Use of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh.

By

Ninsiima Hafusa

191031402

MSC.TE (CSE)

DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

BOARD BAZAR, GAZIPUR 1704,

DHAKA-BANGLADESH

APRIL, 2022

Use of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh

By

NINSIIMA HAFUSA

191031402

MScTE (CSE)

A thesis submitted for fulfillment of the degree of Master of Science in Technical Education with Specialization in Computer Science and Engineering

At The Islamic University Of Technology.

DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISAMIC COOPERATION (OIC)

BOARD BAZAR, GAZIPUR 1704,

DHAKA-BANGLADESH

APRIL, 2022

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANIZATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF TECHNICAL AND VOCATIONAL EDUCATION (TVE)

23rd April 2022

The thesis titled **Use of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh** submitted by **Ninsiima Hafusa** with student No. **191031402** has been found satisfactory and accepted as fulfillment of the requirement for the degree of **Master of Science in Technical Education** (M.Sc.T.E.) with specialization in **Computer Science Engineering.**

BOARD OF EXAMINERS

Prof.Dr.Md. Shahadat Hossain Khan (Chairman)
(Supervisor)TVE Department.

Prof. Dr. Md. Faruque A. Haolader (Ex-Officio)

Head, TVE Department.

Prof. Dr. Abdullah Al Mamun (Member)

TVE Department.

Dr. Dilruba Sultana, (External)

IED, BRAC Uni.

DECLARATION

This is to certify that the study provided in this thesis is the result of Ninsiima Hafusa's investigation at the department of Technical and Vocational Education (TVE), Islamic University of Technology, Gazipur, Bangladesh, under the supervision of Professor. Dr. Md. Shahadat Hossain Khan. This thesis report, in whole or in part, hasn't been submitted for the granting of any degree or diploma anywhere.

Professor. Dr. Md. Shahadat Hossain Khan	**Ninsiima Hafusa**
Supervisor	Student Id. 191031402
Department of Technical and Vocational Education (TVE)	Academic Year: 2020-2021.
Islamic University of Technology, Bangladesh.	
Date: _____	**Date: _____**

DEDICATION

I dedicate this important professional achievement to the Almighty Allah.

I commit this thesis work to my parents, brothers, sisters, and friends who have been by my side in the process of building up this work. May the Almighty Allah reward them abundantly?

Contents

LIST OF TABLES

ACRONYMS

ABBREVIATIONS	ACRONYMS
EEE	Electrical and Electronic Engineering
ME	Mechanical Engineering
CSE	Computer Science and Engineering
CEE	Civil and Environmental Engineering
Ch.E.	Chemical Engineering
MME	Materials and Metallurgical Engineering
GCE	Glass and Ceramic engineering
IPE	Industrial and Production Engineering
DA	Department of Architecture
TVE	Technical and Vocational Education
E-Learning	Electronic Learning
SRS	Student Response System
K-12	Kindergarten to 12th Grade
ML	Mobile Learning
ICT	Information Communications Technology
IUT	Islamic University of Technology
BUET	Bangladesh University of Engineering and Technology
NSU	North South University
DUET	Dhaka University of Engineering and Technology
MLRS	Mobile Learning Readiness Survey
FP	Future Possibilities

BN	Benefits
MDP	Mobile Device Preferences
EI	External Influence
SA	Strongly Agree
A	Agree
U	Undecided
D	Disagree
SD	Strongly Disagree
CVI	Content Validity Index Content Validity Index
SPSS	Statistical Package for the Social Sciences
EFL	English as Foreign Language
OBE	Outcome Based Education

ACKNOWLEDGEMENT

Glory be to the Almighty Allah for keeping me alive to finish this research dissertation, with His mercy, blessings and favor upon me.

I would wish to offer my heartfelt gratitude to my loving father Mr. Byaruhanga Dauda and my dear mother Mrs. Byaruhanga Hadija for their constant care that made me look and be what I am today. May the almighty Allah reward them abundantly.

I would wish to extend my greatest thanks to IUT, Department of Technical and Vocational Education (TVE) for providing me an opportunity to complete an exciting and enriching Programme.

My deepest sense of gratitude must be reserved for my research Supervisor Professor. Dr. Md. Shahadat Hossain Khan for his significant sincere expert advice; guidance and encouragement that made this piece of work a reality and made me learn a lot academically.

I am also grateful to the registrar of IUT Dr. Mwebesa Umar and the head of Technical and vocational Education (TVE), Prof. Dr. Md. Faruque A. Haolader for their words of encouragement and granting me permission to do data collection among the selected engineering universities in Bangladesh.

My heartfelt thanks go to my dear friends and classmates who made the stay at campus enjoyable. Special regards to the Ugandan Community for their valuable contribution, perseverance and patience throughout my study period.

Special gratitude goes to my family, especially my sisters Mrs. Rukundo Sarah, Mrs. Ashababehebwa Nashim, Mrs. Kyomugasho Rehema and Ms. Ainembabazi shifrah, brother Lucky Hamza, my children Nyamihingo Firdaus who were an inspiration, encouragement and support throughout my academic career.

I cannot individually thank all those who made this report a reality, but to you all, I say thank you.

May the Almighty Allah bless you all.

ABSTRACT

The study investigated the use of mobile devices such as smartphones, tablets, and notebooks in teaching and learning in engineering universities of Bangladesh. Focusing on the four factors namely; benefits, future possibilities, preferences and external influence. The research aimed to explore specifically the perception of engineering faculty members in the selected Bangladesh universities. The main objective of the study was to investigate the use of mobile devices in teaching and learning in engineering universities of Bangladesh. The primary data was collected using adapted Mobile Learning Readiness Survey on 184 respondents sent to them by email using a stratified sampling technique. It was analyzed using descriptive statistics of mean and standard deviation, frequencies and percentages. The study found that the use of mobile devices will improve the twenty first-century teaching skills, mobile learning will bring new education opportunities, faculty members prefer to use an electronic textbook rather than a traditional textbook. The researcher recommends that the selected universities should provide adequate mobile teaching devices to their faculty members, initiate in-service training regarding the use of mobile devices and the use of mobile technology to be a priority for teaching students with special needs.

CHAPTER ONE

Introduction

1.1 Background of the Study

In this era of technology, the use smartphones, tablets , iPad has become a basic need for development in many fields of study like engineering education. Consequently, the usage of mobile devices in engineering education is increasing rapidly. Qashou (2021) believes that Electronic Learning is an emerging approach of transmitting knowledge to the learners. For example, mobile learning has become a new technique of learning that engages students to access learning tools by use of mobile devices.

Due to the Covid-19 pandemic, people have been accustomed to using mobile devices for E-Learning and online teaching all over the world (Kulikowski, Przytuła, and Sułkowski, 2021). In this way, the usage of mobile devices in engineering institutions has proven beneficial in some ways and also disturbing in other ways. For example, it had been observed that students could learn anything at any location with the assistance of E-Learning and mobile devices. However, they could also misuse this technology in a way that they might not pay attention to their learning and they might get distracted by social media sites while learning online using their mobile devices (Nikolopoulou, 2020).

In order to promote mobile learning approaches, scholars have been engaged in the establishment of various learning tools. For example, Zarei et al., (2017) developed a smartphone-based Student Response System (SRS) that enabled formative assessment, specifically the development and distribution of teacher voice feedback. On the other hand, (Sinaga et al. 2019) encouraged teachers to use mobile learning tools in a variety of teaching techniques such as problem-based learning, where engineering teachers involved students in these activities to critically explain an issue or project through use of mobile devices. They add that flipped teaching approaches may be conducted at home and make students focus on classroom activities as well as exploring their own learning discoveries.

However, there are challenges of using mobile learning in engineering education institutions. Mohammadi, Sarvestani, and Nouroozi (2020) pointed out that the major issues faced by engineering teachers are lack of technological infrastructure, lack of access to advanced mobile

devices, inadequate pedagogical mobile-learning abilities, and have negative attitudes yet some mobile devices are incompatible with university online management systems.

There has been a lot of in-depth research in this area. The background studies highlight similar topics but limited solutions have been illuminated. Kukulska-Hulme (2012) in his study about the Internet education stated that:

> In a time of change, higher education is in the position of having to adapt to changing external conditions brought on by the widespread adoption of popular technologies such as social media, social networking services, and mobile devices, There must be opportunities for faculty members to have hands-on experiences that can lead to a personal conviction that a particular technology is worthwhile to use and an understanding of the contexts in which it is best used (pg.1).

This study assessed the Engineering faculty members' perception of using mobile devices in education and learning in higher educational institutions. It also highlighted the delusions regarding the use of mobile devices in teaching and learning in higher educational institutions. Specifically, this study analyzed the perception of engineering faculty members in regard to their views about the usage of mobile devices in higher educational institutions as well as the rationale of using them.

It is significant to know that the usage of mobile devices is beneficial in engineering educational institutions in Bangladesh and the world over. The concept of the field of engineering is the use of science and mathematics to solve technical and scientific problems, as such, the usage of mobile devices will assist the teaching and learning process in many ways. Faculty members can prepare their lectures with the help of mobile devices and students can learn any topic at any moment with the help of mobile devices by utilizing different learning platforms such as google classroom, zoom, discussions held with fellow students and teachers among others. Traditional classrooms provide fewer opportunities for both faculty members and learners. (Turnbull, Chugh, and Luck, 2021).There is low level of student interactivity and lack of emphasis on critical thinking. Ahmad (2020) conducted a study on student perceptions of cell phones as learning tools: implications for Caribbean higher education. The findings revealed that students viewed smart phone use as a learning tool and cell phone integration as beneficial. Students were enthusiastic about social networking and collaborative tool for flexible and individualized learning.

1.2 Problem Statement

According to Matzavela and Alepis (2021), the widespread mobile use in education has undergone significant modifications where by it is evident that mobile devices with internet connection will be utilized for education. New, creative, and contentious techniques to implementing a mobile learning process in real-world situations have been developed. However, in the present COVID-19 pandemic situation, where most institutions of higher engineering education are still under lockdown across the globe, faculty members have no option but to opt for mobile learning devices to ensure teaching and learning sustainability. The issue at hand is in the new normal, will the faculty members sustain the use of mobile devices in the physical classroom after the post COVID-19 learning environment? Or will they abandon the mobile devices and adopt the traditional education tools in the physical teaching space? This research study will explore the perception of engineering faculty members on the effective use of the mobile devices in the current situation as well as their perception in the new normal.

This research study tried review previous research studies related to the topic under the study. Iqbal and Bhatti (2020) conducted a research study titled *"*a qualitative exploration of teachers' Perspective on smartphones usage in higher education in developing countries*"*. The objective of their study's goal was to gather faculty opinions on the use of smartphones to promote learning at the tertiary level. The findings showed that mobile phones were considered to be excellent off-campus medium for studying and contact with peers and students by faculty members. In addition, the study revealed that he vast majority of responders were hesitant of utilizing mobile phones for educational purposes; lack of technical assistance and training besides experience; heavy workload and lack of willingness aimed at adopting educational technology. However, this research study was limited to only the usage of smartphones, with qualitative research approach in higher education institutions. Contrary, this research study will focus on mobile learning tools in general, using quantitative research approach seeking perception of engineering faculty members in higher education.

In another research study, Khlaif (2018) conducted a related study about "teachers' perception of factors affecting their adoption and acceptance of mobile technology in K-12 settings". The main objective was to observe the issues influencing the use and mobile device technology acceptance in Palestinian middle schools in a war zone from the teachers' perspective. The findings showed that teachers' views play a significant role in whether or not students embrace mobile learning use

in the classroom. The technical issues connected to hardware and software concerns were also found out to be the key causes for negative views concerning tablet adoption in classroom instruction. The focus of this research was on faculty members' perception of influences affecting the acceptance and adoption of mobile technology in K-12 settings whereas this research study focused on the perception of faculty members on the usage of mobile devices in engineering institution

The rationale of this study is timely especially during this period of the Covid-19 pandemic where institutions of higher learning have been operating under lockdown across the globe. Additionally, this is the period when staff are compelled to procure and use mobile devices if they are to remain relevant in their classrooms. In such circumstances, it is prudent to examine the general faculty members' perception of the mobile device usage in engineering universities to establish the effectiveness of such devices whether positively or negatively regardless of the impact of the pandemic.

