



UHASSELT

KNOWLEDGE IN ACTION

Faculty of Business Economics

Master of Management

Master's thesis

The use of smartphones and mobile applications in higher education: an extended literature review

Barsha Ghimire

Thesis presented in fulfillment of the requirements for the degree of Master of Management, specialization Business Process Management

SUPERVISOR :

Prof. dr. Marijke SWENNEN



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PREFACE

The motivation for this research comes from my interest in exploring innovation in education system backed by recent technological advancement while studying in this university. In this context, I found myself being enthusiastic about the use of smartphone in the learning activities in the classroom at the university level. Following the interest, I had researched on use of smartphone for learning purposes, its adaptation into student's day to day learning activities and impact in their academic performances. I found this thesis to be relevant to the m-learning designer, learner, and teachers to understand m-learning need and prospects.

First and foremost, I would like to thank my parents for providing me all the support and environment, I needed to complete this degree. A sincere thanks go to my supervisor Marijke Swennen who helped me throughout this research with her valuable time and comments. I would like to thank everyone who supported me directly and indirectly during the course of thesis writing.

SUMMARY

The purpose of this graduation thesis “the use of smartphone and mobile application in higher education: an extended literature review” is to analyze the usability and adoption behavior of the smartphone by the university student. Furthermore, the growing popularity of this device among adult students in the university creates an impact on student achievement. This is also explored in the research. The thesis is divided into three parts.

Chapter 1 is introductory and gives an overview of the smartphone being one of the most ubiquitous, dynamic and sophisticated trends in communications being immensely popular with the student. The chapter is subdivided into 3 parts.

Part 1 explaining the statement of the problem as learning with the smartphone being so contently, adoption problem arises.

Part 2 lists the research question and research objective which are:

- How smartphones are used as a learning tool among the students in a classroom at a higher level?
- How the students at university level adopting the learning process?
- What kind of effect do students have from using a smartphone for m-learning in their academics?

Part 3 summarizes the research methodology used. The research is based on secondary data with the extended literature review and analysis from more than 80 scientific articles. The literature search is based on both the referencing techniques i.e forward reference search and backward reference search. In terms of extended literature review, the study focus on the book, literature, and articles and journals related to the smartphone, m-learning and its relevance at the classroom, different online search tools like Google Scholar, Elsevier, Wiley online library, Journal of Educational Technology & Society Conference were used.

Chapter 2 is the main body to the thesis where the literature review begins. Its again sub-divided into 3 parts each part resembling discussion on each research questions.

Part 1 summarizes the evolution of smartphones for learning which started from the 1960s “voting machines” to next-generation “clickers” and now to “smartphones” taking overall. Stowell, J. R. (2015) research to compare the responses from clicker and smartphones showed smartphones use had the more accurate and quick answer than clicker and students and teacher are accepting it more as learning material. Similarly, the web 2.0 technology use especially social sites like Facebook and Twitter for education purpose was an increasing trend. Most of the research concluded social media was mostly used for communication (to stay in touch with friends and family, to share/tag photos, to engage in social activism, volunteering, etc). Woodcock et al. (2012) demonstrated students were using their phones more for playing games and other leisure activities than for learning Exceptionally, twitter was found to be more interactive learning, instant communication, and independent learning approach (Chawinga, W. D., 2017). Similarly, talking about the use of smartphone among various faculties there is a significant difference among students’ attitude towards mobile-learning and use of different applications and technology in terms of their faculty. Chen and Denoyelles (2013) research found that freshmen and sophomores tended to use mobile devices in their courses more often than juniors and seniors.

Chemistry faculty with the use of 2D bar code instructor for video lecturing and podcast facility within smartphone helped students explain the course better. Similarly, students from language faculty also found smartphone app an entertaining media with sharing information through chatting and competing. Furthermore, students of medical faculty were more likely to use devices in 'down-time' than as part of their clinical learning. Regardless of the majority of faculties benefiting from the smartphone app, a medical student of Monash University predominantly use sources other than apps (e.g., books) to study and generally felt that medical apps cannot replace the use of traditional textbooks. Koehler et al. (2012). Further, this part also covers about mobile pedagogy as its mobile devices for learning, which is often accompanied by learner mobility across diverse contexts and settings, puts a spotlight on learners and their experiences, but in so doing it may obscure the vital role played by teachers. In this regard, Passerini and Garnger,(2000) say while developing m-learning, it is necessary to understand the targeted population, first learner characteristics such as self-efficacy, self-directed, and autonomy to perceive a benefit and adopt in the behavior.

Part 2 explains the three tiers model propagated by Liaw (2007) where individual attitude or behavioral intention of the students towards adopting the smartphone-based m-learning technology is measured. The first step is the motivation that comes from access and experience to use the technology which is then guided by social cognition that informs about the social situation, behavior, and interaction. Planned behavior perceived through experience and experience help to perceive the benefit of using a smartphone for mobile learning essentially improvement in learning. Eventually, the student develops self-efficacy to accept the technology and adopt in the behavior. The three tiers model also explains about socio-technological reality in the absence of which the multi-tasking feature of m-learning may distract the students. If mobile learning takes place in this reality and education process develop, it might result in the risk of digital exclusion. Finally, peer influence was stated as influencing factors on the early adopters by looking at smartphone adoption behavior of college students. Similarly, other influencing factor includes self-innovativeness, self-efficacy, the decision maker's attitudes towards a product, financial burden of using the product, family influence, and other demographic factors e.g., age and gender (Lee S. Y. 2014).

Part 3 elaborates the impacts of the transition from paper to digital technology with traditional class-based learning being a supplement to mobile-based learning. The use of smartphone app increased time-on-task completion rate, overall academic performance and helped communication of information among students and teachers. Students were found not only text messaging and calling, but also using mobile learning applications such as GPS, camera, voice calls, emails, Google Drive, and so forth, to create, upload, download and share academic resources with their friends (Mtega, Bernard, Msungu, and Sanare, 2012). However, student obsession, the mobile phone as a distractor, the social media bug and negative psychological impact were found to be some of its hazardous factors.

Chapter 3 is the concluding part of the thesis which explains the multipurpose uses of the smartphone among various faculties and their positive adoption behavior. The positive impact of using smartphone outweigh negative. However, proper surveillance by the university about their student's smartphone activity around the university is important.

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1. Introduction

The continuous evolution in mobile technology and the widespread revolution brought by the internet have given rise to one of the smartest digital devices of the era called "Smartphone". Many writers have defined smartphones according to their features, function, and purpose. Alfawareh & Jusoh (2014) explains about the smartphone as the sophisticated technology which is world-wide and ever-changing trends in communication. It's smart because of its purpose and functionalities, potentially offering advanced computing abilities and connectivity options which are making life easy by incorporating multiple functions in a single screen. Today, smartphones are gaining more popularity among young adults not only to use social media but also for working, playing, shopping, solving day to day problems, and most importantly, learning. In fact, some students generate knowledge by accessing a pool of information from the Internet using their smartphones. Hence, smartphones provide more and more applications for an increasingly wider range of usage, they have become an integrated part of student's everyday life (Anshari et. al 2017).

M-learning and relations with the student

Mobile technologies are widespread among the students for learning, teaching, accessing and exploring knowledge and information. Many people view mobile phones as unlocking the real potential of mobile learning referred to as m-learning. According to EI-Hussein & Cronje (2010) Mobile learning or "m-learning" commonly refers to any type of learning that takes place with the support of easily portable and wireless electronic devices. In one sense, mobile communication devices can be transformed into "classrooms on the move" offering information and learning on-demand via text, multimedia, and interactivities. Regarding the easily portable wireless devices, Hairisine (2016) explains m-learning take place with the support of portable devices, such as tablets, iPhones, Blackberries, Kindles, and even wearables and portable gaming consoles as an important achievement of technology today.

Smartphone technology, with its pervasive acceptance and powerful functionality, is inevitably changing student's behaviors. To illustrate this, a survey was conducted by CourseSmart in 2011 which found that university students commonly used their phones for checking email, Facebook account, Twitter or other social network sites, for playing games, downloading and to use different mobile applications with their continuous web-connectivity features.

Use of smartphone among students

Smartphones with its powerful role can be used among students for various purposes. According to Kelly (2017), the student Pulse Survey from Top Hat¹ conducted by Survata polled 520 students about digital devices, textbooks, and learning in which he found that 94 percent of students in a recent survey said they wanted to use their cell phones in class for academic purposes. The survey

¹ Top Hat is the maker of a classroom engagement platform that allows students to use their own devices to participate in discussions and access course content.

also found that a large number of students, nearly 75%, believed using personal devices in the classroom has improved their ability to learn and retain information. 58% of respondents used their phones to take pictures of lecture slides, 41% used them to Google answers of in-class questions and 39% used them to access a digital textbook. On the other hand, 54% also used cell phones to text friends and 52 percent use them to browse social media during class. From the above study, it is seen that the use of cell phone or now the smartphone has become the most common device for learning purpose.

To demonstrate how popular mobile phone has become among the students at school Stowell, J. R. (2015) in his research found that 64% of students primarily used a mobile device to respond in the classroom. Mobile device users most often reported using a smartphone for polling, 95% with the remainder using a laptop, tablet, or iPod touch. The most frequently used mobile operating system was iOS (43%), followed by Android (19.8%) and Windows (1.8%).

Regarding the use of smartphone application among college students for assisting the learning, a survey by the USA today as cited in Buck, McInnis & Randolph (2013) found that student use different mobile applications, for example, StudyBlue Flashcards which is a device used by students which assists in memorizing key terms in test preparation. Similarly, Evernote Peek is palliation some iPhone users took them as a note-taking cloud service which allows students to organize their notes into study materials. Graphing Calculator is like a calculator which assists students majoring in a math field. Another one is The School Helper app which is an application which helps in managing college schedule, managing academic schedules by tracking grades, homework assignments, notes, and exams on the home screen. Here, students could also add widgets to the main screen as reminders for assignments that need to get done.

A similar kind of case is described by Harley et. al (2007) saying that many universities in Europe introduced desktop computer applications to support students learning considering that the desktop applications provide e-platform to the professors and administrators. The internet platform was basically focused on sending text messages, reminders, due dates, meeting times, assignments, maintain student profiles and databased and finally access to the e-library². The users of this early system especially students responded with positive feedback on their experience because it provided them a sense of belonging.

Statement of Problem

There is now potential for utilizing mobile devices for teaching and learning especially as mobile devices are very popular with young people and the current generation of students and research showing more students are owning them (Brown et al. 2015, 32).

Litchfield, 2010 (as cited in Yufuxin, 2012) say smartphone popularity rises when Google introduced the android system in 2008. The concept of mobile applications came along at the same time when

² An *e-Library or Digital Library* (both terms often used interchangeably) can be defined as a collection of digital objects such as text, visuals, video, audio, etc. stored as standardized and customized electronic media formats (as opposed to print, micro form, or other media), along with means for organizing, storing, and retrieving the contents at existing access points or on own devices.

the first smartphone was released. Ever since many applications to run on an Android operating system are introduced and they are growing very fast. Because of the immense potential of smartphone technology, it has been used to promote learning and education. Learning that is more backed by interactivity to enrich the content, the ability to create courses tailored to each student's progress, preparation for future careers around these technologies.

M-Learning takes students learning style into account by being designed with optional activities that students can choose. These activities help to engage and motivate students which encourages success. Applying this to m-learning (mobile learning) also allows the learning to be more flexible and convenient for the student. (Dawson et al. 2011, 7.)

Although, introduction of these devices may open up possibilities, for example being able to get a better understanding of course content from multimedia available, some students, particularly older students and students who are less familiar with m-learning, find it difficult to adapt to new study habits when they are used to learning in more traditional ways. There is also a similar problem where teachers are unable to use mobile devices to their full potential in learning if they are not completely familiar with capabilities or if they utilize these devices without actually changing their teaching methods to accommodate them (Marez et al. 2015, 14).

