourth Generation – 3G and 4G – networks, coupled with the Global Positioning System (GPS) capabilities in mobile phones, campus orientations can be facilitated through mobile phones WebQuest [Bottentuit, Coutinho, & Sternaldt 2006]. With the emergence of the 4G and Wi-Fi network, Google, and Apple maps it should be possible to make campus orientations a more exhilarating for students in the near future.

The increasing use of mobile phones is not just in Africa. It is a phenomenon around the world in both developed and developing nations. Horrigan (2009) suggested that mobile phones have come very close to replacing laptop and desktop computers as the primary means of wireless Internet access for English-speaking Hispanics (68%) and African Americans (65%) in the U.S. This is far outpacing Internet usage by Caucasian (33%), many of whom choose to use laptops. As a result of the rising mobile phone usage throughout the world, it is imperative that researchers continue to examine ways in which mobile phones can be used to enhance students’ learning processes.

Researchers are beginning to realize the potentials of mobile devices as learning tools, and have begun looking for ways in which mobile technology can better serve people and enhance education. For example, the emergence of Apple's iPhone, iPod, touch mobile digital
devices, and most recently, the Apple's iPad and tablet computers, researchers in Bell Labs, Cambridge University, and Abilene Christian University have begun to analyze what it means to read, write, and publish in the learning space in this digital era [p.2]. Other researchers are focusing on the use of mobile phones in secondary schools. Hartnell-Young and Heym [2008] demonstrated the effective uses of mobile phones with secondary school students completing social-constructivist learning projects in which mobile phones were used for timing experiments, sharing files, photographing scientific equipment, conversing via text message, syncing calendars, creating narrative movies, using the Global Positioning System (GPS) to identify locations, and transferring files from home to school.

Other researchers are focusing on the design of mobile friendly applications that will facilitate the learning process for students. In a report, Alcatel-Lucent [2010] indicated that for hundreds of years educators have relied on non-digital textbooks when distributing information to students. The contemporary paradigm, within which information is disseminated, especially among the recent generation of mobile devices, is changing the educational landscape. It is in fact offering students opportunities for dynamic personal learning experiences.

Researchers such as Jen-Hung Huang, Yu-Ru Lin, and Shu-Ting Chuang [2007] invested the acceptance of mobile learning among university students in Taiwan. They developed and tested the Technology Acceptance Model (TAM), which was designed to explain and predict the acceptance of mobile learning (m-learning) by university students. The study focused on how users access learning material with their mobile devices. With a focus on 313 undergraduate and graduate students in two Taiwan universities, their study identifies two factors that account for individual differences in the use of mobile devices: perceived enjoyment (PE) and perceived mobility value (PMV).
The results of their study show that the data fit the extended TAM model well. Their research shows that consumers hold positive attitudes for m-learning, viewing m-learning as an efficient tool. More specifically, the results indicated that individual differences have a great impact on user acceptance and that the perceived enjoyment and perceived mobility can predict user intentions of using m-learning. There is scant research available in the literature on user acceptance of m-learning from a customer's perspective. The present research shows that TAM can predict user acceptance of this new technology. Perceived enjoyment and perceived mobility value are antecedents of user acceptance. The model enhances our understanding of consumer motivation of using m-learning. It is also important to note that this understanding can aid our efforts when promoting mobile learning.

As mentioned in the rationale for this study, several practical applications for the use of mobile devices have already been developed and explored. These include myHomework, which allows college students to keep track of their homework, projects and dates that these items are due for each of their classes [Neri 2014]. The ability to keep track of their assignments via a mobile devise eliminates the need for handwritten notes that can be easily misplaced or lost by students. The use of myHomework also increases the students organizational skills and increases the students ability to store and retrieve information.

Google Mobile app allows students to search Google using voice input [Google Inc. 2014]. Documents to Go gives students the opportunity to upload Microsoft Word and Excel files and edit the files on their phones wherever they may be [DataViz Inc. 2014]. It is imperative to find out whether students in Ghana make use of these mobile applications for learning purposes, and to find out how they can better use the applications to enhance their education. As a result of
the rising mobile phone usage throughout the world, it is imperative that researcher continue to examine ways in which mobile phones can be used to enhance students’ learning processes.

As the above literature indicates, a number of scholars have written about mobile phones and how they relate to learning. However, none of the literature primarily focuses on the use of mobile phones among college students in developing countries and how mobile phones can be used to enhance or facilitate their learning process. This is an additional reason for conducting a research of this nature. Given that developing countries often lag behind in educational and technological advancements, the knowledge gained from research of this nature will be especially useful to these countries.

**Types of Mobile Devices and their applicability for learning**

The literature on mobile learning discusses various pedagogical benefits mobile devices could provide. Scanlon [2013] reviews the literature on mobile learning and features of mobile learning that allow for location-based learning with regards to collaboration. Valk et al [2010] state that the effects of mobile devices on education could be placed into two categories. First, mobile devices provide access to education while maintaining the quality of educational delivery. Second, mobile devices provide new platforms for facilitating alternative ways of learning.

**Feature Phones**

The simplest of mobile phones, without elaborate features, are fairly powerful. They can be used for group discussions via text messaging, and since some of these mobile phones have cameras, they can be used to take pictures for power points and other projects
need images. These devices can also be used to record assignments, to take verbal notes and practice speeches before making formal presentations. Like the multimedia phone, Smart phones have all the aforementioned features of multimedia phone [Murray 2011]. In addition, Smart phones come with slightly larger screen size, more memory and faster processing capacity. This implies that Smart phones have better Internet accessibility than both the feature and multimedia phones. Therefore instructions or course materials displayed on Smart phones are quite appealing to students that the display on the Multimedia phones [Jhoanarobledo 2012].

**Multimedia Phones**

The multimedia phone's operating system is typically far less complex than the smartphone because the multimedia phone does not need to do as much as the smartphone. The smartphone's operating system is more akin to that of a PC. It has a faster processor; more memory offers more storage capacity. The multimedia phone can perform the duties of a word processor and in most cases a basic spreadsheet. It also includes a camera and a music playback system. Both phones provide Wi-Fi but the smartphone also offers a sophisticated system of web surfing, music and video downloading, email, IM and text notification and access to thousands of applications. The newer models also feature two video cameras for video conferencing [Murey 2011].

**Mobile tablets Computers**

Tablet PCs are mobile PCs that make use of large touchscreens as user-input devices to be operated by a stylus, pen, or finger [11]. Such devices can operate as efficiently as a laptop computer. They are bulky and heavier than iPads, for this reason, most consumers do
not like them. The Apple iPad is smaller, thinner and easier to carry around, therefore student prefer them [Jhoanarobledo 2012].

**E-Book Readers**

The fundamental function of an E-Book Reader is for reading and storing e-books. This device also provides easy access to dictionaries. Many students also use their e-book readers as a replacement for the daily paper, since they can read various editions and magazines on it. Well-known brands include Amazon’s Kindle and Barnes & Noble’s Nook [Jhoanarobledo 2012].

**Mobile Learning**

In today’s technological society, it is easy to continue to learn at any time and in any location. This phenomenon has opened new learning and communication possibilities for students, teachers, curriculum developers, corporations, individual user of mobile technology and especially for institutions that look for ways to offer learning opportunities beyond the face-to-face teaching environment. Mobile learning is generally the process of learning at anytime and place by the use of mobile devices [Korucu and Alkan 2011]. Such devices include handheld computers, and telephones that typically have a display screen with touch input or a miniature keyboard. Personal Digital Assistants (PDA) such as mobile phones, tablets, and digital organizers are among these devices.

Hamat et al [2012] suggest in a survey of university lectures in Malaysia that “mobile technology is providing a new frontier for the application of educational technology within academia.” However, they point out that there is still much to be understood about the concept of
mobile learning before it can be put to good use in higher education. They found that the mobile phone, one of the most popular mobile devices used by students at all educational levels, has not been fully put to educational use. Their study reports that while 65% of participating individuals owned a smart or mobile phone and had a favorable experience with e-learning, 79% of those individuals had never made use of the mobile phone for e-learning. Their study suggests that both instructors and students should be educated regarding the use of the mobile phone as a learning tool. They further suggest that a greater understanding of the capabilities of the mobile phone could lead to more effective student learning.

Cheon et al [2012] also researched college students’ perceptions regarding mobile learning in higher education. They addressed student readiness for learning in their study. They also agree “Although mobile devices are ubiquitous on college campuses, student readiness for mobile learning has not yet been fully explored in the United States.” To address this problem they developed a conceptual model, based on the theory of planned behavior (TPB). They found that students accepted “m-learning reasonably well” and that student attitude, subjective norm, and behavioral control positively influenced the intention of the students to adopt mobile learning. Their study also pointed out that the adoption of m-learning is dependent upon learning and interface environment in which the devices are used. For example, they recommend that when designing a user interface and content structure, special attention should be paid to the screen size and network speed. Cheon et al [2012] found that the students were often frustrated with the small screens size and slowness of the networks they encountered in mobile learning. Therefore it is important to consider learning environment as a major factor in the m-learning environment. Lai [2011] also addresses m-learning, the slowness of the advancement in this area, and the “student as pioneer” in his research. He states that “communication technology (ICT) is
progressing slowly and that students are regarded as pioneers in forcing the faculty to change and adapt to m-learning.

Franklin [2011] states that although mobile learning is progress slowing, El-Hussein & Cronje [2010] point out that mobile learning is becoming an increasingly promising way of delivering instruction in higher education. To support this idea that the delivery of instruction is gaining support, their research reports that Internet usage doubled between 2011 and 2012. In 2011 Internet usage was 4.3%, by January 2012, Internet usage had reached 8.5%. El-Hussein and Cronje [2010] also point out that the research regarding Internet usage is not keeping up with the growth of the Internet.

