An-Najah National University

Faculty of Graduate Studies

IMPACT OF MOBILE LEARNING ON ENGAGEMENT OF TECHNOLOGY EDUCATION STUDENTS' AND LEARNING ATTITUDES

By

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Supervisor

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This Dissertation is submitted in Partial Fulfillment of the Requirements for the Degree of PhD in Learning and Education, Faculty of Graduate Studies, An-Najah National University, Nablus, Palestine.

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Dedication

This dissertation has not just been a personal effort. I want to start by saying that I'm grateful to Allah for giving me the stamina to finish this journey. I dedicate this dissertation work to my closest family members who had to work together and make sacrifices. Many thanks to my relatives and coworkers for their encouragement and support.

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Fortunately, I was admitted to this program with joy and happiness, as I thought that the path to a doctorate was an unattainable fantasy or impossible.

My tight schedule as a university lecturer was a challenge for me as I needed to balance between work and study for the dissertation. Driven by the passion to learn how to think deeply and make a difference in my career, ANNU's Teaching and Learning doctoral program was a good fit for me and it really supported my dream to come true.

I would like to thank my family members for their enormous encouragement. Without the incredible support of my family, my kids, myparents, my friends, and my colleagues I could not have accomplished it.

Despite the enormous amount of work that I went through during working on this dissertation, I have always had the believe that this is only the beginning towards the path of improving the educational landscape, learning, writing, and creating more proposals.

And finally, I would like to thank my colleagues and students at PTUK who were very cooperative and supportive during this journey. I would also like to extend my most sincere appreciation to Prof. Wajeeh Daher for giving me the challenge to seek excellence and excel in every detail of this dissertation, I am truly grateful.

Declaration

I, the undersigned, declare that I submitted the thesis entitled:

IMPACT OF MOBILE LEARNING ON ENGAGEMENT OF TECHNOLOGY EDUCATION STUDENTS' AND LEARNING ATTITUDES

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

Student"s Name	Reham Salhab
Signature	S. Reha
Date	23/5/2023

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IMPACT OF MOBILE LEARNING ON ENGAGEMENT OF TECHNOLOGY EDUCATION STUDENTS' AND LEARNING ATTITUDES

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Abstract

Advancement in Information and Communication Technology (ICT) has changed the teaching and learning processes at higher education institutions, enormous and innovative technological developments along with their tools and applications have invaded the recent education system. Therefore, this dissertation aims is to investigate m-learning effect on learning engagement and attitudes among technology education students.

A mixed approach is utilized in this dissertation to examine the engagement and attitudes of 50 students who take an educational technology class. A quasi-experiment was conducted and a phenomenological approach as well. Data from the experimental group and the control group was gathered. Focus group discussions with three groups and 25 semi-structured interviews were performed with students who experienced m-learning in their course. Analysis of ANCOVA was conducted and revealed an impact of m-learning on engagement and attitudes. Inductive and deductive content analysis were conducted, 17 subthemes for engagement and four organizing themes emerged. Social-mobile interaction, cognitive and metacognitive strategies, excitement and joy, teacher presence, and attendance are the most frequent subthemes. For attitudes, 11 subthemes stem out of three main themes. Subthemes include: personalized learning, visualization of learning motivation, enhancing participation, learning on familiar devices, and social interaction.

As m-learning is stillin its beginnings, the researcher recommends higher education institutions to adhere to a set of guiding principleswhen creating m-learning policies. Additionally, customizing m-learning environment with higher levels of interactivity, to meet the students' needs and learning styles, enrich students' engagement and improve their attitudes towards m-learning.

Keywords: m-learning, mobile technology, learning, engagement, attitudes.

Chapter One

Introduction

One of the main trends in Information and Communication Technology (ICT) advancement of education is the rapid spread of mobile technology. Mobile technology has positively impacted our lives and has taken a significant step ahead of the quality and convenience of modern life. It has become an integral part of most people's lives; they carry mobile devices with them all time and everywhere (Traxler, 2020). Moreover, the impressive features of mobile devices make it possible to replace some of the operations that would often be performed on desktop or laptop computers (Al-Emran et al., 2019). Students can access various online tools on their mobile such as laptops, tablets, or smartphones in classrooms, in order to build relationships with other students according to the needs of the learning setting. They can utilize these tools to study, communicate with one another, and collaborate while doing their coursework in class or from home or another location.

M-learning is defined as employing any handheld, portable device connected to the Internet for *learning* resources and services to *learners* dissemination*;* it can be used whenever and wherever individuals want without any place or time limitations (Shraim & Crompton, 2020). For example, it encompasses all daily activities related to knowledge acquisition. M-learning adoption enables customization and flexibility of learning processes by making learning available 24/7. A clear example, as a result of the integration of multimedia information, it is used both within and outside the classroom.Moreover, many researchers suggest that mobile technology is powerful as it offers significant advantages to teaching and learning processes(Kim et al., 2021; Mikroyannidis et al., 2020). It is concerned with facilitating learning through knowledge building (Naciri et al., 2020). The ubiquity, utility and proliferation of m-learning in daily life imply that the current digital generation supports learning in schools with a digitally rich environment.

M-learning influenced learning positively, helped students to acquire needed information from diverse sources, and constructed knowledge from multiple open-access educational resources. For example, friendly hand-held devices engage students differently through digital games, web-conferencing tools, and social media(Apandi,

2022). Students think critically, discuss ideas, and share opinions (Mohammadi et al., 2020). Additionally, m-learning has shown an expansion in motivation (Yurdagül & Öz, 2018). As a result, m-learning devices enable students to acquire more knowledge and apply it in real-world situations, thereby enhancing cognitive processes from the fundamental to the advanced levels. According to Tang and Hew (2022), utilizing mobile devices has affected students' higher-order thinking skills and actively engaged them in courses. For example, it encouraged students to interact positively with others by communicating, sharing, and collaborating with their peers and instructors, navigating through multiple online sources, and creating and developing content.The various mobile applications implementation has an effect on the student's learning outcomes in higher education. There is an increased need for more personalization and diversity to meet student's learning needs in higher education institutions.

Due to the recent rapid growth of mobile devices worldwide, more than 5.27 billion people – or 67.03% of the world's population – have smartphones, tablets, or other cellular-enabled gadgets like Internet of gadgets (Bankmycell., 2023). According to the Palestinian Central Bureau of Statistics (PCBS), 97% of Palestinian households in 2019 had at least one or more mobile phone lines. This number applied to both the West Bank and the Gaza Strip. In Palestine, 86% of homes had one or more smartphones (91% in the West Bank and 78% in the Gaza Strip)(PCBS, 2023). So, it is crucial to implement this kind on higher education institutions and tailor it to fit students' needs.

As teachers' primary key concern is to keep their students involved and engaged during their classes and make their lessons attractive, they face many challenges as they compete to capture students' attention via various communication stimuli (Farrell & Brunton, 2020). Since people are shifting towards using mobile devices, these devices become an ever-present part of student life in today's networked society. Hence, m-learning is becoming increasingly ubiquitous and transforming how people access and consume information. It is an innovative approach to education that leverages the capabilities of mobile devices to provide learners with access to learning materials and activities anytime and anywhere. This flexibility and convenience make m-learning a promising approach to engage learners who may otherwise face barriers to accessing education, such as time, location, or resource constraints (Wang & Jou, 2020).

Additionally, m-learning has the potential to enhance learner engagement by enabling personalized and interactive learning experiences. By incorporating features such as gamification, social learning, and multimedia content, m-learning can create a more engaging and motivating learning environment (Gumbheer et al., 2022). Moreover, m-learning might overcome engagement challenges due to its flexible capacity and easy access to instructional materials and activities at any time and place. Thus, students may develop different ways of learning through various digital technologies and tools and be engaged in class activities more efficiently.

In Palestine, there is a rapid development of online learning approaches across the Higher Education (HE) institution during the occurred pandemic (Daher et al., 2021; Khlaif et al., 2021). All universities in Palestine mandatorily required online education during the pandemic(Shraim & Crompton, 2020). Students can access course materials online and interact with synchronous and non-synchronous class sessions, discussion forums, and recorded lectures. They can submit their assignments and receive feedback.

The Palestinian HE environment has already dedicated a big budget for the required infrastructure to implement mobile technology in learning (Shaqour et al., 2021). Furthermore, special attention has been paid to students' attitudes and engagement in using mobile technologies in higher education institutions (Shodipe et al., 2021).

This interest in attitude and engagement is due to the central role of the successful implementation of m-learning. Accordingly, the purpose of the present dissertation is to deeply explore the effect of m-learning on college students' engagement and attitudes in a specific course in Palestine. What makes this dissertation unique is the study settings; a mobile Moodle application is rarely investigated in the literature. Moreover, the mixed methodological approach that is conducted in this research to investigate attitudes and engagement concurrently.

1.1 Significance of the dissertation

This dissertation is theoretically and practically significant in many ways. First, it bridges a gap in the literature of research, focusing on the issue of using mobile devices to engage students and provide meaningful learning . Even though some studies have been conducted on the use of m-learning in the Palestinian context (Ewais et al., 2019; Khlaif & Salha, 2020), none have investigated the impact of m-learning as a solution of

effective learning. Also, this study can add to the core of knowledge as it identifies learners' attitudes and engagement when it comes to m-learning. M- learning offers a new way for students to access educational content during with the learning process.

Understanding the influence of mobile learning on students' attitudes and engagement can help to improve the design and usability of mobile learning tools and ultimately enhance the learning experience for students. It also contributes to a better understanding of the connection between engagement and attitudes, which has unfortunately received a little attention in the literature after reviewing the literature. Second, recognition of attitudes and engagement while using mobile learning will increase access to educational content for students who may not have access to traditional classroom-based learning. This dissertation will support current teaching practices by allowing teachers, instructional designers, and learning application developers to improve instructions and change their practices to better fit their student's characteristics, requirements, and preferences. Third, the study intends to uncover essential concepts and conditions that would enable higher education institutions and policymakers in Palestine to improve their current practices in providing and engaging active learning activities, particularly in geographically distant areas.

This dissertation will support future of education in Palestine by providing a base to implement mobile learning that serve learner needs. As mobile technology continues to evolve and become more ubiquitous, mobile learning is likely to become an increasingly important part of the future of education. Therefore, exploring students' attitudes and engagement with mobile learning is important for developing effective strategies to incorporate mobile learning into educational settings.

Fourth, this dissertation depends on constructivism as theoretical framework to link the use of m-learning with engagement and attitudes that was rarely investigated. Moreover, the study's proposed theoretical framework addresses the complaint that m-learning lacks a comprehensive theory, theoretical models, and conceptual frameworks (Dobbins & Denton, 2017).

Fifth, it will improve business opportunities, since there is a growing market for mobile learning tools and applications. Understanding students' attitudes and engagement with mobile learning can help businesses to better design and market their products to meet

the needs and expectations of students. This will be reflected in student success and ultimately promotes student success. By identifying and addressing mobile learning strategies that influence student engagement and attitudes.

Studies have been recently developed to spread awareness toward m-learning engagement (Alioon & Delialioğlu, 2019; Bitrián et al., 2021), which will help researchers to gain a better understanding of the strategies that students need to use, so teachers could improve learning environments by utilizing mobile learning in and out of the classroom. Being always engaged in learning will have a great impact on the student's learning process (Liu & Correia, 2021) as students build avenues of connection with others within or outside of college, as well as new approaches to acquire and absorb knowledge. Therefore, learning opportunities develop as a result of these linkages. Likewise, the results of this research may support further descriptions by providing information of how students remain engaged in learning while interacting with their peers and learning resources. This will improve understanding of what m-learning activities will help students to remain engaged in learning in different contexts. Hence, mobile applications instructional designers can create instruction that encourages effective learning engagement.

Therefore, understanding the effectiveness of m-learning that influences learner engagement and attitudes in this context is essential for educators and instructional designers who seek to optimize the learning experience for mobile learners. This understanding can inform the design and development of effective m-learning interventions and lead to the improvement of educational outcomes for mobile learners.

This study is a very crucial step to explore HE students' attitudes and engagement towards m-learning. The dissertation findings will benefit decision-makers in similar situations to enhance m-learning among their educational institutions.

In summary, studying mobile learning effect on engagement and attitudes of students is significant as it can help to improve the design and usability of mobile learning tools, increase access to instructional material, support business opportunities, and ultimately promote student success.

1.2 Problem Statement

Many studies have shown the necessity of using mobile technologies during classroom instruction to facilitate student's learning e.g.,(Ifenthaler& Schweinbenz, 2016). Researchers (Bitrián et al., 2021; Hwang et al., 2021; Mauricio & Genuino, 2020) argued that the use of mobile devices with diverse applications allows students to access information from multiple resources, interact with teachers and peers, and collaborate to construct knowledge. Thus, there is a need to implement m-learning in higher education institutions and explore students' engagement and attitudes.

This dissertation investigates how using mobile technology with its various tools in teaching and learning to engage and to build positive attitudes for students in HE institutions. As mobile phones and tablets are available for students and lecturers, they should be effective learning tools to help teachers engage their students. Attitudes towards mobile learning plays a significant role in their engagement and success. Attitudes have to be addressed while using mobile learning as mobile phones are handy and easy to use for academic purposes.

The implementation of mobile technology became a must during the pandemic (Biswas et al., 2020; Naciri et al., 2020; Shraim & Crompton, 2020), in turn, the research of this implementation is needed. Two aspects to this implementation are needed: student's attitudes and engagement are crucial to be investigated while implementing mobile learning.

This study is a very crucial step to explore HE student's attitudes and engagement towards m-learning. The dissertation findings might benefit decision-makers in similar situations since it aims to evaluate engagement and attitudes of students while utilizing m-learning in their educational institutions.

1.3 Background

M-learning have been implemented as a powerful a tool with the potential to open up new avenues for education and the learning environment in many countries in higher education (Crompton & Burke, 2018). Adaptation of m-learning is required in educational systems of higher education institutions in some countries to ensure equity and quality of education. Therefore, the goal of this dissertation is to assess how

m-learning affects students' engagement and attitudes toward m-learning. One of these nations is Palestine, which is in the Middle East. Palestinian higher education institutions have been given the task of constructing and maintaining infrastructure for mobile technology and have committed a sizable amount of money to the project. Additionally, numerous colleges have created student applications to aid in studying and provide various services like course enrollment, assignment delivery, and grade retrieval. Many Palestinian universities like the University of Gaza and Al-Quds Open University applied Android Applications to display the courses' schedule and exams' schedule for students, communicating with their instructors and getting their grades from anywhere and anytime by utilizing mobile applications initiatives (Alazaza, 2018; Shraim & Crompton, 2020).

1.4 Theoretical Framework

This dissertation based on the literature within higher education settings showed that student engagement concept is made up four dimensions (Bowden et al., 2017): behavioral engagement, affective engagement, cognitive engagement, and social engagement. Behavioral engagement refers to participating in learning activities and discussions (Tang & Hew, 2022), affective engagement relates to summative levels of emotions experienced by students which maybe shown by: enthusiasm, boring, happiness, and pride (Wang & Jou, 2020), social engagement considers belongings between students, teachers and their classmates (Oertel et al., 2020), cognitive engagement dimension embodies setting goals mastering what students learn by applying processes of thinking (Bowden et al., 2021). Also, the framework of (Yeni & Syahrul, 2021) for attitudes was also adopted that shows attitudes composed of three component: cognitive, emotional and behavioral components. The cognitive aspect refers to the knowledge, views, and beliefs that are related to m-learning. The emotional component is related to likes and dislikes about m-learning, and the behavioral aspect is related to the tendency action toward using m-learning. The researcher wants to find out students' attitudes of using m-learning. If students have a positive attitude, it indicates that students agree, feel comfortable and support the use m-learning in their learning process. If students have a negative attitude, it indicates that students disagree, feel uncomfortable, and unsupported the use of m-learning. For the course design of m-learning activities, the constructivism approach has been adopted as a theoretical

framework. M-learning activities encourages students to actively construct knowledge by providing opportunities for students to participate in the learning process individually or collaboratively (Yakar et al., 2020).

Other theories like connectivism do not seem properly a good fit for mobile learning in this context. This is due to connectivism theory allows learners to create their environment by using different media (i.e blogs, interaction spaces in a type of personal learning wikis, micro-blogging, and social media websites) to create, access, and build networks with each individual at the center of their own network. In turn mobile learning in this context focusing on more comprehensive activities, not solely social networking. Another theory that can not be adopted in this context id behaviorism since its focal point on the stimulus-response relationship and the principles of conditioning. Mobile learning does not involve learning through stimulus-response associations and neither there are reinforcement or punishment of behaviors. Despite of cognitivism emphasizes on the internal mental processes involved in learning, such as perception, attention, memory, and problem-solving. Mobile learning needs additional learning theories that support knowledge construction since it does not only involve the active processing of information and the construction of mental representations, schemas, and cognitive structures. It is a learner center approach where learners interact with each other and with the mobile device system. In this sense, mobile learning lend itself to constructivism since they both motivate learners to be active constructors of knowledge, embed them in a realistic context, and at the same time offer them access to supporting tools.Moreover, constructivism underscores the active construction of knowledge by learners through interactions with their environment and social engagements. Mobile learning, which utilizes mobile devices and technology, aligns with constructivism by providing opportunities for learners to engage in active, hands-on learning, foster social interaction and collaboration, personalize their learning experiences, promote authentic and contextual learning, and encourage reflective thinking and metacognition. By incorporating constructivist principles into mobile learning, educators can create dynamic and meaningful learning environments that empower learners to construct knowledge, connect with others, and apply their learning in real-world contexts.

1.5 Literature Review

1.5.1 Mobile learning (m-learning)

Technology has completely transformed teaching and learning processes in educational institutions globally; educators have realized the benefits of this enormous and rapidly evolving information and communication technology. Therefore, mobile technology, which has become pervasive in our everyday lives, is one of these revolutionary technical instruments that are exponentially rocketing (Bacca-Acosta & Avila-Garzon, 2021). This omnipresence is a result of emerging enhancements in mobile telecommunications and computing. Wireless connectivity has led to the development of mobile technologies (smartphones, tablets, iPads, etc). For instance, Liu and Correia (2021)reported that mobile technology use, like smart phones and tablets, is on the rise as it affects how we interact with mobile applications, such as touching, sliding, dragging, and dropping nonphysical items on a screen, which has become a regular activity in our daily life. In this context, certain universities and other educational institutions are using mobile wireless technology to provide educational services so that educators and students can access information regardless of their location(Hwang et al., 2021).

Mobile technology in learning (m-learning) is a recent and dynamic concept that created a new teaching philosophy. Mobile devices, apparently, are growing faster than the world's population, students can create and maintain effective learning by using these devices which overcomes the time and space limitations of traditional formal learning (Biswas et al., 2020).

Mobile learning (m-learning), is described as electronic learning through the use of mobile devices, such as smartphones, personal digital assistants (PDAs), smartwatches, and tablets (Liu & Correia, 2021). It enables learners to engage in learning activities anytime and anywhere. According to Bernacki et al. (2020), mobile learning is a learner-centered experience that offers opportunities for interacting with digital media, peers, and instructors. In technologically advanced countries, the availability of learning resources has become more accessible, allowing users of mobile devices to engage in complex patterns of mobility, interaction, and collaboration, as noted by (Oertel et al., 2020).

It enables mobility for learners, by learning everywhere and anywhere. This offers opportunities to design teaching and learning in different ways, and this creates a flexible environment i.e harnessing mobile devices to seamless learning opportunities where students learn outside the schools. This resulted in a new learning era that shifts from the static classroom structure of "chalk and talk, as well as desk and texts" and moves towards more learner-centric dynamic environments that facilitate more personalized and contextualized learning (Akintolu et al., 2019). Positive effects of m-learning have been identified in Engineering (Mohammadi et al., 2020); literacy (Kukulska-Hulme, 2021), science (Ewais et al., 2019), mathematics (Naciri et al., 2020), history (King et al., 2014), and theatre art (Zhou & Li, 2019).

Mobility of technology offers learning environments that enable mobility of learners by promoting access to various apps, which provides an ideal platform for informal and formal learning in many disciplines. Nowadays, students regularly use mobile devices to study while on the go (Kumar & Chand, 2019). By reducing the reliance on permanent locations for work and study, this mobility enables formal and informal learning contexts (Cha & So, 2020), and as a result, it changes the way students learn (Crompton & Burke, 2018). In the Palestine's case, several studies (Daher et al., 2018; Ewais et al., 2019; Shaqour et al., 2021) have been conducted in m-learning. A study conducted by (Ewais et al., 2019) mentioned many advantages of educational usage of mobile devices like the flexibility of learning resources accessibility, availability, the ability to interact with different types of content, including text, and images, videos, and animations. Hence, study's results showed that mobile device supports interaction by collaborative learning between students and learners who are in different zones.

Additionally, m-learning was characterized by wireless connectivity that could help teachers deliver learning materials by email and other recent e- learning platforms (Alshammari, 2020). On the other hand, students have access to content while they interact, and communicate instantly with their peers and their teachers to achieve relevant learning goals (Shraim & Crompton, 2020).

Mobile learning facilitates situated and collaborative learning (Hwang et al., 2021), and personalized learning that is adapted to the characteristics of students where they can

pace their learning with multiple learning styles (Al-Razgan & Alotaibi, 2019), and engage in self-directed learning.

Moreover, mobile technology integration enriches learning experiences by offering active learning tools (e.g., discussions, information search, reasoning, problem solving, designing, and application), these tools facilitate students' advanced cognitive development and higher order thinking skills such as analysis, synthesis and evaluation (Kim et al., 2021) With mobile technology assistance, students are encouraged to use metacognitive thinking (Daher et al., 2018).

It accelerates the process of evaluating learning results and gives students and teachers the opportunity to track progress quickly ((Bacca-Acosta & Avila-Garzon, 2021); students are able to connect to different networks to use various media to complete peer reviews and self-assessments. They have more choices for action, they can share their work and feedback publicly, and ask questions or discuss matters with different audiences flexibly (Wang & Jou, 2020).