It seems that powerful learning opportunity is affected first by access to the smartphone devices and the behavioral intention ³ for adopting the smartphone devices in the learning process on the background of the transition from paper to digital technology. In this transition where smartphone has strong presence researcher Wang, Wu, & Wang (2009) presents a different view that use of smartphone for learning will never become an alternative to traditional classroom learning and e-learning because smartphone though has massive potential in learning it still have some limitations when it the context of access and affordability overrules. Use of smartphone for learning could serve only as complementary support to traditional learning as well as e-learning.

Wang, Wu, and Wang (2009) in his research to find the factors that influence one's behavior intention to adopt learning process on smartphones, concluded student's expectancy on performance and effort on study, the social influence of smartphone and its application to the students, student's perceived playfulness while using mobile, and student's capacity on self-management of learning, as the most significant factors that create enabling environment for m-learning. The researchers found out that the student's perceived benefits from the use of smartphone for m-learning for themselves regarded as the most influential aspect of behavioral intention to use a smartphone. In general, these behavioral traits belong to performance expectancy. Thus, this study will be also be focusing on exploring the perceived benefit of m-learning among the students from a different discipline and see how the students are adopting the learning process.

This study will also be exploring the current trend of development in smartphones for the use at a classroom at the university level and explore what affects the use and implication of mobile learning among students for learning.

³ Behavioral intention (BI) is defined as a person's perceived likelihood or "subjective probability that he or she will engage in a given behavior" (Committee on Communication for Behavior Change in the 21st Century, 2002, p. 31).

1.1 Research question and objective

The aim of this research is to find out how students are currently using their smart devices for learning and adopting it on the background of the recent development of m-learning.

The three main research questions for the topic are as follows:

1. How smartphones are used as a learning tool among the students in a classroom at a higher level?
2. How the students at university level adopting the learning process?
3. What kind of effect do students have from using a smartphone for m-learning in their academics?

This study has objectives to identify especially the overall nature of m-learning using a smartphone and the recent scenario for improved learning by using it. The objectives are explained below;

1. To identify the use and implication of the smartphone as a learning tool in a classroom?
2. To find out kinds of technology or mediums that are commonly used for m-learning by students?
3. To find out whether the utilization of mobile applications and technology has improved learning?
4. To assess the kinds of benefit, do students have perceived from mobile learning?
5. To assess how students in college/ university adopting mobile learning?
6. To find out what effect does it creates to students by the transformation from paper to m-learning?

1.3 Research method

The research is wholly based on secondary data. This is the outcome of a thorough study of many articles and library studies. The issues and topics discussed in this research are driven from the second study that talks much on the trend of use and implication of mobile learning, smart phone's role and contribution on improving learning among the students and the effect on student's understanding and academic performance

1.3.1 Study Method: The literature search is based on both the referencing techniques i.e. forward reference search and backward reference search.

Forward reference searching was used where articles that cite an original article or work after it had been published. This type of search focuses on the publications created after an article's publication. It helped expand the knowledge on the topics more by locating follow-up studies and also helped me identify new findings and developments in smartphone usages.

Backward reference searching was also used where the literature search was generated from a list of works cited in an article by other authors which gives a snapshot of the thinking & research available at the time of publication. This type of referencing gives ideas or theories which have influenced a researcher.

1.3.2 Study area and tools: In-terms of extended literature review, the study focus on the book, literature, and articles and journals related to the smartphone, m-learning and its relevance at the classroom. Data is primarily based on an extended literature review through library consultation. The various online tools used for searching the articles are as follows:

- Google Scholar
- Elsevier
- Wiley online library by the British Educational Research Association
- Journal of Educational Technology & Society Conference

1.3.3 Limitation: The study is specifically confined at studying the current trend in m-learning through extended literature review. Therefore, the study can't be generalized. The descriptive nature of the data limits our ability to draw any causal conclusions on the relationships found in the current study.

During the search, some online article publisher didn't allow direct access to which an email request was sent for permission. This took a long time and some even didn't respond. However, with Elsevier, downloading via university link was quickly possible.

Despite the limitations, the study sheds more light on the critical issues of smartphone use in m-learning at the university level.

2. Literature Review

It is important to know about the current trend of using a smartphone for mobile learning and to understand what kind of impact does it have on adapting the learning process and reflecting on academic performance. Therefore, in this section of the thesis existing research and findings will be examined to discuss and review some of the key concepts and ideas related to this thesis.

2.1 Evolution of smartphone and its use with the concept of m- learning

This area will focus on the evolution of the smartphone, how it took over other technology media like clickers and how it has been used by various faculty in the university. Further, it also explores the use of Twitter and Facebook from the smartphone as a tool for learning among students and their impact. Overall, the periodic development of smartphone and m-learning will be explored and discussed.

2.1.1 Smartphone versus Clickers

Before the smartphones came into existence, it was the era of "clickers"⁴ or audio response system. There were the instructional technologies that enable teachers to rapidly collect and analyze student responses to questions during class. Stowell, J. R. (2015) explains the evolution of technology in learning to start with "voting machines" in the late 1960s in some college classrooms to collect and display students' responses. After that, the next generation of classroom response systems used hand-held devices known as "clickers". And today's generation of classroom response systems is built on the power of mobile devices.

According to Christina and Susan (2006), clickers are handheld wireless devices similar in appearance to TV remote controls which allows instructors to display multiple-choice questions on screen to which students can instantly respond by selecting from a list of letters or numbers on their wireless keypads.

Clickers used to promote active participation, engagement, and discussion among all students, even those who might not participate in typical class-wide discussions. Clickers used to be assessment tools, providing students with useful and motivational feedback on their own learning, and providing instructors with information about student learning that helps them respond to immediate student learning needs (Derek, 2019). Clickers increase participation and class discussion as they require students to participate actively, allow instructors to test prior knowledge, and also serve as a way to introduce new concepts and instantly check for student understanding. Research on classroom response systems indicates that when used with active learning techniques such as peer instruction, clickers can improve student learning in measurable ways (Crouch and Mazur, 2002).

The experiment showed the success of the use of clickers which enabled the instructors to meet the stated learning objectives for each class. The student gave positive feedback and demanded more

⁴ Clickers are an interactive technology that enables instructors to pose questions to students and immediately collect and view the responses of the entire class- Carnegie Mellon University

questions with the clickers. The evolution of smartphone technology gradually shifted the use of clickers because of its limited facility.

However, there is very little research done to compare the use and advantage of clickers with mobile phones. Stowell, J. R. (2015) did research to compare the responses of students from the psychology of Learning and Biological Psychology faculty who used clickers to the responses of those who used mobile devices when answering the same multiple-choice questions as a part of the fulfillment of course participation requirement. Here, students were expected to use polling devices (clickers or mobile devices) to answer conceptual questions. Out of the 86 students who participated in the survey, 64% reported primarily using a mobile device to respond in the classroom. Mobile device users most often reported using a smartphone for polling, 95% with the remainder using a laptop, tablet, or iPod touch. The most frequently used mobile operating system was iOS (43%), followed by Android (19.8%) and Windows (1.8%). However, results from Psychology of Learning showed that students using a mobile device had significantly fewer correct answers and more missing responses than clicker users although there were no significant differences in Biological Psychology. This concludes besides exception smartphones are rapidly accepted by students and teacher as learning material.

While exploring the inception of use of smartphone and its application for learning, Wilson & McCarthy (2010) in their research with Ryerson University, started a mobile library service in 2008 where they talked about a modified smartphone friendly site version from their main library website which allowed students to look up library hours, workshop schedules, and basic library consultation. Another research on students experience and expectancy with mobile library conducted at Ryerson University in 2009 concluded that student expressed to use library services mainly for the article search, eBooks material, and library consultation support (Kim. B, 2013). The study at Ryerson by Wilson & McCarthy (2010) found that mobile device has its own limitation to provide a large scale of library scholarly materials. This shows smartphone application is rapidly used among students but the technical barriers still exist.

2.1.2 Smartphone supported with web 2.0 technology

According to ECAR Study of Undergraduate Students and Information Technology (2014) at a time when that traditional learning tools i.e textbooks, e-textbooks, and open contents are growing increasingly unaffordable, student use to prefer less expensive technologies (early-alert systems and other learning analytics, gaming and simulations, mobile devices and web 2.0 technologies⁵) that are increasingly attractive to students from all walks of life.

The increased interest in mobile devices and their use for teaching and research can be attributed to the number of factors including constant expansion of wireless broadband networks, the explosion of power and capacity of the next generation of mobile phones. In that regard, Dzvapatsva, Mitrovic,

⁵ Wikis, blogs, interactive websites and social media are the forms of web 2.0 that have opened new dimension to shared and collaborated learning environment.(Milosevic et al. 2015)

and Dietrich (2014) argue social media technologies that are growing exponentially are able to supplement traditional teaching and learning approaches. A study by Menkhoff et al., 2014 as cited by Chawinga, W. D. (2017) showed that tweeting is a more interactive and exciting way of learning than the traditional classroom lectures. Among the other benefits, the study found that Twitter helped students to be engaged in a discussion with friends and teachers in a free environment especially for knowledge sharing a purpose.

To support the literature of how less expensive and affordable web 2.0 technologies or social media supports learning to the students Chawinga, W. D. (2017) on his own research incorporating Twitter into two undergraduate courses at Mzuzu University, Malawi reveals the utility of Twitter. An analysis of tweets revealed two main purposes which were instant communication and content sharing. He found most of the participants agreed or strongly agreed that they benefitted from Twitter through interactive learning, instant communication, and independent learning. 85% of students used personal phones for their Twitter. Nearly all the students used mobile phones to access Twitter because they said its relatively cheaper and easier to access as compared to the computers available in the University Library. This shows web 2.0 technology easy accessibility makes it more prevalent among students for learning.

In the context of using web 2.0 technology the question of how smartphone is used inbuilt with 2.0 technology and application , researcher Grosbeck, et al. (2011) & Rosen et al. (2013) describes that majority of students spend significant time on Facebook apart from Twitter more for social uses (to stay in touch with friends and family, to share / tag photos, to engage in social activism, volunteering etc.) and less for academic purposes, even if they take part in discussions about their assignments, lectures, study notes or share information about research resources, etc. So, they concluded Facebook though being used by students for non-academic purpose can't be excluded from priority lists of a student.

Despite having the potential for using an academic purpose, smartphone and web 2.0 technology has received more priority by students for personal communications and play games and leisure activities. Researcher Abdullah et al. (2012) reported that university students often use their smartphones for personal communication rather than for learning. A recent study was done on college students by Tossell et al. (2015) found that smartphone use was perceived as favorable prior to study but later revealed students viewed smartphones as detrimental to their educational goals in the end. Similarly, Woodcock et al. (2012) demonstrated students were using their phones more for playing games and other leisure activities than for learning. Furthermore, White and Mills (2012) also found that students were increasingly adopting smartphones with a focus on personal use rather than education.

2.1.3 Use of smartphone in various faculties

This part will cover the trend in use of smartphone among students of chemistry, physics, and language faculty. It will explore different application used in each faculty to facilitate student study environment and how students perceive those modern applications.

2.1.3.1 Smartphone for chemistry faculty

Smartphone applications are now already available for chemists to practice their chemistry skills, to access tables of chemistry-related data, to sketch small molecules and to rotate large biomolecules with the help of augmented reality as said by Williams & Pence (2011). Augmented reality can be defined as the combination of digital information with images from the real world. They explain in their research that two-dimensional bar code to connect a cell phone for information is most commonly used in chemistry experiment and there are various chemistry faculty which are beginning to experiment using smartphones. Abilene Christian University and its chemistry faculty was the one who actively used mobile devices because their school-issued iPhones or iPod touches to all students. They also mentioned about a doctoral researcher Cynthia Powell, who used podcasts designed for smartphones for general chemistry laboratory instruction which helped to expand this type of podcast to support courses in biochemistry and general science for preservice teachers. Similarly, they mentioned about Lucille Benedict from the University of Southern Maine who made students create short instructional videos for common laboratory instruments, and then use 2D barcodes to label instruments so that the video instructions can be accessed with a smartphone. Libman & Huang (2013) also talked about increasing number of high-quality inexpensive chemistry-related apps like Chemical Mahjong game app, Chemistry Helper app, Chemistry Mobile app, PubChem Mobile app used by various universities that transforms the landscape of chemistry teaching and learning of chemical information, exceeding the physical limit of a chemistry handbook or encyclopedia. Hence, there is a rapid use of the smartphone and app by chemistry faculty in universities around the world.