Research that is similar to this includes Diamanduros [2007], which is a quantitative examination of undergraduate use of technology. Harley [2007] is a qualitative study that reveals that text messaging is a critical means by which students communicate and maintain their social networks. Geary [2008] provides an individual perspective supporting mobile phone use in the classroom, while Thornton [2004] describes three connected projects concerning the use of mobile phones by students in Japan (providing an alternative perspective). Fischman [2007] describes a specific case of mobile phone adoption by an educational institution. Although there is a wealth of research concerning the use of mobile phones in education, there was no research specifically applying a transactive memory perspective to mobile learning. Exploring mobile phone usage and potentials for enhancing higher education Ghana, West Africa may be considered a start towards filling this gap.
Transactive Memory Theory (TMT)

Transactive memory is used as the theoretical basis for this research. Transactive memory is a group information processing system where information is distributed among the different members of a group. In a well-integrated system of this nature, if any given member is asked to encode or to retrieve a piece of information, he or she will be able to identify the appropriate group member to accomplish the task. Jackson et al [2012] pointed out that the effective knowledge of a group is made up of internal knowledge, often in the minds of people and external knowledge that can be accessed outside of the individual.

This concept was first proposed in Wegner’s [1987] article “Transactive memory: A contemporary analysis of the group mind. Theories of group behavior.” Wegner [1987] discusses three types of memory: individual, external, and transactive. Individual memory refers to a person's internal storage and retrieval of knowledge. External refers to books, notes, or anything that allows people to store knowledge in an external form for later retrieval.

Transactive memory was originally used to analyze the process by which families accomplish a task. For Peltokorpi [2012], the concept of transactive memory system has been extended from the analysis of families and groups to organizations. In organizational settings, transactive memory explains how individuals access, retrieve, and make use of information base on their knowledge of knowing who knows what and who knows who. While many researchers, including Nevo and Wand [2005] use the theory of transactive memory to examine organizations, Noroozi et al. (2012), note that transactive memory system is the phenomenon that facilitates the acquisition of knowledge, awareness, and coordination among group members. TMT is very important to the success of the multidisciplinary and / or collaborative work of members of a given group.
Wegner [1987], while analyzing the concept of transactive memory observes the three processes, which supported communication among groups. These include directory maintenance, information storage, and retrieval of information. Wegner et al [1987] note that the general principle of transactive memory is that it is a set of individual memory systems, which is often combined with the interactive process among the individuals [p. 186]. There are three conditions that determine a well-developed transactive memory. These are: 1) community members’ differentiated knowledge, 2) members’ knowledge credibility, and 3) members’ ability to coordinate their knowledge with others [Lewis and Herndon 2011]. Transactive Memory Theory consists of the external, individual, and transactive memory.

**External memory**

The use of external memories such as books, notes, and media storage devices, which include mobile phones, has become very necessary since individuals can not always encode, store or recall information. Unlike the individual memory, information stored in the external memories is often retrievable. However, this depends on understanding what and where to find the information. Thus, knowing the location of the information is just as important in the process of retrieving the information. In some occasions, other people can serve as the location of an external storage. For example, a teacher is often in a position to respond to some questions a student may need answers to, and the student may also be in the position to remind the teacher his or her name when the teacher fails to learn the students’ name [Wagner, 1987, p. 188].
Individual memory

Wegner [1987] also noted that the process of individual memory consists of three different steps; the “encoding stage” – the moment of information entering the mind, the “storing stage” – when the information gets settled within the mind, and the “retrieval stage” – when the message is being reproduced. Unfortunately, most of the time individual’s memory may store information and fails to reproduce the information when it is needed. This can occur due to forgetfulness or excitement at the time of encoding the information. Therefore, individuals tend to rely on the use of external memory. In this instance, mobile phones can play a major role in aiding the memories of the individuals, as it is capable of storing and retrieving information. Mobile phone can also be viewed as an individual since it has its own memory for storing and recording information for future retrieval.

Transactive Memory

According to Austin [2003], the dimensions of transactive memory are group knowledge stock, consensus about knowledge sources, specialization of expertise, and accuracy of knowledge. Wegner [1987] states that within instructional psychology perspective, for instance, it is typically known that a teacher and a student form a system of transactive memory that has some special properties. Each of them plays their respective roles with regard to the distribution of knowledge within such system. The transmission of internal memory storage is often viewed as the main responsibility of the teacher, which is a temporal transactive memory process, and the purpose is to form within the student a permanent system of individual memory [p. 203]. A teacher’s interaction with a student in a process where by the student is learning by self-experimentation and only gets corrected when she makes a mistake, is a transactive instructional process. For Wagner, instructional success occurs if the system of transactive memory can
replace itself within the system, and thus, if the teacher can be replaced with an external memory systems such as the library and other portable memories in which case, it is apparent that the mobile phones have memories and Internet capability and therefore, can serve that purpose for students in this day in age. Wagner [1986] also finds it interesting that people who engage in the process of transactive instruction find it quite effective.

Transactive memory theory enhances communication between individuals and is important to the development and maintenance of a well-integrated memory system. Mobile phone, as in external component of a well-integrated system allows group members to maintain communication links over a greater distance. Therefore, it appears that mobile phones can be used to enhance the development of transactive memory systems, or to promote the creation of new systems. Figure 2-3 is an illustration of the transactive memory system as it relates to mobile phones within the context of learning. This illustration, designed for this study positions the mobile phone as an integral component of a TMT system.

The transactive memory process in this illustration takes place when the three main constructs and the telephone come together. Transactive memory process also occurs when an individual (a person) interacts with another person to retrieve information. That person who provides the information serves as an external memory at the time of the transactive process. Similarly, when a person interacts with a mobile phone for the purpose of retrieving information either from the internal memory of the phone or from the Internet, the mobile phone in this scenario serves as an external memory in this process. When an interaction occurs between group members via the mobile phone, transactive memory has occurred.
Figure 2-1: An Illustration of TMT with a mobile phone as an integral component of TMT

Transactive Memory Theory in the Context of Ghana and Culture

Ghana is among the most advanced countries found in West Africa. The country is politically and economically stable. Although changing, tradition is still a very important in the daily lives of individuals and within the economic and educational environment. Although the traditional method of face-to-face communication is fast fading away, the notion of individual and group memory is still very much in the minds of the people today. It has been generally observed that people in Ghana tend to rely upon each other for information that affect their daily lives and well being. Ghanaians still has a great deal of respect for individuals who have a very good memory. In fact, it was and still is a great honor to be identified as a Griot (an individual with the ability to recall and recite the history of a given village or cultural group.) The Griot possessed what can be identified as a kind of Transactive Memory. He or she has their own memory (individual), the memory of the people (external) and Transactive (the ability to interpret and transmit the stored knowledge and history to the people). In addition, the people of
Ghana still continue to make use of the oral tradition in the learning process. Students, especially at the elementary school level are still forced in one way or the other, to memorize information. However, the fast diffusion of mobile technology in the country is beginning to change how individuals at all levels are taught in Ghana’s education system.

To some extent the communication and the preservation of culture is still orally transmitted. However, technologies such as mobile phones, computers, and televisions are now fully integrated in both the towns and villages of the country. In developing learning theories, curricula and mobile learning devices, the culture and ways of communicating must be taken into consideration. Given that there is still a great deal of respect for oral and interactive communication and learning, Transactive Memory Theory could be used as a foundational theory for the development of curricula and new teaching and learning methods that could incorporate the traditional style of communication that prevails in Ghana: and one that is likely to remain as important aspect of learning in Ghanaian education. With the wide spread use of mobile phones and other technological devices in the country, the opportunity for important educational advancements in Ghana could become a reality in the very near future.

An Overview and History of Mobile Phones in Ghana

Ghana, a former British colony, was known as the Gold Coast until 1957 because of the vast amount of Gold found within the country. Located in the western part of Africa, Ghana is bordered by Togo, Burkina Faso, Cote D’Ivoire, and the Atlantic Ocean, and encompasses a total of 239,460 square kilometers with 539 kilometers of coastline. The vegetation in Ghana varies from the savanna region in the northern two-thirds of the country to a tropical forest zone in the south. Gold, timber, industrial diamonds, bauxite, manganese, fish, rubber, hydropower,
petroleum, silver, salt and limestone can be counted among Ghana’s natural resources. Although well endowed with natural resources, the domestic economy continues to revolve around subsistence agriculture, which employs over 60% of the work force of the country. The climate is tropical, warm and comparatively dry along the southeast coast, humid in the southwest, and hot and dry in the northern part of the country. Lake Volta, located in the southeast portion of the country, is the world’s largest artificial lake and encompasses 4,880 kilometers of shoreline [UNICEF 2014].

In 1957, Ghana was the first Sub-Saharan country in Africa to attain political independence. The Ghana Statistics Services [2013] estimated that the population of Ghana was 24,658,823 as of July 2010. There are approximately 73 persons per square mile in Ghana. About 39% of the population is under the age of 14, 15% are between the ages of 15-64 and 3% are age 65 or older. Life expectancy for men in Ghana is 58.07 years and 59.56 for women. The 2007 estimate indicated that the Gross National Income per capita is $380 with much higher incomes found among professional and business people in large cities. Ghana’s population increases with an average of 14,128,310 every five years [World Bank 2012].

The educational system in Ghana consists of both public and private education from elementary through secondary school where the classes are taught in English. About 65% of the males over the age of 15 can read and write, with 46% of the female possessing the same skills. There is a growing number of very well educated individuals who had their education abroad or in one of the many well-established universities and technical institutions in Ghana and other parts of Africa that offer the bachelors, masters and doctorate degrees in all of the major disciplines. As of the year 2000, there was an estimate of 57.9% literate of the population. Figure 00.1 illustrates a close up of the map of Ghana.
Like other places in Africa; long before the emergence of technology in Ghana, local people used instruments for mass communications. Instruments such as drums, trumpets, and gongs were used to relay information from one village to another, in a way similar to the modern telegraph. The people, usually the linguists *(a group of individuals who study linguistics)* or griots *(a class of poets, musicians, and storytellers who maintain oral history and tradition)* would beat the drums, blow the trumpet to announce the death or an installation of a king or local chief. Ghanaians value their cultural heritage and tradition and for that reason, the people occasionally practice the old forms of communications during cultural festivities. And even today, the same sounds of the instruments are played on the radio prior to an announcement of the king’s death or installation. Many mobile phone users have the opportunity to listen to the radio via their mobile phones.

![Figure 2-2: Map of Ghana on the Globe](http://www.mapsofworld.com)

The Gross Domestic Product (GDP) purchasing power parity is $75.9 billion US Dollars as of 2011 ranking at a level 81 compared to the rest of the world, GDP per capita is $3,100 US Dollars. Ghana’s independence on March 6, 1957, became a sign of hope for the entire continent of Africa. It was the first sign of change to the white colonists, of what was to become, according
to British prime minister, Harold Macmillan, [1960] “the wind of change.” Today, cellular phone technology has brought about a new and very different “wind of change”.