A recent study of (Hwang et al., 2021) has stated that m-learning stimulates students to reach higher-order thinking level by encouraging them to engage in more communication and collaboration activities by promoting discussion with their peers, which allows them to engage in self-reflection and gain in-depth knowledge exploration by establishing a solid base of declarative and procedural knowledge; certain misconceptions were eased by using tablets' apps.

Many aspects of m-learning were elaborated like Bernacki et al. (2020), who explained that m-learning facilitates learning across multiple contexts. Also, they discussed how it supports situated learning as well as enables social connections with peers, educators, experts, that is related to collaborative learning, sociocultural learning design-based research, and self-determined learning. Another study by Kukulska-Hulme (2021) which has been conducted, supports these aspects and mentions that m-learning supports situated, contextual, collaborative, and game-based learning; m-learning activities facilitates situated learning through enabling students to learn and use concepts in real-life situations. Also, the study clarified that mobile devices possess features like location, including Global Positioning system (GPS), Radio Frequency identification (RFID), and Bluetooth beacons, which are used to contextualize learning.

Moreover, collaborative leaning was supported by enabling users to communicate, create, and share information in multiple multimedia formats. A more comprehensive description of mobile game-based learning shows that it promotes authenticity, self-reliance, and autonomy of the learners through augmented reality mobile applications (Bitrián et al., 2021; Taub et al., 2020).

Moreover, a previous study by Daher (2017) who concluded that mobile phones provide new affordances to learners to personalize design their own learning and amplifying their voices in innovative ways that positively impacts their learning by encouraging students' motivation, autonomy, confidence, enjoyment, empowerment, and the understanding of the content. However, the potential of m-learning lies in supporting other forms of learning as well like authentic learning in which it utilizes real-life problems in authentic and realistic contexts, situations or environments in which students are made active by constructing knowledge (Alioon & Delialioğlu, 2019).

Several publications (Al-Razgan & Alotaibi, 2019; Binbasioglu & Turk, 2020; Casanova-del-Angel, 2021) have appeared in recent years documenting m-learning tools to enhance students' thinking by providing ways to help them decrease mental effort while processing information. Additionally, m-learning facilitates long-term knowledge creation, since students are practically participating in discussions, asking and answering questions, sharing and editing work, or conducting research. For example, by utilizing their mobile phones for learning, students can download, connect, socialize, read, navigate through multiple online sources, create, develop contents (Shafie et al., 2019).

Additionally, many studies have demonstrated the importance of using m-learning in the classroom to aid student learning (Heflin et al., 2017; Ifenthaler & Schweinbenz, 2016). According to researchers, m-learning applications allow students to obtain material from a variety of sources, communicate with teachers and peers, and cooperate to build knowledge (Khlaif & Salha, 2020). Additionally, m-learning is characterized by its convenient access to the internet and the ability for teachers to deliver learning materials through email and other e-learning platforms. This replaces the traditional method of distributing materials in face-to-face settings in the classroom. M-learning also facilitates communication between students and instructors. For example, according to (Dolawattha, 2019)short and frequent communication was found to be

more effective than intensive reading or longer periods of communication in traditional teaching classrooms.

Another feature of m-learning, which has been revealed after conducting a literature review, it expedites the evaluation of learning outcomes and enables both students and teachers to monitor progress swiftly (Al-Razgan & Alotaibi, 2019). Students are able to connect to different networks and use various media to complete peer reviews and self-assessments (Taub et al., 2020). They have more choices for action; they can share their work and feedback publicly, and ask questions, or discuss matters with different audiences flexibly (Wang & Jou, 2020).

Research on m-learning impact has recently begun to broaden and include aspects of instructional design, learner interaction and learning outcomes (Hwang et al., 2021) This is in line with Daher et al. (2018) who mentioned that these mobile technologies influence positively student's behavior and emotions. More studies are currently addressing mobile tools' effects on learning process to fit learning styles (Bernacki et al., 2020).

Using mobile devices raises students' awareness of the substantial support that they need to facilitate their learning. This calls for greater research attention and efforts in the topic (Liu & Correia, 2021). Meanwhile, there is an increased need for more personalization and diversity of learning activities to meet the students' learning needs in higher education institutions, it is emphasized that teacher's role in crucial to support learner's autonomy while using mobile devices (Kukulska-Hulme, 2021).

Many educators are trying to capitalize on the high percentage of smartphones usage in their classroom by turning them into a tool for learning (e.g., online quizzes, research, educational games, accessing grades, and reading their online instructional material (Siebert, 2019). Moreover, they mentioned that many students have become so accustomed to utilizing their phones during class, they face difficulty keeping it out of sight during a class period, and they prefer smartphones to engage in online learning activities over their Chromebooks that available in the classroom (Siebert, 2019).

1.5.2 Engagement in education

Over the last ten years, student engagement and interaction have been at the forefront of higher education institutions globally (Dobbins & Denton, 2017). The importance of student engagement in any learning environment cannot be overstated. Despite the fact that "student engagement" is conceptualized as a dynamic, varied, and challenging meta-construct, numerous scholars have described and defined it as students' attempts to actively be involved and participate in the teaching learning process (Kuh et al., 2008). It is a multidimensional, multifaceted, and complex concept (Bacca-Acosta & Avila-Garzon, 2021; Daher et al., 2021; Fabian et al., 2018). It is a crucial ingredient for enhancing and optimizing learning by increasing their interest and curiosity about what being taught. Furthermore, it is crucial since it is associated with motivation, positive learning outcomes, achievement, perseverance and resilience (Yurdagül & Öz, 2018). Currently, engagement concept is being investigated in education (Xie et al., 2019), this results in disagreement about the dimensions of engagement; whether there are three components of engagement: affective, cognitive, and behavioral engagement (Attard & Holmes, 2019), or whether there are four dimensions; with a social engagement component (Mazelin et al., 2022).Bowden et al. (2021) showed that student engagement consists of four dimensions: emotional, cognitional, behavioral, and social aspects, these dimensions are influenced by institutional and personal factors. Hence, engagement was commonly related to attention, enjoyment, interest and confidence. In spite of that, researchers are still debating how to measure this multifaceted concept (Shafie et al., 2019). Learning engagement is crucial and widely acknowledged as increasing students' chances of success (Oertel et al., 2020).

To clarify the importance of student engagement a study conducted (Bitrián et al., 2021) clarify how success is facilitated through engagement. Similar arguments have been made that students' progress in the classroom closely correlates with their level of participation in educational environments. Nothing, in their opinion, may aid students' intellectual development more than participating actively in the classroom. Given that engagement affects retention, a link between achievement and engagement is also established. Additionally, student participation in group projects and debates shows that they are engaged in their study (Xie et al., 2019).

1.5.3 Attitudes in Education

Attitudes are defined as a taught tendency to assess people, issues, objects, and events in certain ways (Binbasioglu & Turk, 2020); these assessments might be positive, negative, or neutral, but they are often inconclusive (Akintolu et al., 2019). Cognitive, affective, and behavioral are constructs of attitudes that were identified by many researchers (Demir & Akpinar, 2018; Romero Martínez et al., 2020). Beliefs make up the cognitive component, feelings and emotions make up affective component, and acts and observed responses make up the behavioral component (Adov et al., 2020). Attitudes might affect students' learning process, whether they want to learn or not to learn different subjects in the required manner (Demir & Akpinar, 2018). Attitudes are crucial factors that help them to set goals, solve problems, and change their beliefs towards learning, in positive, neutral, or negative way (Akintolu et al., 2019).

1.5.4 M-learning and Engagement

Recently, the proliferation of mobile devices like smartphones, laptops, smartwatches, and other forms of portable has profoundly changed, which increases the future importance of "m-learning" (Wang & Jou, 2020). Smartphones are one major type of mobile devices that possess more advanced functions than the traditional mobile phones. The functionality of smart phones includes emailing, web-surfing, application installation, and video recording tools. Smart phones equipped with an operating system along with a powerful data processing, Internet access capacity, and useful applications (Attard & Holmes, 2019). A smartphone is a multipurpose device, that is so handy in assisting people to perform their daily and professional activities (Al-Emran et al., 2019). For Generation Z, the use of smartphones and mobile applications is widespread and common in the educational process. Therefore, m-learning had become an accessible environment for students thatensures having access with content while they interact, and communicate instantly with other users to achieve relevant learning goals (Dolawattha, 2019). In fact, smartphones support learning, since learners develop and share knowledge easily by utilizing multimedia materials for various learning activities, writing, listening, and speaking tasks that enhance collaboration (Kukulska-Hulme, 2021). Previous studies have emphasized the importance of m-learning engagement and the positive impact on student's learning (Alioon & Delialioğlu, 2019; Bai, 2019). For example, Dobbins and Denton (2017) commented that students had positive reaction to

integrate smartphone applications into their lectures; mobile applications are seen positive steps to engage students; they were able to ask questions, especially for those that are normally reserved and unwilling to speak in class. This shows that integrating m-learning into lectures would engage the students socially and cognitively during large group lecture sessions.

Many studies have demonstrated the benefits of integrating smartphones in large lecture-based classrooms to assist in promoting student engagement and participation (Bacca-Acosta & Avila-Garzon, 2021). Moreover, few previous studies showed that m-learning engages students by offering more communication and collaboration activities though promoting discussion with their peers, which allows them to engage in self-reflection and gain in-depth knowledge exploration (Hwang et al., 2021).

The use of smartphones has the potential to be meaningful engagement in learning. For example, students who use their mobile devices make conversations with their peers, since using many applications makes it simple for them to ask their peers or instructors questions. (Shafie et al., 2019). Additionally, Akhter (2018) demonstrated that the usage of digital devices in a pervasive computing environment was capable of fostering interactions between teachers and students and in-class participations, which in turn increased engagement. Moreover, Bai (2019) posited that smartphone loaded with various learning tools kept students engaged in the scientific inquiry into the life cycle of the plant and the butterfly in school and outside of school. Another study conducted by (Liu & Correia, 2021)examined various aspects of mobile applications and how they affect learning engagement and reported that ease of use, the availability of learning opportunities, features that help with learning, opportunities for social interaction, and rewards for finishing tasks affected engagement of students. A specific addition of m-learning that it enhances learning engagement, more specifically emotional and social engagement in multiple learning contexts through providing immediate access to information as well as providing enhanced hands-on learning (Tang & Hew, 2022). So, there has been a call to further integrate smartphones into lesson plans to engage students and to better prepare them for today's society.

1.5.5 M-learning and Attitudes

Acquiring information by using mobile technology affects attitudes (Pinto et al., 2020). Acceptance and attitudes are components of successful implementation of mobile technology adoption. These two components are important in determining whether they are ready for implementation of this technology. Students' attitudes played a crucial role in the adoption of m-learning (Yünkül & Cankaya, 2017). This is consistent with findings from other studies that students' attitudes affect m-learning acceptance; they are a significant predictor of student's intention to use mobile technology and influences behavioral intention (Adov et al., 2020). Generally, until recently, the literature revealed diverse results regarding students' attitudes towards m-learning (Botero et al., 2018) with both negative (Mikroyannidis et al., 2020) and positive attitudes (Mauricio & Genuino, 2020). In the last few years, however, there have been a number of studies presenting favorable attitudes towards m-learning (Adov et al., 2020; Al-Emran et al., 2019; Demir & Akpinar, 2018; Fabian et al., 2018).

Mobile technologies contributed positively to students' attitudes towards learning. For instance, Heflin et al. (2017) reported positive student experiences with mobile devices improved student attitudes towards mobile technology. This coincides with Fabian et al. (2018) who found out positive student attitudes towards the use of mobile devices by conducting a quasi-experiment mixed study, since using smartphone in learning math facilitates visualization of abstract concepts, improves engagement in fun and active learning activities, and allows personalization and ownership of learning. Similarly, Demir and Akpinar (2018) investigated the impact of m-learning applications on undergraduate students' attitudes toward m-learning and degrees of animation development and found that views regarding m-learning were much more positive.

As noted by Al-Emran et al. (2019) who investigated students' attitudes towards m-learning, with a focus on gender and smartphone ownership differences. The researchers collected data through a questionnaire survey administered at eight universities in Dubai, United Arab Emirates, with 141 students. The findings showed that male students were more likely to use m-learning systems than females. Additionally, those who owned smartphones had positive attitudes towards m-learning systems than those who did not own smartphones.

Moreover, Mauricio et al. (2020) conducted a qualitative study on the attitudes of ten gender-mixed groups using smartphones in a collaborative essay writing activity. This study supported previous findings and demonstrated that the use of smartphones in collaborative essay writing positively affected the content, organization, and vocabulary of the essay. Learners also reported positive attitudes towards writing in terms of affective, behavioral, and cognitive aspects. Following this, a study by Çavuş (2020) that showed similar positive and encouraging opinions of students towards using m-learning. Students can access course material on the developed system with no effort at anytime and anywhere by MobLrN m-learning system that was developed by the reseracher; it encompasses all the necessary components for learning, including access control, user profiles, learning materials, assignments, self-tests, quizzes, performance measurement, and announcements. Additionally, Al-Qatawneh et al. (2022) conducted a quasi-experiment on college students and implemented m-learning strategy and found a statistically significant differences in attitudes between the two groups towards m-learning.

Therefore, due to the fact that such research is not sufficient in Palestinian context on the basis of the literature, it is deemed necessary to verify the previous findings regarding the engagement and the attitudes towards smartphones in relation to their use in the process of learning an education technology class in a higher education setting. Moreover, it is hoped that the outcomes of this PhD dissertation paper will provide suggestions and recommendations for further exploration in this field to support usage of m-learning in higher education institutions.

1.6 Definition of Terms

Attitudes: positive or negative or neutral opinions or sensations that have been posited to comprise affective, cognitive, and behavioral components (Maio et al., 2018).

The researcher definition for attitudes is the tendency of students to have positive, negative or neutral opinions towards mobile learning in an educational technology class.

Engagement: the degree to which students are involved and actively participate in learning activities. It can be noticed through the level of cognitive, social, behavioral and emotional interaction that students demonstrate during their learning process (Bowden et al., 2021)

The researcher definition for engagement is the involvement of technology education students with mobile devices in an educational technology course.

Mobile learning (or m-Learning): It is a type of "learning that occurs across multiple contexts, through social and content interactions, using personal electronic devices like: mobile phones and tablets, laptops and are easily portable" (Crompton & Burke, 2018) (p. 53).

The researcher definition of mobile learning is a learning environment that utilizes Moodle mobile application that can be accessed by mobile devices.

1.7 Research goals

There is a need to implement m-learning in learning, this is especially true for Higher Education (HE) and in times of emergency education as COVID-19. Working as a lecturer at PTUK, where mobile phones and tablets are used by students and staff pushes everyone to think in ways and methods that can make them effective learning tools as they are handy and easy to use for various purposes. Moreover, due to the COVID-19 pandemic, the implementation of m-learning became a must (Biswas et al., 2020; Naciri et al., 2020). In turn, research of this implementation is needed. Two aspects of this implementation are students' attitudes and engagement will be investigated. This dissertation examines the impact of mobile learning on student engagement and attitudes towards mobile learning, which is a very crucial step to improve HE students' attitudes and engagement in mobile technology as a new learning setting that complements the traditional teaching. Moreover, this dissertation aims to improve the learning experience of students who used mobile learning in their future courses.

1.8 Research questions

1. Is there a significant difference in engagement and its dimensions: emotional, behavioral, cognitive and social between the experimental group and the control group in technology education course?

2. Is there a significant difference in engagement and its dimensions of students who used m-learning due to the interaction effect between group and gender?

3. Is there a significant difference in engagement and its dimensions of students who used m-learning due to the interaction effect between group and technical skills?

4. Is there a significant difference between control and experimental group in their attitude towards using m-learning including its components: emotional, behavioral, and cognitive, and overall attitudes.

5. Is there a significant difference in attitudes of students who used m-learning due to the interaction effect between group and gender?

6. Is there a significant difference in attitudes of students who used m-learning due to the interaction effect between group and technical skills?

7. How does m-learning affect engagement of technology education students?
8. What are Technology Education student's attitudes towards m-learning؟

Chapter Two

Methodology

2.1 Research paradigm

This chapter describes the quantitative and qualitative research methods used to investigate the impact of m-learning on student engagement and attitudes toward mobile knowledge in an educational technology course at Palestine Technical University - Khadoorie (PTUK). A phenomenology and quasi-experimental research design using mixed methods is presented.

2.2 Research Design

To investigate the engagement and attitudes of technology education students in m-learning environment, a mixed-method explanatory sequential design was used. Mixed method design employs different types of inquiry to gain a better understanding of a phenomenon by combining more than one data collection tool (Creswell & Clark, 2017). The sequential approach is used; with the quantitative phase being followed by the qualitative phase; thus, the qualitative findings are used to contextualize the quantitative data (Bowen et al., 2017). A quasi-experimental approach with initial quantitative steps was used in this dissertation, with two pre-existing scales for students.

Because the researcher wants to describe m-learning experience, a phenomenological approach was used for the qualitative step. Both approaches align well with the dissertation objectives in studying the impact of m-learning on PTUK students' engagement and attitudes through the intervention and an implementation of Moodle mobile application (MMA) that was designed with ADDIE course design. A pre-scale and post-scale quasi experimental design was used with a control and an experimental group.

The general argument for using a mixed-method design was that quantitative and/or qualitative approaches alone do not address the problem; qualitative data is used to validate quantitative results, which justifies the design choice (Morse, 2016). In addition, quantitative data were collected, which were then supplemented and enriched with qualitative data(Tezer & Çimşir, 2018). Furthermore, phenomenology approach was chosen for the qualitative method, because it reflects on a lived experience with a

specific group or object to arrive at a more profound and deep understanding of the phenomenon (Patten & Newhart, 2017).

Additionally, a phenomenological approach is used in this dissertation to investigate the lived experience of a group of PTUK students enrolled in an educational technology course who use their mobile devices while learning. As a result, the researcher is digging deeper into the meaning of students' lived experiences with the phenomenon of m-learning; the phenomenological approach was the best choice for this particular study. Following this approach could lead to in-depth categorization of engagement and investigation of students' attitudes while learning while using mobile devices.

Quantitative methods, on the other hand, rely on data from students' self-reported scales, whereas studies that only use qualitative methods are limited in their ability to test hypotheses based on theoretical frameworks or generalize findings due to the small number of participants (Daher & Swidan, 2021). Even though the validity of using self-report scales to assess student engagement has been demonstrated and is now widely used (Lam et al., 2014), scales do not always provide in-depth information. As a result, a qualitative approach will serve as a supplement for additional insights and perspectives, as well as to validate or expand quantitative results obtained from scales (Creswell & Clark, 2017). Because different methods and data sources were used, methodological and data triangulation are present (Turner et al., 2017). Ultimately, the researcher triangulated the results from the quantitative and qualitative analyses to explain students' attitudes and how engaged they were during the implementation of m-learning. Four data collection tools were used in this dissertation that include: a questionnaire, interviews, focus groups, and course logs.

2.3 Research context

To answer the dissertation questions, a mixed approach will be conducted at the PTUK course of educational technology in the second semester of 2021/2022. Two groups were involved in the quasi-experiment, a control group and an experimental group, that were taught by the researcher.

The intervention was conducted in an educational technology course for the experimental group and lasted for a whole semester, 16 weeks. The researcher designed the Moodle mobile course (MMA). The course design utilized ADDIE model to design

the course model. The course's objectives remained the same, but were enriched with engaging and interactive activities that included some Moodle tools, wikis, discussion forums, interactive H5PL videos, micro-learning videos, assignments, gamification platforms, and group work. Individual activities like creating educational videos, submitting assignments, and participating in discussion forums was carried out within the context of mobile collaborative learning projects, such as creating interactive slides using the google application of technology curriculum lessons. Mobile Moodle application was used to deliver this course by smartphones and other mobile devices that have already adapted to.

Appendix B contains a lesson plan designed by ADDIE for one week. At the beginning and end of the course, students completed pre-course and post-course scales for engagement and attitudes. In addition, student focus group discussions and semi-structured interviews were used in the research. All of the data gathered related to the learning activities in which students participated while using their mobile devices both inside and outside of college. The student participants were asked to describe their m-learning experiences and how they perceived m-learning in this course. Because these participants used their mobile devices like smartphones primarily at different times and in different locations, they were asked to thoroughly describe all of their learning behaviors and actions.

2.4 Research participants

The population of this study are students who third year and fourth year students who are taking educational technology class at PTUK.

2.4.1Questionnaire respondents

The present study focused on technology education students at PTUK who are taking educational technology class. Technology Education students are third year and fourth year level at PTUK. Respondents consisted of 50 students, were by random assignment sampling, by matching the demographic characteristics like gender, technical skills, GPA. Random assignment could be used because quasi-experiment is conducted. Respondents were asked to volunteer to participate in this study. Demographic data are shown in Appendix A.

2.4.2 Focus groups and Interviews' Participants

The purpose of this dissertation was to explore the lived experiences of educational technology students who had used m-learning in their course at PTUK in and from their own words and descriptions to identify how they were engaged and their attitudes. At Palestine Technical University Khadoorie (PTUK), technology education students were the only group with a firsthand lived experience of using mobile phones in education. Following that, students were chosen as potential participants for the qualitative phase after experiencing m-learning.

Small groups of 8, 8, and 9 students were chosen from the same group of students who took part in the quantitative part for three focus groups. These groups included technology education students who are taking the educational technology course. They used the Moodle mobile application in their course as designed by the researcher. Students were chosen based on two criteria: they had at least three years of university experience, they were enrolled in education technology classes, and they had prior experience using mobile in their courses. Furthermore, in this dissertation, the researcher selected participants who provide data that is more relevant to the phenomenon being studied (Merriam & Tisdell, 2015). According to Creswell and Clark (2017), a phenomenological study should have 5-25 participants, whereassuggests a different sample size for phenomenological research. A sample size of 6 to 20 people is considered adequate. Following Creswell's advice, our study participants were 16 college students who were chosen to participate in this phenomenological investigation. The number of participants will satisfy both code saturation and meaning saturation (Hennink et al., 2017). Appendix B provides demographic information about the participants in the focus group sessions and semi-structured interviews.