2.1.3.2 Smartphone for physics faculty

Opera & Miron (2014) talked about smartphones being a methodical alternative for students of physics. They talked about different app in mechanics experiments which facilitate modern physics teaching. In this respect, they talked about an application called Angle Meter, which shows measures and displays in real-time the angle value of a slope which will guarantees a good quality of the measurements. Similarly, Accelerometer Monitor app, which is displayed both graphically and numerically in real-time, the projection value of the acceleration of gravity on the three axes of the cartesian coordinate system. The values can be either recorded in a text file and exported through Bluetooth, cable data. Finally, they talked about the use of GPS sensor, the Android Speedometer application which offers huge functions necessary to determine physical measurements of interest for Mechanics experiments like GPS localizing, N-S geographical orientation, average motion speed, the maximum speed, the instantaneous speed, which is helpful in modern teaching of physics.

2.1.3.3 Smartphone for medical faculty

Boruff & Storie (2014) in their article mentioned about the use of the mobile device in medical education at the University of Alberta and smartphone use by a medical student and junior doctors in the UK. The study concluded the frequent use of a smartphone as a reference and information management tool in clinical practices and medical training among faculty and students.

A study on the use of mobile learning technology by final-year undergraduate students at the College of Health Sciences, the University of Nairobi by Masika et al (2015) found that most of the students owned smart devices, a majority of which run on the Android platform. Nearly all students who owned a smart device used for learning. The main educational uses were regular study, revising for exams, taking notes or images and accessing research journals. About three-quarters of the students with smart devices were using medical mobile applications. These were mainly disease management apps, procedure guides, medical dictionaries, laboratory references, drug indexes, and medical calculators. The main challenges were lack of a smart device, lack of technical know-how in accessing or using apps, lack of internet access, cost of acquiring apps and limited device memory.

A review article published by Vinay KV et al. (2013), showed that there is widespread usage of smartphones in medical usage and mentions about 16 and 5 Medical applications available in Android OS and Apple ios respectively. Also, a study conducted by Mohapatra D et al. (2015) at showed that smartphones were used for various purposes by medical students viz, note-taking, cloud storage, imaging, web browsing, clinical handbooks and textbooks, question banks, medical calculators, simulation apps, etc.

A study on the attitudes and behaviors of medical students on mobile learning by Thomas et al. (2018) concluded the findings that m-learning devices have a positive effect on the students' perceived efficiency of working, while experience of usage not only confirmed pre-existing positive opinions about devices but also disputed some expected limitations associated with m-learning devices in the clinical workplace. Students were more likely to use devices in 'down-time' than as part of their clinical learning. As anticipated, both by users and from the literature, universal internet access was a major limitation to use the device.

2.1.3.4 Smartphone for the language class

In terms of language learning in class, Yurdaguil & Oz (2018) found that mobile technologies are used by participants for language learning and language practice. During their study, students were found using smartphone technologies for the following activities: use of dictionary; listening language learning materials; making topic repetition; listening to music; watching language learning videos; watching films; writing practice; practicing collocation; making research; practicing vocabulary; reading practice; translation; pronunciation; using language learning applications; and chatting with foreign friends. In addition, participants stated that language learning is more entertaining when sharing information through chatting and competing. This finding coincides with the study of Chen and Denoyelles (2018) which states that students perceived mobile technologies as powerful learning aids in terms of easy knowledge sharing and retrieval. Applications and websites used for language learning Results showed that students mostly used Turing, Quizlet, TED, Sesli Sözlük (an online dictionary website designed in Turkey) and Google Translate. In addition to them, Oxford Dictionary, British Council, Memrise and Cambridge Dictionary websites were used most by prep-school students. These results can be interpreted as students using their mobile devices to look up the meaning of English words most of the time during their exposure to language learning (Yurdaguil & Oz 2018).

However, the study done by Gustavo et al. (2016) discussed a learning mobile apps in an attempt to understand whether Mobile-Assisted Language Learning (MALL) could foster students' self-directed learning, by means of a language app: Duolingo. It is an unobtrusive tracking dashboard for schools, teachers where they can monitor student practicing languages students and their progress in the Duolingo language curriculum. The research concluded, that even if students are formally introduced to an expectedly convenient and motivating app, only a small number of them make its use and tutor mentoring was always needed. Further, the study showed that for substantial (MALL) usage, a combination of incentives, scaffolding, and curricular integration is needed.

2.1.3.5 Conclusion

It can be concluded that there is a significant difference among students' attitude towards mobile learning and the use of different applications and technology in terms of their faculty. The study by Yurdagul and Oz (2018) claimed that students from the faculty of education are more prone to use of language learning-themed mobile applications than students from the faculty of sciences. On the other hand, Al-Emran, Elsherif, and Shaalan(2016) found that there are no significant differences among students' attitude toward mobile learning in terms of their academic majors. In terms of the academic year, Chen and Denoyelles found that freshmen and sophomores tended to use mobile devices in their courses more often than juniors and seniors.

The multiuse use of smartphones among various faculty of the university is observed nowadays. Different researcher proved smartphone is gaining popularity among students in chemistry, physics, medical and language class. Chemistry faculty being sensitive with chemical use is using 2D bar code instructor for video lecturing and podcast facility to help students explain the course better and students also seem to enjoy using smartphone use in a chemistry lab. Students from language faculty have stated that language learning is more entertaining when sharing information through chatting and competing. Similarly, students of medical faculty more likely to use devices in 'down-time' than as part of their clinical learning. regardless of the majority using the smartphone app has the lowest preference to the medical app for study because they are less likely used it for clinical learning. A research done by Koehler et al. (2012) showed that 72% of a medical student of Monash University use smartphones medical apps and students without smartphones were prepared to obtain one so that they could use medical apps. Only 3% of students indicated that they would not consider obtaining medical apps or a smartphone. However, despite the majority of medical students generally have positive attitudes towards medical apps, they still have reservations to traditional study materials. Most students predominantly use sources other than apps (e.g., books) to study and generally felt that medical apps cannot replace the use of traditional textbooks.

2.1.4 Mobile Learning Pedagogy, its use, and scope

As a result of the rapid development of mobile technologies and their integration into education, the term "mobile learning" emerged. Kukulska and Traxler (2005) conceptualize mobile learning as "it is certainly concerned with learner mobility, in the sense that learners should be able to engage in educational activities". In the mobile learning concept, it is clear that mobile learning is concerned with learners and learning mobility rather than the mobility of technological devices. Within this

scope, mobile learning covers the mobility of learners, mobility of learning, mobility of educators or instructors and mobility of technological devices (Al-Emran et al 2016). It is noteworthy that mobile learning is not only learning that is based heavily on the use of mobile devices, but also learning that is mediated across contexts using portable technologies.

Mobile pedagogy is the art and science of teaching & learning, is combined with the term "mobile" means portable, which refers to learners and learning being mobile, moving between places, linking classroom learning with work, home, play, and other spaces and embracing varied cultural contexts, communication goals, and people. Mobile pedagogy talks about the use of mobile devices for learning, which is often accompanied by learner mobility across diverse contexts and settings, puts a spotlight on learners and their experiences, but in so doing it may obscure the vital role played by teachers (Schlenker 2013, p.3).

Furthermore, to shed more light on the components of m-learning El-Hussein & Cronje (2010) classified it with some essential factors namely; technological mobility as a flexible nature of installed hardware and software in a wireless device via the internet. Similarly, next is the learner's mobility as mobile device cuts the physical limitation of learners. These two factors have contributed to learning's mobility as learning can happen to learner where-ever mobile devices are available.

The mobile pedagogy according to Bierede, M. (2015) entails situated learning, where the place learners are in itself an important part of the learning experience. Like a classroom or a home may not be very interesting places to engage with for learning but ecological sites, historical sites, or commerce sites might create more interesting opportunities. Therefore, mobile devices have a huge scope and can open up new opportunities for situated learning that may not be possible with laptops or other devices.

2.1.4.1 Mobile pedagogy, content and context

Unlike the traditional classroom-based learning where the learning happened on the specific time and place. In mobile learning, the learning is not depended to any designated time and place. Learning through mobile device requires extensive design and pedagogical considerations. The traditional teaching & learning pedagogy is not suitable for mobile learning since the main assumptions on teaching are in the classroom. The main focuses of the mobile learning pedagogical consideration must be directed to the content of the learning materials and the context where the learning occurs (Hosseini, 2009).

As the content of learning materials and context (situated learning) plays a crucial role in learning pedagogy Chen as cited in (Schlenker, 2013) elaborates more that mobile learning isn't bounded to any particular time and location rather the learning is happening continuously across various kind of contexts. The absolute and continuous environment is appropriate to describe the learning process where the learner can use mobile devices to explore from one context to another quite effectively. Thus, learning is never ending and across the contexts, as the technology can't only define learning so pedagogical consideration should be made according to the context of the use of m-learning whose systematic classification could be used to understand the impact of mobile technologies. To shed more light on use scenarios or use context Traxler (2007) categorizes learning into various

contexts. For instance, mobile learning is driven by technology, e-learning on portable devices, smart classroom learning, situated as well as remote mobile learning and finally mobile training. It means contexts refers to what kind of technologies used, devices, locations are preferred, distance and capacity considered in the learning process.

The concept of Mobile learning pedagogy values much on how the learning has captured the context rather than the design of technology. Learning is much affected by context compare to technology. Thus, there is a challenge in higher education because the learning context is more governed by mobile concept, though the technology is available in hand in hand. Lonsdale et al., (2004) argue that the basics of m-learning are changing rapidly as learners mobility is high with various latest technological resources creating new discussions in learning every time. Adding more illustrations on this Russell (2002) described that learning through smartphone is not only limited to a transfer of knowledge and information but also the transfer of complex and a vulnerable network of technology affecting human relationships. In the learning contexts, professors and teachers no longer make control over knowledge and sharing. The learning phenomena shifted from the merely listening context to increasingly conversational and dialogue context among teacher and students. Therefore, learning pedagogy offers an environment where both the classroom and the instructor draws the direction and limitation of the conversion in which mobile technology offers both the opportunity to extend the continuous conversation.

Pedagogy offers us the opportunity to structure and to enrich the language that ties each student to the context in which they work. As such, both the classroom and the professor shape the direction and the boundaries of conversation and more or less create a virtual university where the learning and teaching aren't only limited to the lectures and classrooms.

2.1.4.2 Implication or scope of mobile pedagogy

Talking about the implication and scope of mobile pedagogy Schlenker (2013) viewed that mobile pedagogy can potentially harness the "intuitive" communication channels provided by a smartphone application and social media to feed and extend the conversation among the students and peers as well as with the professors. The context for the conversation is created when the mobile devices also capture the content that stimulated the desire to communicate while hosting the new and updated applications. As a result, the teaching-learning among students and teacher become a truly social activity beyond the classroom where students get an opportunity to harness the intuitive communication based on acquired experience, suggestions, and proposals. The writer concludes that Mobile learning pedagogy could be instrumental in understanding students' behavioral intention and learnings.

Researcher Hosseini (2009) indicate that usability and pedagogical factors play an important role in m- learning platforms. Mobile pedagogy is a complex process with compare to the counterpart in e-learning or traditional classroom. Complexity in mobile devices and mobile content required extensive pedagogical considerations. However, the lack of mobile learning pedagogy was not the showstopper for universities and educational institutes to utilize this device in the educational process. Pedagogy factors are however considered as key factors for learning productivity.

It is essential that the content for the learner on mobile devices must be organized and design based on the device features. The traditional pedagogical roles are not necessarily suited for the mobile device. The mobile learning pedagogy is premature and requires extensive studies. There have been many initiatives in recent years but not enough to have a pedagogy theory for mobile learning (Hosseini, 2009).