The Emergence of mobile phones in Ghana

In 1992, the cellular phone industry started in Ghana with the Mobitel Company initiative. At that time, there were 19,000 mobile phone subscriptions. By 1998, subscription increased to 43,000 and in 1999, it was 68,000 subscriptions [Ghana Web 2012]. Other companies such as the Ghana Telecom, and Space Phone – identified as Mobile Telephone Network (MTN) in early 2000 – began to penetrate the cellular phone market and user subscription increased quite significantly. As of 2011, the United States’ Central Intelligence Agency estimated a total of 284,700 main phone lines, and 21.166 million mobile phone users, which brings Ghana to the global rank of 43 among 219 countries, [the World Fact Book 2012]. Ghana is currently one of the four biggest mobile phone markets in Africa; and the other three include Nigeria, South Africa, and Kenya [Rao 2011].

As of 2014, Ghana has 6 mobile communication companies. These include the MTN – now SCANCOM, which has the larger market share of 54.21%. AIRTEL holds the second market share of 15.83%. VODAFONE has the third market share of 15.01%. While MILLCOM (TIGO) has 12.06% of the market share, GLO MOBILE has 2.06% market share, and the lowest market share holder is EXPRESSO with 0.41% as indicated in figure 2-2. All of these companies offer prepaid services to all consumers. Individuals can purchase SIM cards and minutes at a given cost and assign certain amount of minutes for calling, Internet browsing, and texting.
Table 2-1 also shows the most recent data from the Ghana National Telecommunication Authority dated in January 2014. This data also explains the further growth of mobile telecommunication market in Ghana, West Africa.

Table 2-1: Mobile Voice Market Share for January 2014  
Data Source: National Communication Authority – Ghana

<table>
<thead>
<tr>
<th>Mobile Data Operators</th>
<th>Subscription</th>
<th>Market Share of mobile data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expresso</td>
<td>50,446</td>
<td>0.41%</td>
</tr>
<tr>
<td>Millicom (TIGO)</td>
<td>1,496,529</td>
<td>12.06%</td>
</tr>
<tr>
<td>Scancom (MTN)</td>
<td>6,725,164</td>
<td>54.21%</td>
</tr>
<tr>
<td>Vodafone Mobile</td>
<td>1,861,938</td>
<td>15.01%</td>
</tr>
<tr>
<td>AirTel</td>
<td>1963,799</td>
<td>15.83%</td>
</tr>
<tr>
<td>Glo Mobile</td>
<td>308,031</td>
<td>2.48%</td>
</tr>
<tr>
<td>Total</td>
<td>12,405,907</td>
<td>47.4%</td>
</tr>
</tbody>
</table>
Chapter 3

Methodology

This study examines ways in which mobile phones are used for educational purposes by university students in selected universities in Ghana, West Africa. After a review of relevant literature and research studies, a 50 item questionnaire was designed to obtain information regarding the use of mobile phones by students in selected universities in Ghana. A total of 310 survey was completed by students enrolled in the University of Ghana – Legon, the Kwame Nkrumah University of Science and Technology, and the University for Development Studies between May 2013 and January 2014. The data was collected in three ways, (a) crowdsourcing via the Amazon Mechanical Turk, (b) on-campus computer laboratories, and (c) through the use of printed hard copies. Both qualitative and quantitative analyses were used to examine the research questions because they are more appropriate measurement for a research such as this. Open-ended questions were added to the questionnaire to offer participants with an opportunity to provide additional information on how they make use of mobile phones in their learning process.

Given that the Transactive Memory Theory (TMT) provided the theoretical basis for this study, it was appropriate to ask the participants in the study how they acquire and make use of information through the use of mobile phones. Since Wegner [1987] stated that TMT refers to a group information processing system in which information is distributed among different members of groups, it was appropriate to ask participating individuals of their general use of mobile phones for the purpose of conducting collaborative projects among groups. Hence, the participants were asked whether they use mobile phones when working on individual and group projects. They were also asked if they used mobile phones to contact individual experts.
for information needed for their projects. These questions grow out of the integrative learning aspect of the Transactive Memory Theory that suggests that if any given member of a group is asked to encode or to retrieve any information, that member will know who is the appropriate group member with the appropriate information to solve a given problem project or answer a particular question [Wegener 1987]. The students were also asked to further explain if they do and how do they determine who might be more knowledgeable on some specific subjects.

Also, based on the notion that TMT was originally used to analyze the process by which family members, groups, and organizations accomplish tasks [Wegner 1987, Nevo and Wand 2005, and Peltokorpi 2012], the participants were asked to provide information on how and/or whether they contacted family members, friends, and course mates by the use of mobile phones for information concerning their school work. They were also asked to further explain how they made use of their mobile phones in this situation. Noroozi et al. [2012], supported Wegner [1987] who noted that a transactive memory system is a phenomenon that facilitates knowledge, awareness, and coordination among group members and that it is very important to the success of multidisciplinary and/or collaborative members. For this reason, the participating subjects were asked to explain whether they think that their use of mobile phones improves or impairs their learning processes.

For Wegner [1987], the concept of transactive memory involves three processes, which supports communication among groups. These include directory maintenance, information storage, and retrieval of information. Based upon the concepts related to the maintenance, storage and retrieval of information, the participants in this study were asked to provide detailed information regarding how they use their mobile phones and if they used the mobile phones for maintaining, storing, and retrieving information for learning purposes. The
participants were also asked to provide information regarding if and how they used mobile phones among themselves as interactive tools in their learning processes. This question is related to Wegner’s general principle of transactive memory that individual memory systems are often combined with the interactive process among the individuals in problem solving. [p. 186].

The questions were designed in Google docs, and distributed via the Amazon Mechanical Turk (M-TURK), which allows individuals in any location to participate in this study. Other data was collected from students who made use of computers in public labs that contained a copy of the questionnaire and by the use of traditional printed copies of the survey. While both qualitative and quantitative data can be gleaned from questionnaires used within the context of mobile learning research, this study reports more of the qualitative analysis. Most of the quantitative data is not reported in this study; it is rather reserved for an extensive study in the future.

The data was analyzed at the Pennsylvania State University, University Park, where a request for conducting this research is submitted to the Institutional Review Board (IRB) for approval. Since this study involves human subject, it is necessary to apply for the review of the research processes including the methodology use for data collection in this study. Thus, the IRB form for review was completed and submitted online via the Penn State Office for Research Protection. The request to conduct this study is reviewed and approved prior to the collection of the data.

Research sites

The University of Ghana (UG), the most reputable higher institutions in Ghana [Ansong 2009] located in Accra – the capital city of Ghana – was established in 1948 as a member college
of the University of London during the British colonization. It was named the University College of the Gold Coast until 1961 when it was granted the power to award its own degrees. It was subsequently renamed as the University of Ghana. As the largest institution in the country, the university has about 42,000 students across three campuses in Accra. Approximately 70% of the student population is male, and 30% is female. Over 90% of the students are natives of Ghana and the remaining 4% are international students [Amoa 2011].

The Kwame Nkrumah University of Science and Technology is located in Kumasi and was established in 1951 by Dr. Kwame Nkrumah who eventually became the first president of Ghana. It was named the Kumasi College of Technology at its inception and was an affiliate college of the University of London, until later in 1961 when it was granted full university status at that time. At that time, the institution was renamed the Kwame Nkrumah University of Science and Technology. With three campuses within the country, the university’s population of approximately 32,200, which include both graduates and undergraduate students [KNUST 2013].

The University for Development Studies, located in the north, the less developed part of the country, was established in 1992 by the government of Ghana to work closely with the local citizens to promote sustainable development across the country. The university has four campuses across the northern region of the country and a total population of about 20,000 undergraduate and graduate students [UDS 2014].

Data collection

The data was collected in three ways, (a) crowdsourcing via the Amazon Mechanical Turk and through, (b) on-campus computer laboratories (c) printed hard copies.
Both qualitative and quantitative data analysis were used to examine the research questions because they are believed to be the most appropriate measurement approach for a research such as this. The qualitative data is collected with some open-ended questions via crowdsourcing to the theoretical saturation point. As Vannoy and Salam [2010] drawing from Corbin and Strauss [2008] simply put, “when previously identified concepts were repeated in the data; no new concepts is found” [p. 501].

Amazon Mechanical Turk (M-Turk)

Like many other online services, the use of Amazon Mechanical Turk requires user account creation and login. The main page of the site as shown in figure 001 consists of the main accounts, Human Intelligent Tasks (HITs), Qualifications, Workers, and Requesters. The main accounts’ page provides login options. While the HITs consist of a list of tasks often submitted by the requester, qualifications provide the user the option to assign workers who have specific specialties or qualification. This option does not make a HIT open to the general public but only open to a group of people as specified by the requester. Workers are individuals who work on various tasks within a period of time. As of 2010, there was an estimate of 500,000 active workers in over 100 countries around the world. The workers ages range between 18 – 80 years and their income ranges between $ 0 and 160,000 US Dollars with most of them earning $20,000 – 40,000 US Dollars per year [Paritosh, et al. 2011]. M-Turk workers consist of 12% US workers, and 27% Indian workers. There were a total of 30% Unemployed individuals as of 2010 [Winter and Siddharth 2011].
Data collection and analysis

The majority of the data, 120 responses (38.5%) was collected via the Amazon Mechanical Turk (M-Turk). There were 77 responses (24.7%) of the data was collected through an auto popup set up on the students computer labs on the KNUST campus; and 115 responses (26.9%) of the data was collected in the form of hard printed copies due to the instability of the electricity to power the computers at the time of this survey.

The survey questions were designed via Google Drive by using the form option and set to export results in Microsoft Excel spreadsheet. When using a data collection method such as this, difficult to know whether the participating subjects are really students or have studied in the universities in Ghana. This is because the researcher neither knows nor have a way of knowing who the respondents are; the researcher has to accept how the respondents identify themselves. In order to mitigate this occurrence, the survey questions are set with screening questions to reject the participants’ responses and by default exits the survey if the participating subjects reply “No” to those screening questions.