2.5 Research procedure

Moodle mobile application was used with the integration of a full course designed by the researcher. As this dissertation aimed to explore engagement and attitudes of students who use m-learning, the researcher established novel instructional activities in which students can be engaged into the m-learning environment.

Designing interactive learning activities with mobile technologies can allow students to gain knowledge through interactions with other students, lecturers, and content. The

researcher designed the course using ADDIE model- short for analysis, design, development, implementation, and evaluation.

This model is one of the most general and comprehensive models of educational design, and all models of educational design of all kinds revolve around these five stages, and the difference lies in the focus and expansion in the presentation of one stage without the other. Additionally, the ADDIE model has been studied in a plethora of studies, as it has been technologically accepted on a large scale worldwide and as it is flexible enough to be adapted to different instructional environments such as a m-learning environment(Parsazadeh et al., 2018). Furthermore, ADDIE distinguishes itself by providing the designer with a procedural framework that ensures highly efficient and effective in achieving the objectives and the clarity of its procedural steps and ease of implementation (Shuib et al., 2015).

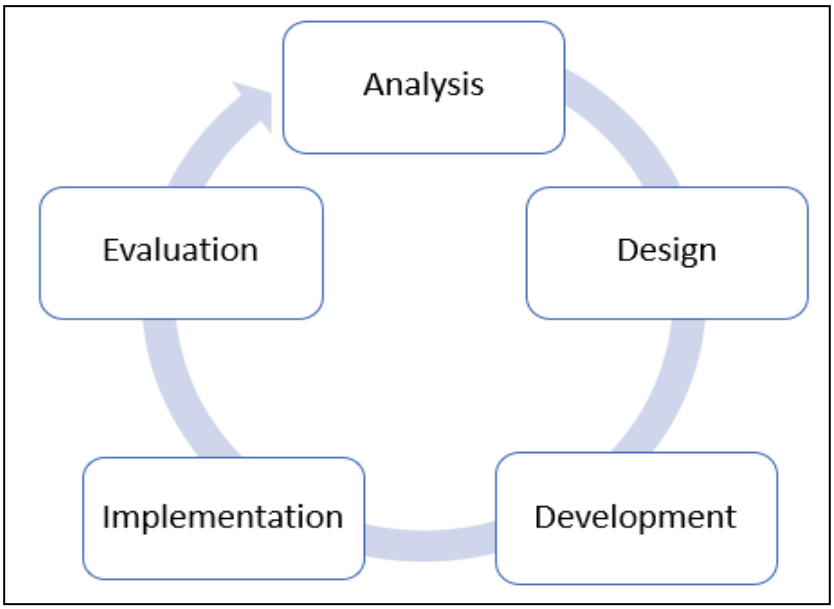
2.6 Course Design

To design the educational technology course, the ADDIE instructional model was chosen. The model was created in 1975 at the University of Florida's Education Technology Center for use in a US Army project that was later adopted by all branches of the United States Armed Forces (Moloney & Xu, 2015).

The acronym ADDIE stands for the model's five stages: analysis, design, design, development, implementation, and evaluation as shown in figure 1. ADDIE is an instructional System Design approach that guides the development of course content production because it is the most universal and simple model that fits the purpose of developing a m-learning system (Shuib et al., 2015).

Figure 1

ADDIE Design



Moodle Mobile Application (MMA) was used to deliver the course because it is already designed for both students and instructors. The Moodle Mobile application is installed on the mobile phones of the students. It is described as "Moodle's official app, which can be freely downloaded from the Google Play Store; it uses HTML, PHP, and JavaScript (Dolawattha, 2019). The researcher did not consider using other mobile applications because it would confuse and distract the students. Furthermore, MMA works well with its features, which are perfectly suited to the course design. The steps for this design are as follows:

2.6.1 Analysis phase

Three steps were completed during this phase: needs analysis, participant characteristics analysis, course content analysis, and learning environment analysis. The mobile Moodle application needs analysis was performed to determine the course objectives and whether specific training is required for participants to instill the required skills for the application's usage. An interview was conducted to determine these requirements.

2.6.2 Design phase

This stage focuses on creating preliminary plans and resources. It consists of establishing educational objectives, lesson planning, tools, and an assessment instrument. In this phase, learning outcomes such as the structure of the content, mental

processes required by participants, knowledge or skills required by participants, the best tools to use, videos or graphics to create, and the length of time for each lesson are outlined.

2.6.3Development phase

The researcher began developing the course material on the Moodle mobile application at this point. The design process's outputs are translated from schemes and scenarios into real learning materials, resulting in the product's components. Moodle, Padlet, canvas, Word wall, Kahoot, Edmodo, Edupuzzle, Google apps such as Google Docs, Google Forms, Google Draw, YouTube videos converted into interactive via H5PL in Moodle were all used.

2.6.4 Implementation phase

It is the actual course material delivery; the mobile Moodle application was developed in two stages: before the experiment and during the implementation of m-learning. A pre-course orientation session was offered to introduce students in the experimental group to the concept of m-learning and to ensure that each student had downloaded the mobile application on their mobile devices. During the four-month m-learning program, students began to learn in class with their instructor and sometimes outside of class as well. Many activities with various goals were planned for the students. This phase focuses on motivating students by asking questions or using activities posted on Moodle applications like Padlet for commenting, brainstorming, and discussing.

2.6.5 Evaluation phase

It determines whether or not learners met the learning objectives in whole or in part. It assesses the efficacy of m-learning instructional strategies, methods, and techniques. It evaluates the entire course to determine whether the lesson plans, instructional material, media, and assessments meet the learning needs. This phase is divided into two parts: formative and summative. Formative evaluation occurs during the development phase of the ADDIE model, whereas summative evaluation occurs at the end of the ADDIE model process to assess and revise course elements as needed. Appendix C contains a detailed description of additional ADDIE course design characteristics. Appendix D contains a one week course material.

2.7 Quantitative Procedure

First, a quasi-experimental research method was used to investigate the utility of mobile learning to help students stay engaged. Two groups of control group and an experimental group of educational technology students were assigned. In both groups, pre- and post-scales were used to assess engagement and attitudes. During the intervention, 25 students in the control group received an educational technology course using traditional methods, while 25 students in the experimental group received an educational technology course using the Mobile Moodle application (MMA) over a period of 16 weeks.

At the start of the course, students in the experimental and control groups were given pre-scales for engagement and attitudes via Google Forms. The educational technology course in the control group was delivered using traditional learning techniques such as lecture notes, PowerPoint presentations, using the computer lab to access the Moodle. A mobile-friendly LMS with an interactive course design, as well as the course's lecture notes, were provided to the experimental group. Furthermore, if students encountered any technical issues with the Moodle mobile application, the e-learning department provided assistance. At the end of the 16-week period, post-scales for engagement and attitudes were distributed electronically to all students via Google Forms.

2.8 Qualitative Procedure

At the end of the course, focus groups were held before proceeding to individual interviews. This strategy aims to gain more depth and detail on the topics raised in the group interview (Lune & Berg, 2017). The incorporation of focus group and individual interview data in this dissertation made three major contributions: an initial model guided the exploration of individual opinions, while subsequent data from individual studies further enriched the conceptualization of the phenomenon; identification of the individual and contextual circumstances surrounding the phenomenon, which added richness to the interpretation of the structure of the phenomenon, which is m-learning in this context; the trustworthiness of the findings was enhanced by a convergence of the central characteristics of the phenomenon across focus groups and individual interviews (Lambert & Loiselle, 2008). Moreover, combining semi-structured interviews with focus groups enhances data richness(Lambert & Loiselle, 2008). Since multiple methods of data were used, this will support triangulation method (Fusch et al., 2018).

2.9 Data Collection tools

Data collection for participants was done sequentially, as is typical for an explanatory sequential design. This design is divided into two stages: quantitative data collection and analysis, followed by qualitative data collection and analysis. During the data-interpretation phase, the findings from both phases complement each other (Warfa, 2016). The overall goal of this design is to quantitatively explain the phenomenon under study and to develop deeper into the results of a qualitative stage. The quantitative data from step one could be used by the researcher to develop the qualitative questioning protocol in step two(Creswell & Clark, 2017). For quantitative design, a pre and post scale, and Moodle course logs were used. For qualitative design, focus group discussions, semi-structured interviews were used.

2.9.1 Quantitative Data collection tools

2.9.1.1 Pre and Post scales

The first two tools for the quantitative method are pre-course attitudes and engagement scales completed by 50 students prior to the intervention (using a smartphone for the course) for the quasi-experiment design. The two scales were distributed online for the control and experimental groups, which is convenient and easy for participants to respond at their leisure and location, as well as time-saving and cost-effective for the researcher (Cohen et al., 2002). An introductory session was held with the participants to provide a brief overview of the nature of the experiment that will be carried out for this specific course. Following the intervention, the two groups completed online post-course scales of attitudes and engagement.

Two pre-scales that were validated by their authors previously were used in this study. There are three procedures involved in this portion: translation from English to Arabic, validating the scales, and assessing their reliability.

2.9.1.2 Engagement scale

A pre-existing scale for engagement was used as an instrument to measure learner engagement (Deng et al., 2020). Despite the fact that student engagement in a technology-mediated learning environment has been measured in a variety of ways, this questionnaire fits well because student engagement has four dimensions: behavioral,

emotional, cognitive, and social engagement. Furthermore, the MOOC environment is similar to some extent to m-learning because MOOCs promise to improve students' access to learning at any time and from any location (Antonova & Bontchev, 2020). Furthermore, both m-learning and MOOCs combine a wide range of solutions for on-the-go learning, promoting personalized learning (Al-Razgan & Alotaibi, 2019), bridging formal and informal learning experiences(Cha & So, 2020), virtual collaboration and communication (Kukulska-Hulme, 2021).

The engagement scale included 12 items that were classified into four dimensions. behavioral dimension of learner engagement as shown in Appendix F, e.g. I designate a regular time for m-learning, emotional dimension, for example. I enjoy watching video lectures on m-learning, cognitive, and other platforms. When I came across something in Moodle that puzzled me, such as social engagement, I frequently looked for more information. I frequently responded to other students' questions. These items asked respondents to rate their agreement with each statement on a five-point Likert scale, with 1 being strongly disagree, 2 being disagree, 3 being neutral, 4 being agree, and 5 being strongly agree.

The scale was validated by assessing face validity by administering the translated scale to professors from various universities with specialties in education psychology, educational technology, curriculum, and instruction, as shown in Appendix E. To assess and a construct validity of a translated scale g principal component analyses with the Varimax rotation test should be conducted (Wang et al., 2022). The questionnaire's construct validity was examined by applying the principal component analysis approach (Maskey et al, 2019). Exploratory factor analysis test was used to assess how well the 12 measured engagement items of this scale represent the number of constructs with a pilot study consisted of 60 students.

Several criteria was used for the factorability of a correlation (Daher, 2019). Each scale item needs to have a correlation of at least.3 with another item. As indicated in table 3, the Kaiser Meyer-Olkin measure of sample adequacy was0.724, which was higher than the usually advised value of.6, and Bartlett's test of sphericity was significant (χ^2 = 776.381, p.001), showing very strong validity of research data (Cheng & Shao, 2022).

Each item shared some common variance with other things, which was further supported by the communalities being all above.5. These broad indicators led to the conclusion that factor analysis was appropriate for all 12 items. The four factors explained 71.34 % of the total variance. The first factor explains 21.15%, the second factor explains 17.67%, the third factor explains 16.17%, and the fourth factor 16.355%. This illustrates the co-relationship and interdependence of the variables, which is a prerequisite for doing a factor analysis. By using the Principal Component Analysis (PCA) technique, items were divided into four factors, and table 3's component loadings were used to name each factor correctly.

Table 1

EFA Result: rotated component matrix for engagement scale (Rotated component matrix)

Sentence	Component			
	1	2	3	4
1.I attend my classes regularly during this course.	.839			
2.I took notes while studying.	.740			
3.I revisited my notes in this course	.803			
4.I often searched for further information when I encountered something that puzzled me during my learning.		.505		
5.IWhen I had trouble understanding a concept or an example, I went over it again until I understood it during my learning		.773		
6.If I watched an instructional video that I did not understand at first, I would watch it again to make sure I understood the content		.824		
7.I was inspired to expand my knowledge during my learning.			.731	
8.I found learning interesting in this course.			.838	
9.I enjoyed watching video lectures during learning.			.852	
10.I often responded to other learners' questions while learning.				.642
11.I contributed regularly to course discussions.				.877
12.I shared learning materials (eg, notes, multimedia, links) with other classmates while learning.				.809

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

To confirm the scale's reliability, Cronbach's Alpha was calculated for each of the four engagement factors. According to Appendix F, reliability for engagement scales is calculated. Internal consistency (Cronbach's alpha) for the affective factor item scores was 0.748, 0.729 for the behavioral factor items, 0.791 for the cognitive factor items, and 0.727 for the social factor items. The reliability measurement for engagement shows that the overall scale has a high level of internal consistency, with an internal consistency of 0.793, which denotes high reliability as shown in Appendix F(Alnahdi, 2020).

2.9.1.3 Attitude's scale

A pre-existing scale was used to evaluate students' attitude towards ICT by (Romero Martínez et al., 2020), and adapted to the context of m-learning as shown in Appendix G, since has it was shown that Information and Communication Technology (ICT) includes wired and mobile infrastructures (Anstey et al., 2021). Moreover, (Casanova-del-Angel, 2021)believed that smartphones may be considered as an ICT, since it is a highly portable technology with massive access. Three constructs with 20 items make up the attitude scale: cognitive (7 items), affective (8 items), and behavioral (5 items). The items are assessed as entirely agree (5), agree (4), slightly agree (3), disagree (2), and completely disagree (3) on a five-point Likert scale (1).

The scale was validated by assessing face validity by administering the translated scale to professors from various universities with specialties in education psychology, educational technology, curriculum, and instruction. Because the researcher used a translated scale from English to Arabic, an exploratory factor analysis is conducted with a pilot study of 120 students for construct validity. Pearson correlation was used to evaluate the scale's validity (Rebouças et al., 2018).

To assess the construct validity of the attitudes scale, Exploratory factor analysis (EFA) has been used as a tool to compile evidence of factorial validity of the attitude scale. The Kaiser Meyer-Olkin measure of sampling adequacy was 0.806, above the commonly recommended value of.6, and Bartlett's test of sphericity was significant (χ= 639.786, p <.001. The communalities were all above.5, further confirming that each item shared some common variance with other items. Given these overall indicators, factor analysis was deemed to be suitable with all 20 items. The three factors explained

62.32 % of the total variance. These values exceed the recommended 50%, indicating good measurement of the construct (Romero Martínez et al., 2020). The first factor explains 35.55%, the second factor explains 14.23, the third factor explains 6.84%.

This illustrates the relationships and interdependence of the variables, which is a prerequisite for doing a factor analysis. By using the Principal Component Analysis (PCA) technique, items were divided into four factors, and table 2 shows component loadings that were used to categorize each factor correctly.

Table 2

EFA Result: rotated component matrix for attitudes scale (Rotated component matrix)

#	Sentences	Component		
		1	2	3
1	I would like to have more technological resources for my studies.	.660		
2	I feel at ease accessing learning material for my university studies.	.699		
3	I get overwhelmed accessing so much information when I learn	.859		
4	When choosing my course, I took into account whether mobile devices would be used in teaching.	.829		
5	I like to work in mobile device.	.530		
6	This course have changed my way of learning.	.721		
7	I like to study more during this course.	.592		
8	I worry that in my future classes I will have to use mobile learning more.	.536		
9	My learning in this course is enhanced.		.765	
10	Using mobile device will help to do my task better		.789	
11	I think that using mobile device is very important these days		.729	
12	It should be a priority to improve mobile learning infrastructure		.726	
13	My way of studying is helped in this course.		.625	
14	My learning in this class is well supported.			.728
15	Mobile devices are important at this current moment in my learning			.438
16	I believe the integration of mobile device into my learning process to be a positive thing			.638
17	Using a mobile device is irrelevant in my learning			.937
18	This type of learning provides flexibility of space and time to communicate with teachers and fellow students			.947
19	This type of learning in this class allows me to acquire basic skills for my learning			.913
20	The use mobile devices of hinders my skills development			.942

Cronbach's Alpha was calculated for each of the three attitudes factors to ensure reliability. The internal consistency (Cronbach's alpha) for the emotional factor item scores was 0.868,.754 for the behavioral factor items, and 0.736 for the cognitive factor items. The total scale had an internal consistency of.834, which indicates high reliability and a good level of internal consistency (see Appendix G) (Alnahdi, 2020).

2.9.1.4 Course logs

Moodle logs are the second quantitative collection tool. Moodle has generated a significant amount of data that can be used to analyze students' behavioral engagement. It records each student's activity, such as watching videos, writing, completing tasks, and interacting with peers. This data provides a wealth of opportunities for analyzing student behavior and can also aid in determining behavior engagement, as behavior engagement is defined as access to course material and participation in in-course activities, as well as other forms of online assessment activities (Al-Khanjari & Al-Kindi, 2020). Course log data, for example, contains nine dimensions of data that explain how students participate in this course (See Appendix H for more information).

2.9.2 Qualitative Data collection tools

The experiences of participants with m-learning were used to collect qualitative data. Focus group sessions and semi-structured interviews were used to learn about and extract students' lived experiences with m-learning. The semi-structured interviews for the qualitative method sought a comprehensive answer to the following research questions:

1. How does m-learning affect student engagement in technology education?
2. What are the attitudes of technology education students toward m-learning after using their mobile devices?

2.9.2.1 Post course focus group sessions

Focus group sessions are used to collect qualitative data. A focus group session is a type of group discussion about a topic that is moderated by a trained group moderator (Sim & Waterfield, 2019).

Following the intervention of using the Moodle mobile application, three focus group sessions were held for 8-10 students per session. Participants in the study who used m-

learning were voluntarily invited to focus group sessions. Participants were chosen based on two criteria: they are at least third academic college level of and are enrolled in educational technology classes for the second semester of 2021/2022. The 120-minute focus group sessions with 24 participants were conducted via ZOOM and in person in the classroom. Permission was granted by the participants to record the session and the answers participants.

The participants came from the same department and course, but at different college levels, and the majority of them had good technical skills. Participants were welcomed and thanked during the focus group, and the dissertation goals were identified. Prompts for focus group discussions were derived from a literature review. Before the study, which was conducted ethically, participants signed a consent form outlining the procedures. The moderator had previously informed the participants that their participation was entirely voluntary and that they could leave at any time. As part of their privacy, the participants' names were not disclosed; their contact information was kept in a secure and locked computer (Ngozwana, 2018).

The questions for focus groups consist of 6 open-ended research questions that were prepared by the researcher to determine the opinions of the participants on m-learning. The form was revised under the control of some field specialists. The open-ended questions that will be asked in the semi-structured form' of the participant are:

1. What impressed you the most in your mobile device learning experience?
2. How do you describe your cognition while working with your mobile device during this course?
3. How do you describe your participation in using mobile devices for learning?
4. How do you describe your emotions and feelings while using a mobile device for learning?
5. Describe common and expected social behaviors and attitudes you follow when connecting with others through different mobile technology resources
6. Describe your negative experience while using mobile learning activities in this course?

2.9.2.2 Post course Interviews

A semi-structured interview was conducted to collect data that emerged from the responses of two participants to gather data research questions by asking open-ended questions that were previously predetermined in a sequential order Importantly, it is clear that interviews are appropriate for data collection from an experimental or phenomenological research design (Adhabi & Anozie, 2017). Furthermore, interviews are more likely to provide detailed information for data collection in order to resolve and inquire about apparent information conflicts; thus, the researcher can directly exclude information that appears to be contradictory (Adhabi & Anozie, 2017). In comparison to using scales solely in studies, they only provide background and personal, contextual information while utilizing learning analytics and focusing on one dimension of engagement but not student attitudes. As a result, at the end of the course, a semi-structured interview was conducted to collect good amount of data on participants while they use m-learning experiences. Interviews were conducted using Zoom, and some were face-to-face based on the interviewees' preferences. Zoom is a video call program in which one of the callers hosts the call; it can also be used as an online data collection tool, as suggested by (Gray et al., 2020).

Semi-structured interviews were used in this dissertation because structured interviews lack sufficient flexibility and adaptability, and they are less powerful in the sense that they limit the researcher's ability to obtain in-depth information from participants' informants when compared to structured interviews. Second, semi-structured interviews are adaptable and flexible, revealing unexpected results that can supplement the findings (Ruslin et al., 2022)

The researchers conducted semi-structured online interviews with 20 students who volunteered to participate after focus group sessions for 25-40 minutes. The interviews were conducted using the Zoom platform. Individual interviews provided insight into the attitudes and engagement experiences of the 25 course participants as they used various m-learning activities tools.

The participants for this study that employed a phenomenological approach were chosen by first identifying those who had specific experiences with the phenomenon of m-

learning. Second, participants must be able to reflect on and describe in detail their lived experiences with this phenomenon (Cilesiz, 2011).

Following the conclusion of the session, the research participants were given forty minutes to speak with the researcher. The interviews were conducted four months after the course was completed, and they included open-ended questions about their mobile learning experience, their opinion on using the Moodle mobile app while learning in and out of class, how they were engaged, and suggestions and recommendations they would like to make.

1. What do you think about your m-learning experience in this course?
2. How were you engaged in m-learning in this course?
3. How did you feel while you were using your mobile device in your learning process?
4. Describe your participation in class after using a smartphone in your learning process.
5. Describe your social interactions in your learning when utilizing a smartphone during your lectures.
6. What did you like the most about this experience?
7. Now that you used mobile device learning for this course, what were your reactions to this kind of learning?
8. Tell me about disappointments you've had with mobile device learning.