There are different types of learning which stand independently or as a part of mobile learning pedagogy. Goh and Kinshuk (2006) have grouped smartphone learning into the following categories with examples. According to him, the first one is Games and competition in learning which is the mobile phone-based games for improving spelling, reading and mathematics skills. Similarly, classroom learning uses smartphones to brainstorm, take quizzes, and vote. Laboratories learning is scientific experimentation to enrich the experiences of students by providing a closer look at real activities. Field trip learning, for example, is a mobile learning system which is based on learning trip developed for bird watching based on a scaffolding concept. Next, is distance learning which is an educational service provided to the student at a distant location using the mobile-based devices. Informal learning is all about learning in informal setting out of the classroom, for example, using m-learning in a museum, park e.t.c.

After knowing about the types of m-learning it is important to discuss what eventually affects the learning among the students. In this regard, Passerini and Garnger,(2000) say while developing m-learning, it is necessary to understand the targeted population, first learner characteristics such as self-efficacy, self-directed, and autonomy. Spiro Jacobson and Coulson, (1995) defined m-learning as multimedia instruction which enables learners to develop compiled cognitive skills, such as understand important elements of conceptual complexity; ability to use acquired concepts for reasoning and inference and competence to apply conceptual knowledge to novel situations with flexibility. According to interaction, when learners increase their interaction with instructors and learners, then, in turn, raise their chances of building their own knowledge because much of learning inevitably takes place within a social context and the process includes mutual construction of understanding (Laiw et al., 2007). Thus, based on fundamental e-learning criteria, there are three considerations in designing effective m-learning environments: learners' self-efficacy, multimedia formats, and interactive environments.

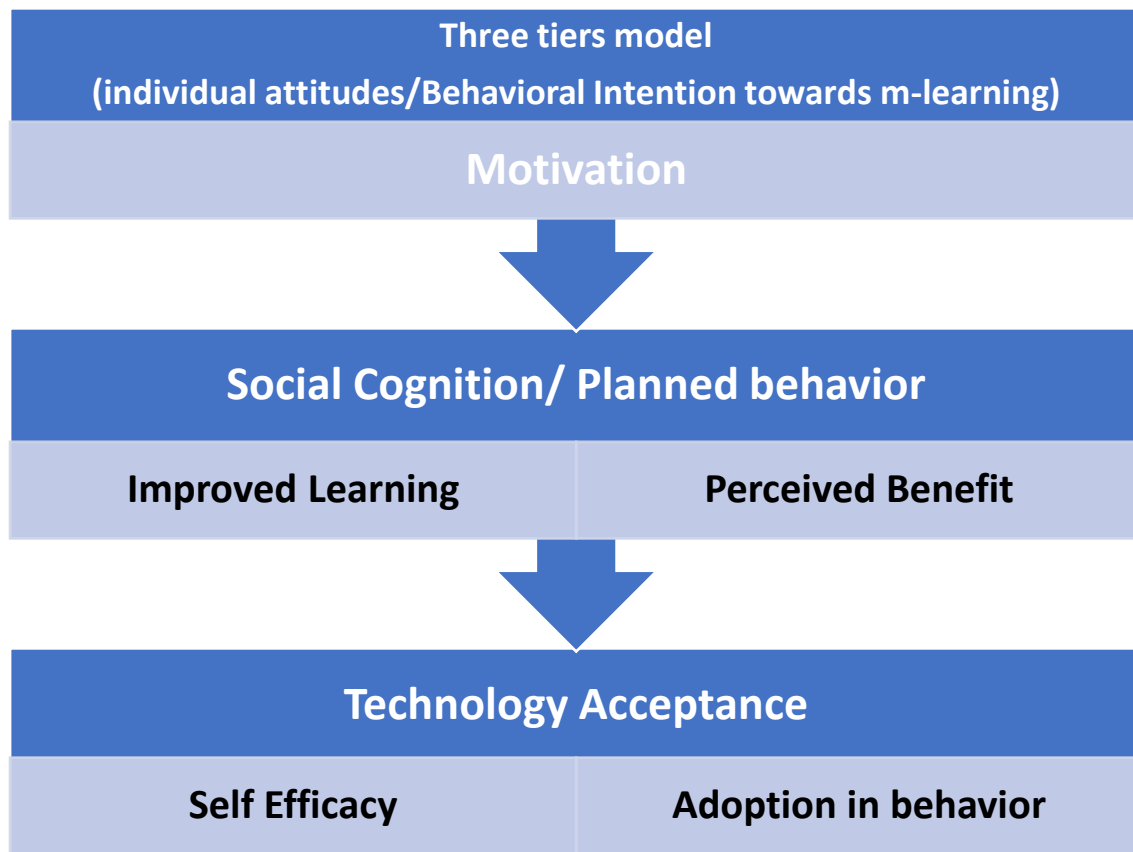
2.2 Smartphone and its adoption in students learning behavior

While discussing transforming the use of smart-phone into learning, self-efficacy of students to adopt the technology is primarily important backed up by multimedia formats and interactive environment. Self-efficacy is determined by the individual attitudes of students towards m-learning

Laiw (2007) in this regard has explained about the three-tier technology model as a multidisciplinary approach to survey individual attitudes towards m-learning which integrates multidisciplinary perspectives that included motivation, social cognition, planned behavior, and technology acceptance model. Individual's attitudes toward information technology can be divided into three determining indicators; the individual characteristics and system quality and behavioral intention.

System quality investigates how affective and cognitive components influence individual behavioral intentions or individual attitudes. The behavioral intention tier is to understand how the three-tier model (motivation, social cognition/ planned behavior and technology acceptance) can predict individual behavioral intention to use technology for a particular purpose (Liaw, 2007).

Figure 1: A 3-tier model for the behavioral intention on m-learning



After discussing the use and implication of smartphones m-learning, how learners/ students adopt m-learning as behavior would also be an important thing to explore. The three tiers model propagated by Liaw (2007) explains the process of individual attitude or behavioral intention of the students towards adopting the smartphone-based m-learning technology. The process is first followed by the motivation that comes from access and experience to the technology. Motivation then is guided by social cognition that informs about the social situation, behavior, and interaction. Planned behavior perceived through experience and experience help to perceive the benefit of using a smartphone for m-learning essentially improvement in learning. Eventually, the student develops self-efficacy to accept the technology and adopt in the behavior.

Learning through technological aids according to Muslimin et al (2017) demands a process about how diffused technology will be used by the adopters to address their needs of ideas, innovation, and technologies. Here in this study, it is worthwhile to see how students internalize the concept of m-learning by using technology like smartphones for learning purposes and adopt it in their behavioral patterns. When there is improved learning realization by students in relation to learning behavior then only, we can see the adaptation of technology. The main focus of this section is to gather the literature that explains the contributing factor for technological innovation and adaptation. Similarly, diffusion of innovation model propagated by Rogers as cited in Uma Narula (2012) explains the important stages of re-orientation that create awareness among students; create knowledge and interest by drawing the attention on technological innovation and further reinforce adopters to help in decision making and adaptations of innovation.

2.2.1 Foundation for acceptance of technologies in learning

In order to understand how people learn Ertmer & Newby (1993) provides the reference of the progression of behaviorism, cognitive science, and constructivism as the foundation in guiding the acceptance of technologies in learning and, hence smartphones too. Mobile learning could be adopted by the following types of learnings as explained forward. The first kind of learning is behaviorism referring to learning with changes in the form or frequency of observable behavior. Mobile devices can simplify feedback and reinforcement mechanism together when faculty and students are using the devices. Constructivism is learning with creating meaning in a context-aware scene from experience which needs high media source and dynamic environments. For instance, gaming zones and visualization could be provided through mobile devices for students. Likewise, informal or situated learning isn't limited to the classroom but beyond the classroom for example museum, park, etc. And finally, the Collaborative learning entails learning approach involving students together to learn to solve a problem or create something. The collaboration among students and faculty suggests recording and sharing instantly using mobile devices.

A thorough study of the above learning approaches seems to be essential for professional designers or instructors. These are an important adoption part of m-learning as it helps teachers understand which strategy to use for what content, for which student, at what time. To do this we also need adaptive learner who is able to function well when situations are unpredictable and task demands change.

2.2.2 Technology/Environment factor m-learning

In the earlier section, the behavioral/ individualistic foundation for the acceptance of the technology was discussed. Here it is equally important to discuss the technological formats and interactive environment it can create to support accepting it.

There are so many mobile applications that support m-learning. For instance, course management systems (CMSs) such as Blackboard, Moodle, and Angel are now commonly practiced among formal learning institutions. The blackboard system of Hasselt University⁶, for instance, is an online platform where a professor can post an article assignment and students can get a notification about the post from their personal blackboard account and university system sends an email to the respective student email which will be directed by students through smartphone and devices. The portability of smartphone makes it easy for the student to read the content anytime and anywhere, post comment and question, further creating a discussion forum with peers and instructors.

M-learning environments, an environmental characteristic such as synchronous and asynchronous interaction also creates a high-level communicative environment that allows students not only to share information but also to determine how to retrieve useful information according to Liaw and Huang (2007). Additionally, he also said environmental satisfaction will motivate learner's better participation in the learning processes. Moreover, he adds learning activities in e-learning provide a great chance for learners and instructors to share their knowledge and experience. In essence, he

⁶ <https://www.uhasselt.be/en>

concludes when users feel less self-confident towards information technology, they are less positive towards the technology.

There are some complications with designing activities in mobile learning despite its wide-ranging educational solutions. To illustrate complication on designing own content Orr (2010) explains that the technological difficulties originated both by hardware and software produces compatibility issues among the different smartphones resulting in the need for content readjustments and selection. At the same time, the absence of the internet is also a problem as it creates dependency on connectivity. It furthermore limits learners and devices' mobility.

Similarly, the difficulties related to digital literacy described by Meyers, Erickson & Ruth (2013) New technologies and developments in media are transforming the way that individuals, groups, and societies communicate, learn, work and govern. This new socio-technical reality requires participants to possess not only skills and abilities related to the use of technological tools but also knowledge regarding the norms and practices of appropriate usage. The three tiers model also explains about socio-technological reality in the absence of which the multi-tasking feature of m-learning may distract the students. If mobile learning takes place in this reality and education process develop, it might result in the risk of digital exclusion⁷.

Hence, mobile learning requires a certain level of technical knowledge that may cause that advanced users to have a certain advantage. less advanced users may feel intimidated by this technology and stay out or feel isolated. The inequalities according to Ferrer, Belvís, & Pàmies (2011) can be significant in the socio-technological reality where some students possess unequal access to the m-learning devices and internet and also lacks device/ system handling skills. It might create an unbalance situation between the upper class and lower-class students. However, in order to reduce this digital divide among the students from different classes the right way to select the right methodology and technique in the context of mobile learning pedagogy design.

Based on the previously mentioned characteristics, Elias and Franklin (2011) concluded that the mobile learning methodology (content) must consider different technical and methodological principles for example Short and direct modules, Communication and visibility, Flexibility and simplicity, Accessibility and mistake tolerance, Multimedia use, Action-oriented approach and Constantly renewed and updated technology and content.

2.2.4 Adoption of behavior in mobile learning

There are various factors that affect the adoption of behavior in mobile learning as said by the various researcher. When investigating the factors that impact people's behavior intention to adopt learning with smartphones Wang, Wu, and Wang (2009) considered the performance expectancy, effort expectancy, social influence, perceived playfulness and self-management as necessary determinants.

⁷ **Digital Exclusion refers to the social division created by** unequal distribution of information and communication technologies (ICTs) in society. Britannica.com

1. Performance expectancy: It refers to users' perceived benefit of learning with mobile for themselves, was the strongest determinant of behavioral intention to use smartphones for learning.

2. Effort expectancy: It means the degree of easiness using smartphones for learning as perceived by users.

3. Social influence: It refers to the extent to which a person thinks other people believe that a person should adopt learning with mobile.

4. Perceived playfulness: It refers to how much of playfulness a person can get out of using the mobile smartphone for learning.

5. Self-management of learning: It is defined as the extent to which an individual feels he or she is self-disciplined and can engage in autonomous learning.