1.3 General Objective of the Study

The general objective of this study was to investigate the use of mobile devices in teaching and learning in engineering universities of Bangladesh as teaching and learning tools.

1.4 Specific Objectives

1. To examine the faculty members' perception of the benefits of using mobile devices as learning tools in engineering education.
2. To explore the faculty members' perception of the future prospects of using mobile devices as learning tools in engineering education.
3. To discover the faculty members' preferences of using mobile devices as their most effective tools in engineering education.
4. To determine external influences that favor the usage of mobile devices in engineering education.

1.5 Research Questions:

1. How do faculty members perceive the benefits of using mobile devices as learning tools in engineering education?
2. What are the faculty members' perceptions of the future prospects of using mobile devices as learning tools in engineering education?

3. What are the faculty members' preferences of using mobile devices as their most effective tools in engineering education?
4. What are the external factors that influence the use of mobile devices in engineering education?

1.6 Significance of the Study

The study the unfolded engineering faculty member's perception of using mobile devices in engineering education and its future possibilities. At the crucial time of the Covid-19 pandemic, the usage of mobile devices had become more popular in the teaching process. Both faculty members and students can use mobile devices to conduct online classes. With the rapid development in technology regardless of the pandemic in the education sectors, this study still revealed what engineering faculty members thought about the integrations and uses of mobile devices in engineering universities of Bangladesh.

1.7 Limitations of the study

The target population was 500 for a sample size of 217 (Krejcie and Morgan 1970) . However, the response was 184 (36.8%). This could have been attributed to the effects of Covid-19 pandemic where the world was on tension including Bangladesh. Moreover, during the time of data collection there could have been challenges of accessing necessary resources of filling the questionnaire such as electricity outage and internet connectivity. This low response rate may be perceived to affect the data analysis.

The researcher targeted faculty members as study respondents, accessing and receiving their responses were a challenge despite repeated mails sent to them. Initially the researcher planned to distribute the questionnaire physically. However, this was hindered by the repeated lockdown by the Peoples republic of Bangladesh as well as IUT to restrict people's movement due to covid-19.

The researcher selected five engineering universities from where to draw the respondents. It could have been with extra benefit if more than ten universities were selected for the study for wider representation. However, this was not achieved because of the restricted movements of people and property during the pandemic period.

CHAPTER TWO

Literature review

This chapter included literature on various sections, including the definition of mobile learning, the benefits of using mobile devices, the pedagogy on mobile teaching, the perception of teaching using mobile learning tools, the perception of faculty members using mobile devices in teaching-learning in higher education, the literature gap, and the conceptual framework.

2.1 Mobile Learning

Mobile Learning (ML) is an e-learning model that using mobile technologies to gain knowledge, skills, and attitudes (Hamidi and Chavoshi, 2018). On the other hand, Crompton et al., (2016) defines mobile learning as the methods of interaction through discussions among people and personal interactive technologies. In addition to acquisition of skills, and interaction of through conversation, Pedro, Barbosa, and Santos (2018) describe ML as an approach that combines mobile computing and e-learning, emphasizing learners' mobility and individualized learning by utilizing mobile technology to enable anytime, anywhere, ubiquitous learning. However, in this study mobile learning refers to the need and ability to learn through mobile devices, such as personal electronic devices such as smart phones, tablets, notebooks through social interactions, and content.

2.2 Benefits of Using Mobile Devices

Whyley (2018) believed that tablets and smartphones as devices of mobile technologies continue to grow and develop. These mobile devices have converted to an educational potential-filled tool in both learning indoors and out (Nikolopoulou et al. 2020, 2021). The literature is revealing the usage of ML in regard to acquisition of skills, conversation among the people, intersect of mobile computing and electronic learning among others. Contrary, this study, focuses on the benefits of using ML tools, future prospects of using ML tools, faculty members' preferences of ML tools in the classroom and infrastructural factor that promote ML tools.

The ML facilitates and improves the learning processes through mobile devices at any point in time and from any setting. In the recent years, ML has established it's self with enhancing student motivation, achievement, and communication are possible pedagogical benefits. Nikolopoulou et al., (2021). Such benefits have been required to promote academic activities in higher institutions

to promote and sustain learning. For example, in some countries, COVID-19 pandemic has infected plus 1.2 billion students in 186 countries which has caused lockdown of education institutions. (Oraif and Elyas., 2021). Instructors and students are currently wondering whether online learning will persist in the post COVID-pandemic, given the abrupt paradigm in many, there has been a shift away from the classroom in many parts of the world. Mobile technology is the utmost common in addition to efficient means of community interaction at present, so the research community is faced with the task of investigating this universal phenomenon's socio-educational possibilities.

Gómez-García et al., (2020) elaborated that educational centres should make minor changes to the school curriculum to integrate technical tools as a source of knowledge, according to the concept of three methods for improving the school through technology, They may include them in the teaching approach and also in the global factors that cause the school to shift. In learning, the use of these mobile technologies enhances performance, accessibility, and value of learning through facilitating access to tools and programs for education and the potential of m-learning technologies to showcase learning materials, not only in text, but also in graphs, sound, and video, and easy access through many different options.

Those who have access to the appropriate technologies, online learning is more successful in numerous ways. For example, students retain more quantifiable content with online learning compared to the old-style classroom teaching. This is owing to the fact that students may learn faster online. Because e-learning saves time because students can go back and reread, skip, or accelerate through ideas at their own pace. Besides, learners can manage their learning materials with internet-connected mobile devices, and share their work on the internet, and faculty members can examine, assess the work of students and offer input or support nearly immediately.

Qashou (2021) conducted a study on the factors affecting m-learning adoption in higher education and it was determined that m-learning is a new learning technique that enables students to perform without temporal or spatial constraint limitations, using mobile devices.

Mobile device use in higher education has been shown to be both beneficial for student learning such as promoting engagement, digital access, instant feedback , focus on discussion and detrimental as a source of distraction such as decreased attention for the user and other students (Godwin-Jones 2018).

2.3 Pedagogy on Mobile Teaching

The integration of technology with pedagogy and subject matter is required because mobile learning enhances the learning experience of students, facilitates learning outside of the classroom, and supports differentiated instruction (Bai 2019).

In the related study titled mobile phone policies and pedagogy by Morris and Sarapin (2020). Numerous university faculty members were discovered to classroom cell phone policies. Approximately half of those who request that students put down their phones deem these policies to be effective. Seventy-four percent of respondents permit the mobile use for basic classroom activities, but there is no true integration with education. In other words, from the above study, mobile devices benefit students and faculty members.

Costa et al., (2020) conducted a study on how do pre-service teachers make a didactic program? Mobile-device collaborative learning. It was discovered that Mobile learning's collaborative learning teaching method is more effective than the conventional method for teaching didactic programming and it enhances motivation, independence in education, instructive teamwork and problem-solving, and time perception in training process. The researcher is in support of these findings.

García-Martínez et al.,(2019) in their study teachers were investigated on professionalization besides the use of mobile devices to boost education clarified that advanced education instruction remains evolving owed to the impact of knowhow and that increasingly, technology is taking over. traditional education strategies and methods. Thus, as a result, mobile gadgets are viewed as crucial tools for comprehension of educational procedures in new ways.

Similarly, the findings of the study conducted by Chavoshi and Hamidi (2019) about Iran's mobile learning adoption: social, individual, technological, and pedagogical factors demonstrated mobile devices as a teaching tool is contingent upon pedagogical, technological, social, and personal considerations. In contrary this study probed faculty perception of using of mobile devices in Bangladesh engineering universities.

Contrary, Kearney, Burden, and Schuck (2018) study conducted titled disrupting education using smart mobile pedagogies. It was found out that a growing body of evidence indicates that traditional pedagogies continue to dominate the field of education despite being misaligned with

the diverse learning opportunities offered by mobile technologies. The researchers argue that teacher educators should assist teacher education in order to promote smart pedagogies.

2.4 Faculty Members' Perception of Teaching Using Mobile Learning Tools.

Positive expectations and attitudes towards technology, as well as some understanding of its benefits, are needed for successful technology integration in the classroom (Al-Jarrah and Talafhah, 2019). Faculty members' expectations are generally understood as a significant impact in the degree to which faculty members incorporate ICTs in teaching, and whether these members properly address the affordances of the ICT tool. Wu et al., (2020) If teachers are un willing or un prepared with the necessary skills, then any ICT innovation would be difficult to maintain (Kalogiannakis and Papadakis, 2019). Hence, Kim and Kim (2017) argue that teachers' motivation and willingness to incorporate mobile devices into their classrooms must be supported. They believe that teachers' confidence regarding mobile device integration boosts their preparedness for success in employing emerging technology in the classroom. They add that teachers have a strong understanding that the capacity of mobile pedagogy needs to be enhanced but are confused with the specific strategy or approaches to enhance this potential and some teachers perceive that improving technological skills is not enough to meet the requirements of education in the digital age. Therefore, this study will add the concept of benefits of using ML tools as a way of promoting mobile pedagogy through teachers' perception.

2.5 Faculty Members' Perception of Using Mobile Devices in Teaching-Learning in Higher Education.

Faculty members may be compelled to use mobile learning tools such as mobile phones, tablets, and note books among others like in the COVID-19 pandemic period where most institutions of higher learning across the globe are still under lockdown and therefore, it has proved hard for them to teach in the physical classroom. In order to sustain learning as well as earning a living, they have to use mobile learning tools.

Shraim and Crompton (2015) conducted a research study on "perception of using smart mobile devices in higher education teaching: a case study from Palestine". The main focus was to examine lecturers' views on the worth of incorporating smart mobile devices into their classroom. The findings showed that Participants were still actively experimenting with cell phones and iPads. They were excited about the educational profits of integrating these gadgets into their classroom activities such as formal and informal education venues by enabling learn anywhere, anytime.

opportunities. This was one of the most essential affordances. On the other hand, participants expressed their concerns about the unreliability and limited connection of Wi-Fi and 3G/4G networks in Palestine. This research study seeks to explore Engineering faculty member's perception of using mobile devices in higher education.

Additionally, Balliammanda (2021) conducted a related pilot study on "Perceptions of teachers on teaching and learning with mobile devices in higher education classrooms in Oman". The objective of the experimental study was to learn more about teachers' perspectives on the usage of mobile devices in universities such as phones, iPads, notes, tablets. Teachers were concerned about using mobile technology in the classroom, according to the report. It was found out that teachers were concerned that this adoption of such technology would to draw attention away from academic goals.

2.6 Research Studies Related to the Current Study

Iqbal and Bhatti (2020) conducted an exploration study titled "a qualitative exploration of teachers' perspective on smartphones usage in higher education in developing countries". The purpose of their study was to gather faculty opinions on the utilization of smartphones to promote learning at the tertiary level. The findings showed that mobile phones were considered excellent medium for extracurricular activity studying and contact with peers and students by faculty members. In addition, the study revealed that majority of respondents were hesitant of utilizing educational use of smartphones; there was lack of technical assistance, lack of training expertise besides experience; heavy workload with scarcity of time and lack of willingness aimed at adopting educational technology. However, this research study was limited to only usage of smartphones, with qualitative research approach in higher education institutions. Contrary, this research study focused on mobile learning tools in general, using quantitative research approach seeking perception of engineering faculty members in higher education.

Case et al., (2019) carried out a research about UAE's mobile learning case to examine factors that could affect mobile learning acceptance. Quantitative, qualitative research approach were used in a concurrent mixed methods design. Thirty-six faculty members were studied. The study found that most participants were late technology adopters. They reported that Mobile Learning is helpful for ubiquitous learning. The faculties also noted that mobile learning is more successful when aligned with local norms. Comparatively, the researcher used a descriptive study to discover the

perceptions of engineering faculties on the use of mobile devices in Bangladesh engineering universities.

Aljaloud, Billingsley, and Kwan (2019) conducted a research study on Saudi Arabian faculty use smartphone clicker apps to improve teacher-student interactions. The goal of the study was to determine what factors influence faculty members' choices to make use of a smartphone clicker technology to expand relationships between students and teachers in Saudi Arabian campus classrooms. A mixed-methods research approach was used. Thirty-three members from Computer Science department answered the survey, and fourteen of them took part in focus group discussions to express their opinions. Faculty members' exercise on how to correctly use a clicker application for smartphones in the classroom activities had a substantial impact proceeding their opinions of the app's helpfulness and the choice to use it, according to findings. The most important thing to note from as a result app developers and trainers for smartphone clickers must take note of these findings. take into account faculty members' perceptions of the technology's suitability as well as their willingness to create learning activities that encourage participation and engagement of students. Comparatively, the researcher used a descriptive to look into the opinions of engineering faculties on the usage of mobile devices including smartphones in Bangladesh engineering universities.