The screening questions include the following; are you currently or have you ever studied in college in Ghana? Do you own a mobile phone or did you own a mobile phone at the time you were in college in Ghana? If the respondents answered “No”, then the survey would be exited to a thank you page and thank the participants for attempting to partake in this study. After all the data was collected and compile, it was reviewed to ensure that there was no data duplications. It is important to review carefully because M-Turk does not prevent users from signing up with multiple accounts. Participants’ Internet Protocol (IP) addresses and M-Turk identification numbers were used to validate the data. It was then exported as a Comma Separated Value (CSV) file and analyzed in R and Microsoft Excel where descriptive analysis is considered.
There were a total of 312 HITs with approximately 50 questions. The HITs were divided into four batches because the researcher was not sure of what is an appropriate amount of money to pay for a HIT such as this. Although it was observed that other requesters paid between $0.15 and $15.00 per HIT. It was important to experiment and examine the cost for completing this particular survey. Therefore, the first 21 HITs was posted with a pay rate of $0.80 cents per survey and participants took the HITs within 01:00 – 03:00 minutes, and completed the HITs in about 40 minutes with an average of 19 minutes 46 seconds per HIT.

A second batch of 21 HITs with a pay rate of $ 0.40 cents was submitted and got taken within 30:00 minutes and completed in about 3:00 hours with an average of 16 minutes 44 seconds per HIT. A third batch of 52 HITs with a pay rate of $0.20 cents were submitted and got taken and completed in approximately 48 hours with an average completion time of 11 minutes 1 second. A final batch with 109 HITs with a pay rate of $0.20 cents was submitted and only 26 of the HITs were completed within 3 weeks and the average time of completion was 9 minutes 1 second. The rate of responses became extremely slow and almost to the dead end. It was presumed that this non-responsiveness of participants on M-Turk could be as a result of the lack of awareness of the M-Turk survey link, Internet connectivity, electricity, and students’ interest in the study. However, there were a total of 120 respondents, which is deemed insufficient for a study such as this, while the researcher is determining to collect sufficient data from at least 300 participants for analysis.

Therefore, the survey questions were set on the students’ computers in the labs at the Kwame Nkrumah University of Science and Technology at the Kumasi campus, to popup during log in. The students then had the option to either complete the survey or discontinue. After few
days of data collection, there were daily electricity outages. This hindered the data collection process because the Internet would not work without the electricity. In addition, the Internet was considerably slow due to the limited bandwidth. Since the electricity was not stable, by the time the students logged in to the computers to start the survey, the power was interrupted; often in the middle of the survey. This discouraged some students completing the survey.

As a result of Internet slowness and the lack of a stable electricity supply, the survey was printed and distributed to students to complete. The students were given the option to complete the survey within 24 hours at their convenience. The printed survey copies were collected and transferred into the data through the Google drive survey form that was linked to the M-Turk. After the data was collected from a total of 312 participants and reviewed 2 of the surveys were rejected due to the insufficiency and inconsistency of the information from the respondents. Therefore, a total of 310 survey collected was considered, analyzed and discussed in this study. To ensure validity of the data, the researcher showed the data to other Penn State graduate students who have experience with conducting studies on M-Turk, and it was confirmed that the data made logical sense.
Chapter 4

Results

Descriptive analysis:

The participating individuals consisted of current undergraduates, graduates, and former student. There were a total of 310 participants, 102 female and 208 male. As indicated in table 4-1 below, the summary of age shows a minimum of 18, First quartile (1st Qu.) is 21.75 – thus, the mid age between the minimum age of 18 and the median age of 23 – and the median is 23. While the mean age is 25.51 and a maximum of 68 years, there is a third Quartile (3rd Qu.) of 26 – thus, the age between the mean of 25.51 and the maximum age of 68. A total of 6 individuals did not provide any information regarding their ages.

Table 4-1: Demography - Summary of participant’s age

<table>
<thead>
<tr>
<th>Min.</th>
<th>1st Qu.</th>
<th>Median</th>
<th>Mean</th>
<th>3rd Qu.</th>
<th>Max.</th>
<th>NA's</th>
</tr>
</thead>
<tbody>
<tr>
<td>18.00</td>
<td>21.75</td>
<td>23.00</td>
<td>25.51</td>
<td>26.00</td>
<td>68.00</td>
<td>6</td>
</tr>
</tbody>
</table>

As shown in figure 4-1 and table 4-2, a larger number of participants (83), thus 26.77% are in their first year of college. With 6 high school graduates, 43 of the participants are currently in college, 13 of them are now in graduate school, 16 reported to be postgraduate and 6 of them decline to indicate their level of education.
Table 4-2: Summary of participants consist of undergrads, grads, and others who have already completed their undergrad education but not currently enroll in school

<table>
<thead>
<tr>
<th>Level of Education</th>
<th>1st Year</th>
<th>2nd Year</th>
<th>3rd Year</th>
<th>4th Year</th>
<th>Graduate</th>
<th>Others (former students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>83</td>
<td>53</td>
<td>36</td>
<td>69</td>
<td>53</td>
<td>16</td>
</tr>
<tr>
<td>(%)</td>
<td>(26.77%)</td>
<td>(17.09%)</td>
<td>(11.61%)</td>
<td>(22.25%)</td>
<td>(17.09%)</td>
<td>(5.16 %)</td>
</tr>
</tbody>
</table>

Figure 4-1: Number of Participants categorized by their level of education

Students’ use of mobile phones in higher education for learning purposes

I. Do students in universities in Ghana use their mobile phones for the purpose of learning?

This survey indicates that most university students in Ghana think that they use their mobile phones for learning purposes and in services of their course works. As shown in figure 4-2, in general, 90% (279 participants) reported using and / or have used their mobile phones in college for learning purposes, with 10% (31 participants) of the participants reporting that they never use their phone for learning purposes.
II. What factors influence the use of mobile phones for learning among university students in Ghana?

The major factor driving the use of mobile phones among students in Ghana for learning purposes is the availability and convenience of the mobile phones. They are very portable and easy to carry around. The few individuals that indicated that they own laptop computers reported that the laptop computers are heavy and inconvenient to carry around campus. The majority of the students indicated that they do not have laptop or desktop computers; therefore, the only tool for accessing information instantly for them is their mobile phones. Hence they rely on their phones for contacting teachers, families and other friends for learning purposes. The students indicated that the information such as research articles and journals found via the internet on their mobile phones is very credible and reliable. Therefore the students feel that they are receiving very accurate information on their mobile phones. Similarly, when they store information in the internal memory of the phone, they are sure of retrieving the information in the future.

**Figure 4-2:** Use of mobile phones for learning purposes in higher education in Ghana

**Factors influencing the use of mobile phones for learning**

- Use Mobile Phone for learning
- Not Use M-Phone

- 90%
- 10%
The students often contact senior members of their classes, and siblings who are more knowledgeable regarding some specific subjects for answers to some of their questions concerning their studies. There are several variables that may contribute to this behavior. This may be due to the respect that Ghanaians have for the ideas and knowledge of individuals that are older than themselves and other senior members Ghanaian society. The need to rely on such individuals may be due to the students’ lack of experience and confidence in retrieving information from an online database system. They are sometimes unsure of their ability to retrieve the proper information. However, these variables are not examined in this study.

Mobile phone usage in higher education in Ghana

III. How do students use their mobile phones to further enhance their learning process?

Unlike the United States where mobile phone users pay monthly rates for their telephone usage, the use of mobile phones in Ghana requires users to purchase prepaid phone cards and minutes, which are used for calling, texting, and Internet browsing. The minimum cost of minutes is 2.00 GHC (Ghana Cedis), which is equivalent to approximately $1.00 US Dollar and a maximum of 20.00 GHC or $10.00 US Dollars for a larger amount of minutes. After purchasing more minutes, users can use a portion of the minutes for Internet browsing while reserving some of the minutes for calling. In Ghana, this procedure is identified as “Internet bundling” [MTN 2014].

Internet Browsing

Within the context of this study, the Internet can be categorized as “external memory” due to the fact that information that are often stored and retrieved in a memory in some electronic
location and retrieved through the same electronic process. It was found that most students use
the Internet as their primary source of information for learning on their mobile phones. One
participant said,

*I use my phone to browse information about my assignments,
project work and for other research. Also, I used it to chat with
friends on social media like Facebook, yahoo and many others.*

Another student states,

*I log onto Google and then type in the information I need from which
I get varied answers to pick from. I then write them down in my jotter
because my phone does not support downloading information.*

Other students store information found on the internet in a written format because they do not
have enough cellular minutes to download some files in their phones or to continuously leave
their data running on their phones. Leaving their phones on for long periods of time consumes
minutes and can become quite costly for most students. Some students have also realized the
importance of the Internet and often use their mobile phones for searching for their course related
information online. A few examples of the participants’ statements regarding the answers to their
question found on the Internet include the following. One student indicated that

*I found an answer to a question when I was given homework to find
answers to the treatment of septic tank that was in my building
construction class.*

Another student also said;

*I once had a genetic assignment and upon opening a page on the net
I found out that the teacher actually copied all the questions from
that page and printed for us. This really helped me to read more on
that topic and understand the assignment.

Many other students indicated that they conduct search in order to find further explanation on
topics or subjects discussed in the classrooms that are difficult to understand during the class
session. One undergraduate student said;

by browsing for information about something I don’t fully
understand in class I get further information, which makes
me understand it more.

Wegner [1987] described three major components of TMT. These include the individual,
transactive, and external memory. The use of mobile phones for retrieving information from the
Internet for the purpose of learning is a classic example of external memory. External memory
can be a book, an individual, or a storage device such as a computer or mobile phone. However in
this study, mobile phones can serve as a member of a group with a memory capable of storing
information that is retrievable by other individuals. In the above scenario, the mobile phone
serves as both a medium and as a member of a group memory, retrieving and storing information
from a server. In addition, the students’ ability to retrieve learning materials via the use of mobile
phones at any time and anywhere is central to the mobile learning process. This aspect of mobile
learning was observable throughout the results of this study.

Text Messaging and E-mailing

As Noroozi et al [2012] suggested, transactive memory system is the phenomenon that
facilitates knowledge, awareness, and coordination among group members and that it is very
important to the success of multidisciplinary and/or collaborative members. The results of this study indicate that most undergraduate students believe that they learn new information from their counterparts and family members who possess in-depth knowledge about certain subjects by way of text messaging for answers because of their uncertainty about a given subject. In a response to an open-ended question, a few participants indicated that they use *WhatsApp* – a considerably low cost text messaging mobile application – to text each other for clarifications regarding a given assignment.