2.9.3 Ethical consideration

This study was carried out after receiving ethical approval from the university and informed consent from all participants. An approval from PTUK was received to carry out the experiment. Furthermore, voluntary participation was offered with anonymity of identities when the research is written. Permission was granted from the Institutional Review Board (IRB) from An Najah National University, to protect participants' personal confidentiality. Additionally, the information of participants was kept confidential and saved on a private computer that only the researcher has access to.

2.10 Data Analysis tools

2.10.1 Quantitative data analysis

Several statistical tests were used to answer the first six questions in this dissertation: descriptive statistics, frequency distributions about the control variables, the arithmetic mean, and standard deviation were used to summarize the main characteristics of the sample. The ANCOVA (one way analysis of covariance) test was used to answer the first three questions, to see if there is a difference in engagement and attitudes between the experimental and control groups. Additionally, an independent t-test was used to determine whether there was a significant difference between the control and experimental groups prior to the experiment to determine students' attitudes and engagement for the control and experimental groups before and after the experiment.

Many parametric statistical tests should meet the assumption of normality (Kim & Park, 2019).Since the sample size is up to 50, Shapiro Wilk test, was used to determine whether the data has a normal distribution of continuous data.To perform ANCOVA, no significance outliers and homogeneity assumptions must be met as well, (Cangur et al., 2018). As shown in Appendix I, preliminary checks were completed to assess the assumptions of normality, linearity, outliers, variance homogeneity, and slope regression homogeneity (Dimitrov & Rumrill Jr, 2003). Shapiro Wilk test revealed that post-scale engagement scores in the experimental group $W(50)= 0.125$, $p=0.05$, for cognitive dimension $W(50)=.124$, $p=.053$, for behavioral dimension $W(50)=.117$, $p=084$, for social $W(50)=.068$, $p=.200$, and for emotional $W(50)=.110$, $p=.180$. This indicates that post-test scores for total engagement scores and their dimensions are normally distributed. Another ANCOVA assumption that must be met is variance homogeneity, as shown in Appendix I. It shows that the assumption of variance homogeneity was not violated for total engagement scores and its dimensions, $F=3.715$, $p=0.060$ for total scores, $F=3.489$, $p=0.068$ for emotional, $F=1.843$, $p=0.181$ for behavioral, $F=3.955$, $p=0.052$ for cognitive, and $F=3.955$, $p=0.052$ for social dimensions.

Another ANCOVA assumption is regression homogeneity. If the covariate is treated as an independent variable, this assumption is used to determine whether or not there was a significant interaction between the independent variable and the covariate (Quarcoo-Nelson et al., 2012). The assumption is violated if the interaction is significant because

there is an interaction between the independent variable and the covariate. If there is no significant interaction between the independent variable and the covariate, this indicates that the regression coefficients do not violate the group test of homogeneity. Tables in Appendix I show the results of the homogeneity of regression Slopes test for engagement scores and their components.

Results show that the test of homogeneity of regression coefficients does not reach a significance level for the emotional component (F=.193, p=.795), for the behavioral component and group interaction that it does not reach a significance level (F=.339, p=.886, for cognitive and group interaction, it does not reach a significance level (F=.906, p=.411), for pre scale total scores and group interaction, it does not reach a significance level (F=.672, p=.381). This indicates that there was a consistent linearity among the two regression lines and the two slopes could be regarded as the same. This shows the satisfaction of this assumption to proceed to ANCOVA.

To answer the fourth research question for attitudes, the ANCOVAtest was performed since the researcher began by checking the assumptions of ANCOVA. Preliminary checks were completed to assess the assumptions of normality, linearity, outliers, homogeneity of variances, and regression of slopes (Quarcoo-Nelson et al., 2012). Shapiro Wilk test revealed that post-scale scores for the behavioral dimension W(50)=.138, p=0.062, for the cognitive dimension W(50)=.126, p=.072, for the emotional dimension W(50)=.105, p=.088, and for overall attitude scores W(50)=.122, p=.194. These findings indicate that post-scale scores follow a normal distribution. Appendix J illustrates another assumption, variance homogeneity. The assumption of variance homogeneity was not violated for total attitudes scores and its component, F =.425, p=0.518 for total scores, F =.346, p=0.559 for emotional, F=1.200, p=0.279 for behavioral, and F=1.210, p=0.277 for cognitive as shown in Appendix J.

The presumption for homogeneity of regression was that pre-test scores, a covariate variable, would be used to determine whether there was a significant interaction between groups and pre-test results. If the interaction is significant, there will be an interaction between them. This finding would violate the group test's assumption of regression coefficient homogeneity. If there is no significant interaction between them, the group test of homogeneity of regression coefficients is not violated. As a result, a covariance analysis can be performed.

Tables attached in Appendix J show the test of homogeneity of regression coefficients results that clarifies it does not reach a significance level (F=.302, p=.906) for cognitive and group interaction, it does not reach a significance level (F= 1.802, p=.176) for behavioral component and group interaction that it does not reach a significance level (F=.795, p=.458) for emotional and group interaction, that it does not reach a significance level. This indicated that the two regression lines were linearly consistent, and the slopes could be considered the same. This demonstrates satisfaction with this assumption for moving on to ANCOVA for attitudes and their components.

To further improve the validity of comparison for the quantitative design, since some students had a previous experience of m-learning that might affect their engagement and attitudes, the researcher controlled the influence of students' initial usage by assessing pre-scale scores by the t-test for both engagements as shown in Appendix I and attitudes in this course.

To investigate whether there is a significant difference in the means of engagement and its dimensions between the experimental and control groups of m-learning students. The ANCOVA test results revealed significant differences in students' engagement after the experiment between the m-learning group and the control group. Even though ANCOVA takes into account the engagement ratings prior to the experiment, a separate t-test is run to examine the disparity between the engagement scores of the two groups prior to the experiment. The results revealed that the means of the engagement ratings for the two research groups were not statistically significant at the 0.05 level prior to the experiment.

The results of the pre-scale engagement scores were analyzed using an independent t-test. A 95% confidence interval was used to interpret the data (0.05 significance level). Means of the pre-scale scores are summarized in this Appendixes I and J that demonstrate the experimental and control groups of participants equal pre-scale scores, indicating that the two classes are similar in their learning abilities before this experiment until they went through this course experience.

ANCOVA was used to examine the significant difference in attitudes and their components between the experimental and control groups of m-learning students. The ANCOVA test results show significant differences in students' attitudes after the

experiment between the m-learning group and the control group. Despite the fact that ANCOVA takes into account the attitude means prior to the experiment, a separate t-test is performed to examine the differences in the attitudes scores of the two groups prior to the experiment. Appendix N shows that the means of the attitude ratings for the two research groups were not statistically significant at the 0.05 level prior to the experiment.

Indicators of behavioral engagement for course logs data analysis are displayed in Appendix H.

Data from Moodle course logs were used to corroborate information gathered from participants and to support qualitative results in behavioral dimension of engagement.

2.10.2Qualitative Data analysis

This dissertation took a phenomenological approach to better understand how technology education students who use mobile technology engage in learning. The information was gathered using verbatim transcriptions of focus group discussions and individual interviews. The majority of the information was gathered through focus group discussions and interviews, which were used to identify major themes and categories of student engagement, attitudes, and barriers to engagement. Students were encouraged to demonstrate the actions or activities that they were explaining because these discussions and interviews were video and audio recorded.

Content analysis of semi-structured interviews and focus group transcripts utilizing both inductive and deductive methods was employed. The content analysis includes an abstraction process and material grouping in order for the researchers to use inductive reasoning to respond to the research questions (Kyngäs, 2020). To generate themes that emerge from participant responses, inductive analysis is conducted. In the deductive analysis, a framework for engagement was used, with four components: social, behavioral, emotional, and cognitive(Bowden et al., 2021). The constant comparison analysis method was used to analyze data and identify recurring themes and actions, as well as to aid in the explanation of aspects of m-learning and how this learning affects perceptions, thinking, and interactions. Because this study includes multiple focus groups, constant comparison analysis is appropriate for data analysis. This enables the researcher to assess both across-group saturation and saturation in general. To code the

data, the researcher used (Creswell & Clark, 2017)six-step approach. First, data from focus group discussions and interviews were transcribed and organized. Second, data was analyzed to determine the tone and get a general sense of the ideas. Third, code statements by inserting segment and text data into them and categorizing and labeling them. Fourth, discuss themes. Fifth, data representation, and finally, data interpretation. Engagement and attitudes are depicted in Tables 3 and 4 respectively.

Table 3

Themes and subthemes of engagement

Themes	Sub-themes	Codes
Social Engagement	Competition	Win, lose, be recognized
	Building community	Share, work collaboratively, cooperate
	Mobile social interaction	Interact with material, interact with mobile interface, discussion, Interact with peers, interact with instructor
	Developing relationship	Connect, became friends, out side class
	Sense of belonging	build relationship with peers
		build relationship with teacher
		support from peers
		provide of support
Cognitive Engagement	Attention	Eyes on screen, pay attention, concentrate
	Cognitive Strategies	Remember, memorize, analyze, create
	Metacognitive Strategies	Solve problems, evaluate, monitor own progress, self-reflect
	Not feeling the time	immersed, state of flow, time passes quickly
	Cognitive curiosity	Asking question, interest
Emotional Engagement	Excitement and enjoyment	happy, relaxed, feel wonderful, excited, I was waiting for this class, I am enthused
	Instructor presence	Teacher presence makes a difference, the instructor encouraged and guided, she was supporting us, she was motivating
	Motivation	Responsible for own learning, do work in class
	Emotional Safety	confidence, express thoughts, not shy
Behavioral Engagement	Effort and time on task	Practice solving problems.
	Participation	Discuss, take part, comment.
	Attendance	Attend classes
	Positive behavior	Work effectively, Respect, privacy

Table 4

Themes and subthemes for attitudes

Themes	Sub-themes	Codes
Emotional component	motivation Self-concept Fewer learning frustrations M-learning fun	Feeling enthused, the instructor motivates Showing my uniqueness, self-esteem Appealing content, feeling satisfied Feeling excited
Cognitive Component	Flexible learning Personalized learning	Easy access to material any time and any where Remembering, memorizing, analyzing
Behavioral component	Enhancing participation Learning on familiar devices Social interaction Gender stereotype and equity access	Share thoughts, takes part in discussion, takes part in activities, answer questions, post comments, Using my own device, I use my device frequently I communicate with my classmates, I interact with the posted material, I interact with my classmates I started to talk with males, I have access to material

An inductive content analysis is used to accurately describe the perspectives of students who went through this phenomenon of m-learning for the last question which is related to barriers and challenges to applying m-learning from the student responses in the interviews and FGDs, using a widely accepted method of conventional inductive content analysis (Hsieh & Shannon, 2005). When there are few previous studies and grounded theories describing the phenomenon in question, this analysis method is appropriate. Table 3 displays the themes and subthemes.

2.11 Trustworthiness

To validate the qualitative data derived from the focus group sessions and semi-structured interviews questions, credibility was assessed by the engagement of the researcher in the intervention process of m-learning usage and data triangulation of data that involves different data collection tools like interviews, focus groups, and course logs (Creswell & Clark, 2017). In addition, member checking was done as a validation technique where the researcher went back to participants at a later stage in the research to hear their responses to the results (Birt et al., 2016).

The code and recode strategy was used to ensure dependability; additionally, I and another specialist in the field independently coded the data, after which we discussed the analytical processes that each of us will perform. For transferability, the researcher described a complete picture of the study's context, including course material, and attempted to allow the reader to determine whether the work is transferable to their context. As a result, dissertation findings from this group can be transferred to another; a detailed description was provided to the reader to provide detailed contextual information (Guba and Lincoln, 1998).

The researcher used confirmability by documenting the procedures for checking and rechecking the data throughout the study; the findings were based on the participants' narratives and words rather than potential researcher biases.

Chapter Three

Results

This dissertation's goal is to investigate the impact of m-learning on the engagement and attitudes of technology education students who are taking an educational technology course. Examining the impact of using Moodle mobile application, through both quantitative and qualitative approaches. This mixed-method that followed an explanatory sequential design (Bowen et al., 2017; Wong & Cooper, 2016). The first part of this chapter illustrates the results of the first six questions and the second part reports the last three questions.

3.1 Results for Research Question

3.1.1 Results for Research Question One

Is there a significant difference in engagement and its dimensions: emotional, behavioral, cognitive and social between the experimental group and the control group in technology education course?

To answer the first question of this dissertation, means and standard deviations were calculated for engagement post scores and its dimensions of the control group students (who were taught in traditional method) and the experimental group (who were taught using m-learning). ANCOVA was conducted to explore the significant differences in the means of engagement and its dimensions of the two research groups.

Results of ANCOVA are shown in table 5 illustrate significant differences between the means of engagement after the experiment between students who used m-learning group and the control group.After controlling for pre- intervention engagement scale score, there was a significant effect of m-learning usage on engagement and its dimensions. Partial Eta squared was calculated and showed that the $\eta_p^2 = 0.839$ for emotional dimension, the $\eta_p^2 = 0.413$ for behavioral, the $\eta_p^2 = 0.724$ for cognitive dimension $\eta_p^2 = 0.695$ for social dimension and the $\eta_p^2 = 0.862$ for overall engagement. The previous results show that there is significant difference between engagement and its dimension of the group of students who used m-learning for educational technology course than the group of students who did not used m-learning in this course. Both at once, these results show that the m-learning causing 86% of the total variance in engagement as a

result of its usage. Effect sizes ranges between 0.413 which is considered small and 0.839 which is considered large as classified by (Richardson, 2011). Results revealed that m-learning affects emotional dimension of engagement by 84% and behavioral engagement 41%.

Effect sizes calculations showed that the difference between engagement after and before m-learning were small to large. Effect size (0.2-0.4) considered small and (0.6-0.8) considered large (Lakens, 2013).

From the estimated marginal means (shown in Table 5), it is seen that the two groups have different engagement scores due to m-learning usage.

Table 5

Analysis of covariance (ANCOVA) summary table for engagement scores by group condition

Source	SS	Df	MS	F	P	η_p^2
Behavioral	1.587	1	1.587	4.306	.043	.084
Group	12.215	1	12.215	33.135	.000	.413
Total	431.894	50				
Cognitive	1.007	1	1.007	2.524	.119	.051
Group	49.281	1	49.281	123.516	.000	.724
Total	527.383	50				
Emotional	.016	1	.016	.083	.775	.002
Group	45.980	1	45.980	245.246	.000	.839
Total	488.738	50				
Social	.088	1	.088	.289	.594	.006
Group	32.513	1	32.513	106.901	.000	.695
Total	508.303	50				
pre_total	.509	1	.509	4.478	.040	.087
Group	33.263	1	33.263	292.667	.000	.862
Total	477.155	50				

Table 6

Estimated marginal means of engagement-post scores

Dimension	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Total	Experimental	3.787[a]	.068	3.650	3.924
	Control	2.270[a]	.068	2.133	2.407
Social post	Experimental	4.020[a]	.102	3.815	4.224
	Control	2.221[a]	.102	2.017	2.426
Emotional post	Experimental	3.703[a]	.069	3.564	3.841
	Control	1.988[a]	.069	1.849	2.126
Cognitive post	Experimental	3.948 [a]	.139	3.669	4.227
	Control	2.113 [a]	.139	1.834	2.392
Cognitive post	Experimental	3.948 [a]	.139	3.669	4.227
	Control	2.113[a]	.139	1.834	2.392
Behavioral post	Experimental	3.146[a]	.122	2.900	3.392
	Control	2.339[a]	.122	2.094	2.585

Note. Dependent Variable: post_total

a. a stands for adjusted group means

The researcher therefore concludes that there is a significant difference between the means of post scale and pre scale engagement scores and its dimensions. Students who used m-learning are engaged with higher means emotionally, cognitively, socially and behaviorally than who did not use m-learning.

3.1.2 Results for Research Question Two

Is there a significant difference in engagement and its dimensions of students who used m-learning due to the effect of interaction between gender and groups?

To answer the second question, the researcher investigated whether there is an interaction between research groups and gender, Two-way ANCOVA was conducted as shown in Appendix L.

Appendix L show the results of ANCOVA of interaction between gender with groups for engagement scores and its dimensions. The interaction of gender with the intervention did not yield significant differences in engagement of students who used m-learning. In other words, there is no effect of gender on engagement scores and its dimensions of students in the experimental group and control group.

3.1.3 Results for Research Question Three

Is there a significant difference in engagement of students and its dimensions who used m-learning due to the interaction effect between group and technical skills?

To answer third question, the researcher investigated whether there is an interaction between research groups and technical skills of students, two way ANCOVA as shown in Appendix M.

The results in pervious Appendix M show that there is an interaction of technical skills with the groups yielded significant differences only in social dimension and cognitive dimension of engagement scores of educational technology students who used m-learning. A look at the effect size showed that $\eta_p^2 = 0.142$ for social dimension, $\eta_p^2 = 0.211$ for cognitive dimension which is a small effect. The previous results show that there is significant difference between engagement and its dimensions of the group of students due to the effect of interaction between technical skill and groups in social, cognitive dimensions of engagement. Both at once, these results show that the m-learning caused about 21% of the variance in cognitive engagement as a results of interaction between technical skills and groups and cause 14% of change in scores in social dimension of engagement. Small effect sizes found where the η_p^2 values ranged between 0.142 and 0.211.

This means there is an effect of interaction between technical skills possession on some engagement dimensions of social and cognitive and the experimental group and control group. Estimated marginal means of social dimensiondue to the interaction of technical skills with groups presented in Appendix M that show there is a significant difference between the mean of post scale social engagement scores of students who used m-learning due to the effect of technical skills. Students with strong skills are engaged socially more than students with weak technical skills. Students with good skills are engaged socially with the lowest mean.

Due to the interaction effect of technical skills in the social dimension of engagement between effect of technical skills that was significant. Post-hoc analysis was conducted using Bonferroni's post-hoc test as shown in Table 8, to identify intervention effects for technical skills.

Table 7

Bonferroni post hoc test for Two- way ANCOVA (Interaction of technical skills and group with social dimension of engagement as a dependent variable)

(I) technical skills	(J) technical skills	MD (I-J)	SE	P	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Weak	Good	-.194	.215	1.000	-.730	.342
	Strong	-.632*	.237	.033	-1.223	-.040
Good	Weak	.194	.215	1.000	-.342	.730
	Strong	-.437	.186	.071	-.901	.027
Strong	Weak	.632*	.237	.033	.040	1.223
	Good	.437	.186	.071	-.027	.901

Note. Dependent Variable: social post

The post-hoc analysis in table 8 showed significant differences in students' social component scores, as a result of the interaction between technical skills and groups. The social dimension of students' engagement with strong technical skills (M =3.528, SE = 0.170) was significantly higher than in weak technical skills (M = 3.063, SE = 0.299).

From the estimated marginal means (shown in table 9), it is seen that the two groups had different means due to the interaction of skills among groups in the cognitive dimension. It shown that there is a significant difference between the mean post scale engagement scores in the cognitive dimension of students who used m-learning due to the effect of technical skills. Students with strong, good, and weak technical skills are engaged socially respectively.

Table 8

Estimated marginal means of cognitive dimension of engagement due the interaction effects of technical skills

Technical skills	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Weak	2.811[a]	.175	2.458	3.164
Good	2.891[a]	.099	2.691	3.091
Strong	3.466[a]	.138	3.187	3.745

Note. cognitive post

Bonferroni's post-hoc test was conducted in table 10. The post-hoc analysis illustrate significant differences in cognitive dimension component of engagement as a result of the interaction effect between technical skills and groups. The cognitive dimension of students' engagement with strong technical skills (M = 3.466, SE = 0.138) was

significantly higher than in weak technical skills (M = 2.811, SE = 0. 175). Also, the cognitive component of students in the strong technical skills was significantly higher than in good technical skills (M = 2.891, SE = 0.099).

Table 9

Bonferroni post hoc test for ANCOVA (Interaction of technical skills and group with cognitive component of engagement as a dependent variable.

(I) technical skills	(J) technical skills	Mean Difference (I-J)	Std. Error	Sig.[b]	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Weak	Good	-.080	.207	1.000	-.596	.436
	Strong	-.655*	.218	.013	-1.198	-.113
Good	Weak	.080	.207	1.000	-.436	.596
	Strong	-.575*	.173	.005	-1.006	-.144
Strong	Weak	.655*	.218	.013	.113	1.198
	Good	.575*	.173	.005	.144	1.006

Based on estimated marginal means
*. The mean difference is significant at the.05 level.

3.1.4 Results for research question Four

Is there a significant difference between control and experimental group in their attitude towards using m-learning including its components: emotional, behavioral, and cognitive, and overall attitudes?

In order to answer the fourth research question, ANCOVA was performed to investigate the effect of m-learning on students' attitudes and its components and the estimate of effect size by partial Eta squared (η_p^2).

Differences between means of the two research groups' attitudes after the experiment presented in Appendix R, that shows the means of the experimental group are higher than those of the control group in attitudes and their components.

Significance of the differences in the means of attitudes and its components was examined between the two groups by conducting ANCOVA.

ANCOVA table in Appendix N shows that after controlling for pre- intervention attitudes scale score, there was a significant difference between the means of the two groups due to the effect of m-learning usage on attitudes and its components. The effect size was calculated partial eta squared that showed η_p^2 = 0.569 for emotional

component, $\eta_p^2 = 0.676$ for behavioral, $\eta_p^2 = 0.576$ for cognitive component and $\eta_p^2 = 0.678$ for overall attitudes. The preceding results illustrate that there is significant difference between the means of attitudes and their components of the group of students who used m-learning for educational technology course than the control group. Both at once, these results illustrate that the m-learning causes the change with 57.6% of the total variance in attitudes as a result of its usage. This accounts for the variance is more in the components of attitudes, where the η2 values varies between 0.569 and 0.623, which is considered a moderate effect. Estimated marginal means of attitudes and its components are shown in table 10.