2.7 Literature Gap

This study is in response to the probable research areas Nikolopoulou (2020) pointed out in his research study that would be referred for future researchers. He suggested to the future researchers to investigate the perception of faculty members on use of mobile devices for classroom education pedagogy. The reviewed literature above cantered on mobile learning tools in schools and higher institutions of learning, no study has been mentioned regarding the perception of members in the engineering education. Therefore, the researcher seeks to add value in the literature by focusing on perceptions towards engineering education. Secondly, the research studies were conducted in different research locations where respondents may have different perceptions. This research study targeted engineering institutions of higher learning in Bangladesh to explore engineering faculty members' perception.

2.8 Conceptual Framework

Mobile learning has dominated the educational process at all levels and types in this technologically interconnected world. It is no longer optional to discuss its effectiveness; rather, it

has become a necessity. This spread is a result of interactive technologies that encourage students, faculty members, and parents to participate in and interact with the educational process (Shawky 2019).

CHAPTER THREE

Methodology

3.0 Introduction

This chapter presented the research methodology that was used in the study. It focused on the research design, population of the study, sample size and sampling technique, data collection instrument, validity and reliability of the instruments, data collection procedure, data analysis strategy and ethical issues. The purpose of these variables was to help in the investigation of the faculty members' perception of mobile device usage in engineering universities of Bangladesh.

3.1 Research Design

This study used a quantitative research design with a descriptive survey to investigate engineering faculty members' awareness of using mobile devices in universities. Creswell (2015) defines a research design as the overall plan for connecting conceptual and empirical research problems. It is a type of inquiry that gives precise instructions for research techniques. On the other hand, Beins and McCarthy (2012) explain that surveys are a norm of modern life, with pollsters examining our lives and social scientists revealing trends in attitudes and behavioural patterns. Based on this background, the researcher found the descriptive survey research approach a conducive approach to illuminate faculty members' perception of using ML tools in classroom learning during this pandemic period.

3.2 Population of the Study

The study population had been well-defined as the whole set of analysis or data Creswell (2015). The research was conducted out in five different engineering institutions in Bangladesh specifically IUT, BUET, BRAC University, North South University (NSU) and DUET with a population of 500 participants (faculty members). These universities were selected according to their engineering backgrounds and how accessible they were to the researchers. The population distribution was illustrated in Table 3.1 across departments (University websites 2021).

Table 3.1: Study Population Distribution

S/No	University	EEE		ME	CSE	CEE	Ch.E	MME	GCE	IPE	DA	Totals
1	IUT	45		33	34	25						156
2	BUET	28		30		28	28	30	30	30		204
3	BRAC	20			20						20	60
4	DUET	20		20	20	20						80
											TOTALS	**500**

***Table 1**: Study Population Distribution.*

Key: EEE-Electrical and Electronic Engineering, ME-Mechanical Engineering, CSE-Computer Science and Engineering, CEE- Civil and Environmental Engineering, Ch.E-Chemical Engineering, MME-Materials and Metallurgical Engineering, GCE-Glass and Ceramic engineering, IPE-Industrial and Production Engineering, DA-Department of Architecture. Though TVE and Electrical and Computer Engineering ECE departments were included in this study later on.

3.3 Sample Size and Sampling Technique

A stratified sampling method was employed to survey the engineering faculty members. This method involved strategically selecting respondents from each group and the research goal was to assess the perception and views of the respondents. The sampling technique was based on the Krejcie and Morgan (1970) table which stipulates that a total of 500 respondents requires a sample size of 217 respondents (Nikolopoulou et al. 2021).

Table 3. 2: Showing the sample and their characteristics

S/No	Department	Female	Male	Totals
1	EEE	4	35	39
2	ME	8	20	28
3	CSE	3	50	53
4	CEE	5	8	13
5	Ch.E.	1	5	6
6	MME	2	5	7
7	GCE	2	4	6
8	IPE	2	5	7
9	DA	1	7	8
10	TVE	1	9	10
11	ECE	0	7	7
	Total	**29**	**155**	**184**

***Table 2** : Sample, there characteristics and the department*

3.4 Data Collection Method

In order to access the respondents, permission was obtained by sending a formal request to the head of the respective Departments using e-mail including the study's objective and data collecting guidelines and the time required for respondents. After permission was granted a questionnaire was sent to the respondents through their e-mail addresses. The researcher obtained the e-mail addresses of the respondents either from the Heads of Departments or from the institution websites if available. Two weeks were allocated to respondents in which to answer. The questionnaires was sent online which offered a simple and faster method of data collection (Darmaji et al. 2019; Domingo and Garganté 2016). The online MLRS was distributed to the target population of 500 for a sample size of 217 according to (Krejcie and Morgan 1970). However, the response was 184(36.8%).

3.5 Data Collection Instrument

In pursuit of assessing the readiness of engineering faculty members about what they perceive of the usage of mobile devices for classroom instruction such as mobile phones, tablets and note books, there is critical need to identify an instrument that is suitable for measuring effective teaching and learning. Such instrument needs valuation of faculty members' willingness and their readiness to adopt mobile education for their students. This research study requires such an

instrument to explore the engineering faculty members' perception of using mobile devices in the higher institutions of education. The researcher therefore selected Mobile Learning Readiness Survey (MLRS) as suitable for this research study. MLRS is characterized by four factors namely; 1- possibilities, 2- benefits, 3- preference, and 4- external influences. The researcher adopted all of them with multidimensional scaling by validating associated items and their reliability in order to investigate the relationships between the factors. The proprietors of the MLRS instrument Christensen and Knezek (2017) demonstrated that the instrument possesses required psychometric properties of undisputable consistency, content validity index, which make It a valuable resource for technology integration research and professional growth.. Against this background, the researcher believes MLRS is the most suitable for this research study.

It has four factors namely; Factor 1: is related to future possibilities (Possibilities) with 6 items; Factor 2; improve classroom instruction (Benefits) with 13 items; Factor 3 is related to mobile device preferences (Preferences) with 3items, and Factor 4 is related to the environment/context (External Influences) with 6 items.

The survey is divided in to five sections: Section A seeks to acquire details on the characteristics of faculty members (demographic data) including gender, age, teaching experience, department. Section B contains Mobile Learning Readiness Survey (MLRS) statements/items on future possibilities (FP). Section C contains MLRS items on benefits (BN). Section D contains MLRS items on mobile device preferences (MDP). Section E contains MLRS items on external influence (EI). All the items were measured on the 5 Likert Scale of 1 to 5 points: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD).

The MLRS was given to 1430 educators in the USA and found to be reliable (Cronbach's alpha). 92 for all items; MLRS developers suggested this instrument to identify and measure mobile learning attributes. (Nikolopoulou et al. 2020). (See Appendix I)

3.6 **Validity and Reliability of the Instrument**

3.6.1 **Validity of the instrument**

Validity is described as the extent to which the research instrument used for data collection method accurately measures what it is meant to measure on how relevant research findings are claimed to be about Creswell (2015). The validity of the questionnaire of this research study was obtained by discussing it with my supervisor for ratification in view of content validity and submitting it to three independent validators in the department of TVE in IUT determined by expert judgment. The

total number of items presented to the validators were 28 and all the items of the constructs were subjected to the validators. The questionnaire's validity was determined and calculated via using the Content Validity Index (CVI). The instrument became valid when the CVI was 0.6 and above Creswell (2015).

3.6.2 Reliability of the Instrument

Reliability of the instrument refers to the extent to which a data collection instrument yields consistent results Singh (2007). The researcher pre-tested the instrument on 100 engineering faculty members during pilot study. The items used to measure reliability excluded demographic variables; age, sex, teaching experience and department. Cronbach's Alpha as used in SPSS to assess the reliability of the items in the questionnaire. The instrument became valid when the reliability is 0.7 and above (Christensen and Knezek 2017; Creswell 2015).

3.7 Data Analysis Strategy

Data was analysed using the Statistical Package for the Social Sciences (SPSS) version 21. It was analysed by presenting descriptive statistics variables of mean and standard deviation, frequencies and percentages across the four factors of benefits (BN), future possibilities (FP), mobile device preference (MDP) and external influences (EI). In addition, pie charts were used for analysing demographic data representation (Santos, Bocheco, and Habak 2018; Shodipe and Ohanu 2020; Soffer and Yaron 2017).

3.8 Ethical Issues

In order to adhere to ethical issues throughout the procedure of data collection and analysis, the researcher required permission from the academic heads of departments and consent from respondents. The objectives of the study and the purpose of findings were explained towards the respondents. Respondents were not required to write their names and those of their institutions anywhere on the instrument. The researcher provided the respondents the option to terminate the study at any time without any inconvenience or effect. The researcher ensured honesty in reporting the research findings and guarding against plagiarism, where reference was made to other people’s work and sources acknowledged.

CHAPTER FOUR

Data Presentation, Analysis and Discussion of Findings

4.1 Introduction

This chapter presents and analyses the data obtained from the field. The findings of the research study are also discussed and interpretations provided. The study's goal was to investigate faculty members' perception of using Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh.

The study aimed to answer these questions:

1. How do faculty members perceive the benefits of using mobile devices as learning tools in engineering education?
2. What are the faculty members' perceptions of the future prospects of using mobile devices as learning tools in engineering education?
3. What are the faculty members' preferences of mobile devices as their most effective tools in engineering education?
4. What are the external factors that influence the use of mobile devices in engineering education?

4.2 Pilot test and reliability and validity

The researcher tested the instrument through pilot study on 100 respondents. The purpose of the pilot study was to test the content validity and reliability of the research instrument in preparation of the research study. In regard to the content validity, the researcher submitted 28 items of the instrument to 3 validators including the supervisor. Out of the 28 items across the four factors, 4 items were rephrased and 2 were replaced. This resulted into 22 valid items plus 6 items that were adjusted after the validity exercise. When the Content Validity Index was calculated, it was found to be 0.786 (22/28*100) which implied that the instrument was valid and acceptable for the research study (Creswell 2015) .

In addition, the researcher tested the Cronbach's alpha reliability of the 28 items for the four factors using SPSS version 21. The purpose of the reliability test was to check the internal consistency among the items within the four factors. The summary of the total reliability of all the 28 items was demonstrated in table 4.1:

Table 4.1 showing the summary of the total reliability of all the 28 items

Domain/Factors	Number of Items	Mean	SD	Cronbach Alpha
BN	13	2.408	7.89	.83
MDP	3	3.09	3.57	.83
FP	6	2.065	4.07	.71
EI	6	2.302	3.56	.60
TOTAL	**28**	**2.385**	**15.77**	**.90**

***Table 3**: Showing the summary of the total reliability of all the 28 items*

It was therefore concluded that the Cronbach's alpha of internal consistency was above 0.7 Creswell (2015) which implied that the instrument was reliable and valid for the research study.

Table 4.1 shows the internal consistency reliabilities of four factors generated by this Mobile Learning Readiness Survey (MLRS) for this collection of data. As stated by (DeVellis's, 2017; Christensen and Knezek, 2017) that the general rule of acceptance is that 0.6-0.7 reliability shows acceptable reliability, and 0.8 or higher is very reliable. Thus, the overall Cronbach alpha for all the items is .90 which is most reliable with the least Cronbach alpha as 0.6 for External Influences (EI) which falls within the acceptance level.

4.3 DATA PRESENTATION ON DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

4.3.1 Data Presentation on Gender

The study sought to ascertain the demographic characteristics of respondents that participated in the study regarding the gender, teaching experience, age bracket and department. Kothari (2004) states that the demographic characteristics point at the respondent's suitability in responding to the questions on variables under study.

Table 4.2: The distribution of respondents according to Gender

Data on gender was collected using an online questionnaire filled by the participants and the findings were as follows;

Gender	Frequency	Percent
Male	154	83.7
Female	30	16.3
Total	**184**	**100.0**

***Table 4**: The distribution of respondents according to Gender*

The table 4.2 and figure 1 above show that out of 184 faculty members, more of the respondents in this study were males [154 (83.7%)], followed by females [30 (16.3%)]. It was found that male participants were more than female participants which was perceived that there are more male faculties in engineering universities in Bangladesh than female faculties.