TMT also suggests that individuals rely on each other’s memories to accomplish a given task. Students in Ghana, particularly, undergraduates seem to rely on their colleagues who are more knowledgeable than they are on certain subjects. A total of 5 male and 7 female students indicated that it is just easy to text senior course mates for answers to questions they do not know than looking it up by themselves. Another 21 year old female student said:

*My brother and I are both accounting majors and he is more knowledgeable than me, so I always *WhatsApp* him for answers instead of googling. In fact, I use Google only when he is busy and not responding to my text.*

Transactive memory process allows collaboration between members. Mobile phones appear to facilitate this process quite successfully among college student in Ghana. Some participants have indicated using text messaging and email to arrange and schedule collaborative meetings. They also reported discussing course related topics and ideas for their projects via text messaging where ever they are; whether on the bus or at the dining table. This can be attributed to the inherent and flexibility of mobile learning. Participants in the study indicated that they prefer to use *WhatsApp* instant messaging application because of it’s easy accessibility. As shown in
table 4-3, WhatsApp usage was the highest (8.4%) in term of usage in the social media application category, followed by regular phone text messaging and e-mail with 5.8% usage respectively.

**Audiovisual Recording**

As indicated earlier in this study, one of the major components of the TMT is the external memory. As Wagner [1987] suggested that the use of external memories such as books, notes, and media storage devices such as mobile phones has become very necessary since individuals cannot always encode, store or recall information. It is the culture of Ghanaian students to rely on textbooks, and note-taking with pencil, pen, and paper. It is very uncommon to see students in Ghana taking notes on Laptops or tablet computers during class. Some students do have the laptop and tablets computers, however, they feel more comfortable taking notes with pen and paper. This is because they seem to think that they are accustomed to taking notes with pen and paper and can do so rather quickly. In addition, many students are unable to type fast enough to keep up with the lectures presented by their instructors.

While a few students may make use of mobile phones to record portions of lectures to enhance their note-taking in the classroom setting, the majority of the students do not use their mobile phones to record research related interviews, class lectures, and seminars for future reviews. Although, mobile phones are quite convenient, it also important to note that it is quite cumbersome to take notes with the phones. Mobile phones, tend to be good for taking short notes. The few individuals that use their mobile phones often for note-taking in class do not appear to have access to a personal desktop or a laptop computer. A 29 year old female graduate student said:

*I do not have a laptop and I do not write fast enough to take all the notes in class and follow the lecture at the same time, so I use my*
iPhone to record the lecture and review it after the class to update my notes.

Four graduate students indicate that they use their mobile phones to download articles from the Internet into the phones and save them for later use. On the contrary, none of the undergraduate students have indicated saving downloading articles into their phone for latter reviews.

The camera capability of mobile phones is also an important feature for leaning. Some students take pictures of notes, and events for future reviews. Another participant said “I take photographs of notes and verify my assignments with my phone.” Individuals who run out of browsing time rely on the basic features of the mobile phones such as the camera, dictionary, and the calculator. A 24 year old female participant states:

*in mobile phones generally we used calculator and dictionary part, when we don’t put net card in mobile. If there is net card there then anything we can check it out.*

A 23 year old mail student also said; “*Dictionary is my favorite application as I get to learn about so many words a day which enhances my vocabulary skills.*”

Very few students made mention of their use of mobile phones for note taking, or for reviewing their documents in Potable Document Formats (PDF), Microsoft Word, and Microsoft Power Point in preparation for their classes, assignments and exams. The students’ interaction with mobile phones is a transactive memory process in that the students retrieve already recorded or stored information from the phone during learning process.
IV. What kinds of mobile educational tools do the university students in Ghana use and why?

In was reported in March of 2014 that there were over a 120 billion mobile application downloaded with 7% of which was educational application and 5% was books. Many of these applications are available for college students for iOS, Windows, Blackberry, and Android mobile devices [Statistics Brain 2014]. A few of these educational applications for college students include (a) BenchPrep, an interactive course library that contains several course materials and practice test questions and flash cards for student [BenchPrep 2014]. (b) iStudiezPro, an application that keeps track of students scheduled assignment and exam deadline, and grades of students [iStudiezPro 2014]. (c) Ever Note, also an application that syncs text, audio, photo, and video to an online account, to connect students with resources to study [Ever Note 2014]. And (d) StudyBlue, which uses text, pictures, and audio to create the digital flashcards to assist students with their learning process [StudyBlue 2014].

The result of this study, however, suggests that students in Ghana do not seem to utilize the various educational applications. Table 4-3 indicates the number of times participants used the Internet and Browsers, Social media and Text-messaging, Audiovisuals, Dictionary, Word processing, and Other applications for learning purposes.
Table 4-3: Mobile Application used by students in higher education in Ghana

<table>
<thead>
<tr>
<th>Applications / Tools and Brief Descriptions</th>
<th>Frequency of use</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internet and Browsers</strong> [applications for surfing the Internet, and exchanging email.]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opera mini [an Internet browser for mobile devices]</td>
<td>* 161</td>
<td>* 51.9%</td>
</tr>
<tr>
<td>Google Search Engine [a search tool that enables users to search information including audio visual images on the World Wide Web]</td>
<td>110</td>
<td>35.5%</td>
</tr>
<tr>
<td>E-mail [electronic mail system that allows exchange of mail, images and documents]</td>
<td>18</td>
<td>5.8%</td>
</tr>
<tr>
<td>Wikipedia [an encyclopedia for referencing online materials]</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td><strong>Social Media and Text Messaging</strong> [an instant text voice messaging application capable of exchanging audio and visual images]</td>
<td>* 63</td>
<td>* 20.3</td>
</tr>
<tr>
<td>WhatsApp</td>
<td>26</td>
<td>8.4%</td>
</tr>
<tr>
<td>FaceBook</td>
<td>8</td>
<td>2.6%</td>
</tr>
<tr>
<td>Tango</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>Twitter</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>YouTube</td>
<td>2</td>
<td>0.64%</td>
</tr>
<tr>
<td>Viber</td>
<td>1</td>
<td>0.32%</td>
</tr>
<tr>
<td>Phone Messaging application</td>
<td>18</td>
<td>5.8%</td>
</tr>
<tr>
<td><strong>Audio Video Camera</strong> [an application for recording audiovisuals]</td>
<td>* 13</td>
<td>4.2%</td>
</tr>
<tr>
<td><strong>Dictionary</strong> [an application for finding words and meanings]</td>
<td>* 10</td>
<td>3.2%</td>
</tr>
<tr>
<td><strong>Word Processing and Documents Viewers</strong> [an application for note taking viewing and editing documents]</td>
<td>* 35</td>
<td>11.3%</td>
</tr>
<tr>
<td>Word To Go</td>
<td>8</td>
<td>2.6%</td>
</tr>
<tr>
<td>Microsoft Word</td>
<td>7</td>
<td>2.26%</td>
</tr>
<tr>
<td>Rich Note</td>
<td>1</td>
<td>0.32%</td>
</tr>
<tr>
<td>Microsoft Power Point</td>
<td>4</td>
<td>1.3%</td>
</tr>
<tr>
<td>Excel</td>
<td>1</td>
<td>0.32%</td>
</tr>
<tr>
<td>Kingsoft Office</td>
<td>1</td>
<td>0.32%</td>
</tr>
<tr>
<td>PDF Reader</td>
<td>13</td>
<td>4.2%</td>
</tr>
</tbody>
</table>
Other Applications | * 18 | * 5.8%  
--- | --- | ---  
Maps [applications for navigating places around the world] | 2 | 0.64%  
Alarm Clock [an application often used as a reminder] | 4 | 1.3%  
SSRN [Social Science Research Network] | 4 | 1.3%  
Student Planner [an application for scheduling and planning lessons] | 1 | 0.32%  
Udemy Online Courses [an application for on-demand online courses] | 2 | 0.64%  
YES [an entertainment application for exchanging images] | 1 | 0.32%  
Learn English [an application for learning English language] | 1 | 0.32%  
Gaming [entertainment application] | 3 | 0.96%  

In general 90% of the participating individuals indicated that they use and/or have used their mobile phones for at least one time while in college for learning purposes. 10% of the participants indicated that they did not make use of their mobile phones for learning purposes. The participants primarily use browsers to surf the Internet for educational information such as class schedule, arranging for meetings regarding group projects, looking up for meaning of words, books, journals, and articles. Firefox, and Opera mini are the browsers most often used by the participants in this study. Other applications used frequently by the participants are the calculator for mathematical assignments and the Calendar and Alarm for scheduling and reminding the students of various events.

As the table 4-3 indicates that 51.9% of the students make use of the Internet, browsers with the Google search engine for learning purposes. The students appear to make frequent use of the Google search engine at 35.5% of the time. They also appear to use social media and text messaging applications at a total of 20.3% of the time. In this category, WhatsApp (an audio, visual and text messaging application for mobile communication) shows the highest usage at
8.4%, while Viber (also a text and audio visual messaging tool for communication) has the lowest usage at 0.34%. There is a total of 11.3% usage of other applications for word processing. These include Word to go – for creating, editing, and viewing text Documents –, Microsoft word, Power Point, and Portable Document Format (PDF) Reader. In this category, PDF Reader shows a usage of 4.5%; and Kingsoft Office, Rich note, and Microsoft Excel usage of 0.32% each. While the Dictionary application usage is at 3.2%, the voice recorder for recording class lecture is of 4.2% usage. The Other application category shows a total usage of 5.8%.

Most of the participants reported that use their mobile phone because they do not own laptops. All participants, including individuals who have the laptops, think that their mobile phones are more convenient to use. The mobile phone is also light in weight, easy to carry around and quick to use. It is imperative to point out that it has been observed during this study that there are several reasons leading to the students’ use of these few mobile applications as shown in table 4-3. However, these reasons are not discussed in details, as they are not the major focus of this study. They will however, be considered in future studies.

Variables that may influence the use of few mobile applications for learning among college students in Ghana.

There are several reasons contributing to the individuals’ use of fewer educational mobile applications. The data gathered in the survey suggests that students do not make use of the various mobile phone applications for the following reasons.