Similarly, another researcher Milosevic et al. (2015) also defined behavioral intention as is structured and shaped by five different components namely:

1. Performance expectancy: It suggests that individuals will find mobile learning is useful due to the opportunity that mobile is the device for gaining access to information quickly anytime anywhere.

2. Effort expectancy: It suggests utilizing the system fully, students should believe that an M-learning system meets their needs and value.

3. Lecturer's influence: Lecturer's influence comes from social influence, which is defined as the extent to which a person experiences that it is important to use new information technology because others believe that he or she should use it (Venkatesh et al., 2003).

4. Quality of service: In-terms of reliability and response, content quality and safety, according to Rai et al. (2002), which was used as the most adequate for this researching, having in mind that it was related to the intended behavior of students.

5. Personal innovativeness: It is the personal willingness to accept and use new information technology. Here students with a higher degree of personal innovativeness are more likely to develop a positive opinion on a smartphone than those with a lower degree (Ahmad & Love, 2013).

After defining the five components related to intended behaviour Milosevic et al (2015) conducted a research at the University of Belgrade to reveal the intended behavior of students during the acquisition of m learning which showed 98.5% of the students at Technical Faculty, have more than 5 years' experience in mobile devices using, but only 43.8% use them for learning purpose. The reasons for this could be lack of information on mobile learning adoption. So, Milosevic et al (2015) concluded m-learning examined in such a way leads to an influence on the improvement of the quality of the overall learning process, its application as a motivational technique is attractive to the students, and its positive effect to their satisfaction with the educational process.

What actually are the influencing factors to the early adopters on a smartphone for m-learning. Lee S. Y (2014) came to the conclusion after examining the smartphone adaptation in learning behavior

that normative influence of peers on an early adopter was the most influencing factor for adaptation of smartphone. Along with the peer influence, there were some additional contributing factors examined for an instance self-innovativeness, the decision maker's attitudes towards a product, self-efficacy to use technology, financial liabilities of using product and services, and family influence which showed their influence was comparatively less than the peer's influence. The behavior of the adoption of smartphone among the students was carried out using random utility theory⁸. Their findings showed that friends, financial burden and other family members are the most important influences on the adoption of smartphones among college students. Random utility theory is used to evaluate the stimulus-response of the students using a random variable from which a sample is taken at each presentation of the stimulus. This idea, which goes back to Gustav Fechner psychology by Thurstone (1927), which explains its use as often observed inconsistency in choice experiments, where a subject on repeated presentations of one particular subset of alternatives does not always select the same alternative. In the similar content Lee S. Y. (2013), the students were requested to choose the program on the basis of preference, but it was found that their choice was not consistent so the applicability of random utility models provided the much wider option.

2.3 Effects from using a smartphone for learning in University

The use of smartphones for educational purposes has increased many folds among society to guide students right career paths and achieve their future dreams. The transition from paper to digital-based learning and to mobile learning is a long way which has both positive and negative impacts. This is discussed here. Those impacts also generate an outcome in students' performance.

2.3.1. Adapting Transition from paper-based learning to digital learning

The immense potential exists to promote the use of mobile technology in education like more interactivity to enrich the content, the ability to create courses tailored to each student's progress, and the preparation for future careers around these technologies. However, learning is affected by the transition from paper to digital technology. A study conducted by Gary Small (2009) to show how cognitively, reading on-screen and reading on paper does not create the same brain activity, showed reading on paper activates areas of language, reading, memory, and vision whereas reading on a webpage, the same areas are activated, plus those of decision-making and complex reasoning. This concludes reading on the webpage is more useful and this transition from paper to digital is rapid.

Talking about the advantages from the rapid digitalization made possible because of the use of the smartphone, Elias, Crescente and Lee (2011) says widespread availability and affordability and internet connectivity and Multimedia content delivery and creation options, as well as the continuous and situated learning support, has revolutionized the learning in the digital age today. Furthermore, they view this approach decreases in training costs and it is more potentially a rewarding learning experience and also helps improving levels of literacy, numeracy, and participation in education amongst young adults. The communication and networking features of a mobile phone as part of a

⁸ **Random utility theory** is based on the hypothesis that every individual is a rational decision-maker, maximizing **utility** relative to his or her choices.

larger learning activity, e.g.: sending media or texts into a central portfolio or exporting audio files from a learning platform to your phone is always rewarding.

Hence, the number of benefits provided by mobile learning is far greater than those offered by the traditional way of education in the classroom (Kamarul, Felix, & Ammar, 2014). First of all, one of the advantages is related to the information flow rate: a student can have the help of encyclopedia, dictionaries, reference books at any time and any place in just a few moments, Mobile devices can be used for access to a variety of content, but also for creating their own content which students will share later with other students and teachers entirely independently from the classes (Milosevic et al. 2015)

While the new generation of today are familiar with the technologies that are growing faster than anything else and also have seamless exposure to the smart devices with wireless internet connectivity around them which has made them engaged with social media and blogs, at the same time some teachers and professors who are potential knowledge transformers are one step behind the technology. Michael Evan (2009) explains this conflicting situation in a way where new generations and early adopters are regarded as the digital natives because of their easy adoption and use of technology whereas the first generations i.e teachers and parents who are less familiar with digital smart technology are referred as a digital stranger or alien. In the changing context to combat the challenge of digital transition and get involved in communication, one must accept it as a new powerful learning tool and understand its current and future potential.

2.3.1.2 Student engagement, collaboration, and mobile learning

Student engagement can be understood using Cole & Chan, 1994 definition (p. 259) as "the extent of students' involvement and active participation in learning activities." Berman, 2014; Lippmann, 2013 also said student engagement through active classroom participation through smartphones is an important ingredient for learning that has many educational benefits for students. In one study by Hamann, Pollock, & Wilson(2012) they saw students' overall satisfaction with small groups was greater than their satisfaction with full-class or online discussions. These students reported that small groups were more likely to "stimulate interest" and help them engage the material. This can be linked to our earlier discussion by Berman, 2014; Lippmann, 2013; and adding a smartphone to motivate small groups may create better output in the classroom. According to O'Connor (2013), even teachers can employ different strategies for better student engagement, highly structured small groups benefiting from smartphones.

2.3.2 Improvement in academic performance

There are many studies carried out on smartphone use in relation to academic performance. Norries, Hossain, and Soloway (2011) in their study demonstrated that students' achievement increases significantly when students use mobile learning devices, including smartphones, during learning time. This is because their time-on-task completion will increase as they have the device at hand. Norries et al. (2011) also found that students were constantly using the smartphone camera to take pictures of abstract concepts taught in class so that later they could relate them with the concrete ideas.

Similarly, Woodcock et al. (2012) reported that respondents in their research believed that smartphones had allowed them to improve productivity and eventually their learning performance. Kumar (2011) indicated that students were downloading online lectures and reading from e-books to improve learning. Another study conducted by Mtega, Bernard, Msungu, and Sanare (2012), shows the respondents in their study do not just use traditional mobile learning applications, such as text messages and calls, but they utilize mobile learning applications such as GPS, camera, voice calls, emails, Google Drive, and so forth, to create, upload, download and share academic resources with their friends. Hong, Chiu, and Hong (2012) in their research conducted with the university student of Taiwan that student uses the smartphone to contact by calling and texting to their peers and instructors whenever they have difficulty with academic tasks. All the above-mentioned researches illustrated that smartphones have created sophisticated avenues for students to learn and it is undeniable that more students are spending more time using mobile apps. This is positively correlated with the higher rate of smartphone ownership among higher education students (Bowen, Kyle, & Mathew, 2012).

Smartphones within and outside classrooms make it easier for students and teachers to collaborate with students on sick leave or who miss college for some reason. It's a way of communication of information within teachers and students also. Srivastava (2005) also declares teachers and students would be able to attend the class through their smartphone and keep up their work, as it compensates the limited access of internet and data access and has become an integral part of the education system in developing countries.

Ezemenaka (2013) says it is possible for students to enhance and broaden their academic horizon by browsing for academic materials and equip themselves better toward preparation for exams through their smartphone.

Jacob and Issac (2008) describe the multiple benefits of the use of the smartphone as a learning tool both to the learner and instructor. They explain how the learner can easily access to the instructional materials and can interact with the instructor via using mobile devices from any location. They also viewed its importance for the instructors too, since they can access services and interact with students at the same time.

Using a longitudinal design, Gulek and Demirtas (2005) provided substantial evidence that using technology enhances student learning and educational outcomes. The findings of the study revealed that compared to technology users, students using technology showed significantly higher achievement (overall GPA) and had high scores on criterion-referenced standardized tests.

2.3.3 Negative impacts of the use of smartphones in the classroom

A smartphone can generate huge benefits to the modern-day learning system. However, it has some bad implications too. Providing the reference of research conducted at Hack College as explained by Alexander (2011) was of the total 57 percent of college students who were using smartphones in their daily life over 60% of that number reported that they were obsessed to their mobile phone. Students were found too much engaged with their mobile devices that separation with mobile was impossible. Among the total students participated in a survey, 75% reported that phones were their

sleeping partner and 88% percent reported that they use the phone to text before class. A clear distinction of what overruled the smartphone illustrated in this study which revealed that the purpose of having smartphone i.e. 97 % of students used for social networking. However, smartphones were used by 40% of students for exam preparation. There are various other negative impacts that are discussed as follows.

Technological concerns

Technological limitation applied to the devices and internet service and connectivity is one of the reasons affecting the use of smartphone in the classroom. In Siau, Lim and Shen's research (as cited in Wang, Wu, & Wang., 2009) the researchers have mentioned about the mobile features and versions for an example having small screens and multifunction keypads, few computational power, short battery life, difficult text input and few computational power, low resolution of display and less friendly user interface as the technological limitation for using it in learning. The version and operating system that differs in a different brand of mobile phone have a compatibility issue and as a result, it doesn't support mobile learning in smartphone devices and thus makes difficult for learning (Masiru et al; 2014). Another researcher Ally & Samaka, (2013) raised the price as a problem since mobile devices with better features are rapidly growing with quickly changing features and are usually expensive.

Student obsession

Obsession is a major side effect of technology especially with students using smartphones. In this topic Mehdipour and Zerehkafi (2013) noted obstacles related to mobile learning through smartphones, including student obsession with devices during class, sending and/or receiving entertainment messages from colleagues, isolation from teachers, lack of attention when the teacher is speaking and a decrease in academic achievement. The adoption of this technology in the educational process may limit student creativity and innovation.

The mobile phone as a distractor

There are some educators who say mobile devices shouldn't be allowed in class as it is distracting. Students may spend time texting, surfing websites or chatting online with their friends, which means that they are not paying attention to the teacher (Tindell & Bohlander, 2012). Research done by (Chaklader & Bohlander, 2009; Rosen ,2011) shows that test performance is significantly lower for the students who are distracted by mobile devices during a lesson, indicating that there is a loss of concentration if students are doing class unrelated tasks In addition, Tindell & Bohlander (2012) also found while student doing other tasks on the mobile device, possibility is high that the instructor can be distracted by a student's actions which would impact on classroom management.

The social media bug

There is no doubt that mobile technology has drastically changed the cultural norms and behavior (Gowthami and Vental 2016). Smartphones are used by students to text, co-operate on social networking sites, check e-mails, play online games and even watch channels. But this can be a

source of distraction with access on the internet as they can misuse during exams through access online information to write the answers.

Mental illness

Smartphone's with a camera and video features can increase cyber bullying and hazing. Bhargavi et. al (2014) claims these are commonly witnessed among college students in developing and developed countries which can lead to mental illness and suicide at the extreme. Also, the high frequency of smartphones can have negative effects on mental health among youngsters.

Negative psychological impact

According to psychologist Danielle Einstein (2018), there are also some negative psychological impacts of using smartphone devices. Mobile phone and smartphone today are commonly used by students for communications and chat on social media which happens to avoid more challenging face to face conversations. Similarly, the playful use of mobile phone and its entertaining applications and messages release dopamine hormone in the brain which creates addiction among adopters. And another kind of tendency arises while using mobile is the frequent attention to check the mobile phone though it is not necessarily important in the moment.