4.3.2 Data Presentation on teaching experience

Data on teaching experience was collected using an online questionnaire filled by the participants and the findings were as follows as shown in the table 4.3;

Table 4.3: The distribution of respondents according to teaching experience

Teaching Experience	Frequency	Percent
1-5 years	96	52.2
6-10 years	41	22.3
11-15 years	28	15.2
16 years and above	19	10.3
Total	**184**	**100.0**

***Table 5**: The distribution of respondents according to teaching experience.*

The findings in the table 4.3 and figure 2 above show that the highest number of respondents involved in the study were within the bracket of 1-5 years of teaching experience [96 (52.2%)], and faculties within 6-10 years of experience were 41(22.3%). In addition, the study showed that faculties between 11-15 years of experience were 28 (15.2%) whereas faculties with 16 years and above teaching experience were 19 (10.3%). The study found that the faculties within the five years of experience as a teacher are believed to youth and more interested in the use of mobile devices in the classroom than the rest of the generations.

4.3.3 **Data Presentation on Age Bracket**

Data on age bracket was collected using an online questionnaire filled by the participants and the findings were as follows as shown in the table 4.4;

Table 4.4: The distribution of respondents according to Age bracket

Age Bracket	Frequency	Percent
25-30	90	48.9
30-35	40	21.7
35-40	27	14.7
40 and above	27	14.7
Total	**184**	**100.0**

Table 6*: The distribution of respondents according to Age bracket.*

The findings in the table 4.4 and figure 3 above show that the highest number of faculties involved in the study were within the bracket of 25-30 years [90 (48.9%)]. This was followed by faculties within 30-35 years represented by [40 (21.7%)], followed by 35-40 years represented by [27 (14.7%)]. In addition, faculties with 40 years and above were [27 (14.7%)]. The study findings perceived that the faculties within 20-30 years of age are believed to be interested in accessing and using mobile devices than the rest of the faculties. This may imply that in the recent recruitment of engineering faculties across universities in Bangladesh, the youth have been preferable for employment according to the technological trend.

4.3.4 **Data Presentation on Department**

Data on department was also collected using an online questionnaire filled by the participants and the findings have been shown in the table 4.5;

Table 4.5: The distribution of respondents according to Department

Department	Frequency	Percent
CSE	53	28.8
EEE	39	21.2
ME	28	15.2
TVE	10	5.4
CEE	13	7.1
MME	7	3.8
IPE	7	3.8
ECE	7	3.8
DA	8	4.3
GCE	6	3.2
Ch.E.	6	3.2
Total	**184**	**100.0**

Table 7*: The distribution of respondents according to Department.*

The result in the table 4.5 and figure 4 above show that the highest number of faculties involved in the study were predominantly from Computer Science and Engineering (CSE) [53 (28.8%)] department across the universities. This was followed by faculties from the Electrical and Electronic Engineering (EEE) department with [39 (21.2%)], followed by faculties from the Mechanical Engineering (ME) department with [28 (15.2%)], followed by faculties from the Technical and Vocational Education (TVE) department with [10 (5.4%)], followed by the faculties from the Civil and Environmental Engineering (CEE) department with [13 (7.1%)], followed by the faculties from the Department of Architecture (DA) with [8 (4.3%)]. The faculties from the Departments of Materials and Metallurgical Engineering (MME), Electrical and Computer Engineering (ECE) and the Industrial and Production Engineering (IPE) were represented by [7 (3.8%)] in the study, followed by the department of Glass and Ceramic engineering (GCE) with [6 (3.2%)] in the study. In addition, the faculties from the Department of Chemical Engineering (Ch.E.) with the lowest participants with [6 (3.2%)]. The researcher found that the faculties from the CSE department topped the study, implying that they were more interested in using classroom with mobile devices than the rest of the faculties in the other engineering universities studied.

4.4 PRESENTATION AND FINDINGS ON THE RESEARCH QUESTIONS

The research questions investigated the use of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh: Faculty Members' Perception. The data was obtained by

use of adapted questionnaire from the engineering faculty members. As per the research design, the researcher computed and presented the findings by total mean score and standard deviation, frequencies and percentages were also used to present and analyse findings.

4.4.1: HOW DO FACULTY MEMBERS PERCIEVE THE BENEFITS OF USING MOBILE DEVICES AS LEARNING TOOLS IN ENGINEERING EDUCATION?

Thirteen (13) items were used to answer this question, with the aim of assessing faculty members' perspectives of the benefits of learning on mobile devices at Bangladesh engineering universities. The descriptive statistics results were presented and analysed using SPSS version 21 using frequencies, and percentages, mean and standard deviation.

4.4.1 (i): Findings on the Descriptive Statistics using Frequency and Percentage

The researcher presented findings on the descriptive statistics using frequency and percentage as illustrated in the Table 4.6 across the 13 items of the benefits (BN). The findings have presented in the combined format (Agree (4) and Strongly Agree (5), then Disagree (2) and Strongly Disagree (1), Undecided (3) has been presented independently).

Table 4.6: Showing faculty members' perception of the benefits of using mobile devices as learning tools in engineering education.

Items	SA%	A%	UN%	D%	SD%
BN1: Mobile technology can play an important role in higher education.	21.2(39)	47.3(87)	21.7(40)	8.2(15)	1.6(3)
BN2: Mobile technology can be used to improve 21st-century teaching skills.	42.4(78)	38.6(72)	13.0(24)	3.8(7)	1.6(3)
BN3: Mobile technology can enhance learning if there adequate support for teachers	32.6(60)	53.8(99)	10.9(20)	1.6(3)	1.1(2)
BN4: Mobile technology can be used to improved traditional literacy programs.	27.7(51)	42.9(79)	15.2(28)	12.5(23)	1.6(3)
BN5: Technology can be used to level the playing field for special needs students.	32.1(59)	41.8(77)	18.5(34)	3.3(6)	4.3(8)
BN6: The use of mobile technology in the online classroom increases student participation in classroom discussions.	22.8(42)	29.3(54)	14.1(26)	25.5(47)	8.2(15)
BN7: The use of mobile devices in the online classroom allows students to work together more often.	20.1(37)	29.3(54)	19.0(35)	23.9(44)	7.6(14)
BN8: The use of mobile technology in the online classroom allows students to own their learning.	20.1(37)	45.1(83)	21.7(40)	11.4(21)	1.6(3)

BN9: The use of mobile technology in the online classroom increases student engagement.	20.7(38)	31.5(58)	18.5(34)	23.9(44)	5.4(10)
BN10: The use of mobile technology in the online classroom allows students to develop creativity.	16.8(31)	35.3(66)	29.3(54)	13.6(25)	4.3(8)
BN11: The use of mobile technology in the online classroom makes students more motivated to learn.	15.2(28)	39.7(73)	23.9(44)	15.8(29)	5.4(10)
BN12: Mobile technology should be used to connect learners to people, content, and resources.	32.1(59)	48.4(89)	11.4(21)	6.0(11)	2.2(4)
BN13: Having a mobile device would improve student organization.	18.5(34)	45.1(83)	20.7(38)	10.9(20)	4.9(9)

Table 8*: Showing the frequency and percentage of the faculty members' perception of the benefits of using mobile devices as learning tools in engineering education.*

Table 4.6 summarizes engineering faculty responses across thirteen items on the benefits (BN) of using mobile devices as educational resources in Bangladeshi engineering universities. Majority of faculty members [86.4 % (159)] strongly believe that mobile technology devices used as learning tools in engineering education would be of great benefit in enhancing learning if teachers are adequately supported, while [12.5% (23) disagree. This finding is consistent with the findings of the Serhan (2020) study, which discovered that many universities were attempting to be more prepared for the fall 2020 semester by providing staff and faculty members with training workshops on the use of various technologies, teaching, and assessment.

Furthermore, [81% (150)] faculty members firmly perceive that the use of mobile technology devices as learning tools like smartphones, tablets, etc. will be beneficial in improving 21st-century teaching skills, while [13% (24)] undecided and [5.4% (10)] disagree. This finding is consistent with a study by Liesa-Orús et al., (2020) titled professors' perceptions of ICT tools for teaching the 21st century, in which it was discovered that ICT technologies are at the core of the skills demanded in the 21st century. As a result, it has been suggested that that educational activities provided through these technology tools be complemented with an investment in the 21st century skills like critical thinking, problem-solving, communication and teamwork.

Additionally, [80.5 % (148)] faculty members believe that using mobile phones, tablets, and other mobile devices as learning tools will be a cutting-edge connecting learner to people, content, and resources, whereas [11.4 % (21)] were undecided and [8.2 % (14)] disagreed. According to the findings of Ott et al., (2018), students who use mobile phones as learning tools help them with their schoolwork, but they must strike a balance between their usage and the teachers' arbitrary

enforcement. As a result, mobile phones are increasingly becoming a learning resource for students.

However, faculty members least perceived [67.9% (125)] that utilizing mobile technology policies as learning aids will be of benefit in allowing them to be better organized in teaching, [21.2% (39)] of the faculty members were undecided and [10.9% (20)] disagreed that using mobile devices will necessarily allow them to be better organized in teaching.

4.4.1 (ii): **Findings on the Descriptive Statistics using mean and standard deviation.**

As shown in Table 4.7, the researcher presented the findings based on descriptive statistics using mean and standard deviation for each of the thirteen benefits of using mobile devices.

Table 4.7: Showing faculty members' perception of the benefits of using mobile devices as learning tools in engineering education.

	N	Mean	Std. Deviation
Mobile technology can be used to improve 21st-century teaching skills.	184	4.16	5.29
Mobile technology can enhance learning if there is adequate support for teachers.	184	4.15	6.02
Mobile technology should be used to connect learners to people, content, and resources.	184	4.02	5.08
Technology can be used to level the playing field for special needs students.	184	3.94	5.10
Mobile technology can be used to improve traditional literacy programs.	184	3.82	4.30
Mobile technology can play an important role in higher education.	184	3.78	4.76
The use of mobile technology in the online classroom allows students to own their learning.	184	3.70	4.39
Having a mobile device would improve student organization.	184	3.61	4.18
The use of mobile technology in the online classroom allows students to develop creativity.	184	3.47	3.42
The use of mobile technology in the online classroom makes students more motivated to learn.	184	3.43	3.48
The use of mobile technology in the online classroom increases student engagement.	184	3.38	2.61
The use of mobile technology in the online classroom increases student participation in classroom discussions.	184	3.33	2.35

The use of mobile devices in the online classroom allows students to work together more often.	184	3.30	2.18

Table 9: *Showing the mean and standard deviation of the faculty members' perception of the benefits of using mobile devices as learning tools in engineering education.*

In Table 4.7, The engineering faculty members who participated in the study perceived that mobile technologies are thought to be used as learning aids in engineering education would be of great benefit in improving the 21st century teaching skills (M= 4.16: SD= 5.29). This was followed by their perception that such mobile technology devices can be of benefit in enhancing learning if there is sufficient sustenance for faculty members (M= 4.15: SD= 6.02). Additionally, the faculty members who participated in the study perceived that mobile technology devices should be beneficially connecting people, material, and resources to learners (M= 4.02: SD=5.08).

The researcher discovered that faculty members perceived that the use of mobile technology tools there are benefits of connecting people, material, and resources to learners (M= 4.02: SD= 5.08). This was supported by the findings of Nikolopoulou (2020) in which he revealed that mobile devices have many benefits such as the facilitation of informal and formal learning. However, he explained that this comes with the challenge where by smart/mobile phones have been seen more as distracters in the classroom rather than learning aids.

The researcher also discovered that engineering faculty members believed that for students with special needs, mobile technology can help level the playing field. (M= 3.94: SD= 5.10). This finding is related to the study conducted by Maher and Young (2017) titled the use of mobile devices to support young people with Disabilities and it was found out that mobile devices provide a variety of communication capabilities for special needs students or students with a physical disability to interact with their faculty members and peers through social networking sites, video conferencing systems, discussion forums, email, and web-based message boards. In a study conducted by Tolorunleke (2021) about special needs students use mobile devices to learn and recommended students with special needs to use assistive mobile tech for learning more frequently.