- Lack of awareness of the availability of other educational applications.
- Lack of finance for purchasing enough minutes to download the applications.
- Lack of understanding the values of the applications.
• Lack of newer and updated phones. Some students own old mobile phones that are incapable of running newer applications.
• Lack of better mobile communication infrastructure in Ghana to enable high-speed Internet connections.
• Lack of finance for purchasing updated mobile money to purchase updated mobile phone.
• Easy accessibility to some answers from individuals who are more knowledgeable on some specific subjects.

As shown in figure 4-3, the results of the data indicate that mobile phones are perceived to positively impact students learning process in higher education in Ghana. The majority of the participants thus, 65.35% indicate that their use of mobile phones enhances their learning process. While 3.96% of the population indicates that their use of mobile phones impairs their learning process, 13.86% say they are not sure whether their use of mobile phones enhance or impair their learning process and 16.83% of them skip the question of whether they think their use of mobile phones enhance or impair their learning process. It is important to reference that individuals who think their use of mobile phone impairs their learning process also indicate that they mostly use their phones for gaming, watching movies, and chatting with friends for fun.

The students’ gender, age, ethnicity, and culture do not show any significant differences on their use of mobile phones for learning purposes. Their educational experiences and their level of technical skills particularly in the use of mobile phones, appear to have some influence in their use of mobile phones for learning. Hence the data suggest that there is some correlation between higher level of education and higher use of mobile phone for learning.
Mobile phones and transactive memory in learning processes

V. How and why do mobile phones relate to and support transactive memory in the context of learning in Ghana?

According to Wegner [1987] Transactive Memory Theory (TMT) has three main constructs; these include, the individual, external and Transactive memory. In his paradigm, each person has an individual memory, which is the first construct in TMT. External memory is composed of items or devices that are used to record and store information for later retrieval. Transactive memory refers to group knowledge and the accuracy of the collective memory. In a perfect transactive memory system these three constructs come together to form effective knowledge system.
Given Wegner’s [1987] analysis of TMT, mobile phones can serve as individual and/or external memory. Therefore, mobile phones become the vehicle for accomplishing all three aspects of TMT. The Mobile phones become the primary link between individuals during the transactive memory process. The potentials of the mobile phones include directory maintenance, information storage, and retrieval of information. In this study, it was found that the current mobile phones that students in Ghana use, are well equipped with the capability to maintain directory, store, and retrieve data. A participating subject confirmed this when she said,

*with my mobile phone, I get easy access to my course schedule, see lecture videos, pictures, and read articles.*

*In addition, it is so easy to share educational information among friends over the phone.*

Another participant said;

*there was a time I had all the information for my assignments by browsing the Internet on the phone when.*

*This helped me a great deal to learn new information and be able to score high in my class assignments.*

The potential of the mobile phones also allows student to exchange information in their learning processes by way of texting, sharing, and retrieving and saving ideas on their mobile phones.

One participant said,

*as a medical student, I am not good when it comes to the Arts and History subjects; so I always chat with my trusted friend Alice on WhatsApp for answers to some Arts and History questions.*

This phenomenon appears to be perpetuated among students in Ghana because a large number of library resources an other educational materials are not readily available to the students.
Many students are in one way or the other obligated to rely on their mobile phones as the primary tools for interaction, learning, and collaborative work. As the participants affirm during this study, educational tools such as desktop computers, laptops, and tablet computers are quite cost-prohibitive. Most brands of mobile phones on the other hand are considerably more affordable for most students. A 26 year old, a fourth year student stated that,

*Mobile phone is cost-effective as compared to using a public internet cafe. It is easier as well because one does not have to travel on a longer journey just for information."

Another student stated, “I use my mobile phone to search for information online and this enables be to complete my assignments in time, since I don't have any Internet access at home”. For most students, mobile phones are the primary source of obtaining information such as research articles, statistical information and other data over the Internet; therefore, mobile phones facilitate the transactive memory process and learning among students in Ghana. Without mobile phones most students would have to travel long distances to Internet Cafes to access the Internet. In addition, most communities in Ghana do not have adequate public Internet services, they do not stay open an adequate number of hours to accommodate student, and electricity power supply is not stable. However, with mobile phones individuals are able to gain access to the World Wide Web at any time and place.

The general principle of transactive memory is that it is a set of individual memory systems often combined with the interactive process among the individuals [Wegner et al. 1987]. Participants in this study confirm this theory when they indicate that mobile phones facilitate interaction and thus, promote their learning process. A mobile phone does not only serve as a
vehicle for interaction among students, but also as an individual memory. Therefore, it is appropriate to state that mobile phones further enhance the development of transactive memory process among students in Ghana.

As Lewis and Herndon [2011] stated, there are three conditions that determine a well-developed transactive memory system. These are: 1) the differentiated knowledge among community members, 2) the credibility of the knowledge of the members, and 3) the ability of the members to coordinate their knowledge with others. It has been observed throughout the study that all participating students have different experiences, ways of understanding, and learning, which they recognize in each other. This phenomenon was demonstrated during this study when a student said;

My colleagues and I plan our group project work by text messaging on WhatsApp, Tango, and Viber. Last semester for example, my self as a business advertisement student and two other students (a computer science and a communication major) had to design a Website for our communication skill class project. While I was on the bus traveling home for that weekend, my group chatted about ideas for the project and decided that the project be divided into three portions and be completed base on each person’s skills. As a business major, I did some writings and design all the graphics on my friend’s laptop, the communication student did most of the writings, and the computer science also did some writings, and put all the content together in a Website.
The students also appear to have innate respect and trust for their senior course mates and professors who are more knowledgeable in some specific subjects. A third year student said;

*I rely on the TA in my biochemistry class and always contact her by text first because I think she is more knowledgeable than me, and she always response to my questions. Some times I email the professor for clarification on some assignments.*

A first year student also stated; *“for my French class, I chat my friend Sauma on WhatsApp for help in learning the language because she speaks French and I believe everything she says”*

They also show their ability to interact with each other via the mobile phones for the purpose of facilitating their learning processes. The student attributes and their use of mobile phones for learning purposes identified above exemplify Lewis and Harndon’s [2011] description of a well-developed transactive memory system. The availability of mobile phones with Internet capability allows students to interact, and learn new information in a timely fashion and within the paradigm of the transactive memory system and more importantly, this occurs regardless of time, distance, and space.
Chapter 5

Discussion

The use of mobile phones seems to encourage transactive memory process in the context of learning among college students in Ghana. The data shows that individuals seem to contact each other by phone call, text message and email for the purpose of retrieving information regarding their courses and for learning purposes. They also appear to retrieve learning materials and other information from the Internet through the use of the mobile phones. The Internet, according to Wegner [1987] is an external memory, thus, a storage device. External memory of the Transactive Memory Theory (TMT) refers to books, notes, or anything that allows people to store knowledge in an external form for later retrieval. In this instance, it can be said that the theory of transactive memory component that addresses interactions between individual memory (a person’s internal memory) and external memory (the mobile phone), is clearly revealed. The use of mobile phones by individuals participating in this study serves as an important role in the learning processes of university students in Ghana. It was found that mobile phones are used by Ghanaian students to perform the tasks of directory maintenance, information storage and retrieving information during their learning processes.

However, the concept of group thinking and group sharing of knowledge in TMT specifically for group projects as described in Wegner [1987], does not seem to be quite pervasive among the university students in Ghana with regards to accomplishing their collaborative projects. The aspect of this phenomenon that mobile phones seem to encourage and facilitate is the preparation, scheduling for the collaborative meetings, and discussing ideas over the phone and text messaging.
The participating subjects indicated that their mobile phones usage in school helps to enhance their learning process. As shown in the results, most students 90% reported using and/or have used their mobile phones for learning purposes; whereas 10% of the participants reported neither using nor have used mobile phones for learning purposes. While the vast majority of the participants claim to use mobile phones for learning purposes, 65.35% perceive that mobile phone usage enhance their learning process, and 3.96% of the participants perceive that their use of mobile phones impairs their learning process. It is imperative to note that the majority of the participants that indicated that their use of mobile phones impair their learning process, also indicated that they often use their mobile phones for playing games, and chatting with friends for fun. There were 13.86% of the participants that said they were uncertain whether their use of mobile phones enhance or impair their learning process and 16.83% refrain from responding to the question of whether their use of mobile phones enhances or impairs their learning process.

**Mobile phones and learning in the context of Ghana**

Although, mobile phones usage seems to enhance students’ learning process, as students show the lack of awareness regarding mobile features and other mobile applications, it is imperative to note that increasing awareness of the various educational application might help to enhance students’ learning process. Very few individuals seem to take complete advantage of their phone’s features. Perhaps, the students can be encouraged to find time and explore the many features of their mobile phones to ascertain how they can better use those features to further enhance their learning process. The audiovisual capability of mobile phones for example, can be a very powerful tool for learning, if more students use it for recording lecture sessions for future reviews.
Due to the range of capabilities found in the more recent mobile devices, students find that these devices provide more options in terms of functionality. A unique feature of this phone is its specific affordances or prosperities of the system, which allow certain actions to be performed. However, it has been observed during this study that feature phones are the most commonly used mobile phones among the students in Ghana. With feature phones, there are some limitations as to how they could be used for educational purposes because of their limited capabilities (calling, texting, calendaring, and managing contacts). Since they are primarily capable of calling and texting and organizing schedules, instructional designers could design text-based lessons for students and the students could use the calendar feature to learn time and lesson management. However, in regards to text messaging lessons, the small screen size of the feature phones can be viewed as a hindering factor for learning process. This is because it may be quite uneasy to the eyes of the students when reading. Also, there is no considerably enough screen space to display learning materials.

In order to accommodate small screen size mobile devices, instructional designers may be forced in one way or the other to design their lessons briefly with precisions and by primarily focusing on the main points. In other words, while screen size is small and restrictive and not good from instructional design perspectives, it may be a good reason for instructional designers to ignore all unnecessary information and focus on the main points in their lessons. All students do not learn the same way. What is useful to one group of students may not be seen as useful to another set of students. What one student sees as unnecessary may be in fact, important information that may help other students to understand the subject matter.

Another important mobile phone feature that could be use to enhance students’ learning process is the radio capability. The newer feature phones are equipped with radio capability, and
this is widely spread in African countries such as Ghana. The radio feature allows users to listen to their favorite radio stations. An example of the feature phone with radio capability is the Vodafone 255 manufactured by Zhongxing Telecommunication Equipment Corporation (ZTE) in China. This radio feature has been observed to be one of the commonly used features in the phone.