Table10

Estimated Marginal Means of attitudes scores and its component

Dimension	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Total post	Experimental	3.251[a]	.099	3.051	3.450
	Control	1.855[a]	.099	1.656	2.055
Cognitive Post	Experimental	3.183 [a]	.115	2.952	3.413
	Control	1.887 [a]	.115	1.656	2.118
Behavioral Post	Experimental	3.262[a]	.100	3.061	3.463
	Control	1.844[a]	.100	1.643	2.045
Emotional post	Experimental	3.144[a]	.121	2.902	3.387
	Control	1.796[a]	.121	1.553	2.038

Note. a stand foradjusted group means

From the estimated marginal means shown in table 10, it is seen that the two groups have different engagement scores due to mobile learning usage. It shows that there is a significant difference between the estimated mean posttest attitudes scores of students taught with m-learning and those who did not.

3.1.5 Results for research question Five

Is there a significant difference in attitudes of students who used m-learning due to the interaction effect between group and gender?

To answer the fifth question, the researcher investigated whether there is an interaction between research groups and gender, ANCOVA was conducted as shown in Appendix O.

Results in Appendix O show that the interaction effect across experimental and control group of gender among on attitudes yielded non-significant Fs values.

3.1.6 Results for research question Six

Is there a significant difference in attitudes of students who used m-learning due to the interaction effect between group and technical skills?

To answer the sixth question, the researcher investigated whether there is an interaction between research groups and technical skills of students, two- way ANCOVA was conducted as shown in Appendix P.

Appendix P shows that there is no interaction effect across experimental and control group due to technical skills on overall attitudes scores. The F values indicate significant differences due to the interaction of technical skills between the groups only in cognitive component of educational technology students who used m-learning. Cognitive component of attitudes is affected by technical skills among groups by 14% of mobile learning. Estimated marginal means of cognitive component are shown in Appendix P.

Due to the interaction effect of technical skills on the cognitive component of attitudes that was significant. Bonferroni's post-hoc test was conducted as shown in Appendix P to identify intervention effects for technical skills. Post-hoc results revealed significant differences in cognitive component of attitudes, due to the effect of interaction between technical skills and groups. The cognitive component of students' attitudes with strong technical skills (M =3.224, SE = 0.141) was significantly higher than in weak technical skills (M = 2.200, SE = 0.104). Also, Students with strong technical skills attitudes scores were higher than scores of students who have good technical skills (M=2.468, SE=.094).

3.1.7 Course logs

Course logs for Moodle application was used to calculate participation rate, interaction rate, and task completion rate as shown in Appendix H. Appendix H shows the following results.

Participation rate

By calculating students' numbers who were participating in this course activities divided by the total number of students in this course. The average participation rate of the students is 91.2%

Task completion rate

The number of students who turned in their individual and group tasks and assignments like creating posters, designing concept maps, and designing interactive videos was divided by the total number of students. The average student's number who completed the tasks was 23, with a task completion rate of 89.7%.

Interaction rate

Calculated by dividing the number of interaction comments to Padlet, discussion forums, by the total number of students' post and comments. 92% is the rate of students' interaction.

3.2 Qualitative Results

3.2.1 Results for research question Seven

What is the effect of m-learning on engagement of technology education students?

Answering this research question required analyzing the data and identifying themes for engagement. Four basic themes were found based on the framework that was used in the data analysis tool, Appendix K highlights the percentages of these themes.

A. Social engagement

Students clarified how they socially were involved and how they became part of social networks while participating in mobile social activities.

1. Developing a community

Participation in tasks and discussion requiring some amount of interpersonal connection which is happened via social discussions and posts in mobile applications that were integrated with Moodle. Students that use m-learning leave comments, engage with one another's work, a student clarified:

"Using my mobile device to comment on my classmates posts on Padlet, google document, and Edmudo gave me the sense that we are a community of learners in this class, and not lonely, compared to other classes where I used to listen to the lecture without connecting with others ".

2. Mobile Social Interaction

Students talked about how mobile devices supported their interaction socially.When using a mobile device, students have mostly interacted with Moodle mobile content, interacted with peers and instructors, and interacted with interfaces that enhances their social involvement.

A student numerated: “mobile devices usage is very helpful that eases my interaction with course content and peers, this case was totally different from e-e learning, we have more control to how to interact and to choose what to interact to, m-learning is more flexible."

A student said that “one of his classmates became his close friend after discussing and sharing ideas using his mobile device.”

Since Moodle offers interactive content and supports social connection, it encourages social mobile interaction.

3. Developing relationships

Students talked about how they kept up a social network while participating in mobile social activities.

A student claimed. Moodle mobile application facilitates connection via social sharing functions frequently, which allowed students to get know their classmates outside of the classroom.

One student said, “I was able to make connections and new relationships with my classmates in this class every lecture since when we used our mobile phones we have the chance to socialize with other”.

Another student articulated “I had the chance to know my classmates better through what they share on mobile Moodle application, their posts describe their personalities.”

4. Sense of belonging

The students discussed how they managed their social networks while engaging in mobile social activities. Socialization and communication with their peers

Social forums in mobile applications that were coupled with Moodle enable participation in tasks requiring some degree of new personal ties. M-learning enhanced students to leave comments, communicate with each other. A student said: "commenting on a peer post on Padlet's Edmudo helped them understand they weren't alone in the class." Moreover, students frequently used inclusive pronouns, such as "we, us, our group" to address their class, which indicates a sense of belonging.

5. Competition

Students were able to satisfy their desire of rivalry by using mobile programs like Word wall, Socrative, and Kahoot. Applications for gamification offered a rewards system to users. Correctly answering students believe they are the greatest. Everyone was competing to produce the finest outcomes because they all wanted to win. Prior to playing the game, they attempted to win by learning and comprehending the rules.

A student stated:

"The ranking system in Kahoot is what I like the most. I was so motivated to be in the top and I had to study to win the game, you can learn and have fun, even though it was challenging for me because I have competed with classmates. No stress learning environment!"

Hence, students were socially engaged when using m-learning by first, participation in mobile social activities since m-learning enables sharing content from a website many mobile applications, enhances collaborative learning as learners can access information with no time and space limits, interacts with their peers and instructor more frequent. Second, m-learning helps students to maintain a social network while learning; students are capable to increase their relationships number and frequency while cooperating and helping each other. Third, students compete with each since m-learning combines discussions and game elements which encourages students to think critically and raise their energy levels in competing with each other which creates a lively classroom dynamic. They like to out- perform each other for every quiz, so that they can be

recognized on the scoreboard. Fourth is closeness, students showed that m-learning facilitates group learning; class sessions were designed with more time allotted for group discussions.

M-learning helps students to discuss issues, share ideas and explain concepts so they start to feel close to each other.

B. Cognitive engagement

Cognitive engagement refers to students be actively trying to stay attentive and invest mental process to understand new information.

Based on students' responses from FGD and interviews, m-learning influences student cognitive engagement by offering a good design that utilizes multiple segmenting materials into "bite-size" activities like short games, and micro-lectures videos.

A students mentioned that:

"By using m-learning with mini instructional videos helps me to understand concepts more quickly and in turn to recall information easily, more over H5PL videos facilitates concept comprehension since I am answering questions while I am watching the videos too."

1. Attention

Students claimed that mobile learning makes them more focused and attentive during focus groups and interviews. The majority of pupils claimed that using their phones caught their attention.

Many students described mobile applications as different, interactive like educational videos, that grabbed their attention.

A student mentioned: "educational games that were designed to use by our mobile phones drives me to stay focused and attentive".

Moreover, integrating different apps like padlet via mobile phones enables students to share knowledge in peer interactions and pay attention to each other's' comments. One student said:

“My mobile device allows me to share my ideas instantly with different means which helps me to construct knowledge, compared to traditional teaching that requires more effort from me to ask my friends and receive responses from my classmates. While I was reading my classmates’ responses, I started to think in a different way which improved my critical thinking skills and to do my best effort into producing a good response.”

2. Cognitive and meta-cognitive strategies

Cognitive methods like comprehension, analyzing and problem-solving are essential for learning. Most of the participants mentioned how m-learning usage that is augmented with multimedia facilitates their memorization and enhanced their thinking skills. Moreover, they confirmed this by pointing to the usage of microcontent and mini-videos on the Moodle app, according to a student:

"Micro-videos eases my comprehension of ideas because it's easy to understand one or two concepts while you carrying your phone instead of staring for an hour at a long boring video."

Additionally, it has been discovered that m-learning enhances metacognitive skills like problem-solving, assessment, and thinking monitoring. Many students reported that while m-learning improves their problem-solving skills, both their technical skills when they face a mobile technical issue and their academic skills such searching for information have increased. One student noted, for example, that "they had more awareness of the tools of m-learning such Google Docs, Padlet, and Edmodu and how to deal with them." M-learning was also found to support metacognitive strategies like: recognizing one’s own learning style and needs, task planning, gathering and managing their own learning, monitoring and evaluating their task success. A student commented:

“I was able to recognize my learning style when I used my mobile device for this course, I started to notice that I learned more by playing games and find it the most appropriate learning strategy that fit my needs”.

3. Not feeling the time

Students described the state in which they are so engaged and even pay attention to the time. They mentioned that mobile activities were so fun and nothing else seems matter

to them. A student mentioned “While I was playing word wall puzzle, I was not feeling how the time passes during the lecture!”

4. Cognitive Curiosity

It refers to the willingness and search for new information. Many students mentioned that m-learning use, can abet the learner’s desire to browses for knowledge.

A student assured: “using my mobile device in this course motivates me us look for more information and learn related concepts instantly with more flexibility”.

We see that m-learning activities enhances attention to concepts. Additionally, interactivity of mobile phones that allow students to participate via feedback, adaptation, control, or multimedia motivates students’ interest and curiosity. Moreover, interactive multimedia used in Moodle mobile application improves memory retention due to material visualization variety in many formats like: text, images, animation, audio, and minivideos.

Students also uses metacognitive strategies as m-learning activities makes students actively monitor their progress and adjust their learning strategies accordingly.

C. Emotional Engagement

1. Excitement and enjoyment

While most participants openly acknowledged the beneficial effect of adopting m-learning on their feelings, focus group discussions and interviews revealed the reasons behind this. They felt m-learning boosted their emotional engagement as they asserted this course was different by making them feel enthusiastic and enjoyed. A student said: "My cell phone is part of my spirit. It was just a great feeling that made me happy to use it in class."

2. Instructor presence

When implementing m-learning, many students confirmed that instructor presence make them feel comfortable, as she found ways to support students emotionally and stay connected with them. This dimension's indicator was a sense of connection. The participants expressed their feelings towards the instructor's presence, they said they

liked how approachable the instructor is, and said they were grateful for the instructor's efforts to use this device in an academic context.

Students who were interviewed claimed that they felt the instructor presence helped them to stay in touch all the time with her as she helped them to stay on track by a great of support from here that enabled them to succeed. While another student added “I was always looking for help when installing some apps, I could not do it without the instructor support”.

3.Motivation

Most students mentioned how m-learning motivated them. They explained that m-learning activities due to the accessibility to different sources of knowledge. A student said:

“During a traditional lecture you can hide. You cannot hide in m-learning. Many students need to be seen and motivated to show up, you have to be more visible to keep up with the class. This makes you perform better in group work or even individually, you do not want to appear as someone who cannot manage to solve problems.”

4. Emotional safety

M-learning environment was described by many students as safe, where they may communicate their ideas and opinions, it helped them feel more self-assured and less shy. Here are a few quotes from students:

"I always felt like my voice didn't sound clear enough to be heard in class, but using mobile devices made me more comfortable expressing myself and sharing my opinions without letting my classmates listen to my voice, it is just a new way to express my ideas with confidence."

The researcher notice that participants are emotionally engaged by several indicators. First, pleasure and excitement resulting from the nature of mobile devices that is part of their life that is full of joy and fun. Second, instructor presence is crucial for emotional support, encouragement, and feedback while students on their phones.

Third, one of the indicators of emotional engagement was motivation; creating engaging activities inspires pupils to learn. Fourth, pupils who were less confident to answer

during traditional instruction are more likely to be emotionally engaged during m-learning.

D. Behavioral engagement

Behavioral engagement is assessed by observable actions and participation that students reported like:

1. Effort and stay on task

By encouraging students to exert more effort and remain focused, m-learning increased behavioral engagement. One student said:

"This is our first experience in using our mobile devices in class. Actually, as a recognized student it was a challenge to keep up with hard work to stay on track. I dedicated special effort in using connected m-learning resources, and I would always do some extra work to get a little above average student."

Another student added:

“Mobility and synchronicity of Moodle mobile application motivated me to work hard and do my best to learn by maximizing my study efforts, I reviewed and memorized all the materials before we started playing Kahoot!”.

2. Attendance

Students that use m-learning appear to be more likely to attend classes on time, contribute more in class and outside of it, and behave well overall. The FGD and interviews produced this kind of interaction.

3. Participation

M-learning activities are frequently utilized by students. More than with traditional education, the majority of pupils engaged in their learning while using technology. A student said, "M-learning helps me to participate while I am at home because I have diabetes and have missed numerous classes as a result."

4. Positive behavior

Many students demonstrated their respect for one another's opinions and choices, according to one student. Additionally, students showed improved participation by routinely attending this class and sharing in-class and extracurricular activities. A student mentioned:

“Mobile usage in this class taught me to listen to other ideas carefully and offer criticism with respect. I was reading the comments on Padlet and when the teacher asked us to comment on each other, I was careful not to hurt their feelings and be objective.”

Mobile learning engaged the students behaviorally by encouraging them to attend classes, participate, and show good behaviors.

3.2.2 Results for research question Eight

What are Technology Education student’s attitudes towards m-learning؟

Data from focus groups and interviews were analyzed. Three themes have been identified as shown in Appendix L for determining the attitudes toward m-learning. The answers given by creating the ten sub-themes for the themes that were coded and analyzed according to the "positive", "negative" and "neutral" directions. Moreover, in focus group discussions the interviews are based on three components of attitudes, they are cognitive, behavioral, and affective component (Yeni & Syahrul, 2021).

Themes and subthemesare shown in Appendix K which illustrates the main themes and subthemes as following:

A. Cognitive component

It refers to the cognitive experience underlying attitudes. This component includes knowledge, beliefs about m-learning. This component had 2 subthemes

1. Personalized learning

Students shows interest in m-learning. Students learn in different ways. They prefer to learn with other choices according to their learning styles, they like variety of instructional materials - videos, audio, and other multimedia formats. 22 students

showed the they support m-learning as it individualizes their learning. 2 students showed negative attitudes of this sub-theme towards m-learning related to this feature. A student asserted:

"With m-learning I recognize concepts easier, with mini videos that break the information into short ideas, I was able to analyze the concepts and draw conclusions since I am a visual learner."

This illustrates that m-learning creates positive attitudes for students who took this course. Mobile Moodle application activities learning platforms offer personalized learning for students.

2. Visualization of learning

Most participants believed that the use of m-learning during the lecture helps them to visualize abstract concepts in this course. M-learning was described as not as an alternative to traditional teaching**.** Instead, m-learning activities and resources align and complement traditional teaching methods by adding different learning options like microlearning, gamification, google draws, and concept maps. Students believe that m-learning creates a rich experience that helps them to memorize concepts.

A student explained:

"M-learning clarified abstract concepts like Dale's pyramid in this course and made me grasp them easily compared to traditional teaching, I think that's precisely justify why they should be brought together."

This shows that using m-learning contributes to a greater understanding of concept in this class.

B.Behavioral component

The component 'behavior' encompasses the behavioral experiences involved in the formation of students' attitudes toward m-learning in educational technology course. This component also includes overt actions toward m-learning and intentions to act. Four themes were identified in this component.

1. Enhancing Participation

M-learning activates students' participation; they learn without shyness and being watched by their classmates. All students have positive attitudes towards m-learning as it increases their participation. A student reported:

"I never participated in during lectures in a classroom, I always felt that my voice does seems good enough, m-learning makes it easier for me to participate in forums and posting tools, this really made a difference for me."

Another student clarified:

"Using my mobile device while learning fosters discussion beyond the classroom, I was able to ask questions any time, discuss topics more deeply with no stress, and have more time to go through my classmates' topics as well."

On the other hand, a student complained that:

"The negative experience that made me sometimes do no catch up with the class while using my mobile device is bad connection of my device that prohibits me to participate in all activities during class."

This reports that m-learning has a good influence on students' participationas a subtheme of the behavioral component of their attitudes.

2. Flexible learning

One of the prodigious things that Moodle mobile application offers related to learning is flexibility with no time and space limits. All the participants agreed that they can open the application whenever they want, wherever they are. Attending formal classes with an appointed place and time seems boring for students. Students pointed to different flexibility options that m-learning offered like flexibility of time, flexibility of content, and flexibility of teacher contact. 25 student expressed positive attitudes of the behavioral component towards flexible learning.

For instance, two participants said:

"Yes, the mobile Moodle app enables me to work offline, I can browse course contents offline with no hassle and participate in learning activities, then once I am connected

back to the Internet, the app will synchronize all the necessary information with my Moodle site."

Another student mentioned how m-learning helped her to gain knowledge while she is out of reach to class, she commented:

"I do not attend my classes regularly since I am diabetic and I have to visit the clinic very often during the week, Moodle mobile application made my learning flexible as enabled me to access content and ask my teacher related questions learners to this content."

Another student added: "with Moodle mobile applications I was able to choose the order in which I complete my learning activities".

It shows that m-learning helps students to study and access information anywhere, anytime. This is true to some extent; most students indicated they regularly used their devices when they were on the move. Moreover, short lessons make m-learning more convenient for them to learn.

3. Learning on familiar devices

M-learning has shifted the types of devices that learners use when they learn. They are familiar with smartphones usage and feel comfortable with them. Most students showed positive attitudes towards this subtheme. A student commented:

"We got used to use college desktops which causes privacy issues like not logging off your account or forgetting personal stuff like images, m-learning resolved this problem since I am using my own device with no worries at all."

It seems that mobile devices with their different platforms are ideal for delivering concise and engaging learning content in various formats to learners.

4. Social Interaction

Learners these days are equipped with skills that enable them to learn on their own, they are able to establish connections with others. M-learning accounts for a huge popularity of social media sites and apps that give the learner chances to interact. A student clarified:

“Using my mobile device enabled me to socialize with my peers and my instructor more than traditional teaching where I used to stay calm and listen to the instructor with no mere interaction.”

It shows that most students agreed that m-learning increase their interaction with their peers and their instructor as well. This remarks that learners show positive attitudes, they can establish online learning communities along with their in-class peers that they barely interact.

5. Gender stereotype and equity access

As gender equality has been a concern in developing countries, m-learning provides a safe and conducive environment for both genders to interact with sufficient and diverse resources. Moreover, m-learning helps students to overcome paying attention to gender issues and remove the gender gap when asking help and interacting with each other and commenting on each other’s work. A student mentioned

“This is the first class that I talked to male students as they help me when I need help and I ask them for help without thinking about gender issues”.

Another student clarified that “ I was always feel not comfortable to talk with male students in this department because of cultural reasons, also they are few of them who sit separately from the female seats, this course was totally different!, they were asking for help and offering assistance if we need as well with the mobile devices while we try to access the course.”

This illustrates that students shows positive attitudes towards m-learning usage as it reduces the gender gap between students.

C.Emotional component

Emotional component of attitudes is related to likes and dislikes about m-learning in this context where participants express their feelings.

1. Self-concept

M-learning helps students to interact by publishing comments and thoughts with the intention of showing their idea. Many students mentioned that m-learning activities

facilitates learners to how they want to be seen or how they want to see themselves. Only 18 /25 showed that m-learning affected their self -concept. A student commented "I am working on interesting and challenging activities that makes me think and show the best to class."

It seems that m-learning activities helps students to increase sense of ownership; students feel responsible for their own learning and use their strength to express their ideas.

2. Fewer learning frustrations

Many students explained that learning strategies that were used affected learners to have positive attitudes and complete the course involving chunks of content that they enjoy to learn compared to the bulk of information that they used to assimilate in traditional teaching. Fortunately, students clarified that m-learning has minimized many frustrations that students used to experience during traditional teaching. A student articulated:

"What I like the most about this class is the small snippets of m-learning material the instructor designed instead of the long boring lecture that we are used to."

This points out that m-learning influences students' attitudes positively as the design of the course is based on content segmentation and chucking big concepts into bite-sized so learners do not feel bored.

3. Motivation to study

Many students mentioned the desire to experience m-learning in this course.

Participants reported a wide range of motivators for them to persist while learning with peers and the instructor as the most important. A student stated:

"This class was different in terms of sharing my opinions on many tools like Padlet, google documents, forums. I did not feel a hassle while dealing with the m-learning activities, I discussed my problems with classmates and my teacher at first place to find e solutions for these problems."

Another student elaborated “The course instructor facilitates m-learning, she was as a motivator for us, we have a very active and devoted teacher honestly.”

This implies that m-learning affects students’ attitudes by having a motivating content and a motivating instructor?

4. M-learning fun

Moodle m-learning application activities seem enjoyable to complete. Students mentioned how content format which in a consumable formlike mini-instructional videos, blogs, gamification, short presentations is compelling and visually pleasing for students. Most students express positive attitudes towards m-learning.

A student claimed: “I enjoyed the gamification tools like Word wall and with the awarding points, that makes the learning process more rewarding for me.”

This identifies positive attitudes towards m-learning process which is fun for mobile learners and easy to consume and improve knowledge by gamification tools.