Engineering faculty member who participated in the perceived that mobile technology can be applied to traditional literacy programs to improve them (M= 3.82: SD =4.30). In related study conducted by (Mohammadi et al. 2020) on mobile phone use in education and learning by

technical-engineering faculty . It was found out that mobile phones have several advantages as a teaching aid, such as increasing individualism in teaching-learning hence playing a great role in improving the traditional literacy programs.

Additionally, in the Table 4.7, it was discovered that the engineering faculty members who participated in the study perceived that there are minimal benefits to using mobile technology to increase student participation in classroom discussions. (M=3.33: SD= 2.35). However, in the study conducted by Khan et al., (2017) about engaging students to maximize online learning, it was found out that classroom discussions boost student engagement and critical thinking. With further advantages of better communication abilities. In addition, Maddix (2012) believes that online discussion success affects online course effectiveness .

Engineering faculty members also perceived that there are minimal benefits of allowing students to work together more often when using mobile devices (M= 3.30: SD= 2.18). This conclusion is contradictory to the perception of Khan et al., (2017) in which they believe that fostering a collaborative learning environment where students from many fields, nationalities, and ethnicities can work together is vital.

4.4.2: WHAT ARE THE FACULTY MEMBERS' PERCEPTION OF THE FUTURE PROSPECTS OF USING MOBILE DEVICES AS LEARNING TOOLS IN ENGINEERING EDUCATION?

This question was answered by six (6) items that sought to assess the faculty members' perceptions of the future prospects of using mobile devices in engineering universities in Bangladesh as learning tools. The findings were presented and analyzed using mean and standard deviation, frequencies and percentages run through SPSS version 21.

4.4.2 (i): Findings on the Descriptive Statistics using Frequency and Percentage

The researcher presented findings on the descriptive statistics using frequency and percentage as illustrated in the Table 4.8 across the six items of the future possibilities (FP). The findings have presented in the combined format (Agree and Strongly Agree, then Disagree and Strongly Disagree, Undecided has been presented independently).

Table 4.8: Showing faculty members' perception of the future prospects of using mobile devices as learning tools in engineering education.

Items	SA%	A%	UN%	D%	SD%
FP1: Mobile learning will bring new learning opportunities.	43.5(80)	47.8(88)	7.1(13)	1.1(2)	0.5(1)
FP2: Mobile learning will increase the flexibility of learning.	40.8(75)	44.0(81)	7.6(14)	5.4(10)	2.2(4)
FP3: Mobile learning will improve communication between students and teachers.	31.0(57)	42.4(78)	12.5(23)	12.0(22)	2.2(4)
FP4: Mobile technology will improve communication between students.	32.1(59)	47.8(88)	10.3(19)	5.4(10)	3.8(7)
FP5: Using mobile devices will allow me to be better organized in teaching.	25.5(47)	42.4(78)	21.2(39)	9.8(18)	1.1(2)
FP6: Using a mobile device will help me be better organized in my daily activities	36.4(67)	35.9(66)	17.9(33)	7.1(13)	2.7(5)

***Table 10**: Showing the frequency and percentage of the faculty members' perception of the future prospects of using mobile devices as learning tools in engineering education.*

Table 4.8 summarizes the responses of the engineering faculties across six items on the future possibilities (FP). It was found that majority of the faculty members [91.3% (168)] perceive that the use of mobile devices as educational resources like smartphones, tablets etc. will bring new learning opportunities in future. This result accords with the research conducted by Sattarov and Khaitova (2019) titled mobile learning as new forms and methods for enhancing educational effectiveness in which they found out that in order to implement mobile learning strategies, forms, and methods, organizational research, and methodological work is required. Furthermore, [84.8% (156)] of the faculty members perceive that mobile learning will increase the flexibility of learning. This echoes the study findings conducted by El-Sofany and El-Haggar (2020) about the efficiency with which mobile learning strategies can be used to improve learning results in higher education and they found out that mobile technology for e-learning improves students' concentration, flexible access to mobile technology skills and learning materials . However, faculty members least perceived [67.9% (125)] that using mobile devices will allow them to be better organized in teaching. Moreover, [21.2% (39)] of the faculty members were undecided and [10.9% (20)] disagreed that using mobile devices will necessarily allow them to be better organized in teaching.

Therefore, the biggest percentage of the engineering faculty members agreed that mobile learning will bring new learning opportunities in Bangladesh. These findings were related to the quantitative study conducted by Kadwa and Alshenqeeti (2020) where by Most faculty members

considered smartphones as effective tools for teaching vocabulary. Ease of use, learning through game applications and exposure to foreign language cited as key benefits. These benefits would lead to creation of more new learning opportunities.

4.4.2 (ii): **Findings on the Descriptive Statistics using mean and standard deviation.**

The researcher presented findings on the descriptive statistics using mean and standard deviation as illustrated in the Table 4.9 across the six items of the future possibilities (FP).

Table 4.9: Showing faculty members' perception of the future prospects of using mobile devices as learning tools in engineering education.

Items	N	Mean	Std. Deviation
Mobile learning will bring new learning opportunities.	184	4.32	6.42
Mobile learning will increase the flexibility of learning.	184	4.16	5.59
Mobile technology will improve communication between students and teachers.	184	3.88	4.42
Mobile technology will improve communication between students.	184	4.0	5.27
Using a mobile device will allow me to be better organized in teaching.	184	3.81	4.29
Using a mobile device will help me be better organized in my daily activities.	184	3.96	4.28

***Table 11**: Showing the mean and standard deviation faculty members' perception of the future prospects of using mobile devices as learning tools in engineering education.*

According to the Table 4.9 the study revealed the distribution of total mean scores with the anchor point (> 3.0) indicating that engineering faculty members perceive that future prospects of mobile devices as learning tools will bring new learning opportunities. (M= 4.32: SD= 6.42). Also, it was discovered faculties perceive that mobile learning will rise the flexibility of learning. (M= 4.16: SD= 5.59). It was discovered that faculty members perceive future prospects of mobile devices as tools used in learning will help to improve communication between students (M= 4.0: SD= 5.27). In another development, engineering faculty members perceive that in future, mobile devices will aid them to become more organized in their daily activities (M= 3.96: SD= 4.28) However, the researcher found out that engineering faculty members least perceived that the future prospects of

mobile devices as learning tools will help students and faculty members communicate better. (M= 3.88: SD= 4.42) and also least perceived that mobile devices will enable them to be better organized in teaching. (M= 3.81: SD= 4.29).

The most perception of mobile devices in increasing flexibility and bringing new learning opportunities was similar to the study conducted by Iqbal and Bhatti (2020) in which they discovered that the most respondents were skeptical of smartphone education. They saw them as a source of diversion, time waste, technological stress, and sensitive alienation. Insufficient training and assistance, as well as a lack of technical expertise and experience were major barriers in adoption. On the contrary, Dashtestani (2016) conducted a related study on how Iranian students learn English on mobile devices (EFL) and it was discovered that the that implementation of mobile learning would expand EFL learning opportunities in Iran.

4.4.3 WHAT ARE THE FACULTY MEMBERS' PREFERENCES OF USING MOBILE DEVICES AS THEIR MOST EFFECTIVE TOOLS IN ENGINEERING EDUCATION?

Three (3) items were used to answer this question, with the purpose of assessing faculty members' preferences of mobile devices as their most effective tools in engineering education in Bangladesh. The results were presented and analyzed using SPSS version 21 using mean and standard deviation, frequencies, and percentages.

4.4.3 (i): Findings on the Descriptive Statistics using Frequency and Percentage

As shown in Table 5.0, the researcher presented findings on descriptive statistics utilizing frequency and percentage across the three items of mobile device preferences (MDP). The results have been given in a combined format (Agree and Strongly Agree, then Disagree and Strongly Disagree, Undecided has been presented independently).

Table 5.0: Showing faculty members' perception of mobile device preferences as their most effective tools in engineering education.

Items	SA%	A%	UN%	D%	SD%
MDP2: I prefer to use an electronic textbook rather than a traditional textbook.	21.7(40)	28.8(53)	9.8(18)	25.5(47)	14.1(26)
MDP1: I prefer to read a book on a mobile device e.g. smartphone, tablet or notebook rather than a traditional book.	21.7(40)	28.3(52)	7.1(13)	25.5(47)	17.4(32)
MDP3: I prefer to use a mobile device e.g. smartphone, tablet or notebook rather than a desktop computer for teaching.	19.0(35)	22.8(42)	13.0(24)	32.1(59)	13.0(24)

***Table 12**: Showing the frequency and percentage of the faculty members' perception of using mobile device preferences as their most effective tools in engineering education.*

Table 5.0 summarizes the responses of the engineering faculties across 3 items on preferences of using mobile devices as their most effective tools in engineering education. It was found out that the majority of the faculty members [50.5% (93)] prefer to use an electronic textbook rather than a traditional textbook. On the other hand, they mentioned that [50% (92)] they prefer to read a book on a mobile device rather than a traditional book. However, majority [45% (83)] of them do not prefer to use a mobile device as an effective tool rather than a desktop computer for teaching.

According to these findings, a similar study was conducted by Guma et al., (2017) about Muni University's mobile learning program in Uganda. The study collected responses from students on mobile learning. It was recommended that students and lecturers should be allowed to utilize mobile devices to create virtual classrooms, discussion forums, and use pre-recorded lectures with PowerPoint. According to this study, the researchers concluded that it is becoming increasingly impossible to dismiss the advantages of using mobile devices. Such advantages include data storage, access to data, device mobility, and social media use.

4.4.3 (ii): **Findings on the Descriptive Statistics using mean and standard deviation.**

As shown in Table 5,1 the researcher reported the findings based on descriptive statistics utilizing mean and standard deviation for each of the three items of the mobile device preferences (MDP).

Table 5.1: Showing faculty members' perception of the mobile device preferences as their most effective tools in engineering education.

Items	N	Mean	Std. Deviation
I prefer to use an electronic textbook rather than a traditional textbook.	184	3.81	2.33
I prefer to read a book on a mobile device e.g. smartphone, tablet or notebook rather than a traditional book.	184	3.11	2.26
I prefer to use a mobile device e.g. smartphone, tablet or notebook rather than a desktop computer for teaching.	184	3.02	2.15

Table 13*: Showing the mean and standard deviation of the faculty members' perception of the mobile device preferences as their most effective tools in engineering education.*

In Table 5.1, the engineering faculty members who participated in the study revealed that they mostly prefer to use electronic textbook as their effective teaching tool rather than a traditional textbook in engineering education [(M= 3.81: SD= 2.33)]. However the study conducted by Andrew and Grange (2018) in two university campuses in the UAE discovered the contrary whereby in their findings, students' attitude towards technology and their choices for learning devices on both campuses were favorable about using technology in the classroom, however, tablets and phones were the least popular options among some students who chose them for specific purposes. They therefore preferred the combination of traditional books and technological devices (e.g., computers, smartphones etc.) as learning techniques.

Additionally, in their responses, faculty members revealed that they prefer to read an electronic textbook instead of a traditional textbook [(M=3.11: SD= 2.26)]. These findings was in agreement with the study was conducted by Gu, Wu, and Xu (2015) regarding the benefits of using e-Textbooks as well as the many factors that influence their use. The study recommended that researchers need to investigate more into the pedagogical design of e-Books and their functions to aid learning need to be evaluated further.

Although it was their least response [(M= 3.02: SD= 2.15)] compared to the above responses in Table 5, faculty members prefer using a mobile device e.g. smartphones, tablets, notebooks etc. as a teaching tool rather than a desktop computer for learning. In contrary, Kaliisa, Palmer, and Miller (2019) conducted a related study comparing developed and developing country mobile learning context. According to the study, it was discovered that students preferred computers to smartphones or other portable devices for mobile learning. It was suggested that for integration of

mobile pedagogy in higher education effective, faculty members and mobile curriculum creators must consider providing training and mobile content that is compatible with the most common devices.

4.4.4 WHAT ARE THE EXTERNAL FACTORS THAT INFLUENCE THE USE OF MOBILE DEVICES IN ENGINEERING EDUCATION?

This question was answered by six (6) items designed to measure faculty members' perspectives of external variables (EI) influencing the mobile learning in engineering education in Bangladesh institutions of higher learning. The results were presented and analyzed using SPSS version 21 using mean and standard deviation, frequencies, and percentages.