Danielle Einstein (2018) has described the relationship between uncertainty and the possibility of co-occurring the number of psychological problems. He claimed the excessive use of smartphone reduces the adopter's ability to deal with an uncertain environment which is usually associated with students feeling distracted and tense during the tests and examination time. Thus, when the students are uncomfortable with uncertainty caused by the smartphone, they are more prone to the epidemic of anxiety and depression.

The negative effect on students' academic performance

Jacobsen and Forste (2011) in their study in the USA found a negative connection between the use of mobile phone simply for calling and texting with the overall academic performance among the university students. Yet in another research by Lepp, Barkley, and Karpinski (2015) reported that students who used the cell phone more on a daily basis like for internet use, email, and social networking sites such as Facebook, Instagram besides study work were likely to have a lower GPA than students who used it less.

Facebook is a renowned social media platform commonly used by students in the classroom. Is Facebook really distractive for students? What is the significance of Facebook to a students' academic performance? To find answers to these questions, research was conducted by Kirschner & Karpinski (2010) where they tend to determine the relationship between academic performance and Facebook usage. A sample was taken from a population of 219 university students and they found that Facebook users had lower Grade Percentage Averages and they were online most of the time and utilized very little time for their studies in comparison with students who did not use Social Networking Services (SNS). Only 26% of students reported that SNS impacted positively and helped to grow in their lives and 74% said that it had an adverse impact like procrastination, lack of

concentration, distraction and poor time management. With these results, we can't deny the fact that at some point, students' performance is affected when they are using Facebook. This can again be supported by another research done by Tayseer, et al. (2014) as he found that there is a correlation between the students' GPAs and their usage of social networks. These researches and studies demonstrate wise, selective and purposeful uses of smartphone technology provides empowering learning opportunities and thus enhances the student's career outcome.

Hence, a number of studies have reported either a negative relationship or no significant relationship between technology use and academic performance. Fuchs and Wossmann (2004) surveyed students in 31 countries using a very thorough, detailed survey in order to eliminate other probable causes of the decrease in academic performance and stated in their results that the "sheer ubiquity of information technology is getting in the way of learning". Similarly, findings from a recent study by Sana, Weston, and Cepeda (2013) suggest that technology use in classrooms has a negative effect on achievement, as measured by performance on a comprehension test.

2.4 Future challenges in the use of smartphones for learning

The future challenge is that powerful learning opportunity will be affected first by access to the smartphone devices and the behavioral intention for adopting the smartphone devices in the learning process on the background of the transition from paper to digital technology and the equitable access to everyone.

Although, introduction of smartphone may have open up possibilities, for example being able to get a better understanding of course content from multimedia available, some students, particularly older students and students who are less familiar with m-learning, find it difficult to adapt to new study habits when they are used to learning in more traditional ways. There is also a similar problem where teachers are unable to use mobile devices to their full potential in learning if they are not completely familiar with capabilities or if they utilize these devices without actually changing their teaching methods to accommodate them (Marez et al. 2015, p14).

The difficulties related to digital literacy or digital exclusion as described by Meyers, Erickson & Ruth (2013) will be the most challenging. New technologies and developments in media are transforming the way that individuals, groups, and societies communicate, learn, work and govern. This new socio-technical reality requires participants to possess not only skills and abilities related to the use of technological tools but also knowledge regarding the norms and practices of appropriate usage. In the absence of socio-technical reality, the teaching and learning could bring distraction to the student which results in digital exclusion. It means although, the introduction of the smartphone may have open up possibilities for the students to get a better understanding of course content through digital and multimedia tools and medium available. However, some particular students who can't afford increasing expensive devices and access internet connectivity will be deprived of taking the advantage. Similarly, particularly older students and students and students who are less familiar with m-learning might find it difficult to adapt to new study habits when they are used to learning in more traditional ways. Thus, digital technology might create an unequal environment or exclusion to which Mobile learning pedagogy developers and academician need to seriously consider while designing the course (Marez et al. 2015, p14).

Similarly, another challenge is related to the content and context of m-learning introduced with the notion of mobile pedagogy. Learning has more to do with content and how we capture context than how we design technology. The relation between content and technology is quite contradictory after all it is difficult to assume its technology-driven content or content-driven technology that m-learning stands for. Though the latest technology is handy, the challenge of context is continuously shifting. The context is being affected by a continuous shifting of fundamentals of learning that matter whenever we move to different locations, use new learning resources and initiate a new conversation. Therefore, the transfer of knowledge and source of education isn't limited to the possession of instructors and teachers. And the learning process has become more discursive, interactive and engaging. In this context, the challenge is how mobile pedagogy uses on the background of technological advancement (Lonsdale et al., 2004, Sharples, 2005).

The future major complexity that will arise with m-learning devices and mobile content is that it will demand extensive pedagogical consideration to address the need. Pedagogical factors according to Hosseini (2009) are however considered as key factors for learning productivity. Therefore, the content for the learner on mobile devices must be organized and design based on the device features. The traditional pedagogical roles are not necessarily suited for the mobile device. The mobile learning pedagogy is premature and requires extensive studies on this in the future.

While making the consideration for future learning pedagogy, Passerini and Garnger,(2000) opined that understanding the context of the targeted population, first learner characteristics such as self-efficacy, self-directed, and autonomy as well as their technological need and competencies will be important. Similarly, multimedia formats and interactive environments in designing m-learning environments will be effective.

Organization for Economic Cooperation and Development (OECD) 2015 report on "Education in a Glance" notes that in countries where investment in technology for education is high no significant improvement in student performance in science, mathematics and reading is shown. Whereas the same report said that countries like those in Asia where students spend the least time on the new technology also have a sound result. It showed that the smartphones with its widespread expansion, having interactive and user-friendly features haven't reached out to the classroom of many schools and universities in Asia and Africa and not adopted and accepted by institutions and students. Hence, OECD report,2015 at the end concluded that a reason might be that the technology and applications aren't fully mature enough.

There are additional other challenges with the use of smartphones in the classroom. Adaptive learning according to R. Y. Ting, (2005) will be the challenge for the future as it demands comprehensive quality of mobile learning pedagogy that is driven by the development of instructional strategies and educational content that is compatible to the learner's requirement and need. Therefore, in order to further enhance the adaptive learning; location of the learner, unlimited text display must be in taken into account while developing learning courses and module.

Many of the researchers talk about different challenges like IT infrastructure, network security, negative attitude, etc. but very few talked about lack of awareness among teachers about the positive educational value that mobile phones possess. (Businge et al. 2018), provides an example,

about cases in South Africa where students were using their mobile phones to send 'bullying' messages to other students, cheat on tests using SMS messaging, and access pornographic materials and sex chat rooms. Due to these reports teachers' perceived use of mobile in the classroom as wrong and don't support its use and even ban using it in the classroom. So, it's a huge challenge for teachers as well as students both to properly use smartphones in the classroom.

Another challenge could be the cost of buying smartphones. As Android and IOS are developing their system software rapidly and to keep up with this pace needs a huge cost. N. Y. Asabere (2013) explicated this as the biggest problem for developing nations university who are trying to offer technology for mobile learning with a tight budget. Due to the high cost of deploying mobile learning technologies, most educational institutions in developing nations cannot implement smartphone learning.

3. Conclusion

By analyzing the increased interest in mobile devices and their use for learning attributed to the number of factors including constant expansion of wireless broadband networks, the explosion of power and capacity of the next generation of mobile phones, this thesis has explored the multiuse of smartphone and their impact on student learning behavior. The use especially social sites like Facebook and Twitter was found to be an increasing trend for student learning after the inception of Web 2.0 technologies that supports interactive blogs, wikis, and websites (Milosevic et al. 2015).

The education center for applied research ECAR (2012) survey concluded 67% of a student viewed a mobile device as an important tool for academic success and activities among different faculty. Different researcher says the smartphone is gaining popularity among students in chemistry, physics, medical and language class. However, a research done by Koehler et al. (2012) showed that 72% of a medical student of Monash University use smartphones medical apps and students without smartphones were prepared to obtain one so that they could use medical apps but they prefer book to the app and think mobile app can never replace the learning through books. The most important features of the smartphone are mobility, and the capacity to allow students to learn anywhere anytime.

Despite having the potential for providing a wide range of learning opportunities and educational solution by smartphone learning, the challenges and difficulties still remain when it comes to design its own learner's user module. This means the complex technological design is yet problematic to the learner to understand and develop skills sets to handle it. This is the difficulties related to 'digital literacy' described by Meyers, Erickson & Ruth (2013). This new socio-technical reality requires participants to possess not only skills and abilities related to the use of technological tools but also knowledge regarding the norms and practices of appropriate usage. Hence, mobile learning requires a certain level of technical knowledge that may cause that advanced users to have a certain advantage.

Though the students have the necessary access to smartphone devices its adoption into learning is very low. Research at the University of Belgrade by Milosevic et al. (2015) revealed 98.5% of the student have more than 5 years' experience in using mobile devices, but only 43.8% use them for learning purpose. The reasons for this was a lack of technical knowledge, skills, and abilities on mobile learning adoption.

Hence, mobile learning adoption factors are an important part of determining learning behavior in students. When learning is adopted it shows some impact or changes in behavior accordingly, the impact that smartphone learning adoption will have on students' performance and day to day life. Milosevic et al. (2015) found that student's perceived benefits from the use of smartphone for m-learning for themselves were the most influential aspect of behavioral intention to use a smartphone. In general, these behavioral traits belong to performance expectancy.

M-learning using smartphones provides adaptive learning as well as collaborative learning opportunities to the students which in general provides a unique learning experience for students. The advanced communication features inbuilt in smartphone to support the mobile learning with

creative collaborative environment among the students which help to do the task jointly as well as develop creativity, collaborative skills, and communication among the students. It is more interactive and more techno-savvy so the students at a higher level were found shifting more to them-learning and adapting the technological advances available mainly smartphones.

Meanwhile, the collaboration between the lecturer and the colleagues has become trendier and more interactive so that students were found consulting and combining with the available multiple sources of knowledge and resource material. More literature discussed above has indicated that through the use of smartphones, students were found to achieve a greater level of direct engagement with the proposed content, which in turn improved overall achievement. They indicated that technology was highly correlated with student motivation, and also found a significant correlation between technology use and academic achievement.

In another study indicates that the students' long-term knowledge retention in a technology-enhanced classroom (Virtual Age) subsequently influenced learning outcomes, and students who use technology outperform in engagement and achievement. On the question of whether persistent absorption and engagement with mobile technology whether facilitate or hamper their learning experiences and academic performance? Regarding this statement, it was found that technology affordances and accessibility has contributed to learning environments which means easily retrieving and sharing information to instant access and interaction with faculty and peers. it was found that students using various technologies mainly smartphones facilitated their learning experiences and effectively meet academic challenges. Gulek and Demirtas (2005) explained that using technology enhances student learning and educational outcomes. The findings of the study revealed that compared to nontechnology users, students using technology showed significantly higher achievement (overall GPA) and had high scores on criterion-referenced standardized tests. Similarly, Ezemenaka (2013) says, students, enhance and broaden their academic horizon by browsing for academic materials and equip themselves better toward preparation for exams through their smartphone. Smartphones use wasn't just limited to text messages and calls, but also for GPS, camera, voice calls, emails, Google Drive, and so forth, to create, upload, download and share academic resources as concluded by Mtega, Bernard, Msungu, and Sanare (2012). These facts showed smartphones higher use in academic purposes with better performances in class.

While on the contrary, many researchers claim the use of a smartphone to have a negative relationship with student performance. Like Jacobsen and Forste (2011) in their research findings revealed that students who were more engaged on their mobile phone for calling, texting and gaming had low academic results. Yet in another research, Lepp, Barkley, and Karpinski (2015) reported that students who used the cell phone more on a daily basis were likely to have a lower GPA than students who used it less. Similarly, factors such as technological concerns, student obsession, the social media bug, mental illness were some of its negative impacts not to be missed. The use of social media was an integral part of learning. But mostly its use was limited to social purpose. Facebook users were found to have lower academic results and who were online most of the time and utilized very less time for academic purposes. While Chawinga, W. D. (2017) research proved Twitter to have benefited through interactive learning, instant communication, and independent learning to support students' performance.