Chapter Four

Discussion

While Chapter 4 of this dissertation presents theresults and findings as per the quantitative and qualitative data, Chapter 5 identifies how m-learning affects engagement and attitudes for technology education students. This chapter compares these results with previous literature on the topic to interrupt them correspondingly. This chapter also elaborates on the answers to the research questions which allows further understanding of how to make m-learning an effective learning environment in terms of engagement and attitudes for college students in this course.

4.1 M-learning effect on engagement

The findings related to RQ1, pertaining to the effect of m-leaning on learning engagement, indicates that there was significance of the differences between the means of the two groups (experimental and control groups) after conducting ANCOVA. Students within the experimental group, who used Moodle mobile application means are higher than the control group student on the engagement scale. Consequently, using m-learning positively impacts students' engagement by completing specific mobile activities with Moodle application. The results of interviews and FGDs match the quantitative results, students' responses implied that they experienced feelings of joy while using m-learning since it meets their needs and learning styles on the Moodle mobile application. Moreover, students reported that m-learning was augmented with diverse interactive mobile activities which facilitate their interaction with their peers and their instructor that raises their confidence and motivates them to learn. This result fits well with previous studies that asserted the importance of m-learning facilitating interaction with instructors, communication, and collaboration opportunities among students (Alioon & Delialioğlu, 2019; Bai, 2019).

Moreover, there was a significant difference with the increased m-learning usage on the emotional engagement dimension between groups. This indicates that students might have enjoyed Moodle mobile application with other elements that were implemented in this course, which illustrates that the majority of students felt comfortable, relaxed, confident, and motivated while using m-learning during their lectures, this might be due to the nature of the activities that focused on multimedia like mini videos, interactive

videos, and educational games. This finding is confirmed by Lackmann et al. (2021) who illustrated that emotional engagement can be affected by the visual characteristics of multimedia learning material. Moreover, it seems that m-learning elements and activities in this course allow students to share opinions and provide opportunities to choose their study setting and learning preferences that fit their needs which raises their confidence and motivation through this course. This strengthens previous research of Daher (2017) who reported that student's voice while using m-learning has emotional consequences on motivation and confidence. In line with this finding, the study of Tang and Hew (2022) who asserted that m-learning applications affects students emotional engagement, since these applications are user friendly and support interactive learning environment, which helped to develop positive feelings while learning. These findings go in line with the results of the students' responses from the interviews and FGDs that show positive emotions, such as enjoyment toward m-learning interactive activities, and new tools, where students expressed their feelings when they completed their work and solved problems by themselves, as a result kept students emotionally engaged (Moya et al., 2021). It seems from these results that students expressed their excitement and happiness, thus it is a new experience for them to use mobile devices to access learning Moodle application in a college course in class (Alkhalaf et al., 2017). Indeed, many subthemes merged for this dimension like excitement, enjoyment, motivation, instructor presence, and emotional safety. Excitement and enjoyment got the highest share of frequency, most of the students mentioned that m-learning could relax and even entertain them during their learning process, since their mobile devices are part of their identity and they could access learning resources and feel the joy, due to diverse activities posted on Moodle mobile application. Students are comfortable while using m-learning, they enjoy it, as such m-learning increase students' desire to be involved while they learning process Dirin et al. (2022). It could be concluded that emotional engagement stimulates other dimensions of engagement. There has been a study which supports this finding, Hewson (2018) reports that emotional engagement is a pre-request for other dimensions of engagement since positive emotions like excitement and motivation in a learning environment would stimulate and augment the scope of students' attention, cognition, actions, and build social relationships.

Also, the research results show that students in the experimental group were engaged cognitively more than their colleagues in the control group with medium effect size.

One possible explanation based on the interviews and FGDs results is that most students who were interviewed confirmed that m-learning tools and activities like: gamification, micro-learning videos, discussion boards, gamification, concept maps, wikis facilitate cognitive learning strategies that came first in frequency for this dimension. Hence, m-learning gives students the chance to be active learners and select the activity that garbs their attention and stimulates visual and working memory, that enhances cognitive engagement. This is in line with the findings of (Chang et al., 2015) who reported that diversified m-learning activities helps in attracting attention and avoiding cognitive overload. This also confirmed the findings of (Al-Razgan & Alotaibi, 2019; Gumbheer et al., 2022) who reported that m-learning was recognized its potential for learning process to be adaptable to preferential way in which learners receive and process learning activities. Moreover, Wang and Jou (2020) also investigated m-learning flipped classroom and confirmed how it engages students cognitively by moving students from the basic knowledge receiving to a higher level of knowledge application and utilization.

Metacognitive strategies and immersion themes followed cognitive strategies in frequency as well, students who used m-learning were engaged cognitively, since they are learning to enhance their knowledge by going beyond the requirements of the material. This can be explained as m-learning facilitates problem solving which would engage them by stimulating their high-order thinking and in-depth knowledge exploration. Students might be aware of their own learning and might control their learning process, monitor and plan, and evaluate their learning since m-learning material is on their phones which raises their awareness and motivates them to learn flexibly and easily. The literature emphasizes these results of (Daher et al., 2018; Damopolii & Kurniadi, 2019), who found that m-learning offers assistance in encouraging students to use metacognitive thinking skills in learning and problem solving. Another subtheme of cognitive dimension is cognitive immersion; this can be explained as m-learning provides richer media like gamification which provides a more immersive experience for students. Students did not feel the time when they were engaged cognitively in m-learning and they become more attentive (Lai, 2016; Najjar & Salhab, 2022).

Cognitive curiosity is the least subtheme that came in frequency. Though literature confirms this as that cognitive curiosity and interest present in certain apps like games

(Hochberg et al., 2018). Thereafter, the researcher suggests the need for instructors to be aware of the role of designing certain mobile activities like gamification elements to promote cognitive curiosity and interest.

Additionally, cognitive engagement could be explained as m-learning is enriched with multimedia elements which involves students' grit in facing and solving problems which helps them to invest their time and energy assimilate knowledge. This happened as m-learning provides immediate and quick access to information in different and diversified tools. This is supported by many studies who reported that cognitive engagement is enhanced by multimedia tools due to active processing of incoming information which facilitates learning by stimulating senses like seeing and hearing to perceived process (Lackmann et al., 2021).

Results also revealed significant differences in the social component of engagement between experimental and control groups due to the effect of m-learning. Although the scale results showed a moderate effect size of m-learning in this dimension, the interview and FGDs results revealed more nuance. This means that m-learning enhances social engagement more than other dimensions with 29%. This could be explained as most of the students who used m-learning reported that they developed a sense of community with the instructor and with their peers. They described m-learning as affording wider diversified social communication more than online learning and traditional classes, since the portability feature of mobile devices encourages students to participate in mobile social activities and facilitates building relationships with their peers. The highest share of social engagement is the sub-theme of social mobile interaction, learners are connected constantly and interacting with the learning environment, content, platforms, peers, and instructor. Because of this, m-learning would help students to interact more than e -learning. This result is in line with previous studies (Tu & Sujo-Montes, 2015) which described m-learning environments as human networks that offers students the opportunity to build networks, interact with mobile platforms, and engage in extra personal interaction in social environments. In terms of social engagement, competition has the lowest share. It seems that there is a general feeling of happiness among students, some problems from time to time, but they aren't seriously competitive with each other. This findings align with Tang and Hew (2020) who asserted that social presence is supported by mobile instant messaging and engages students more than asynchronous forums. Another explanation that was extracted from

students' interviews and FGD's is that m-learning supported social engagement is through interaction social presence of shy students who usually do not participate in traditional teaching.

In terms of behavioral engagement, there is also a significant effect among groups with the lowest effect size. This finding is also supported by interviews and FGDs that show behavioral engagement is the least share in frequency among other themes was impacted by how, and when students participate in learning activities with their mobile devices. Contrary evidence was found with high course logs percentages of interaction rate, participation rate, task completion rate respectively. This finding in line with the study of Tang and Hew (2022) who investigated the effect of using mobile instant messaging on students and found that students are behaviorally engaged the most. It seems that m-learning allows students to interact more in the course that would encourage students to participate in m-learning activities such as asking questions and expressing their ideas. Additionally, interviews and FGDs show that students become more persistent and stay focused on tasks while using m-learning. Hence, m-learning should help students to review and prepare their lectures with flexibility which acts as an outlet for reserved students to communicate with comfort. For example, students explained that m-learning increases their participation in class, since they can express their thoughts and ideas with ease and with no limitations. Moreover, many learning strategies like gamification make them more persisted to achieve certain educational goals while staying on task. Studies by (Mazelin et al., 2022) confirm this finding by explaining that game-based learning engages students behaviorally by encouraging them to participates more in class. Positive behavior was another subtheme that was an indicator of behavioral engagement while using m-learning. For example, students respect their peers' thoughts and ideas and used constructive criticism (Erdoğdu & Çakıroğlu, 2021).

The present results show no statistically significant differences in engagement dimension scores due to the interaction effect between gender and groups. Thus, the m-learning influenced male and female students equivalently. This was also reported by (Alsadoon, 2018; Nistor, 2013) who found no gender differences in their studies and explained that students being digital natives and the closing of the technology gender gap leading to more gender equity in m-learning. They are both engaged while they use

Moodle mobile application while learning. On the other hand, some studies show the effect of gender on engagement and its component in favor of males (Deng et al., 2020).

Results also show that there is an effect of technical skills possession on engagement scores and its dimensions of social and cognitive of students in the experimental group and control group.This finding conquers with (Farrell & Brunton, 2020) who reported that having the necessary digital skills to comfortably and competently engage with the technological aspects of m-learning environments that requires good technological skills. Interviews and FGDs supported these findings partially, since the highest two themes show that students are socially and cognitively when they possess good technical skills or weak skills. Accordingly, students with strong technical skills reported that they were attracted and satisfied with the use of the mobile application for Moodle application which increased their awareness in their learning process by competing with other students, and building more relationships and be socially engaged, which in turn was reflected on their performance by being more attentive, comprehend more information when dealing with new mobile applications that were integrated in Moodle mobile applications that engaged them cognitively (Figuccio et al., 2021). On the other hand, few students with weak technical skills mentioned that they were also socially and cognitively engaged, since m-learning facilitates social interaction with their peers, who helped them to solve some technical problem they encountered, when using their mobile devices to download some learning application and activities. This in turn helped them to be build a new community of learners and be engaged cognitively by learning new concepts and not even feel the time while they apply what they learn during gamification and compete with others as well (Bitrián et al., 2021).

There is one more explanation related to the fact that students who are equipped with digital skills are able to download mobile application, exploit digital images for mobile use, and be more knowledgeable about mobile security (Günay, 2022), the researcher explained this particular effect on cognitive and social engagement as students with high levels of digital skills can concentrate easily when working with their mobile devices, communicate with their peers and instructor and interact with no hassle since they can solve many technical problems with ease (Bergdahl et al., 2020). Also, another study showed a contradiction results that reported no relation between low levels of technical skills and disengagement (Tadesse et al., 2018).

Results revealed that m-learning affects engagement socially, cognitively, emotionally, and behaviorally. Although it was found in this dissertation that m-learning devices may limit students' behavioral engagement particularly, this is could be due two reasons. First, it can be related to the social engagement that may urge students to maintain interpersonal relationships rather than joining learning activities (Yu et al., 2022). Second, college students may not pay attention to the behavioral issues and behavioral engagement since they have other reasons that make them less committed to behavioral issues (He et al., 2020). Moreover, m-learning affected social engagement that centers on creating relationships and social support received by the peer group which results in enthusiasm, improves self-esteem which consequently support emotional; cognitive, and behavioral wellbeing.

4.2 M-learning effect on Attitudes

The results in chapter 4 showed that the group of students' attitudes scores who used m-learning are significantly higher than the group of students who did not use m-learning. Interviews and FGD's showed that there is an effect cognitive, emotional, and behavioral components of attitudes respectively while using mobile devices to access learning content. These findings go in line with the study which has been conducted by Özcan (2022) who explored the effect of m-learning on attitudes of college students and results revealed statistically significant differences in attitudes and its components. Moreover, all other attitude scores were also affected positively are consistent with previous studies (Mauricio & Genuino, 2020; Wang & Jou, 2020; Yünkül & Cankaya, 2017) who reported the effect of m-learning on attitudes due to many characteristics of m-learning like: increasing motivation, accessibility, portability, ease of use, and enhancing cognition.

Most of the students in the interviews showed their positive attitudes towards m-learning due to the potential for personalized learning, learning with enjoyment، and interaction with peers. Cognitive component of attitudes got a moderate effect size and the highest share among other themes of attitudes from interviews and FGDs analysis. The researcher could explain this finding standing to the point that the cognitive component of attitudes refers to knowledge, views, opinion that related to an object (Yeni & Syahrul, 2021). This aspect in this dissertation is related to the students'

opinions, view, or expectation about using m-learning. Students' views and opinions show the prodigious things for Moodle mobile application as it offers personalized learning.

In this dissertation, students explained how m-learning increasingly affects their views and opinions with its ubiquitous tools prompted that facilitate and allow learners to work at their own and select the activity they prefer according to their learning styles which influences their attitudes positively. Most students showed that they support m-learning as it individualizes their learning according to their needs and preferences. Personalized learning helps students to accomplish learning goals according to their needs of learning. Hereafter, it appears that m-learning with its tailored activities to enable students to understand concepts, recognize relationships between ideas, and visualize abstract concepts. Additionally, students can use their own devices and access the resources they prefer and do the research they need for information. These findings go hand in hand with the study of (Wang & Jou, 2020) who reported that m-learning benefited students of different learning styles in their personalized learning, it gives students more freedom, enabling them to clearly recognize their weakness and personalize problems in the courses while using different resources that they select upon their preferences. Moreover, this is in line with (Sheromova et al., 2020) who reported that when students learn in their preferred modality and in different formats, they understand and process information, analyze, synthesize, and solve problems.

Additionally, there is another subtheme which is visualization of learning. Most studentsmentioned thatm-learning helped them to support their understanding by watching mini videos, using concept maps, using images to visualize relationships in Padlet that complements traditional teaching methods.

From these results it is clear that M-learning seems to successfully bridge the gap in learning activities between face-to-face instruction and m-learning activities. Students viewed m-learning as a catalyst to traditional teaching. M-learning is characterized by offering opportunities for students to learn material that is poorly understood in traditional teaching, it can improve students' cognitive skills like attention, memorizing, understanding by new learning options it offers like: mobile flipped learning, gamification, and brainstorming. These strategies enhance the views of students positively towards m-learning. This is in line with previous studies (Vorona-Slivinskaya

et al., 2020) who reported that m-learning improves student's knowledge and memorization by helping them visualize many objects. The researcher also related this effect to the design of the course that was customized upon the needs of the students in the analysis step that were carried by implementing the ADDIE model. The course was enriched with a variety and plentiful of interactive activities like: Kahoot, Word wall, Padlet, mini videos to fit students' needs. This variety of activities throughout the whole semester differ in their settings and formats of the concepts that differ completely from other classes delivered by the traditional method in this semester. For example, mobile media serves to visualize the learning objects and concepts that grab the attention and motivate student to learn. It seems that m-learning activities in this course can explain abstract concepts that is characterized by more accessibility, that it can provide significant satisfaction to students (Sari & Nurcahyo, 2018). A study conducted by Parsazadeh et al. (2018), who designed m-learning tool, named by the Intelligent M-learning Tool for college students by utilizing ADDIE through mobile phone with game-like applications, inquiry based activities and flashcard-like information, found this application fit students learning needs and styles by offering personalized learning environment.

For the behavioral component of attitudes, there was a significant difference in this component between the two groups and in favor with the experimental group who used m-learning with large effect size. This differs from the interviews and FGD's results where this theme came with the second share among other themes. The highest share of behavioral component in m-learning is the sub-theme of flexibility. For example, students mentioned how m-learning engaged them behaviorallydue its flexibility, as this class lectures were given out of the classroom sometimes in the university garden, where students found this setting different and unique for them for learning. The researcher explained this positive attitudes due to m-learning that might enable students to spend more time collaborating and interacting positively with their peers, as well as more time presenting work and commenting on other work which fortifies behavioral component of attitudes. This is in line with (Kariippanon et al., 2019) who clarified that flexible learning enables students to spend less time being taught explicitly and working individually in traditional classrooms significantly less time in a whole-class setting, and more time working in groups, relative to traditional classrooms.

Moreover, all participants agreed that they can open the application whenever they want, wherever they are and attend formal classes with an appointed place and time seems boring for them. Students pointed to different flexibility options that m-learning offered like flexibility of time, flexibility of content, and flexibility of teacher contact, 25 student expressed positive attitudes towards flexible learning. Moreover, it seems that students view m-learning flexible, since it enables them to carry their devices easily without worrying about their textbooks and hardcopies material which makes access easy and the material available with them inside and outside the class. This finding conquers with (Kokoç, 2019) who addressed flexibility dimensions such as time, place, learning resources, interaction, and pace of learning that enhances behavioral component of attitudes. These positive attitudes expressed by participants in this study reflect calls by Al-Qatawneh et al. (2022) who conducted a quasi-experiment to investigate the attitudes of undergraduate students in Arabic grammar course and found m-learning has been associated with being flexible.

The other sub-theme is familiarity and proficiency of students in the use of technology these days, students are probably quicker and use their smart phone very often than at desktop computers. These findingsdemonstrate an intuitive understanding of the findings of previous studies e.g. Biswas et al. (2020) who found positive m-learning attitudes of students who used their own mobile phone for academic purpose, since it is private and they use it frequently for social media purposeswhich affects the behavior component of their attitudes. Participation is the next subtheme for this component was more specifically for students who described themselves as introverted. This is because m-learning gives more opportunities to introverted students to voice their opinions and thoughts and gives the extroverted students an additional place to express themselves. They clarified that they used m-learning without shyness and being watched by their classmates which gives more opportunities to participate and to voice their opinions and thoughts and gives the extroverted students an additional place to express themselves. This finding also align with Callahan (2021) who recommended to involve introverted students by online activities and give them a chance to participate. The third subtheme for this component that affected students' attitudes towards m-learning is social interaction. M-learning looks like accounts for interactive activities, social media sites and apps like Kahoot that enable students to create, share and exchange content with others in the class which foster a sense of community and give

the learner chances to interact. All students agreed that m-learning increases their interaction with their peers and their teacher as well. This remarks that learners show positive attitudes since they can establish online learning communities that can make their learning experience more collaborative and successful. This finding goes in line with (Apandi, 2022) who illustrated that m-learning creates a positive learning environment by facilitating collaboration, and social experience during gamification that fortifies behavioral component of attitudes.

Results also show that there is an additional significant difference in the emotional component of attitudes between the two groups. The experimental group emotional component scores of attitudes are higher than that of the control group. Effect size was also moderate among other components. Compared these results with the interview and FGDs results which shows this theme with the least share among other components. The biggest share of emotional attitudes is the sub-theme of fewer learning frustrations**.** Many students in interviews and FGDs showed interest in m-learning that affected learners to have positive attitudes and complete the course involving chunks of content that they enjoy while learning compared to the bulk of information that they used to assimilate in traditional teaching. Fortunately, it is possibly that m-learning has eliminated many of these frustrations for students. The reason behind this is due to learning on a mobile platform giving learners the ability to access learning content in small and concise amounts without feeling bored.

Additionally, learners have access to various formats on the mobile device of their selections, and at a time that works best for them, learners are less apt to feel intimidated and frustrated. This finding is confirmed by (Mauricio & Genuino, 2020) who indicated that students expressed their enjoyment and enthusiasm in writing when they used their personal mobile devices. Also, the researcher explained this effect due to the mobile audio-visual learning characteristic that facilitates learning by making it more appealing and faster to use and download compared to regular desktops which also affects their emotions. These results align with the findings of (Adov et al., 2020) who showed that using mobile devices in learning is useful and is strongly related to how easy it is to use and how enjoyable it is to use it.

Motivation is another subtheme of the emotional component of attitudes that were expressed by many students. Participants reported a wide range of motivators for them

to persist while learning with peers and the instructor as the most important. (Al-Qatawneh et al., 2022) who attributed the positive attitudes of students in their study to increased motivation for them due the availability of material and encouraging communication between students and the instructor.

The third subtheme of emotional component is students felt that m-learning is fun. Students found that Moodle m-learning activities are more enjoyable to complete, since the format is delivered in a consumable forlike mini-instructional videos and gamification which is compelling and visually pleasing for students. These findings fit preceding studies that indicate this positive attitude since students experienced this fun feeling towards M-learning i.e., (Apandi, 2022; Demir & Akpinar, 2018). These studies indicated that students felt excited, joyful, and happy when they used m-learning and tablet computers while learning.

The fourth sub-theme is self-concept thathelps students to interact by publishing comments and thoughts with the intention of showing their idea. It seems that m-learning activities helps students to increase sense of ownership; students feel responsible for their own learning and use their strength to express their ideas. These results are consistent with (Cachón-Zagalaz et al., 2020) who conducted a questionnaire survey to investigate the relationship between smartphone usage and self- concept among college students and found that self- concept correlates positively with smartphone usage. This can be explained by students who like to use m-learning since it enhances their self -esteem and confidence.

Furthermore, no significant differences in attitudes' scores were found that are due to the interaction effect between gender and groups. Thereafter, m-learning seem to affect male and female students in the same way. Similarly, previous studies' results support these findings (Fabian et al., 2018). This conquers with the results reported by Pinto et al. (2020) who found that gender is not a pivotal factor that affects attitudes toward the use of mobile technologies in the learning process. Some studies have already revealed that the gender variable is insignificant; gender is not a pivotal factor that influences attitudes toward m-learning could be affected by gender. These findings echo the results of the student interviews and FGD's where a subtheme in gender stereotype and equity access of behavioral component of attitudes emerged where the fourth subtheme that came next is bridging gender gap. Students manifested their positive attitudes towards

expressing their views toward the use m-learning since it minimized gender stereotype and equity access. They mentioned that males are most of the time do not interact with them because of cultural limitation.