4.4.4 (i): Findings on the Descriptive Statistics using Frequency and Percentage

As shown in Table 5.2, the researcher presented findings on descriptive statistics utilizing frequency and percentage across the six items of external influences (EI). The results have been given in a combined format (Agree and Strongly Agree, then Disagree and Strongly Disagree, Undecided has been presented independently).

Table 5.2: Showing the external factors that influence the use of mobile devices in engineering education.

Items	SA%	A%	UN%	D%	SD%
EI1: My curriculum is conducive to students having their own technology.	18.5(34)	52.7(97)	14.7(27)	11.4(21)	2.7(5)
EI2: My administration is supportive of students having their own device.	15.8(29)	53.3(98)	19.0(35)	8.7(16)	3.3(6)
EI3: My university is doing a good job of using technology to enhance learning.	24.5(45)	57.6(106)	12.5(23)	3.8(7)	1.6(3)
EI4: My campus technical infrastructure and wireless network can accommodate students bringing their own technology.	22.8(42)	54.3(100)	15.8(29)	4.3(8)	2.7(5)
EI5: students are more knowledgeable than I am when it comes to using mobile technologies.	17.9(33)	39.7(73)	19.0(35)	15.2(28)	8.2(15)
EI6: Mobile technology would introduce a significant distraction in my classroom.	23.4(43)	35.9(66)	22.3(41)	12.5(23)	6.0(11)

***Table 14**: Showing the frequency and percentage of the external factors that influence the use of mobile devices in engineering education.*

Table 5.2 summarizes the responses of the engineering faculty members across the six items on the perception of the external factors that influence utilization of mobile devices in engineering

education in Bangladesh high institutions. It was discovered that the majority of the faculty members [82.1% (151)] strongly agreed that their schools are utilizing technology to their full potential to improve education which influences the use of mobile devices in engineering education and [5.4% (10)] disagree.

Furthermore, [77.1% (142)] of faculty members firmly approved that campus technical infrastructure and wireless networks can accept students who bring their own devices which influences mobile device use in engineering education with [15.8% (29)] undecided and [7% (13)] disagree. Anon (2018) conducted a study on digital infrastructure in higher education and it was found out that Wi-Fi and internet access are essential tools for today's students to enhance their learning and well-being. Institutions of higher learning must guarantee that they provide a high-quality digital environment that meets these and other organizational requirements. Therefore, institutions of higher education are required to address a number of issues, including the need for a comprehensive, scalable security infrastructure.

Additionally, [71.2 % (131)] faculty members agreed that their curriculum is conducive to students having their own technology whereas [14.7 % (27)] were undecided and [14.1 % (26)] disagreed.

However, [57.6% (106)] faculty members least agreed that students are more knowledgeable than them when it comes to using mobile technologies, [19% (35)] undecided and [23.4% (43)] disagree that students are more knowledgeable than them in using mobile devices will positively influence their use in engineering education. In the study conducted by Ngampornchai and Adams (2016) about Northeastern Thailand students' e-learning readiness. It was observed that many Thai students owned smartphones and laptops, whereas only 23 percent owned desktop computers. Students have access to basic software utilities and mostly use web browsing on the internet, communicating with collegues, and viewing YouTube videos. But had little knowledge of Wiki, forums, video chat, and blog technologies.

4.4.4 (ii): **Findings on the Descriptive Statistics using mean and standard deviation.**

As shown in Table 5.3, the researcher presented descriptive statistics findings using mean and standard deviation across the six items of the external influences (EI).

Table 5.3: Showing the external factors that influence the use of mobile devices in engineering education.

Items	N	Mean	Std. Deviation
My university is doing a good job of using technology to enhance learning	184	3.99	6.21
My campus technical infrastructure and wireless network can accommodate students bringing their own technology.	184	3.90	5.68
My curriculum is conducive to students having their own technology.	184	3.72	5.22
My administration is supportive of students having their own devices	184	3.69	5.32
Mobile technology would introduce a significant distraction in my classroom.	184	3.58	3.10
Students are more knowledgeable than I am when it comes to using mobile technologies.	184	3.44	3.20

Table 15: *Showing the mean and standard deviation of the external factors that influence the use of mobile devices in engineering education.*

In Table 5.3, the engineering faculty members who took part expressed the external factors that influence the use of mobile devices in engineering education. The highest mean [(M= 3.99: SD= 6.21)] of the faculty members believe that the university's practice of using technology to enhance learning is an external factor that influences them to use mobile devices for teaching. A related study conducted by Kebritchi, Lipschuetz, and Santiague (2017) examining a literature review on teaching online courses in higher education. . It was observed that universities play an important contribution to improvement of online education, and that these institutions must provide instructor training and development, technical training for students for development of online course material and delivery. Additionally, the mean of [(M=3.90: SD= 5.68)] of the faculty members mentioned that technical infrastructure and wireless network on campus, as external factors, can accommodate students who bring their own devices in classroom.

The average [(M= 3.72: SD= 5.22)] of the respondents also mentioned that the university curriculum, as an external factor, is favorable to students owning their own technology for learning. On the other hand, faculty members on the average mean of [(M= 3.69: SD= 5.32)]

indicated that the university administration, as an external factor is in favor of students having their own electronic devices.

However, among the least average mean [(M= 3.58: SD=3.10)] of the responses, it was reported that mobile technology, as an external factor, would introduce a significant distraction in the faculty members' classrooms. This finding is in line with observations of (Anshari et al., 2017; Nikolopoulou 2020) in which they urged that smart phones are seen as classroom distractions, not learning aids.

CHAPTER FIVE

5.1 Discussion of Findings

The discussion of the findings was based on the study's set questions, specifically on faculty members' perceptions of the benefits of using mobile devices, their perceptions of future prospects, their mobile device preferences, and external factors that influence the use of mobile devices.

5.1.1 Benefits of using mobile devices

The study's major findings discovered that if faculty members are adequately supported, mobile technology can help improve 21st-century teaching aids. while also enhancing learning. These findings indicate that the availability of mobile devices like smartphones, tablets, notebooks etc., if provided to the engineering faculty members can improve their skills in the classroom teaching. In this contemporary era of science and technology, engineering faculty members require adequate support from their respective universities and the government if they are to improve their teaching skills in their respective universities. For example, in the study conducted by Khlaif (2018) on K-12 teachers' perceptions of mobile technology adoption and acceptance in Palestine. It was discovered that insecurity and warfare had had a negative impact on the Palestinian educational system in a variety of ways. As a result of occurrence, the Palestinian Education Ministry gave tablets to rural schools in order to improve instruction and 4-subject learning outcomes. This would be advantageous if engineering faculty members at the five universities chosen for this study received such assistance.

However, the study findings revealed that engineering faculty members believe (based on low mean responses) that using mobile devices in the online classroom does not necessarily increase student participation in classroom discussions or allow students to work together more frequently. This was in their least rated mean and standard deviation. The researcher believes that this finding may support the idea that when students are provided with their own mobile devices, they may not necessarily require group classroom discussion as they have access to subject content on different sources for example internet knowledge, e-books and e-journals. This enhances individual learning. In contrary, in the study conducted by Khan et al., (2017) on online active learning maximizing student learning, it was found out that classroom discussions boost student engagement and critical thinking. With further advantages of better communication abilities. In

addition, Maddix (2012) believes that the success of online discussion largely influences the effectiveness of online courses.

5.1.2: Future prospects of using mobile devices

Faculty members strongly responded that the use mobile learning devices will bring new learning opportunities. The second highest ranked point was that mobile learning will boost learning flexibility. Dashtestani (2016), who did a parallel study about Iranian EFL students use mobile devices fearlessly, discovered similar findings (EFL). It was determined that using mobile learning in Iran environment will give students with additional learning chances. Similarly, this opportunity may as well apply to the faculty members in engineering education in Bangladesh. In contrary, the study conducted by Iqbal and Bhatti (2020) discovered that the most respondents were suspicious about smartphone education. Students measured them as a foundation of diversion, time waste, technological stress, and sensitive alienation. Adoption was hampered by a lack of training and assistance, as well as a lack of technical understanding and background. However, according to this study, using mobile devices allows engineering faculty members not only to diversify their teaching skills, but also to access different teaching platforms such as LMS, zoom link, google meet, google classroom, Moodle, blackboardLearn, coursera, and others.

Additionally, the use of such mobile devices promote research among faculty members.

The least ranked item by mean and standard deviation was that faculty members at the five institutions who took part in the survey believed that using mobile devices would not help them organize their classroom instruction better. The researcher is in support of the respondents' perception whereby methods, skills and techniques of teaching require classroom management, relevant curriculum, and course outline among others which may not necessarily reflect the type of mobile device required for organization in teaching.

5.1.3: Mobile Device Preference (MDP)

In regard to engineering faculty members' preference of using mobile devices, the study found that 50% of the faculty members prefer mostly to use an electronic textbook rather than a traditional textbook. Additionally, in their response, they indicated that they prefer to read a book on a mobile device e.g. smartphone, tablet or notebook rather than a traditional book. This finding explains that engineering faculty members prefer to access teaching materials, using their mobile devices, such as electronic books in addition to creating their own virtual classrooms, discussion forums, and accessing pre-recorded lectures Guma et al., (2017). The researcher believes that by

using mobile devices to access e-books and other related teaching materials, the engineering faculty members take advantage of avoiding storage issues of traditional books and monetary issues of purchasing costly traditional books. Additionally, by reading and using e-books, they are able to access latest editions for contemporary training.

5.1.4: External factors influencing the use of mobile devices

The engineering faculty members who were examined in the study revealed in their responses that their respective universities strongly support and promote the use of cutting-edge mobile technologies in teaching and learning. As a result, institutional policies strongly influence engineering faculty members to use mobile devices for teaching. This finding is related to the findings of Kebritchi, Lipschuetz, and Santiague (2017) when they investigated a literature review on online teaching in higher education. Higher education institutions were found to contribute part in improving the educators' professional development to upgrade of online education, training for students, and technical assistance for online course material creation and delivery. In addition to the external factors influencing mobile device use in engineering education, faculty members revealed that their universities provide technical infrastructure and Wi-Fi required to accommodate students who bring their own technology.

5.2 Implications of the study

5.2.1 Theoretical implication of the study

The theoretical implications of the study have been derived from the study findings. For example, engineering faculty members perceive that using the mobile learning devices will improve 21st-century teaching skills. This finding implicates that engineering faculty members will be compelled to apply mobile learning devices such as smartphones, tablets and notebooks if they are to achieve teaching and learning outcomes in engineering education. This would add not only to the body literature of using mobile learning devices but will also add value to the practice in the engineering classrooms. Additionally, the engineering faculty members perceive that mobile technology can be beneficial to enhance learning if there is sufficient assistance for faculty members. This finding informs the concerned administration in the selected engineering universities to provide adequate support to their faculty members as policy, in order to achieve outcome-based education (OBE) in Bangladesh.

On the other hand, engineering faculty members, did not rate strongly agree that technology can help level the playing field for students with special needs. The implication is that students with special needs such as the disabled, students with autism, physical difficulties like arthritis, students with visual or hearing impairments etc. will not have due consideration in engineering education. In contrary, the researcher believes that such students need learning support with the use of mobile learning devices.

Furthermore, engineering faculty members rated strongly agreed that mobile learning will increase the flexibility of learning. This implies that the selected universities are expected to promote flexibility in teaching by allowing different forms of teaching methodologies such as blended learning.

Engineering faculty members responded that they prefer to read a book on a mobile device e.g. smartphone, tablet or notebook rather than a traditional book. This finding informs the selected universities to formulate policies that provide faculty members with preferred mobile devices as well as e-resources such as e-libraries to enhance their contemporary teaching knowledge.

Moreover, engineering faculty members responded that using mobile technology would announce a weighty distraction in their classroom. That would happen in circumstances where such universities do not have policies of managing technology use in their universities. The researcher believes that the distractions can be controlled if there are regulations and laws governing the use of mobile technology in classroom teaching.

The study will unfold engineering faculty member's perception of using mobile devices in engineering education and its future possibilities. At the crucial time of the Covid-19 pandemic, the usage of mobile devices has become more popular in the teaching and learning process. Both faculty members and students can use mobile devices to conduct online classes. With the rapid development in technology regardless of the pandemic in the education sectors, this study still reveals what engineering faculty members think about its integrations in classes.