Hence, there is immense potential in promoting the use of mobile technology in education like more interactivity to enrich the content, the ability to create courses tailored to each student's progress and preparation for future careers around these technologies. The smartphones' positive impact outweighs the negative impact and proper guidance and its effective use will make universities' and students' learning collaboration more effective. The extended works of literature have shown that despite limitations, smartphones offer the potential to increase learning that deserves further investigation.

To address the future challenge, it is important to conduct some attitudinal and descriptive studies before developing mobile learning applications in a pre-determined subject area to save time and cost. In this regard, learners' perceptions of the use of mobile devices for educational purposes should be inspected as it may shed light on their motives for using mobile technologies. Moreover, attitudes towards any kind of educational technology could be used to measure to what extent users of such technology (learners and instructors) have ambitions to use specific technology. Towards further investigation, an in-depth interview could be done, where we could analyze the gap between the researcher's finding an actual scenario. An in-depth interview questionnaire sample is attached in the appendix for further overview.

Finally talking about mitigating the challenges with transition from the traditional classroom to digital m-learning, We can't completely separate traditional class-based learning activities with mobile-based learning because one hasn't completely shifted to each other rather complimented both kinds of learning. Traditional lectures will certainly be supplemented by the concepts of m-learning and other technology because the essence of each lecture is the transfer of knowledge and knowledge transfer should be facilitated by m-learning (Furio et al. 2014).

4. References

- Al-Emran, M., Elsherif, H. M., & Shaalan, K. (2016). Investigating attitudes towards the use of mobile learning in higher education. *Computers in Human Behavior*, 56, 93-102.
- Alexander, A. (2011). How reliant are college students on smartphones? Retrieved March 13, 2012.
- Alfawareh, H. M., & Jusoh, S. (2014). Smartphones usage among university students: Najran University Case. *International Journal of Academic Research*, 6(2)
- Aljomaa, S. S., Qudah, M. F. A., Alburan, I. S., Bakhiet, S. F., & Abduljabbar, A. S. (2016). Smartphone addiction among university students in light of some variables. *Computers in Human Behavior*, 61, 155-164.
- Ally, M., & Samaka, M. (2013). Open education resources and mobile technology to narrow the learning divide. *The international review of research in open and distributed learning*, 14(2), 14-27.
- Anshari, M., Almunawar, M. N., Shahrill, M., Wicaksono, D. K., & Huda, M. (2017). Smartphones usage in the classrooms: Learning aid or interference?. *Education and Information Technologies*, 22(6), 3063-3079.
- Asabere, N. Y. (2013). Benefits and challenges of mobile learning implementation: Story of developing nations. *International Journal of Computer Applications*, 73(1).
- Berman, R. A. (2014). Engaging students requires a renewed focus on teaching. *Chronicle of Higher Education*, 61(3), 28e30.
- Bhargavi, K., Balachandrudu, K. E., & Nageswar, P. (2013). Mobile phone radiation effects on human health. *International Journal of Computational Engineering Research*, 3(4), 196-203
- Bin Abdullah, M. F. A., Negara, A. F. P., Sayeed, M. S., Choi, D. J., & Muthu, K. S. (2012). Classification algorithms in human activity recognition using smartphones. *International Journal of Computer and Information Engineering*, 6(77-84), 106.
- Boruff, J. T., & Storie, D. (2014). Mobile devices in medicine: a survey of how medical students, residents, and faculty use smartphones and other mobile devices to find information. *Journal of the Medical Library Association: JMLA*, 102(1), 22.
- Bowen, K., & Pistilli, M. D. (2012). Student preferences for mobile app usage. *Research Bulletin*(Louisville, CO: EDUCAUSE Center for Applied Research, forthcoming)
- Buck, J. L., McInnis, E., & Randolph, C. (2013). The new frontier of education: The impact of smartphone technology in the classroom. In *American Society for Engineering Education*(Vol. 1, No. 1, pp. 1-11).
- Chaklader, A., & Bohlander, R. W. (2009). The effects of text messaging on attention. In the *meeting of Eastern Psychological Association, Pittsburgh, PA*.
- Chase, T. J., Julius, A., Chandan, J. S., Powell, E., Hall, C. S., Phillips, B. L., ... & Fernando, B. (2018). Mobile learning in medicine: an evaluation of attitudes and behaviors of medical students. *BMC medical education*, 18(1), 152.
- Chawinga, Winner Dominic. "Taking social media to a university classroom: teaching and learning using Twitter and blogs." *International Journal of Educational Technology in Higher*

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Cole, P. G., & Chan, L. K. S. (1994). Teaching principles and practice (2nd ed.). New York, NY: Prentice Hall.

- Chen, B., & Denoyelles, A. (2013). Exploring students' mobile learning practices in higher education. *Educause Review*, 7.
- Chen, Y. S., Kao, T. C., & Sheu, J. P. (2003). A mobile learning system for scaffolding bird watching learning. *Journal of Computer Assisted Learning*, 19, 347-359
- Chou, L. D., Lee, C. C., Lee, M. Y., & Chang, C. Y. (2004, March). A tour guide system for mobile learning in museums. *The 2nd IEEE International Workshop on Wireless and Mobile Technologies in Education, 2004. Proceedings.* (pp. 195-196). IEEE.
- CourseSmart. (2011). Digital dependence of today's college students revealed in a new study from CoursesmartTM. Retrieved on 01-Jun-2011
- Crouch, C. H., & Mazur, E. (2001). Peer instruction: Ten years of experience and results. *The Physics Teacher*, 69(9), 970-977.
- Dahlstrom, E., & Brooks, D. C. (2014). with a foreword by Diana Oblinger. *ECAR Study of Faculty and Information Technology*, 3-3.
- Derek Buff (201) Clickers and Class Room Dynamics. Vanderbilt University. Retrieved on May 25, 2019.
- Dzvapatsva, G. P., Mitrovic, Z., & Dietrich, A. D. (2014). Use of social media platforms for improving academic performance at Further Education and Training colleges. *South African Journal of Information Management*, 16(1), 1-7.
- El-Hussein, M. O. M., & Cronje, J. C. (2010). Defining mobile learning in the higher education landscape. *Journal of Educational Technology & Society*, 13(3), 12-21.
- Eric M. Meyers, Ingrid Erickson & Ruth V. Small (2013) Digital literacy and informal learning environments: an introduction, *Learning, Media and Technology*, 38:4, 355-367
- Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance improvement quarterly*, 6(4), 50-72.
- Evans, M. (2009). Mobility, games, and education. In R. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education* (pp. 96-110). New York: NIG Publishing.
- Ezemenaka, E. (2013). The usage and impact of internet-enabled phones on academic concentration among students of tertiary institutions: A study of the University of Ibadan, Nigeria. *International Journal of Education and Development using ICT*, 9(3).
- Ferrari, M., Yap, K., Scott, N., Einstein, D. A., & Ciarrochi, J. (2018). Self-compassion moderates the perfectionism and depression link in both adolescence and adulthood. *PloS one*, 13(2)
- Ferrer, F., Belvís, E., & Pàmies, J. (2011). Tablet PCs, academic results and educational inequalities. *Computers & Education*, 56(1), 280-288.
- Fuchs, T., & Wößmann, L. (2004). *What accounts for international differences in student performance?* (No. 1235). CESifo working paper.
- Furió, D., Juan, M. C., Seguí, I., & Vivó, R. (2015). Mobile learning vs. traditional classroom lessons: a comparative study. *Journal of Computer Assisted Learning*, 31(3), 189-201.

- García Botero, G., & Questier, F. (2016). What students think and what they actually do in a mobile assisted language learning context: new insights for self-directed language learning in higher education.
- Goh, T., & Kinshuk, (2006). Getting ready for mobile learning-adaptation perspective. *Journal of Educational Multimedia and Hypermedia*, 15(2), 175-198.
- Grant, M. M., Tamim, S., Brown, D. B., Sweeney, J. P., Ferguson, F. K., & Jones, L. B. (2015). Teaching and learning with mobile computing devices: A Case study in K-12 classrooms. *TechTrends*, 59(4), 32-45.
- Grosseck, G., Bran, R., & Tiru, L. (2011). Dear teacher, what should I write on my wall? A case study on academic uses of Facebook. *Procedia-Social and Behavioral Sciences*, 15, 1425-1430.
- Gulek, J. C., & Demirtas, H. (2005). Learning with technology: The impact of laptop use on student achievement. *The journal of technology, learning, and assessment*, 3(2).
- Hairisine, K. (2016, March 11). What is m-learning? Retrieved February 05, 2019,
- Hamann, K., Pollock, P. H., & Wilson, B. M. (2012). Assessing student perceptions of the benefits of discussions in small-group, large-class, and online learning contexts. *College Teaching*, 60(2), 6575
- Han, S., & Yi, Y. J. (2019). How does the smartphone usage of college students affect academic performance?. *Journal of Computer Assisted Learning*, 35(1), 13-22.
- Harley, D., Winn, S., Pemberton, S., et al., 2007. Using texting to support students' transition to university. *Innovations in Education and Teaching International* 3 (44), 229
- Hashemi, M., Azizinezhad, M., Najafi, V., & Nesari, A. J. (2011). What is mobile learning? Challenges and capabilities. *Procedia-Social and Behavioral Sciences*, 30, 2477-2481.
- Hashim, K. F., Tan, F. B., & Rashid, A. (2015). Adult learners' intention to adopt mobile learning: A motivational perspective. *British Journal of Educational Technology*, 46(2), 381-390.
- Hoffman, C., & Goodwin, S. (2006). A clicker for your thoughts: Technology for active learning. *New Library World*, 107(9/10), 422-433.
- Hong, F. Y., Chiu, S. I., & Huang, D. H. (2012). A model of the relationship between psychological characteristics, mobile phone addiction and use of mobile phones by Taiwanese university female students. *Computers in Human Behavior*, 28(6), 2152-2159.
- Hwang, G., Wu, T., & Chen, Y. (2007). Ubiquitous computing technologies in education. *International Journal of Distance Education Technologies*, 5(4), 1-4, October-December 2007
- Ibrahim, N. A., Salisu, M., Popoola, A. A., & Ibrahim, T. I. (2014). Use of smartphones among medical students in the clinical years at a medical school in Sub-Saharan Africa: A pilot study. *Journal of Mobile Technology in Medicine*, 3(2), 28-34.
- Jacob, S. M., & Issac, B. (2014). Mobile devices and their mobile learning usage analysis. *ArXiv preprint arXiv:1410.4375*.
- Jacobsen, W. C., & Forste, R. (2011). The wired generation: Academic and social outcomes of electronic media use among university students. *Cyberpsychology, Behavior, and Social Networking*, 14(5), 275-280.