While using m-learning helps students to overcome paying attention to gender issues and remove the gender gap when asking help and interacting with each other and commenting on each other's work. This illustrates that students show positive attitudes towards m-learning usage as it reduces thegender gap and guarantees easy access to many students. This is parallel with (Alshammari, 2020) who states that m-learning bridges the everlasting gap of gender separation between female and male students.

On the other hand, these results contradict with other studies (Al-Emran et al., 2019; Albelali & Alaulamie, 2019) who indicated a statistically significant difference among the students in terms of their gender where the differences were in favor of male students. A possible explanation for this nonsignificant finding of gender which is that Gen Z, whether male or female, find it easier to learn and grasp the information by the short bursts of data provided from m-learning applications that were integrated in this course.

Significant differences in cognitive component of attitudes of educational technology students were found due to the interaction between technical skills and groups of the study. This could be attributed to the effect of possession of technical skills on cognitive component of attitudes specifically as found in this dissertation, while possession of technical skills has no significant differences on emotional, behavioral or overall attitude scores. This is could be explained in a way that cognitive component of attitudes is related to the students' technical skills of m-learning, which is not the case with emotional and behavioral components. Also, another possible explanation for this could be attributed in a way that that students who have excellent technical skills with m-learning usage shows higher attitudes scores due to unlimited space and time freedom that enable them to consume and produce knowledge easily. Moreover, technical skills seem to allow students acquire basic skills of the subject and facilitates knowledge consuming and producing, analyzing, and synthesis during m-learning that affects their learning positively, this shows harmony with findings with (Özcan, 2022) who found a positive and advanced relationship between prospective users of digital

literacy levels and m-learning attitudes, and reported that digital literacy explains 35% of m-learning over all attitudes.

These results show that m-learning affected the students with the excellent technical skills more than students with the weak technical skills. These results could be due to the more technical skills abilities students possess the more they perceive m-learning in a positive way (Avcı & Ergün, 2022). Here, the researcher assumes that a student who has a low level of skill with the technology is more likely to deviate from existing use due to the obstacle of accessing and using information while they learn, therefore they are less likely to see m-learning as easy to use. Compared with skilled students, confident users would be more likely to expand the use of the device and be able to solve technical problems easily and have positive attitudes towards learning. This is in line with the findings of (García-Martínez et al., 2020).

Based on these findings that are related to engagement and attitudes of this dissertation, the researcher suggests instructors should always design a motivating m-learning environment that takes into consideration students' needs, satisfaction, and social interaction. ADDIE design seems to work perfectly with m-learning in this course. This finding conquers with study of (Parsazadeh et al., 2018) who reported the efficiency of using ADDIE model to create a cooperative and interactive m-learning application that was developed in this dissertation Also, this finding conquers with a systematic map study (Shuib et al., 2015) that utilized ADDIE model for a m-learning application with similar tools like: discussion rooms, game based application, and learning content to personalize learning by identifying the characteristics of learners and their preferred styles.

4.3 Conclusions

This dissertation provided an insight into PTUK students' engagement and attitudes when they use mobile learning. Results have shown that mobile learning affects students' engagement and attitudes positively with some differentiation between their dimensions. Because m-learning does not only involve using mobile devices for transmitting information to learners, instructors should also consider learners' learning styles, attitudes, and engagement characteristics. Hence, analyzing the content, using interactive tools, setting proper objectives, identifying how to deliver content, selecting

activities, and assessing learning outcomes is a significant step in designing a mobile meaningful learning environment.

Based on the dissertation results that illustrate customizing a m-learning environment with higher levels of interactivity that is designed to help meeting the students' needs and learning styles, would enhance students' engagement in four dimensions: emotional, cognitive, social, and behavioral.

This study shows the effect of m-learning on engagement and attitudes; students' responses were positive when using the mobile instructional material that individualizes their learning with diversified tools could boost their engagement, and stimulates mobile-social interaction patterns. Apparently, mobile social interaction characterizes social engagement while using m-learning; it is more than a replication of online learning that can be accessed by laptops. Mobile app features are not generally found on computers like social sharing, audio, video recording, and location-based technology, but they make students engaged more socially. Moreover, mobile devices are universally transportable, potable, and easily accessible anytime and anywhere which supports student's interaction with the content, peers, and instructors. Additionally, findings show that using m-learning could better facilitate interpersonal relationships. The researcher also found that m-learning can afford a higher level of emotional engagement that stimulates cognitive engagement, as shown by many indicators of metacognitive strategies and immersion.

Based on the study's findings, the researcher suggests that instructors can always offer help, support students' learning, and motivate students while using m-learning in class, as this can enhance their self- confidence and maintain their desire and interest in learning to engage them emotionally. Participation and task completion are indicators of behavioral engagement that were found to be influenced by using m-learning. Therefore, researchers suggest that instructors can look for more tools and mobile applications to improve the instructional design of m- learning experiences and promote our theoretical understanding of student engagement. The findings of this study would benefit instructors as they might be encouraged to actively cultivate a constructivism knowledge exchange in a m-learning environment through students' interactions. For example, instructors can demonstrate to students how to provide constructive comments and build on one another's ideas while using m-learning.

Based upon the findings of this dissertation, it seems that m-learning motivated the research participants' students due to its interactivity, portability, accessibility, and convenience of use. While there are other learning environments, such as online learning, that are effective at boosting student engagement, m-learning stands out from them due to its accessibility and usability as well as the fact that it is already familiar and more friendly to the students.

Based on the findings of this dissertation one of the primary implications of mobile learning is that it makes learning more accessible. Mobile devices are more affordable and accessible than traditional computers, which makes them an excellent tool for learners who may not have access to a computer at home or in college. Moreover, mobile learning is also highly flexible. With mobile devices, learners can access learning materials at any time, from anywhere, which means they can learn at their own pace and according to their own schedule. Additionally, mobile learning supports personalized Learning; mobile devices also enable personalized learning, which means that learners can choose the learning materials that are most relevant to them and learn at their own pace. This can help to increase engagement and motivation among learners, as they are more likely to be interested in the learning materials if they are tailored to their needs. Ultimately, mobile learning enhanced collaborative Learning; mobile devices also enable collaborative learning, which means that learners can work together on projects and assignments even if they are not in the same physical location. This can help to foster teamwork and communication skills among learners.

As a result, it will boost student engagement more than other formats of learning environments.

4.4 Research Limitations and future research

As the present study utilized mixed approach method, future quantitative research with a broad selection of college students to study engagement and attitudes in m-learning with more demographic variables like: college level, digital skills, GPA, academic specialty, social status, and academic standing to investigate students' engagement and attitudes in a mobile learning environment.

Another limitation is the course design model which is ADDIE, more efforts should be dedicated to the instructional design process for mobile activities. Different designs

could be adopted to examine the students' engagement in the learning process. The study was conducted in a bachelor's degree course, it would be interesting to design mobile-based courses in different contexts, such as school and post-graduate settings.

One of the limitations the current study is generalizability. Exploring the impact of mobile-based courses across many contexts and subjects, such school and post–graduate settings, is recommended. The fact that this study took place for only one semester is another limitation. The engagement phenomenon on mobile platforms would be better understood with more longitude studies. Additionally, future studies are needed to expand a m-learning theoretical framework similar to the one the researchers used here may address this problem.

Moreover, the researcher is a lecturer carried out the intervention in this course. To minimize this limitation, data trustworthiness was assessed as described in this dissertation. Future research could be conducted with different settings.

4.5 Recommendations

The findings of this dissertation are crucial for further research, and subsequent work can be carried out to strengthen the m-learning field. As the research is blossoming in this field, more papers should be published and reported in a journal form or a conference to allow researchers to collaborate and develop innovative solutions in this field. The use of controlled studies to investigate student involvement using learning analytics is advised for future research.

In addition to the current research in field, additional quantitative research with an experimental design is required to explore students' participation and attitudes in m-learning with many demographic variables that has not been investigated in this dissertation like: academic year, and social status, economic statutes, technological expertise to see if they affect students' engagement in mobile settings in different disciplines. ADDIE instructional design model used in in this course, mobile design activities has to be given more attention. To improve the learning opportunities for students, many designs could be implemented. Future studies should look at how different instructional strategies affect students' experiences, particularly how they interact with mobile devices during the learning process.

Based on the findings of this dissertation, program developers must create new mobile applications with interactive tools, since this will boost students' social engagement, in turn their cognitive and behavioural development.

More experimental research should be performed in this area to designate models to support the use of m-learning applications in the higher education sector. Best practices should be utilized to develop m-learning apps in developing countries. Furthermore, additional studies need to be conducted with different learning theories like connectivism when designing the mobile instructional content. Also, eengagement in the mobile environment could be assessed by different collection tools like: using learning analytics.

As students who used m-learning in this course reported fluctuations in connectivity that interrupt them from learning, the research could solve this issue by adapting the m-learning content to the flow in network resources with low connection where the students can display adequate amount of information to learn.

Unfortunately, instructional designers and teachers should take into their consideration the potential negative influences of m-learning. Although the portable m-learning devices may greatly enhance students' social engagement, they may limit students' behavioral engagement. Instructors should try to balance between learning activities that aim to maintain interpersonal relationships and enhance cognitive skills, in other words it is a good idea to pay attention to social balance and keep it up with the cognitive engagement. On one hand, m-learning may offer more flexibility and easy access to students. On the other hand, there are still some challenges that exist. Also, instructors should take into consideration to create activities that focus on behavioral engagement by posting content that activate students' actions and responses are learners like clicking pages, moving pages up and down to review the contents, and implementing learning analytics. Moreover, instructors should design activities with appealing multimedia components.

Thereafter, the formal implementation of m-learning in higher education to provide equitable access is very much in its infancy. Thisdissertation suggests a strong need for institutional, cross-institutional, national m-learning specific policies to ensure better implementation of m-learning to engage students better.

Policymakers should legislate m-learning policies at the national and local levels in accordance with established policies at all levels. Local policies should drive implementation in specific areas or institutions, while national policies should give overall structure and guidance. The usage of mobile technology in schools and universities may be subject to existing policies that are unduly restrictive. To provide districts and institutions with greater direction, it can be necessary to clarify or amend national policies.

4.6 Implications and Contributions of the dissertation

Although this study is conducted in a Palestinian context, it demonstrates that the m-learning experience has no impact on the personal or cultural background of the students. Therefore, students from various cultural backgrounds may be engaged in the learning process and exhibit similar attitudes when using m-learning. In other words, the study's used framework for engagement and attitudes may be adopted in various educational and cultural contexts. With relation to the usage of m-learning, this study provided a variety of practical guidelines for students, teachers, instructional designers, higher education institutions, and policy makers.

The results of this dissertation support engaging students and encouraging them to enhance their m-learning experience and provide knowledge base for instructors to design interactive mobile activities and with effective learning strategies to create a meaningful learning environment. An initial action step includes augmenting Moodle mobile application for students to include interactive elements that stimulates student's thinking and makes this experience fun. The study also provides a launching point to substantiate the further application and exploration of m-learning in higher education institutions. The results encourage college instructor to instill engagement elements pertaining for learning process. Finally, due to positive results of this experience, policymakers may move forward in decision-making regarding a new m-learning integrating process in the traditional teaching class.

Overall, mobile learning has significant implications for education. It has the potential to make learning more accessible, flexible, personalized, collaborative, interactive, and effective. As such, it is likely to play an increasingly important role in education in the years to come.

List of Abbreviations

Abbreviation	Meaning
ICT	Information and Communication Technology
M-learning	Mobile learning
HE	Higher education
HEI	Higher Education Institutions
ANCOVA	Analysis of Covariance
ADDIE model	analysis, design, development, implementation, and evaluation
MMA	Mobile Moodle Application

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Appendixes

Appendix A

Questionnaire respondents

Sample characteristics

Classification	Category	Number	Proportion
Experimental Group			
Gender	Male	6	24%
	Female	19	76%
GPA	Excellent	3	12%
	V.Good	14	56%
	Good	8	32%
Technical Skills	Excellent	4	16%
	V.Good	12	48%
	Good	9	36%
College level	Third level	16	64%
	Fourth level	9	36%
Control Group			
Gender	Male	8	32%
	Female	17	68%
GPA	Excellent	5	20%
	V.Good	12	48%
	Good	8	32%
Technical Skills	Excellent	12	48%
	V.Good	12	48%
	Good	1	4%
College level	Third level	16	64%
	Fourth level	9	36%

Appendix B

Qualitative participants description

Semistructured interview and focus group participants description

Fictive name		Gender	GPA	College level
Semi structured interviews and focus groups				
1.	S1	Female	Good	Fourth
2.	S2	Female	Good	Fourth
3.	S3	Male	Good	Fourth
4.	S4	Female	Good	Fourth
5.	S5	Female	Excellent	Fourth
6.	S6	Female	Good	Fourth
7.	S7	Female	Excellent	Third
8.	S8	Female	Good	Fourth
9.	S9	Female	Good	Third
10.	S10	Female	Excellent	Third
11.	S11	Male	Good	Third
12.	S12	Female	Very Good	Third
13.	S13	Female	Very Good	Third
14.	S14	Female	Very Good	Third
15.	S15	Male	Very Good	Third
16.	S16	Male	Very Good	Third
17.	S17	Male	Very Good	Third
18.	S18	Female	Very Good	Third
19.	S19	Female	Very Good	Third
20.	S20	Female	Very Good	Third
21.	S21	Female	Very Good	Third
22.	S22	Female	Very Good	Third
23.	S23	Female	Very good	Third
24.	S24	Female	Very Good	Fourth
25.	S25	Male	Very good	Fourth

Appendix C

CourseADDIE model (continuation)

Analysis of students' characteristics: It is the process of determining the minimum abilities and skills that students must have to complete tasks that matches their characteristics, their context and needs. Needs include skills of using Moodle mobile application and designing visual and electronic educational aids according to the psychological and cognitive basics within this course. The researcher reviewed the syllabus of the educational technology course and analyzed it. An initial interview with the participants was conducted to gather information about students' mobile phone usage habits, the brands of phones they use. Students 'characteristics were as follows:

First: Analyzing personal characteristics

1. Number of students: 25 students at PTUK university from the technology education department who are enrolled in an educational technology course in the first semester of 2021/2022 at the Faculty of Arts and Educational Sciences in the main branch in Tukaram. The academic abilities of the students range from medium to very good based their academic records that the researcher knowledgeable of after conducting the initial interview with them. Moreover, the researcher has taught the students several educational courses such as multimedia in education and teaching methods before this course.

2. Socio-economic status: The course consists males and females. All students are unmarried except for a one married female student.

Students are educated within third- and fourth-year level. Female students are not working at that time, male students are not working except two student who work part-time after college hours. Students are supported financially and classified as middle class; they are supported by their parents and the two married female student is supported by her husband.

3. The learners' age ranges from (19- 21(year old, which is the stage of early adulthood. This stage is characterized by several physical, mental, social, and emotional characteristics, including:

a. Characteristics of physical development: In this stage, the individual has reached the peak of biological and physiological development, where motor ability, visual and auditory systems reaches their maximum capability.

b. Characteristics of cognitive development: mental abilities reach their peak during early adulthood, and research confirms that tasks that require speed in response time or reaction time, short-term memory, and the ability to perceive complex relationships are performed in a high manner in the early twenties. In addition to mental maturity, the student is distinguished by developmental tasks of early adulthood like: the ability to deal with abstract concepts and conclusion, the ability to take responsibility, make decisions, rely on oneself, openness to experience, the ability to criticize, autonomy, reflective thinking, and establishing identity. Students at this stage are also distinguished by the ability to think, perseverance, good listening and emotional stability. Students are also characterized by being more performers than their ability to memorize; for this group of students they tend to develop performance and practical abilities because of their specialty.

c. Characteristics of emotional and social development: This stage is characterized by emotional maturity and the ability to handle frustration, control emotions, self-control, self-control, flexibility, and high self-esteem. They have a passion for getting to know new friends, and this freedom allows them to develop successful personal relationships with others, and the topic of the current study helps in the rapid response of students to each other when working in cooperative groups, which increases their performance sharpen their skills and accept the opinions of others.

Second: Analyzing academic characteristics (what experiences are students expected to have as a basis for building appropriate educational environment for m-learning:

• Technical skills

1. The ability to deal with the Android and iOS environment.

2. The ability to connect and roam the Internet, and upload and download files using the mobile device.

3. The ability to deal with mobile applications and web browsers on mobile devices and the ability to deal with some educational platforms such as Moodle.

4. The ability to deal with e-mail, and other communication tools over the network.

5. Each student has a mobile device connected to the WIFI network so that he/ she can access the course at any time.

6. Web searching skills; these skills were provided through their study of several specialization courses such as computer applications, multimedia, and computer maintenance.

Cognitive ability:

At this stage cognition begins to stabilize, characterized by relativistic thinking; young people begin to become aware of more than simplistic views of right vs. wrong. They begin to look at ideas and concepts from different angles and understand that a question can have more than one right (or wrong) answer. They start to use logic thinking to solve real-world problems while accepting contradiction and imperfection. This group of students had a previous experience many educational concepts like: education, instruction, learning, teaching methods, measurement and evaluation.

3. Learning environment Analysis:

Implementation of m-learning in this course certain capabilities like:

Using mobile devices that students have in their possession.

WiFi connection

Downloaded mobile Moodle publication

Android and IOS

4. Content/Task Analysis of educational technology course by identifying knowledge, skills and attitudes needed for the course.

•Knowledge of basic mobile application such as uploading, downloading and creating instructional movies.

Knowledge of basic educational concepts: teaching, learning and instruction.

Effectively handling Gmail

Creating and activating accounts on different mobile applications and websites.

• Skills of using the Moodle application correctly.

• Effective Communication skills with students and lecturers during and after the lecture.

• Thinking skills: analytical, critical and creative thinking.

• Skills of integrating educational technology tools with teaching methods based on constructivist learning that motivate and encourage students to interact, discuss, brainstorm, think, and share knowledge with emphasis on instilling ethics like: privacy, plagiarism, values of respect peers' opinion, and cooperation manners.

Following the scientific method in solving problems while designing and implementing educational aids and encouraging different cooperative learning grouping and problem-based instruction to promote students' learning performance.

• Designing skills of a traditional teaching aids like: visual teaching Aids, audio teaching aids, mechanical teaching aids, Audio-Visual Teaching Aids based on the curriculum.

Define concepts such as:

Education, learning, technology, the importance of technology, fields of technology.

Educational technology, multimedia, visual aids, audio-visual aids, behavioral theory, cognitive theory, the systematic approach of educational technology, the importance of educational technology, Dale pyramid, teaching aids, interactive teaching aids, direct experience, purposeful experience, indirect experience, field trips.

Instructional design, Lewis Brown model, Kemp model, Hammerus mini model, ASSURE model, computer in education, computer in education strategies, simulation, gamification, e-learning, synchronous e-learning, asynchronous e-learning, multimedia, interactive e-learning tools, blended learning, blogs, e-learning management system, virtual reality, virtual classrooms, interactive video, digital library, blogs,….. etc

Attitudes identifications

• Appreciate the efforts of programmers and application makers for m-learning.

• Internet knowledge and internet skills (digital skills): using internet **cautiously** when using m-learning.

• Cooperate and collaborate with students during m-learning activities.

• Avoiding bias in judgment.

• publishing and sharing information.

• Time management.

• Respect privacy of colleagues and lecturers while using mobile devices.

• Avoiding fraud and plagiarism while publishing and sharing information on mobile devices.

• Patience while using mobile devices for learning.

• Dealing wisely with the obstacles that pop up during the use of m-learning.

• Training on deliberation when conducting course activities.

• Active listening.

• Accept criticism and feedback positively.

• The student's ability to express themselves properly.

Based on the previous task analysis the following learning objectives could be formulated:

- Identify, describe, and apply emerging technologies in teaching and learning environments
- Demonstrate knowledge, attitudes, and skills of digital age work and learning
- Plan, design, and assess effective learning environments and experiences
- Implement curriculum methods and strategies that use technology to maximize student learning
- Develop technology-enabled assessment and evaluation strategies
- Extend student learning beyond the walls of the classroom.
- Prepare students to be safe, responsible and innovative digital citizens
- Enable students to take responsibility for their own learning
- Provide students with the tools to be successful in their future teaching profession.
- Provide equal access to technology and tools to all students in order to provide equal opportunities for all students
- Provide necessary technology for students to facilitate learning.
- Utilize specific and interactive mobile applications for supplemental instruction like padlet, word wall, and brainscape.

Learning outcome are identified as follows:

- Discuss history and impact of educational technology.
- Identify factors that influence the development of educational technology like
- behaviorism, communication theory, and information technology.
- Define concept of educational technology and identify the stages of its development.
- Determine the relationship between instructional design and instructional technology.
- Distinguish between educational technology and instructional technology
- Explaining the psychological and educational factors associated with the development of the concept of educational technology
- Clarify the difference between educational technology and instructional technology.
- Explain the importance of using educational communication technology in education.
- Explanation of the steps for designing educational aids.

- Differentiate between educational designs
- Explain concepts of multimedia
- Produce online instructional material like: google sites for a lesson, interactive instructional videos, online quizzes.
- Produce instructional material for a lesson in technology curriculum.
- Apply evaluation criteria for teaching aids in classroom.

Methods: Instructional Strategies:

• Interactive teaching (discussion of objectives / use of technological tools such as padlet / interactive videos).

•Brainstorming

• Project based learning

• Flipped Learning

• Survey strategy.

• Concept maps

• Cooperative Learning

• gamification

• Peer Learning: Think Pair Share

To design a more engaging course by moodle mobile application for this study, interactive a, timeliness, learnability, memorability, error, and cognitive load, were considered during the design phase of the course.