5.3 **Recommendation**

Based on the study findings and theoretical implications, the researcher made recommendations.

In this era of technology, the use mobile devices are at high demand for faculty members. It is therefore recommended that the selected universities provide adequate mobile teaching devices to their faculty members. In practice, the researcher suggests that the use of mobile devices should be mandatory to every faculty member.

Moreover, the study emphasizes the use of mobile technology devices in the classroom teaching. However, to achieve that, they need adequate training on mobile device application. The researcher recommends that universities need to initiate in-service training on the use of mobile devices and this can be achieved through short courses, seminars, webinars, conferences, workshops and colloquiums.

In contrary, engineering faculty members did not highly rate the use for mobile technology devices for students' special needs. However, the researcher recommends that the use of mobile technology to remain apriority aimed at instructing students with special needs in order to provide them with access to designed software and hardware for learning enhancement.

Based on the findings engineering faculty members strongly agreed that the use of mobile technology devices help to link students with people, content, and resources. This perception implies that faculty members are able to communicate with their learners in the conducive learning environment. The researcher therefore recommends that the faculties should engage their learners using mobile devices in the classroom teaching. As per rule, the researcher recommends that learners should require to avail themselves with modern mobile equipment for learning.

5.4 Recommendation for future research study

According to the outcomes of the research study, theoretical implications and recommendations, the researcher suggests the following areas for future research.

1. A comparative study between students and faculty members on the use of mobile devices in the classroom.
2. The use of mobile devices as teaching and learning tools in engineering education in other countries other than Bangladesh.
3. A comparative study of the use of mobile devices across gender.

5.5 Conclusion

The study investigated the use of mobile devices in teaching and learning in engineering universities of Bangladesh. It focused on the perceptions of the engineering faculty members in the five selected universities. The study revealed that engineering faculty members have skills of teaching and learning with mobile devices. However, they need adequate support from their respective universities. The study concludes that such support is mandatory. Moreover, the faculty members perceive that mobile technology devices used in their institutions require policies for integrating mobile teaching with technology. The study revealed some challenges that are linked

with mobile device use in the classroom such as destruction among learners. Such challenges can be overcome by institutional regulations. In this era of technology, the researcher believes that there is no option but to consider blended learning and modern teaching platforms accessed using mobile devices. As the world adapts high technology in the diversity of disciplines by theory and practice, the study findings implicate that the trend of teaching and learning will be vastly dependent on the mobile technology skills of the faculty members in their classrooms. This should cut across globalized teaching and learning.

REFERENCE

Abdulaziz, A., Billingsley, W., & Kwan, P. (2019). Factors That Influence Teachers' Decisions to Use Smartphone Clicker Apps to Enhance Teacher-Student Interactions in University Classrooms in Saudi Arabia. Learning: Research and Practice, 5(1):67–86, https://doi.org/10.1080/23735082.2018.1459802

Andrew, M., Taylorson, J., Langille, D. J., Grange, A., & Williams, N. (2018). Student attitudes towards technology and their preferences for learning tools/devices at two universities in the UAE. Journal of Information Technology Education: Research, 309–44, https://doi.org/10.28945/4111

Anon. (2018). Digital Infrastructure in E-Government. 3974683.

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, https://link.springer.com/article/10.1007/s10639-017-9572-7

Balliammanda, K. (2021). Perceptions of teachers on teaching and learning with mobile devices in higher education classrooms in Oman: A pilot study. Studies in Technology Enhanced Learning, 1(2), https://doi.org/10.21428/8c225f6e.daa1c7dc

Christensen, R., & Knezek, G. (2017). Readiness for integrating mobile learning in the classroom: Challenges, preferences and possibilities. Computers in Human Behavior, 76, 112-121, https://doi.org/10.1016/j.chb.2017.07.014

Christensen, R., & Knezek, G. (2017). Validating a mobile learning readiness survey: Assessing teachers' dispositions toward adoption. Journal of Digital Learning in Teacher Education, 33(4), 148-159, https://doi.org/10.1080/21532974.2017.1347536

Creswell, J. W. (2002). Educational research: Planning, conducting, and evaluating quantitative (Vol. 7). Prentice Hall Upper Saddle River, NJ.

Crompton, H., Burke, D., Gregory, K. H., & Gräbe, C. (2016). The use of mobile learning in science: A systematic review. Journal of Science Education and Technology, 25(2), 149-160, https://link.springer.com/article/10.1007/s10956-015-9597-x

Darmaji, D., Kurniawan, D., Astalini, A., Lumbantoruan, A., & Samosir, S. (2019). Mobile learning in higher education for the industrial revolution 4.0: Perception and response of physics practicum. International Journal of Interactive Mobile Technologies, 13(9):4–20, https://www.learntechlib.org/p/216574/

Dashtestani, R. (2016). Moving bravely towards mobile learning: Iranian students' use of mobile devices for learning English as a foreign language. Computer Assisted Language Learning, 29(4), 815-832, https://doi.org/10.1080/09588221.2015.1069360

Domingo, M. G., & Garganté, A. B. (2016). Exploring the use of educational technology in primary education: Teachers' perception of mobile technology learning impacts and applications' use in the classroom. Computers in Human Behavior, 56, 21-28, https://doi.org/10.1016/j.chb.2015.11.023

El-Sofany, H., & El-Haggar, N. (2020). The effectiveness of using mobile learning techniques to improve learning outcomes in higher education. International Journal of Interactive Mobile Technologies, 14(8):4–18, https://www.learntechlib.org/p/216981/

Gómez-García, M., Soto-Varela, R., Morón-Marchena, J. A., & del Pino-Espejo, M. J. (2020). Using mobile devices for educational purposes in compulsory secondary education to improve student's learning achievements. Sustainability, 12(9), 3724, https://doi.org/10.3390/su12093724

Gu, X., Wu, B., & Xu, X. (2015). Design, development, and learning in e-Textbooks: what we learned and where we are going. Journal of Computers in Education, 2(1), 25-41, https://link.springer.com/article/10.1007/S40692-014-0023-9

Guma, A., Businge, P. M., Nkamwesiga, L., & Andogah, G. (2017, july). Use of mobile devices by students to support learning in universities: a case of Muni university assessing organisational information systems security by human insiders in private and public Unversities in Uganda. View Project Indigenous Knowledge View Proj.

Hamidi, H., & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology. Telematics and Informatics, 35(4), 1053-1070, https://doi.org/10.1016/j.tele.2017.09.016

Iqbal, S., & Bhatti, Z. A. (2020). A qualitative exploration of teachers' perspective on smartphones usage in higher education in developing countries. International Journal of Educational Technology in Higher Education, 17(1), https://link.springer.com/article/10.1186/s41239-020-00203-4,

Al-Jarrah, J. M., Talafhah, R. H., & Al-Jarrah, T. M. (2019). ESL teacher perceptions of using educational mobile applications to develop the language skills of ESL elementary school students. European Journal of Foreign Language Teaching, 65-86, https://doi.org/10.5281/zenodo.2257442

Kadwa, M. S., & Alshenqeeti, H. (2020). The impact of students' proficiency in english on science courses in a foundation year program. International Journal of Linguistics, Literature and Translation, 3(11): 55-67, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3741621

Kaliisa, R., Palmer, E., & Miller, J. (2019). Mobile learning in higher education: A comparative analysis of developed and developing country contexts. British Journal of Educational Technology, 50(2), 546-561, https://doi.org/10.1111/bjet.12583

Kalogiannakis, M., & Papadakis, S. (2019). Evaluating pre-service kindergarten teachers' intention to adopt and use tablets into teaching practice for natural sciences. International Journal of Mobile Learning and Organisation, 13(1), 113-127, https://www.inderscienceonline.com/doi/abs/10.1504/IJMLO.2019.096479

Kebritchi, M., Lipschuetz, A., & Santiague, L. (2017). Issues and challenges for teaching successful online courses in higher education: A literature review. Journal of Educational Technology Systems, 46(1), 4-29, https://doi.org/10.1177/0047239516661713

Khan, A., Egbue, O., Palkie, B., & Madden, J. (2017). Active learning: Engaging students to maximize learning in an online course. Electronic Journal of E-Learning, 15(2), pp107-115, https://academic-publishing.org/index.php/ejel/article/view/1824

Khlaif, Z. (2018). Teachers' perceptions of factors affecting their adoption and acceptance of mobile technology in K-12 settings. Computers in the Schools, 35(1), 49-67, https://doi.org/10.1080/07380569.2018.1428001

Kim, H. J., & Kim, H. (2017). Investigating teachers' pedagogical experiences with tablet integration in Korean rural schools. The Asia-Pacific Education Researcher, 26(1), 107-116, https://link.springer.com/article/10.1007/s40299-017-0331-8

Robert, K. V., & MORGAN, R. V. (1970). DETERMINING SAMPLE SIZE FOR RESEARCH ACTIVITIES . EDUCATIONAL AND PSYCHOLOGICAL MEASUREMENT, 30, 607-610, https://www.studocu.com/my/document/politeknik-balik-pulau/educator/krejcie-morgan-1970-determining-sample-size-for-research-activities-educational-and-psychological-measurement-30-607-610/21030831

Kukulska-Hulme, A. (2012). How should the higher education workforce adapt to advancements in technology for teaching and learning?. The Internet and Higher Education, 15(4), 247-254, https://doi.org/10.1016/j.iheduc.2011.12.002

Kulikowski, K., Przytuła, S., & Sułkowski, Ł. (July, 2022). E-learning? Never again! On the unintended consequences of COVID-19 forced e-learning on academic teacher motivational job characteristics. Higher Education Quarterly, 1-6, https://doi.org/10.1111/hequ.12314

Liesa-Orús, M., Latorre-Cosculluela, C., Vázquez-Toledo, S., & Sierra-Sánchez, V. (2020). The technological challenge facing higher education professors: Perceptions of ICT tools for developing 21st century skills. Sustainability, 12(13), https://doi.org/10.3390/su12135339

Maddix, M. A. (2012). Generating and facilitating effective online learning through discussion. Christian Education Journal, 9(2), 372-385, https://doi.org/10.1177/073989131200900209

Matzavela, V., & Alepis, E. (2021). M-learning in the COVID-19 era: physical vs digital class. Education and Information Technologies, 26(6), 7183-7203, https://link.springer.com/article/10.1007/s10639-021-10572-6

Mohammadi, M., Sarvestani, M. S., & Nouroozi, S. (2020, February). Mobile phone use in education and learning by faculty members of technical-engineering groups: concurrent mixed

methods design. In Frontiers in Education (Vol. 5, p. 16). Frontiers, 1-9. https://doi.org/10.3389/feduc.2020.00016

Ngampornchai, A., & Adams, J. (2016). Students' acceptance and readiness for E-learning in Northeastern Thailand. International Journal of Educational Technology in Higher Education, 13(1), https://educationaltechnologyjournal.springeropen.com/articles/10.1186/s41239-016-0034-x

Nikolopoulou, K. (2020). Secondary education teachers' perceptions of mobile phone and tablet use in classrooms: benefits, constraints and concerns. Journal of Computers in Education, 7(2), 257-275, https://link.springer.com/article/10.1007/s40692-020-00156-7

Nikolopoulou, K., Gialamas, V., Lavidas, K., & Komis, V. (2021). Teachers' readiness to adopt mobile learning in classrooms: A study in Greece. Technology, Knowledge and Learning, https://link.springer.com/article/10.1007/s10758-020-09453-7

Oraif, I., & Elyas, T. (2021). The impact of COVID-19 on learning: Investigating EFL learners' engagement in online courses in Saudi Arabia. Education Sciences, 11(3), 99, https://doi.org/10.3390/educsci11030099

Ott, T., Magnusson, A. G., Weilenmann, A., & Hård af Segerstad, Y. (2018). "It must not disturb, it's as simple as that": Students' voices on mobile phones in the infrastructure for learning in Swedish upper secondary school. Education and Information Technologies, 23(1), 517-536, https://link.springer.com/article/10.1007/s10639-017-9615-0

Pedro, L. F. M. G., Barbosa, C. M. M. D. O., & Santos, C. M. D. N. (2018). A critical review of mobile learning integration in formal educational contexts. International Journal of Educational Technology in Higher Education, 15(1), 1-15, https://link.springer.com/article/10.1186/s41239-018-0091-4