It is important to note that feature phones with radio capability are widely used among all generations within Ghana. Most users of feature phones with radio capability listen to the radio through their phones. Although, it appears that individual listeners of the radio may learn new information in one way or the other by listening to some radio programs such as spelling competition, and other science and mathematic programs. Such learning process is often informal and for that matter, some listeners may have the tendency to not take this form of learning process seriously. Perhaps, educators could design required and formal lessons to be delivered through the radio at a given time. Other slightly advanced feature phones such as the Nokia 6060 /6061/6062 series, come with a rear digital camera and a screen size of 2.5mm, a resolution of 128 x 160 pixels, a battery life span of 3.50 hours could be use for exchanging project images among students for learning purposes.

**Educational Implications for learning in Ghana**

Throughout this study, it has been observed that the transactive memory process is mostly a natural phenomenon found among the student in Ghana and mobile phones tend to facilitate this process. To further enhance students’ learning processes, it is imperative that the use of mobile phones for learning purposes among students is encouraged and adopted throughout the universities in the country. Currently, most institutions do not have well equipped computer labs
in Ghana. The few universities and colleges that have computer labs often face the issue of electricity power supply. Many students cannot afford good desktop, laptop, and tablet computers.

However, they can afford some fairly good mobile phones that allow them access to online learning materials. Therefore, there is the need to change educational policies to incorporate mobile phones as learning tools in the educational system of the Ghana instead of prohibiting mobile phone usage in elementary and secondary educational system. It may be of value for universities to subsidize the cost of telephones for students to facilitate the increased use of telephone in the learning process. This will be very important for two reasons, the unavailability of a sufficient amount of text books, the fact that most of the current information such as scholarly publication and free online lessons can be found in the digital world by the use of mobile phones.

**Conclusion**

The use of mobile phones among students around the world has become very common and the number of subscribers continues to increase by thousands per day [ITU 2014]. The International Telecommunication Union – ITU – [2014] reported that the number of mobile phone subscription was 6.8 billion in 2013. For the past five years, mobile subscription in sub-Saharan Africa alone has increased 18% a year, totaling 253 million users as of June 2013. This brings the rate of mobile phone penetration to 31% of the population. The 2013 report of the Group Special Mobile Association – GSMA – (the largest association of mobile telephone operators world wide) estimated that mobile phone subscriptions would reach 346 million users by 2017 [Maylie 2013]. As of December 2013, Ghana, a considerably small country in West Africa with
a population of over 25 million, had a total subscription of 24.9 million, thus, 99.7% of the population of the country [GSMS 2013]. Many of the people in the country have multiple subscriptions of diverse mobile telephone network service to ensure continues connectivity base on the poor network condition.

This increasing wide spread of mobile phones has made it possible for almost all students in both secondary schools and colleges in Ghana to own and use mobile phones for not only communicating with friends and family members. Base on this increasing use of mobile phones, the author of thus research study initially assumed that student would most likely use their mobile phones for learning purposes. As a matter of fact, this study indicates that most university students use their mobile phones for learning purposes. This study shows that 90% of the 310 participating subjects have used mobile phones for the purpose of learning and only 10% of them indicate not using mobile phone for learning. While the majority of the participants claim to use mobile phones for learning purposes, 65.35% perceive that mobile phone usage enhance their learning process, and 3.96% of the participants who often chat with friends and play games, perceive that their use of mobile phones impairs their learning process. While there was no correlation between the students gender, ethnicity, and financial backgrounds and their ability to use mobile phones for learning, their experience with mobile phones and technology appears to influence their use of mobile phones for learning.

Throughout this study, it was observed that the university students in Ghana appear to rely on their mobile phones for learning due to the lack of adequate learning materials and tools such as laptop, desktop, and tablet computers. The availability of mobile phones, quick and easy accessibility of electronic learning materials such as books, articles, lecture videos and lessons on the phone, are among other factors that influence the students’ use of mobile phones for the purpose of learning. This study also shows that the university students often use the Internet and
the Google search engine for retrieving research articles and other learning materials. They also use word processing applications for note-taking, other applications such as the dictionary, audiovisuals, and social media for interacting with friends, teachers, and senior course mates for learning purposes.

This study also shows how and why mobile phones relate to and support transactive memory in the context of learning in Ghana. Transactive Memory Theory (TMT), as described by Wegner [1987], and other researchers such as Lewis and Herndon [2011] has been found to be quite pervasive among students in Ghana. The use of mobile phones among university students in Ghana seems to perpetuate this phenomenon and facilitate the students learning processes. Therefore, in order to enhance the educational system of the country, it is imperative for the Ghana Education Services to change its educational policies to incorporate mobile phones as learning tools in the learning processes of students and to encourage educators to find ways for integrating mobile phones in all educational curricula instead of banning the use of mobile phones for junior and senior high students.

Limitations

The use of social network / online survey in the context of Ghana – West Africa

Given the lack of good Internet and electricity infrastructure and services some students were unable to access the surveys on line in a timely manner. As a result, ways had to be found to provide the participants with paper copies of the survey. Ghana, like many other developing nations around the world particularly in Africa often experience lack of electricity power supply each and every other day. The most unfortunate aspect of this issue is that the power goes off and
on quite unannounced. Therefore, a study conducted via crowdsourcing may be a slower process as compared to the traditional paper-based surveys. However, the power supply and Internet services are fairly good on major university campuses such as the University of Ghana, the Kwame Nkrumah University of Science and Technology, and the University for Development Studies.

Another issue is that the cost of Internet surfing is considerably high for average students who primarily rely upon their parents for money. Therefore, they may not use the little amount of money they have, to purchase browsing time to complete a survey; unless they know that they will get paid more than the cost of airtime they spend on the survey. This may have the tendency to drive the cost of the survey higher than the normal cost of Human Intelligent Task (HIT) on Amazon Mechanical Turk. While crowdsourcing may cost high in the context of Ghana, it is in fact, really worth the time as compare to the traditional paper based survey. Since crowdsourcing is typically anonymous, researchers often do not have a complete sense of who the participants really are; the researchers just have to accept who the participants say they are. The strength of using crowdsourcing is that it is fast and well organized. It is also a good way of collecting large data for research.

Since the focus of this study is on a specific population, the issue of the lack of complete understanding of who the participants are cannot be controlled. Perhaps a more appropriate way to collect data through crowdsourcing is to organize the process through various colleges and departments and conduct the survey in the departmental computer labs where Internet services and power supply are fairly stable. This can also help to minimize the potential issue of Internet and power supply that may arise.
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Appendix A

Survey Questions

Exploring Mobile Phone Usage in Higher Education in Ghana - West Africa

Inform Consent for Exploring Mobile Phone Usage and the Potentials for Enhancing Higher Education:

1. Purpose of the Study: The purpose of this research study is to explore how and why University / College students use their mobile phones for the purpose of learning. This study will also examine what mobile phone applications they use, what they do not use and why.

2. Procedures to be followed: You will be asked to answer about 50 questions on a survey.

3. Duration: It will take about 30 minutes to complete the survey.

4. Statement of Confidentiality: Your participation in this research is confidential. The data will be stored and secured at the IST Building in a locked/password protected file. In the event of a publication or presentation resulting from the research, no personally identifiable information will be shared.

5. Right to Ask Questions: Please contact M. Nadhir Muntaka at (814) 863-2888 with questions or concerns about this study.

6. Payment for participation: You will be rewarded $0.20 Cents for completing and submitting the survey.

7. Voluntary Participation: Your decision to be in this research is voluntary. You can stop at any time. You do not have to answer any questions you do not want to answer.

8. The researcher has the right to reject and not pay for any suspicious / dishonest responses and submissions.

You must be 18 years of age or older to take part in this research study. If you agree to take part in this research study and the information outlined above, please sign your name and indicate the date below.

If you wish to have a copy of this form for your records, please provide your email address in the next page and a copy will be emailed to you.

If you agree to the above, please click Continue, otherwise close the browser to quit this survey.
NOTE:
This survey is intended to examine the use of mobile phones in higher education in Ghana, West Africa; so you must have college / university education experience in Ghana and you must be a mobile phone user to participate in this study. Please exit the browser if you have no higher education experience in Ghana. Else, you will not be paid. Thank you for your participation.

* Required
Top of Form
Select ACCEPT if you agree to the above and willing to participate in this study, or DECLINE and exit the browser if you do not agree. *
Mark only one oval.

- ACCEPT (To continue) Skip to question 2.
- DECLINE (Please close the browser) Skip to "SORRY !!! You do not meet the requirements to take this survey. Thank you for your attempt; please close the browser. ."

Consent form

Optional : Please provide your email address if you need a copy of the consent form emailed to you.

Screening Questions
About yourself
Are you currently a university / college student or have you been to college / university before? *
Mark only one oval.

- YES (To continue)
- NO (Please exit the browser)

Action: If the No, Skip to "SORRY !!! You do not meet the requirements to take this survey. Thank you for your attempt; please close the browser. ."
If Yes, then continue.

In what university in Ghana did you have learning experience?

_______________________________  ___________________________  __________

Do you have and use a mobile phone? *
Mark only one oval.

- YES (To continue)
- NO (Please exit the browser) After the last question in this section, skip to "SORRY !!! You do not meet the requirements to take this survey. Thank you for your attempt; please close the browser. ."

What kind of mobile phone(s) do you have? *
How many mobile phones / or SIM card do you have?
Mark only one oval.

- 1.  2.  3.  4.  5.  6.  7.  8.  9.  10

Why do you carry / have more than one mobile phone or SIM Card?
Please explain with specific details. _____________________________  __________
_________________________  _____________________________  __________
_________________________  _____________________________  __________
**Demography**

About yourself: Please continue...

This survey is intended to examine the use of mobile phones in university / college education and you must have college experience and you must be a mobile phone user to participate in this study.

If you are currently a student, what is the name of your college / university? *

_______________________________________  __________________________

What is your highest level of education? *

*Mark only one

- High School Graduate
- Now in College
- College Graduate
- Masters Degree
- Now in Graduate School
- Post Graduate
- Decline *After the last question in this section, skip to "SORRY !!! You do not meet the requirements to take this survey. Thank you for your attempt; please close the browser. ."*

What is your current year in college? *

*Mark only one oval.