- Johnson, E. M., & Howard, C. (2019). A library mobile device deployment to enhance the medical student experience in a rural longitudinal integrated clerkship. *Journal of the Medical Library Association: JMLA*, 107(1), 30.
- Kelly, R. (2017). Survey: 94% of Students Want to Use Their Cell Phones in Class. Retrieved February 5, 2019,
- Kirschner, P. A., & Karpinski, A. C. (2010). Facebook® and academic performance. *Computers in human behavior*, 26(6), 1237-1245.
- Kim, B. (2013). The present and future of the library mobile experience. *Library Technology Reports*, 49(6), 15-28.
- Koehler, N., Yao, K., Vujovic, O., & McMenamin, C. (2012). Medical students' use of and attitudes towards medical applications. *Journal of mobile technology in medicine*, 1(4), 16-21.
- Kukulska-Hulme, A., & Traxler, J. (Eds.). (2005). *Mobile learning: A handbook for educators and trainers*. Psychology Press.
- Kukulska-Hulme, A., Traxler, J., & Pettit, J. (2007). Designed and user-generated activity in the mobile age. *Journal of Learning Design*, 2(1), 52-65.
- Lee, S. Y. (2014). Examining the factors that influence early adopters' smartphone adoption: The case of college students. *Telematics and Informatics*, 31(2), 308-318.
- Lepp, A., Barkley, J. E., & Karpinski, A. C. (2015). The relationship between cell phone use and academic performance in a sample of US college students. *Sage Open*, 5(1)
- Liaw, S. S. (2007). Computers and the Internet as a job assisted tool: based on the three-tier use model approach. *Computers in Human Behavior*, 23(1), 399-414.
- Liaw, S. S., Huang, H. M., & Chen, G. D. (2007). Surveying instructor and learner attitudes toward e-learning. *Computers & Education*, 49(4), 1066-1080.
- Libman, D., & Huang, L. (2013). Chemistry on the go: a review of chemistry apps on smartphones. *Journal of Chemical Education*, 90(3), 320-325.
- Lim, C. P., & Churchill, D. (2016). Mobile learning
- Lippmann, S. (2013). Facilitating class sessions for ego-piercing engagement. *New Directions for Teaching and Learning*, 135, 43e48.
- Litchfield, S. (2010). Defining the smartphone. Retrieved July 16, 2010
- Liu, G. Z., & Hwang, G. J. (2010). A key step to understanding paradigm shifts in e-learning: towards context-aware ubiquitous learning. *British Journal of Educational Technology*, 41(2), E1-E9.
- Lytle, R. Y. A. N. (2012). 5 apps college students should use this school year. *USA Today*.
- Marcos, L., Támez, R., & Lozano, A. (2009). Mobile learning as a tool for the development of communication skills in virtual discussion boards. *Comunicar*, (33), 93-100.
- Marez, L. & Montrieux, H. & Schellens, T. & Vanderlinde, R. 2015. Teaching and learning with Mobile Technology: A Qualitative Explorative Study about the Introduction of Tablet Devices in Secondary Education. Retrieved 18 September 2017.
- Masika, M. M., Omondi, G. B., Natembeya, D. S., Mugane, E. M., Bosire, K. O., & Kibwage, I. O. (2015). Use of mobile learning technology among final year medical students in Kenya. *Pan African Medical Journal*, 21(1).

- Mbabazi, B. P., Ali, G., Geoffrey, A., & Lawrence, N. (2018). Mobile devices for learning in universities: challenges and effects of usage.
- Mehdipour, Y., & Zerehkafi, H. (2013). Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research*, 3(6), 93-101.
- Menkhoff, T., Chay, Y. W., Bengtsson, M. L., Woodard, C. J., & Gan, B. (2015). Incorporating microblogging ("tweeting") in higher education: Lessons learned in a knowledge management course. *Computers in Human Behavior*, 51, 1295-1302.
- Milošević, I., Živković, D., Manasijević, D., & Nikolić, D. (2015). The effects of the intended behavior of students in the use of M-learning. *Computers in Human Behavior*, 51, 207-215.
- Mohapatra, D. P., Mohapatra, M. M., Chittoria, R. K., Friji, M. T., & Kumar, S. D. (2015). The scope of mobile devices in health care and medical education. *International Journal of Advanced Medical and Health Research*, 2(1), 3.
- Montrieux, H., Vanderlinde, R., Schellens, T., & De Marez, L. (2015). Teaching and learning with mobile technology: A qualitative explorative study about the introduction of tablet devices in secondary education. *10(12)*,
- Mostakhdemin-Hosseini, A. (2009). Analysis of Pedagogical Considerations of M-Learning in Smart Devices. *International Journal of Interactive Mobile Technologies*, 3(4).
- Mtega, W. P., Bernard, R., Msungu, A. C., & Sanare, R. (2012). Using mobile phones for teaching and learning purposes in higher learning institutions: The case of the Sokoine University of Agriculture in Tanzania.
- Murphy, K. P., & Russell, S. (2002). Dynamic Bayesian networks: representation, inference, and learning.
- Muslimin, M. S., Nordin, N. M., Mansor, A. Z., Ismail, I. M., & Hamdan, F. (2018). Application of Learning Theories in Design and Development of the Mobile Application for Microeconomics Course. *Advanced Science Letters*, 24(4), 2475-2479.
- Naismith, L., Lonsdale, P., Vavoula, G. N., & Sharples, M. (2004). Mobile technologies and learning.
- Narula, U. (2006), *Business Communication Practices: Modern Trends*, New Delhi: Atlantic Publisher & Distributors.
- Norris, C., Hossain, A., & Soloway, E. (2011). Using smartphones as essential tools for learning. *Educational Technology*, 51(3), 18-25.
- O'Connor, K. (2013). Class participation: Promoting in-class student engagement. *Education*, 133(3), 340-344.
- Oprea, M., & Miron, C. (2014). Mobile phones in the modern teaching of physics. *Romanian Reports in Physics*, 66(4), 1236-1252.
- Orr, G. (2010). A review of literature in mobile learning: Affordances and constraints. In *2010 6th IEEE International Conference on Wireless, Mobile, and Ubiquitous Technologies in Education* (pp. 107-111). IEEE.
- Papadima-Sophocleous, S., Bradley, L., & Thouësny, S. (Eds.). (2016). *CALL communities and culture—short papers from EUROCALL 2016*.
- Passerini, K., & Granger, M. J. (2000). A developmental model for distance learning using the Internet. *Computers & Education*, 34(1), 1-15.

- Rashid, T., & Asghar, H. M. (2016). Technology use, self-directed learning, student engagement and academic performance: Examining the interrelations. *Computers in Human Behavior*, *63*, 604-612.
- Roman, R., Najera, P., & Lopez, J. (2011). Securing the internet of things. *Computer*, (9), 51-58.
- Rosen, L. D., Whaling, K., Carrier, L. M., Cheever, N. A., & Rökkum, J. (2013). The media and technology usage and attitudes scale: An empirical investigation. *Computers in human behavior*, *29*(6), 2501-2511.
- Sana, F., Weston, T., & Cepeda, N. J. (2013). Laptop multitasking hinders classroom learning for both users and nearby peers. *Computers & Education*, *62*, 24-31.
- Sánchez Prieto, J. C., Olmos Migueláñez, S., & García-Peñalvo, F. J. (2014). Understanding mobile learning: devices, pedagogical implications and research lines. *Teoría de la Educación. Educación y Cultura en la Sociedad de la Información*, *15*(1).
- Sandoval, J. O., & Santoyo, A. S. (2011). Implementación de una actividad educativa en modo colaborativo con apoyo de smartphones: una experiencia universitaria. *Eduotec: Revista electrónica de tecnología educativa*, (36), 3-19.
- Schlenker, L. (2013). Mobile Pedagogy. *International Association for Development of the Information Society*.
- Sharples, M., Taylor, J., & Vavoula, G. (2005, October). Towards a theory of mobile learning. In *Proceedings of mLearn* (Vol. 1, No. 1, pp. 1-9).
- Shi, W. Z., Sun, J., Xu, C., & Huan, W. (2016). Assessing the Use of Smartphone in the University General Physics Laboratory. *Eurasia Journal of Mathematics, Science & Technology Education*, *12*(1), 125-132.
- Siau, K., Lim, E. P., & Shen, Z. (2001). Mobile commerce: Promises, challenges and research agenda. *Journal of Database Management (JDM)*, *12*(3), 4-13.
- Spiro, R. J., & Feltovich, P. (1995). J., Jacobson, MJ, and Coulson, RL Cognitive Flexibility, Constructivism, and Hypertext: Random Access Instruction for Advanced Knowledge Acquisition in Ill-Structured Domains. *Constructivism, Hillsdale, NJ: Erlbaum*.
- Srivastava, L. (2005). Mobile phones and the evolution of social behavior. *Behaviour & Information Technology*, *24* (2), 111-129.
- Stowell, J. R. (2015). Use of clickers vs. mobile devices for classroom polling. *Computers & Education*, *82*, 329-334.
- Tayseer, M., Zoghieb, F., Alcheikh, I., & Awadallah, M. N. (2014,). Social Network: Academic and Social Impact on College Students. In *ASEE 2014 Conference Paper, University of Bridgeport, Bridgeport, CT, USA*.
- Tindell, D. R., & Bohlander, R. W. (2012). The use and abuse of cell phones and text messaging in the classroom: A survey of college students. *College Teaching*, *60*(1), 1-9.
- Ting, R. Y. L. (2005, July). Mobile learning: Current trend and future challenges. In *Fifth IEEE International Conference on Advanced Learning Technologies (ICALT'05)* (pp. 603-607). IEEE.

- Tossell, C. C., Kortum, P., Shepard, C., Rahmati, A., & Zhong, L. (2015). You can lead a horse to water but you cannot make him learn: Smartphone use in higher education. *British Journal of Educational Technology*, 46(4), 713-724.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.
- Vinay, K. V., & Vishal, K. (2013). Smartphone applications for medical students and professionals. *Nitte University Journal of Health Science*, 3(1), 59.
- Wang, Y. S., Wu, M. C., & Wang, H. Y. (2009). Investigating the determinants and age and gender differences in the acceptance of mobile learning. *British journal of educational technology*, 40(1), 92-118.
- White, J. Mills. (2012). Get smart!: Smartphones in the Japanese classroom. In *JALT2011 Conference Proceedings*. Tokyo JALT.
- Williams, A. J., & Pence, H. E. (2011). Smartphones, a powerful tool in the chemistry classroom. *Journal of Chemical Education*, 88(6), 683-686.
- Wilson, S., & McCarthy, G. (2010). The mobile university: from the library to the campus. *Reference Services Review*, 38(2), 214-232.
- Woodcock, B., Middleton, A., & Nortcliffe, A. (2012). Considering the Smartphone Learner: an investigation into student interest in the use of personal technology to enhance their learning. *Student Engagement and Experience Journal*, 1(1), 1-15.
- Yu, F., & Conway, A. R. (2012). Mobile/smartphone use in higher education. *Proceedings of the 2012 Southwest Decision Sciences Institute*, 831-839.
- Yurdagül, C., & Öz, S. (2018). Attitude towards Mobile Learning in English Language Education. *Education Sciences*, 8(3), 142.

5. Appendixes

Interview Questions

My name is Barsha Ghimire. I am from Hasselt University. I am here to conduct a study on the use of smartphone form-learning on the university level. I would like to talk to you about your experience of having access and using a smartphone for mobile learning in your university level. Your answers are very important for us to find the scenario of smartphone use among students for mobile learning. The information you give us will be treated in the strictest confidence and your name will not be given to anyone. You are free not to take part in this study or to stop the interview at any time. If you do not wish to participate in the interview you will not be penalized. The interview will last approximately 30 minutes and will be recorded (unless you are uncomfortable with this then only written note will be taken). Are you willing to take part in this study?

Are you agreed to participate in this study?

Yes

No

In-depth Interview Guidelines for students at Hasselt University

1. Name:
2. The venue of the interview:
3. Date of Interview:
4. Subject Stream:
5. University level:
6. Explain your experience of using a mobile phone in your day to day life?
7. Describe your purposes of using a mobile phone?
8. Explain if you use your smartphone for any kind of learning? (Blackboard)
9. Explain the trend of using smartphones for learning at your classroom?
10. What kinds of programs or applications support your learning and how does it work, describe?
11. What other tools do you use on your mobile device for learning purposes? (like one note, word, google drive)
12. How often do you use social media in the classroom? What is the main purpose?
13. Based on your experience, what kind of educational/ learning support and service have you received from your University that is smartphone friendly? (Probe)
14. Share any suggestions or ideas that you have about how mobile devices can be utilized more effectively for studying.
15. How do you perceive m-learning from your smartphone differently from your regular class lecture and assignments?
16. Describe the benefits of using smartphones for learning that you have experienced?

17. Share if the use of a smartphone has disturbed your learning activities?
18. What kind of disadvantages have you perceived because of using m-learning?
19. How do you compare the regular class lecture and activities with m-learning?
20. What kind of positive and negative effects have you experienced because of this change?
21. Describe how easy or difficult in your experience to adopt m-learning in your regular learning activities?
22. How have you perceived the growth of m-learning in the future classroom? (Probe)