Qashou, A. (2021). Influencing factors in M-learning adoption in higher education. Education and information technologies, 26(2), 1755-1785, https://link.springer.com/article/10.1007/s10639-020-10323-z

Santos, I. M., Bocheco, O., & Habak, C. (2018). A survey of student and instructor perceptions of personal mobile technology usage and policies for the classroom. Education and Information Technologies, 23(2), 617-632, https://link.springer.com/article/10.1007/s10639-017-9625-y

Serhan, D. (2020). Transitioning from face-to-face to remote learning: Students' attitudes and perceptions of using Zoom during COVID-19 pandemic. International Journal of Technology in Education and Science, 4(4), 335-342,

Eppard, J., Hojeij, Z., Ozdemir-Ayber, P., Rodjan-Helder, M., & Baroudi, S. (2019). Using mobile learning tools in higher education: A UAE Case, 13(11): 51-59, https://www.learntechlib.org/p/216634/

Obafemi, A., Oluwaseun, I. A., & Adebayo, T. (2021). Use Of Mobile Device As An Assistive Technology For Learning Among Students With Special Needs. IJER (Indonesian Journal of Educational Research), 6(1), 41-45, https://doi.org/10.30631/ijer.v6i1.182

Shodipe, T. O., & Ohanu, I. B. (2021). Electrical/electronics technology education teachers attitude, engagement, and disposition towards actual usage of Mobile learning in higher institutions. Education and Information Technologies, 26(1), 1023-1042, https://link.springer.com/article/10.1007/s10639-020-10297-y

Shraim, K., & Crompton, H. (2015). Perceptions of using smart mobile devices in higher education teaching: A case study from Palestine. Contemporary Educational Technology, 6(4), 301-318, https://dergipark.org.tr/en/pub/cet/issue/25742/271542

Soffer, T., & Yaron, E. (2017). Perceived learning and students' perceptions toward using tablets for learning: The mediating role of perceived engagement among high school students. Journal of Educational Computing Research, 55(7), 951-973, https://doi.org/10.1177/0735633117689892

Turnbull, D., Chugh, R., & Luck, J. (2021). Issues in learning management systems implementation: A comparison of research perspectives between Australia and China. Education and Information Technologies, 26(4), 3789-3810, https://link.springer.com/article/10.1007/s10639-021-10431-4

Whyley, D. (2018). Barriers to mobile learning advancements in the United Kingdom. Second handbook of information technology in primary and secondary education, 807-816,

Wu, L., Looi, C. K., Multisilta, J., How, M. L., Choi, H., Hsu, T. C., & Tuomi, P. (2020). Teacher's perceptions and readiness to teach coding skills: a comparative study between Finland, Mainland China, Singapore, Taiwan, and South Korea. The Asia-Pacific Education Researcher, 29(1), 21-34, https://link.springer.com/article/10.1007/s40299-019-00485-x

Zarei, A. Khairiyah M. Y., Mohd, F. D., & Dayang, H. H. (2017). Mobile Learning for Engineering Education Reform. *Sains Humanika*, 9(1–2), 1–6.

APPENDIX 1

Sample Consent Letters

OFFICE OF THE REGISTRAR
ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
BOARD BAZAR, GAZIPUR

Registrar
IUT

15 September, 2021

REQUEST FOR OFFICIAL RECOMMENDATION FOR DATA COLLECTION FOR MY RESEARCH RESPONDENTS.

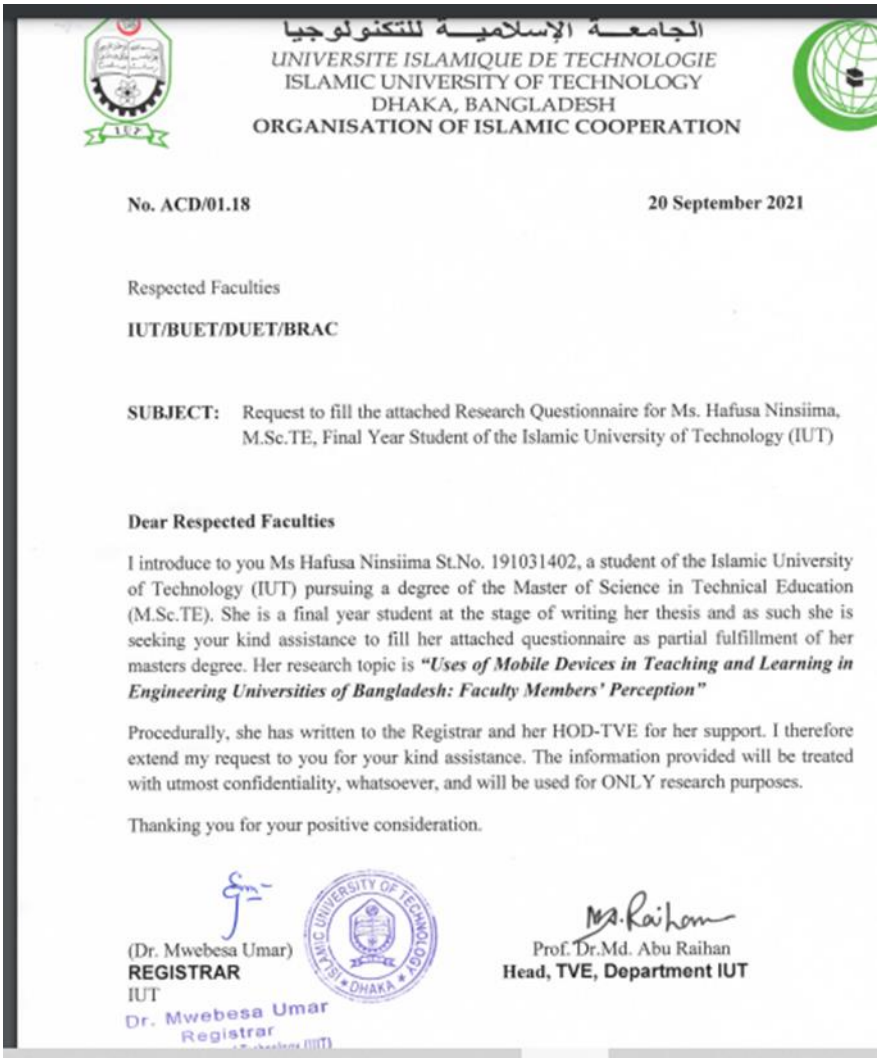
My name is Ms. Hafusa Ninsiima a student at your university with student ID: 191031402, from the TVE Department on MSc.TE Programme.

I would like to request for your recommendation to carry out my data collection from the teachers of the Islamic University of Technology. My masters thesis is specifically based on the Engineering Teachers as research study respondents. Your assistance, in this matter, will allow me to access the respective respondents.

Thank you for your time and consideration.

Sincerely,

Ms. Hafusa Ninsiima
M.Sc. TE Candidate
Mob.Tel. No. 01641-823467
Email: Haffieninsiima@gmail.com



الجامعة الإسلامية للتكنولوجيا
UNIVERSITE ISLAMIQUE DE TECHNOLOGIE
ISLAMIC UNIVERSITY OF TECHNOLOGY
DHAKA, BANGLADESH
ORGANISATION OF ISLAMIC COOPERATION

No. ACD/01.18 **20 September 2021**

Respected Faculties

IUT/BUET/DUET/BRAC

SUBJECT: Request to fill the attached Research Questionnaire for Ms. Hafusa Ninsiima, M.Sc.TE, Final Year Student of the Islamic University of Technology (IUT)

Dear Respected Faculties

I introduce to you Ms Hafusa Ninsiima St.No. 191031402, a student of the Islamic University of Technology (IUT) pursuing a degree of the Master of Science in Technical Education (M.Sc.TE). She is a final year student at the stage of writing her thesis and as such she is seeking your kind assistance to fill her attached questionnaire as partial fulfillment of her masters degree. Her research topic is ***"Uses of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh: Faculty Members' Perception"***

Procedurally, she has written to the Registrar and her HOD-TVE for her support. I therefore extend my request to you for your kind assistance. The information provided will be treated with utmost confidentiality, whatsoever, and will be used for ONLY research purposes.

Thanking you for your positive consideration.

(Dr. Mwebesa Umar)
REGISTRAR
IUT
Dr. Mwebesa Umar
Registrar

Prof. Dr.Md. Abu Raihan
Head, TVE, Department IUT

APPENDIX II

Mobile Learning Readiness Survey (MLRS) data collection instrument

Dear respondent,

I am a post graduate student at the Islamic University of Technology (IUT) Board Bazar Gazipur pursuing a degree of Master of Science in Technical Education (MScTE), carrying out research on the "**Use of Mobile Devices in Teaching and Learning in Engineering Universities of Bangladesh".** Please your candid response in this questionnaire is hereby solicited. Please be assured that your responses shall be handled with the highest discretion and shall only be used strictly for the purpose of this research.

If you are interested in the research findings, please provide me with your email address. For further details contact me on e-mail haffieninsiima@gmail.com or hafusa@iut-dhaka.edu.
Thanks for your cooperation and acceptance to fill the questionnaire in advance.

NINSIIMA HAFUSA
MScTE student- researcher.

SECTION A: **Please select the appropriate**: -

1. Gender of respondent

Male ☐

Female ☐

2. **Teaching experience**

1-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years and above ☐

3. **Age Bracket**

25-30 ☐

30-35 ☐

35-40 ☐

40 and above ☐

4. Department

In the following sections you've been asked to kindly tick the boxes to answer the questions by selection of the answers provided in the boxes.

Strong Agree (SA), Agree (A); Undecided (UD), strongly Disagree (SD) or Disagree (D) with the statements in the sections below.

SCALE	SA	A	UD	D	SD
	Strongly Agree	**Agree**	**Undecided**	**Disagree**	**Strongly Disagree**

SECTION B

Related to future possibilities (Possibilities);

ITEMS	SA	A	UD	D	SD
1. Mobile learning will bring new learning opportunities.					
2. Mobile learning will increase the flexibility of learning.					
3. Mobile learning will improve communication between students and teachers.					
4. Mobile technology will improve communication between students.					
5. Using mobile devices will allow me to be better organized in teaching.					
6. Using a mobile device will help me be better organized in my daily activities.					

SECTION C

Related to practices for improving classroom instruction (Benefits);

ITEMS	SA	A	UD	D	SD
1. Mobile technology can play an important role in higher education.					
2. Mobile technology can be used to improve 21st-century teaching skills					
3. Mobile technology can enhance learning if there is adequate support for teachers.					
4. Mobile technology can be used to improve traditional literacy programs.					
5. Technology can be used to level the playing field for special needs students.					
6. The use of mobile technology in the online classroom increases student participation in classroom discussions.					
7. The use of mobile devices in the online classroom allows students to work together more often.					
8. The use of mobile technology in the online classroom allows students to own their learning.					
9. The use of mobile technology in the online classroom increases student engagement.					
10. The use of mobile technology in the online classroom allows students to develop creativity.					
11. The use of mobile technology in the online classroom makes students more motivated to learn. 12. Mobile technology should be used to connect learners to people, content, and resources.					
13. Having a mobile device would improve student organization					

Related to mobile device preferences (Preferences);

ITEMS	SA	A	UD	D	SD
1. I prefer to read a book on a mobile device e.g. smartphone, tablet or notebook rather than a traditional book.					
2. I prefer to use an electronic textbook rather than a traditional textbook.					
3. I prefer to use a mobile device e.g. smartphone, tablet or notebook rather than a desktop computer for learning.					

SECTION E

Related to the environment/context (External Influences).

ITEMS	SA	A	UD	SD	D
1. My curriculum is conducive to students having their own technology.					
2. My administration is supportive of students having their own device.					
3. My university is doing a good job of using technology to enhance learning					
4. My campus technical infrastructure and wireless network can accommodate students bringing their own technology.					
5. Students are more knowledgeable than I am when it comes to using mobile technologies.					
6. Mobile technology would introduce a significant distraction in my classroom.					

Thank You for Your Participation!

(If you are interested in research findings, please provide me with your email address.)

APPENDIX III

Sample Size (S) required for the given Population Sizes (N)

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	256	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

Source: Adapted from Krejcie & Morgan (1970)