- 1st year
- 2nd year
- 3rd year
- 4th year
- 5th year
- 6th year
- Other
- None

Gender *

I am a

*Mark only one oval.

- Male
- Female
- Decline

What is your age? *

*Mark only one oval.

- 18 years, 19 years, 20 years .................. 75 years

What is your tribe/Ethnicity? *

Mark only one oval.

- Akan, Guan, Mole-Dagbani, Grussi, Gruma, Mande, Ga / Dangme, Ewe, and Other

What country, state, and city did you grow up in? *

_________________________  ___________

What is your major of study (Specialization)? __  ___________ ___________
What year did you graduate from college / When will you graduate? *
*Mark only one oval.

Have you ever been enrolled or are you currently enrolled in an online course? *
*Mark only one oval.
- Yes
- No

Have you ever traveled outside Ghana? *
Mark only one oval.
Yes
No
Please provide a list the countries you have been to __________  __________  __________  __________

About your mobile phone usage:

Are you using your mobile phone in school or have you used it for college related work? *
*Mark only one oval.
- Yes
- No Skip to question 26.

About your mobile phone usage... Continues
How do you use your mobile phone for learning purposes? Please explain. *
________________  __________________  __________________  __________________

What do you usually use your mobile phone for? *
Please select all that is applicable to you
Check all that apply.
- Texting friends and family members for answers / ideas relating to course work
- Class and homework schedule
- Calls to friends and family members for answers / ideas relating to course work
- Reading class notes / assignments
- Browsing for ideas and answers to course related work
- Alert / Alarm for course related work
- Just browsing for fun
- Face-booking or Twitting (Social media)
- Calculating (Using the calculator for course related work)
- Just phone calls for fun
- Streaming educational videos
- Playing educational games
- Playing games just for fun
- Video chatting for fun
- Streaming movies just for fun
- Video chatting for educational purposes
- Other:

What are some of the other things you use your mobile phone for (Please specify)
Do you do or have you done any group project by using your mobile phone? Please explain.
What applications do you use often for school / college related work?

Please explain why you use your mobile phone in school / college for learning purposes

Explain why you use your selected application/s

Which mobile applications are your favorites?

Explain why you made the applications your favorite?

If you are currently NOT using any mobile phone application for the purpose of learning, please explain why

If you are not currently in college, have you used your mobile phone in college for course related work?

What did you use your mobile phone for (Please specify)

How frequently do you browse the Internet with your phone? * 
Mark only one oval. 

Scale -1-5

0 = Not Frequently 5= Very Frequently

About your mobile phone usage:

Have you ever learned anything or anything related to your study or gotten an answer to a quiz, assignment, or test by contacting friends, roommates, project
partners, and / or family members with your cell phone? *
Mark only one oval.
Yes
No Skip to question 37.

Explain how do you determine who to contact for by phone for learning purposes.

______________________  ________________  _______________  _______   ___  

About your mobile phone usage... Continues
Does your mobile phone usage enhance and/or impair your studies? *
Mark only one oval.
My mobile phone usage enhances my education
My mobile phone usage impairs my education
I am not sure

In what ways does your mobile phone usage enhance your learning process or your coursework?

In what ways does your mobile phone usage impair your learning process or your coursework?

Using some specific examples, how and under what circumstances have you learned something or get an answer to a question related to your coursework / schoolwork by using your cell phone. *

Please rate the following statement where it is applicable to you:
Please Note: 0 = Not Sure 1 = strongly Disagree 2 = Disagree 3 = Slightly Agree 4 = Agree 5 = Strongly Agree
I use my mobile phone primarily for texting friends and family members for fun. *
Mark only one oval.

Not sure Highly agree

I use my mobile phone just for talking with friends and family members. *
Mark only one oval.

Not Sure Strongly Agree

My mobile phone helps me to learn in college. *
Mark only one oval.
I use my mobile phone to store information while in college and use the information when I need it. *
*Mark only one oval.

I use my mobile phone to get information from the Internet while in college. *
*Mark only one oval.

I use my mobile phone to contact friends for course or school related information when I cannot remember or I do not know the answer to the question *
*Mark only one oval.

I use my mobile phone to get information related to coursework while in college. *
*Mark only one oval.

I feel that my use of mobile phone had helped me to learn about things I would not have learned if I did not use the mobile phone. *
*Mark only one oval.

I really believe that my use of mobile phone had helped me improve the quality of my Education. *
*Mark only one oval.
I like to enroll in online courses. *
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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I use my mobile phone in college a lot for the purpose of learning during my 1st year.
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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I use my mobile phone in college a lot for the purpose of learning during my 2nd year.
*Mark only one oval.*

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<th>Strongly Agree</th>
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I use my mobile phone in college a lot for the purpose of learning during my 3rd year.
*Mark only one oval.*

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<th>Strongly Agree</th>
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I use my mobile phone in college a lot for the purpose of learning during my 4th year.
*Mark only one oval.*

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<th>Strongly Agree</th>
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I use my mobile phone in college a lot for the purpose of learning during my 5th year.
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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I use my mobile phone in college a lot during my as a graduate student.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I DO NOT use my mobile phone in college for any school related work.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I SOME TIMES use my mobile phone in college for any school related work.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I use my mobile phone in college a lot for any school related work.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I use my mobile phone in college a lot for school related work and for learning because of my high level of education.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I use my mobile phone in college a lot for school related work and for learning because I am just a beginning college student.  
*Mark only one oval.*

| Not Sure | Strongly Agree |

I think my level of education affects the way I use my mobile phone for learning.  
*Mark only one oval.*

| Not Sure | Strongly Agree |
The higher level I go in college education, the LESS likely I am to use my mobile phone for the purpose of learning and doing school related work. 
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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The higher level I go in college education, the MORE likely I am to use my mobile phone for the purpose of learning and doing school related work. 
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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**In what year of your college education do you think you use mobile phone a lot for the purpose of learning?**
*Check all that apply.*

- 1st year
- 2nd year
- 3rd year
- 4th year
- 5th year
- 6th year
- Graduate school (Masters)
- Graduate school (Ph.D)
- Other:

I am highly skilled in term of mobile phone usage 
*Mark only one oval.*

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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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I do not really know how to use my mobile phone so I do not use it for learning purposes. 
*Mark only one oval.*

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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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My experience with technology is what encourages me to use my mobile phone for
learning purposes.
*Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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- **I do not have enough technical experiences; therefore, I do no like to use my mobile phone for learning purposes.**
  *Mark only one oval.*

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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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- **Culturally, where I grew up from, we do not have the tradition of using the mobile phone for learning purposes.**
  *Mark only one oval.*

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<th>Not Sure</th>
<th>Strongly Agree</th>
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- **I use my mobile phone for learning purposes because my friends and people around me do use their phones for learning.**
  *Mark only one oval.*

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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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- **I like to store my files and school related notes in my phone and use then when ever I want.**
  *Mark only one oval.*

<table>
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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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- **I like to read my notes online by using my mobile phone.**
  *Mark only one oval.*

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<tr>
<th>Not Sure</th>
<th>Strongly Agree</th>
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- **I like to just contact my friends and / or family members for information by using my mobile phone.**
  *Mark only one oval.*
Not Sure                Strongly Agree

This part of the survey is optional.

**What is your current income per year?**
Please report currency in US Dollars
Mark only one oval.

- Less Than 1,000  *After the last question in this section, skip to question 74.*
- 1,000 - 5,000  *After the last question in this section, skip to question 74.*
- Over 100,000  *After the last question in this section, skip to question 74.*
- I decline to respond *After the last question in this section, skip to question 74.*

**As a student, what was your household income per year?**
Please report currency in US Dollars
Mark only one oval.

- Less Than 1,000  *After the last question in this section, skip to question 74.*
- 1,000 - 5,000  *After the last question in this section, skip to question 74.*
- Over 100,000  *After the last question in this section, skip to question 74.*
- I decline to answer this question *After the last question in this section, skip to question 74.*

**What is your current occupation?**

**SORRY !!! You do not meet the requirements to take this survey. Thank you for your attempt; please close the browser.**

**NOTE:** This survey is intended to examine the use of mobile phones in college education so you must have college experience and you must be a mobile phone user to participate in this study.

Thank you for participating in this research !!! Please click on *Submit co complete.* Please provide any additional comment regarding your use of mobile phone and / or how this survey can be improved.

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Screen reader support enabled.
Appendix B

Definitions of Terms Considered for this Study

**Adults:** Matured individuals over age of 25 and above who are graduate students

**Educational Mobile Application:** Any mobile application or tool that students can use to enhance their learning process.

**Griot:** A poet, or an individual who has a great memorization skills and is capable of committing information into memory and reproduce the information when necessary.

**Internet Bundling:** The process where by individual mobile phone users purchase, distribute, and reserve some of their mobile minutes, thus, data plan for Internet browsing.

**Learning Process:** Every formal and informal activity that is conducted for the purpose of learning new information or building upon existing information for further development.

**Mobile Learning (m-learning):** The process of learning by the use of mobile device at any time and any place.
Vita

M. Nadhir Ibn Muntaka

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EDUCATION:
The Pennsylvania State University Aug 2012–Present
Graduate student: MS Information Science & Technology

Research Areas:
Socio-cultural, Economic, Political, Health, and Psychological Impact of Technology on People in Developing Regions
Effects of Educational Technology in Developing Regions
Impact of Modern Technology on Traditional Health Care System in Developing Regions

The Lock Haven University of Pennsylvania (LHUP) May 2009
M. ED, Teaching and Learning with Technology (3.90 GPA)

The Pennsylvania State University Aug 2005
BA Integrative Arts (Web Development, Computer Graphics and Digital Photography)

Areas of Emphasis:
Theory and application of interactive internet-based communication and information management
Computer Graphics and Digital Photography
Computer Hardware

PUBLICATIONS

Book Chapter:

Knowledge Base Articles:

Peters, D. and Muntaka, M. N. I. 2013. “University Collaborative Suite:” Definition of the University Collaborative Suite (UCS) - Special Shared Resources (SSR). Information Technology Services - Knowledge base. the Pennsylvania State University

Muntaka, M. N. I. 2013. “University Collaborative Suite: How to Archive Messages from the UCS Desktop Client”. Information Technology Services - Knowledge base. the Pennsylvania State University