Appendix D

Course design for one week

تصميم الخطة الدراسية لمساق تكنولوجيا التعليم باستخدام تطبيق مودل التعليمي

INSTRUCTIONAL PLAN Length: 36 **lectures (45 mins each)**

Sequence of instructional procedures/activities/events:

الأسبوع الأول: التكنولوجيا

المحاضرة الأولى: مفهوم التكنولوجيا

الهدف العام:

التعرف على مفهوم التكنولوجيا

تمكن الطلبة من استخدام بعض تطبيقات جوجل مثل الجيميل ومستندات جوجل.

تحليل حاجات الطلبة التعليمية من خلال المناقشة وطرح أسئلة عن خبراتهم السابقة عن تكنولوجيا التعليم والوسائل التعليمية و مهاراتهم التقنية لتفعيل استخدام التعلم النقالعن طريق عمل مقابلات واستجواب الطلبة حول المساقات التي تم اجتيازها مثل مدخل الى التربية وأساليب التدريس وعلم نفس تربوي و القياس والتقويم ومساقات الحاسوب مثل صيانة الحاسوب وتطبيقات الحاسوب.

تحليل خصائص الطلبة: يمكن تحليل خصائص الطلبة عن طريق اجراء مناقشة صفية لتشخيص خصائصهم الاكاديمية و الثقافية والاجتماعية واتجاهات الطلبة نحو استخدام التعلم النقال في التعليم و الاستفسار عن مهاراتهم التقنية لاستخدام الحاسب اللوحي والهواتف الذكيةودافعيتهم نحو استخدام التعلم النقال في التعليم.

تحليل البيئة الصفية: معرفة المتطلبات اللازمة للمحاضرة من توفر قاعة دراسية مناسبة لعدد الطلبة مع تواجد الانترنت والأجهزة النقالة للطلبة والمحاضر و توفر المصادر التعليمية التي سيتم استخدامها مثل المصادر

المفتوحة والتطبيقات التعليمية على الأجهزة النقالة وتنزيل بعض التطبيقات على الجهاز مثــل تطبيــق مــودل وتطبيقات جوجل.

تحليل المحتوى ويشمل المفاهيم والإجراءات والحقائق مثل مفهوم التكنولوجيا ومستندات جوجل لهذه المحاضرة.

التصميم:

المخرجات التعلمية

أن ينشئ الطالب جيميل خاص به بعد مشاهدة الفيديوهات التعليمية القصيرة عن طريق الأجهــزة النقالــةخلال المحاضرة.

أن يوضح الطالب مفهوم التكنولوجيا بلغته الخاصة من خلال المناقشة الصفية والمشاركة في مستندات جوجــل باستخدام الأجهزة النقالة.

أن يعطي الطالب أمثلة على أدوات تكنولوجية يستخدمها بحياته العملية والعلمية عــن طريــق اســتخدامتطبيق لبرنامج Padlet باستخدام الأجهزة النقالة.

أن يناقش الطالب مفهوم التكنولوجيا مع زملائه خلال المحاضرة.

أن يصدر الطالب حكما على طبيعة التكنولوجيا في حياته العلمية والتي يستخدمها بشكل يومي.

أن يقدر الطالب أهمية التكنولوجيا في حياته اليومية وكيف تدعم تعلمه من خلال مناقشة المحاضر وزملائه.

تحديد الاستراتيجيات التعليمية: استراتيجية العصف الذهني و المحاضرة والتعلم الــذاتي و اســتراتيجية الــتعلم التعاوني.

تحديد أدوات التقويم التكويني أثناء هذه المحاضرة وهي المناقشة و استخدام مستندات جوجل.

تحديد الوسيلة: المنصة التي سيتم استخدامها وهي منصة مودل واستخدام الأجهزة النقالة بين أيدي الطلبة.

التعلم التعاوني.

التطوير

-انتاج أنشطة تدريبية باستخدام تطبيقات جوجل مثل العمل التعاوني علـــى مســـتند جوجـــل لتوضـــيح مفهـــوم التكنولوجيا

/

الاسم	ماذا تعني لكم التكنولوجيا	صورة تمثل التكنولوجيا
سمية هندي	التكنولوجيا هي: كلمة يونانيّة الأصل، تتألّف من مقطعين، وهما: "تكنو"، التي تعني فن، أو حرفة، أو أداء، أمّا المقطع الثاني فهو "لوجيا"، أي دراسة، أو علم، وبذلك فإنّ كلمة تكنولوجيا تعني علم المقدرة على الأداء، أو التطبيق. يُمكن تطبيق التكنولوجيا في جميع مجالات الحياة اليوميّة، إذ تُستخدم في العمل، والاتصالات، والنقل، والتعليم، والتصنيع، والتجارة، وغيرها من الاستخدامات التي تُفيد الإنسان إذا تمّ استخدامها بشكل صحيح.	
تيماء شواهنه	إنّ التكنولوجيا تقوم بتوظيف مجموع المعارف المختلفة، من أجل تحقيق رغبات الإنسان بهدف التقدم في المجتمع الذي يعيش فيه كما أنها النظام المسئول عن تصنيع الأشياء وعن استخداماتها، ويتضمن هذا النظام على العنصر البشري والعديد من العوامل الأخرى مجتمعين سوياً.	
ارين عمرو	اسلوب حياة مطلوب مع التطور والتقدم الحاصل في المجتمع	

حسب خبرات الطالب السابقة عن طريق العصف الذهني.

استيراد أفلام تعليمية قصيرة من اليوتيوب عن مفهوم التكنولوجيا.

رفع الأنشطة عن التكنولوجيا وفوائدها

التنفيذ

تحفيز الطلبة وجلب انتباههم عن طريق فيلم تعليمي قصير عن مصطلح تكنولوجيا بشكل جماعي.

توضيح طريقة انشاء حساب جيميل عن طريق فيلم قصير يشاهده الطالب باستخدام الجهاز النقال والمتابعة مـــع المحاضر ان كان لديه أي استفسار.

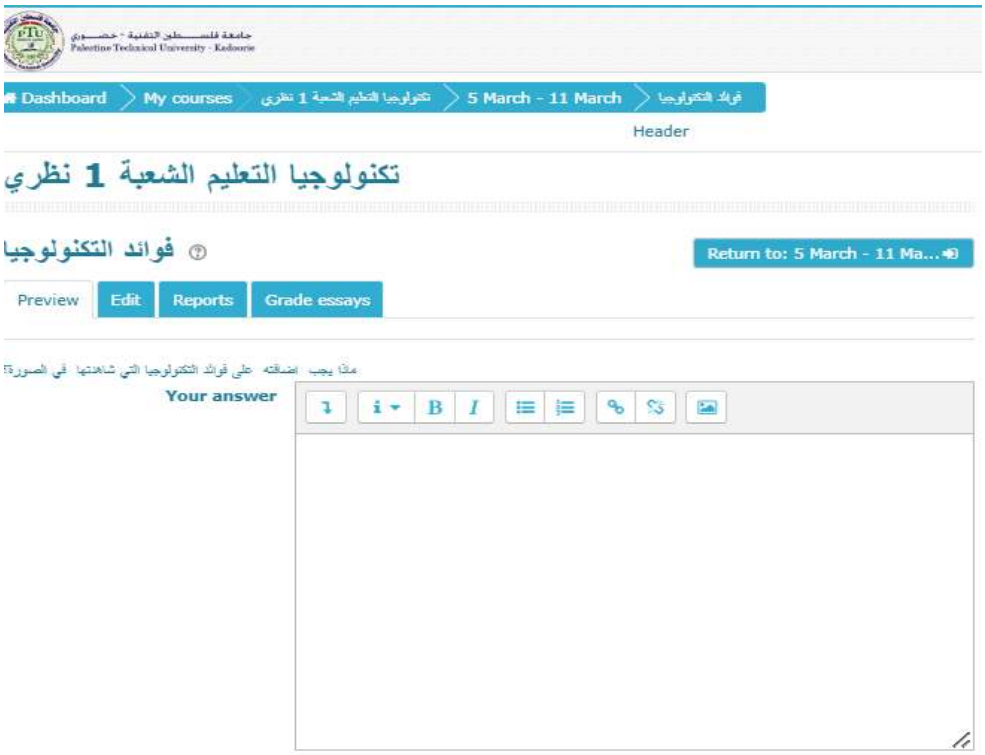
استخدام أسلوب العصف الذهني و كتابة ماذا تعني التكنولوجيا باستخدام مستندات جوجل بشكل تعاوني ومن ثمة مناقشة الأفكار والعبارات والتوصل لمفهوم التكنولوجيا.

شرح معلومات عن مفهوم التكنولوجيا من واقع الحياة العملية ومناقشة الطلبة بشكل جماعي عن طريقة المناقشة والحوار.

الانتقال الى نشاط عن فوائد التكنولوجيا على مودل والاجابة عن الأسئلة التي تلي هذا النشاط.

التقويم: أن يختر الطالب أحد تعليقات زملائه عن تعريف التكنولوجيا الذي نشره على مستندات جوجل ويضيف عليه بشكل شفهي حسب وجهة نظره بعد استكمال الشرح. (تقويم تكويني)

أن يجيب الطالب على السؤال التالي:

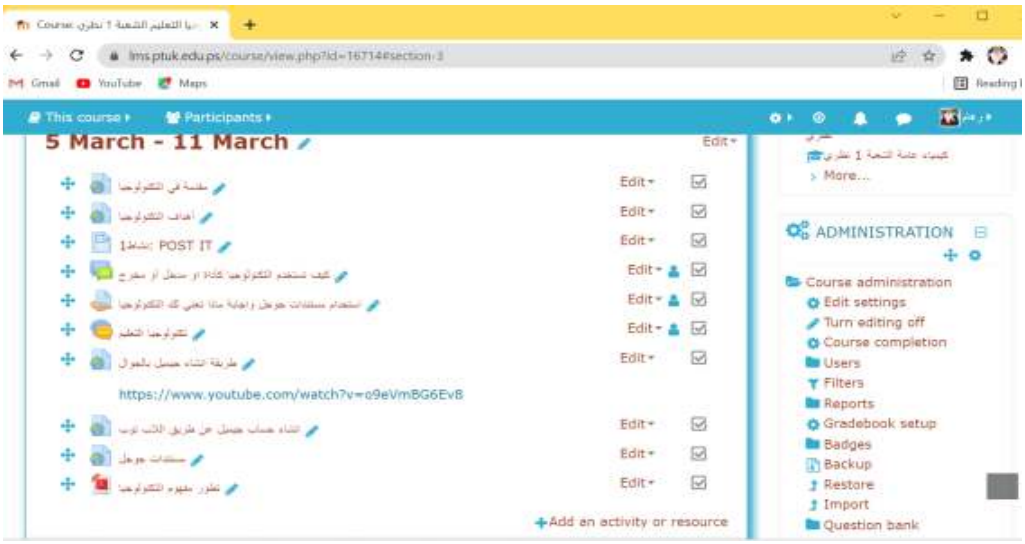


أن يجيب الطالب على الواجب المنشور على المودل بعد قراءة الورقة العلمية تطور مفهوم التكنولوجيا واستخداماته في العملية التعليمية. وتتمثل الأسئلة فيما يلي:

وضح كيف تغير مفهوم التكنولوجيا على مر الأزمة.

هل تؤيد استخدام التكنولوجيا في العملية التعليمية ووضح السبب.

(تقويم ختامي)


lms.ptuk.edu.ps/course/view.php?id=16714#section-3
This course
Participants
5 March - 11 March
Edit
1نشاط: POST IT
https://www.youtube.com/watch?v=o9eVmBG6Ev8
Add an activity or resource
More...
ADMINISTRATION
Course administration
Edit settings
Turn editing off
Course completion
Users
Filters
Reports
Gradebook setup
Badges
Backup
Restore
Import
Question bank

Appendix E

Face validity

أسماء المحكمين للاستبانات

الرقم	الاسم	الدرجة العلمية	التخصص	مكان العمل
1	أ.د. خالد خنفر	أستاذ دكتور	التعلم الالكتروني	دائرة التعلم الالكتروني – جامعة فلسطين التقنية خضوري
2	أ.د. فؤاد إسماعيل عياد	أستاذ دكتور	المناهج وتكنولوجيا التعليم	كلية التربية – جامعة الأقصى – غزة
3	ا. د. جولتان حجازي	أستاذ مشارك	علم نفس تربوي	التربية التكنولوجية–جامعة فلسطين التقنية خضوري
4	ا.د. عفيف زيدان	أستاذ دكتور	مناهج وطرق تدريس	جامعة القدس–أبوديس
4	د. مجدي الجيوسي	أستاذ مشارك	علم نفس تربوي	التربية التكنولوجية–جامعة فلسطين التقنية خضوري
5	د. نهى عطير	أستاذ مشارك	تكنولوجيا تعليم	الدراسات العليا–جامعة فلسطين التقنية خضوري
6	د. هشام شناعة	أستاذ مساعد	علم نفس تربوي	التربية التكنولوجية–جامعة فلسطين التقنية خضوري
7	د. ريما دراغمة	أستاذ مشارك	المناهج وطرق التدريس	التربية التكنولوجية–جامعة فلسطين التقنية خضوري
8	د. زهير اخليف	أستاذ مساعد	تكنولوجيا التعليم	جامعة النجاح الوطنية
9	د. محسن عدس	أستاذ مشارك	المناهج وطرق التدريس	جامعة القدس–أبوديس
10	د.حسن عبدالكريم	أستاذ مساعد	دائرة المناهج والتعليم	جامعة بيرزيت–رام الله

قائمة المحكمين للتصميم التعليمي على مودل

الرقم	الاسم	الدرجة العلمية	التخصص	مكان العمل
.1	أ.د. فؤاد إسماعيل عياد	أستاذ دكتور	المناهج وتكنولوجيا التعليم	كلية التربية – جامعة الأقصى – غزة
.2	ا.د. مجدي سليمان عقل	أستاذ دكتور	المناهج وتكنولوجيا التعليم	كلية التربية– الجامعة الإسلامية–غزة
.3	د. نهى عطير	أستاذ مشارك	تكنولوجيا تعليم	الدراسات العليا–جامعة فلسطين التقنية خضوري
.4	د. بلال يونس	أستاذ مشارك	تكنولوجيا التعليم	جامعة فلسطين التقنية خضوري
.5	د. معاذ عمر	أستاذ مساعد	مناهج وطرق التدريس	جامعة فلسطين التقنية خضوري
.6	د. زهير اخليف	أستاذ مساعد	تكنولوجيا التعليم	جامعة النجاح الوطنية
.7	د. يوسف صباح	أستاذ مشارك	تكنولوجيا المعلومات	جامعة القدس المفتوحة–رام الله

قائمة المحكمين لأسئلة المجموعة البؤرية والمقابلة

الرقم	الاسم	الدرجة العلمية	التخصص	مكان العمل
1	د. زهير اخليف	أستاذ مساعد	تكنولوجيا التعليم	جامعة النجاح الوطنية
2	د. عبدالغني الصيفي	أستاذ مشارك	مناهج وطرق التدريس	جامعة النجاح الوطنية
3	د. معاذ عمر	أستاذ مساعد	مناهج وطرق التدريس	جامعة فلسطين التقنية خضوري

Appendix F

Engagement scale

Table F.1: Engagement Scale

العبارة	أوافق بدرجة كبيرة جدا	أوافق بدرجة كبيرة	أوافق بدرجة متوسطة	أوافق بدرجة ضعيفة	أوافق بدرجة ضعيفة جدا
الانخراط السلوكي					
1. أواظب على الانتظام في الدراسة خلال تعلمي					
2. أعيد النظر في ملاحظاتي السابقة أثناء حل في هذا المساق					
3. أدون الملاحظات للمساق الذي أدرسه أثناء تعلمي في هذا المساق.					
الانخراط المعرفي					
4. عندما تواجهني مشكلة نتيجة عدم فهم المعلومات، استمر في محاولاتي حتى يتم استيعابها					
5. أبحث عن المزيد من المعلومات أثناء تعلمي عندما أواجه ما يتحداني					
6. أكرر حضور المحاضرات الالكترونية لأصل للفهم والاستيعاب في حال عدم قدرتي على استيعاب المعلومات من أول مرة للمشاهدة					
الانخراط العاطفي					
7. تزداد دافعيتي أثناء تعلمي هذا المساق.					
8. أشعر بالمتعة في دراستي لهذا المساق.					
9. أواظب على حضور الأفلام التعليمية للمساق					
الانخراط الاجتماعي					
10.أشارك في المناقشات الجماعية بانتظام في هذا المساق.					
11.أستجيب غالبا لأسئلة الزملاء بما يخص المساق عندما يطلبون المساعدة أثناء تعلمهمز					
12.أشارك المواد التعليمية(روابط، أفلام تعليمية، ملخصات...) مع زملائي في هذا المساق.					

Table F.2: Reliability of engagement scale

Dimensions	Constructs (No.)	Cronbach's Alpha
Emotional	3	.748
Behavioral	3	.729
Cognitive	3	.791
Social	3	.727
Total	12	.793

Appendix G

Attitudes scale

جدول G.1 استبانة الاتجاهات للطلبة نحو التعلم النقال

العبارة	أوافق بشدة	أوافق	محايد	أعارض	أعارض بشدة
المجال الانفعالي					
1. دراستي تحسنت بشكل أفضل قي هذا المساق.					
2. أشعر بالراحة عند تعلمي بسبب تمكني من الوصول الى المحتوى التعليمي بكل سهولة					
3. أشعر بأن التعلم بهذا المساق يشكل عبئا ثقيلا علي عند الدراسة.					
4. أهتم كثيرا في هذا المساق أكثر من غيره.					
5. دافعيتي ازدادت في هذا المساق.					
6. أشعر بالسعادة عندما أتعلم في هذا المساق.					
7. أشعر بالثقة بالنفس عند التعلم في هذا المساق.					
8. أشعر بالقلق من الزامي باستخدام االجهاز النقال في مساقات أخرى.					
المجال السلوكي					
9. بامكاني الوصول الى موضوعات مختلفة في هذا المساق.					
10. استخدم تطبيقات متنوعة أثناء تعلمي.					
11. يسهل التعلم النقال عملية التعلم.					
12. أجد صعوبة في التعامل مع الجهاز النقال					
13. لقد تغيرت طريقة تعلمي في هذا المساق.					
المجال المعرفي					
14. تساعدني طريقة تعلمي الوصول للمعلومة في هذا المساق.					
15. يدعم الجهاز النقال دراستي لهذا المساق.					
16. اعتقد أن عملية تعلمي في هذا المساق كانت إيجابية.					
17. الجهاز النقال لا يدعم تعلمي.					
18. اتسم تعلمي في هذا المساق بالمرونة التي تتيح الوقت والمساحة للتواصل بين المحاضر والطلبة					
19. ينمي تعلمي في هذا المساق مهاراتي المستقبلية التي سأحتاجها في مستقبلي المهني.					
20. طريقة التعلم في هذا المساق تعيق دراستي وتعملي في مساقات أخرى.					

Table G.2: Reliability statistics for attitudes scale

Component	Constructs	Cronbach's Alpha
Emotional	8	.868
Behavioral	5	.760
Cognitive	7	.736
Total	20	.839

Appendix H

Moodle course logs

Table H.1:Moodle course logs

IP address	Origin	Description	Event Name	Activity	Student Name	Event context	Access date, time
206.84.64.19	ws	The user with id '9705' viewed the 'url' activity w ith course module id '806503'.	Course module viewed	URL: نشاط عن أهميةتكنول وجيا التعليم	مرح سعد محمد عساروه	Course تكنولوجيا لتعليم الشعبة 1 نظري	10/06/22 , 00:57

Table H.2: Indicators of behavioral engagement

Behavioral engagement in course logs	Indicators
Participation rate Interaction rate Task completion rate	Participates in discussions, watches mini videos, Interact to posts on padlet, google docs, and Edmodo. Complete assignments, turn in projects.

Table H.3: Course logs measurement

Measurement	Mean
Participation rate	91.2%
Interaction rate	92%
Task completion rate	89.7%

Appendix I

Assumptions for ANCOVA for engagement

Table I.1: Normality test of post scale engagement scores(Shapiro-Wilk)

Dimensions							
	Statistic	**Df**	**P**	**Dimension**	**Statistic**	**Df**	**P**
Cognitive pre	.953	25	.297	Cognitive post	.942	25	.167
Behavioral pre	.919	25	.050	Behavioral post	.918	25	.050
Social pre	.923	25	.059	Social post	.943	25	.173
Emotional pre	.940	25	.146	Emotional post	.941	25	.156
Pre total	.930	25	.088	Post total	.459	25	.310
Cognitive pre	.942		.161	Cognitive post	.928		0.077
Behavioral pre	.942		.167	Behavioral post	.935	25	.111
Social pre	.965		.334	Social post	.978	25	.853
Emotional pre	.939		.139	Emotional post	.939	25	.142
Pre total	.983		.934	Post total	.942	25	.167

Table I.2: Levene's Test of Equality of Error Variances for engagement scale

Dependent variable	**F**	**df1**	**df2**	**Sig.**
Total post	3.715	5	44	.060
Emotional post	3.489	1	48	.068
Cognitive post	3.955	1	48	.052
Behavioral post	1.843	1	48	.181
Social post	.489	1	48	.448

Table I.3: Test of Homogeneity of Regression Slopes for total engagement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Group	9.467	1	9.467	86.524	.328
pre_total * group	.221	3	.074	.672	.581
Total	492.077	50			
Corrected Total	33.502	49			
Group	17.983	1	17.983	55.519	.774
group * social pre	.362	2	.181	.558	.577
Total	508.303	50			
Group	1.025	1	1.025	4.219	.046
group * emotional_mean	.386	2	.193	.795	.458
Total	361.737	50			
Group	6.559	1	6.559	15.574	.393
group * behavioral	.713	5	.143	.339	.886
Total	431.894	50			
Group	1.192	1	1.192	3.582	.065
group * cog	.603	2	.302	.906	.411
Total	358.577	50			

Table I.4:T-test for engagement scores before the m-learning usage

Component	Experimental *M* (*SD*)	Control *M* (*SD*)	*T*	*p*
Emotional	1.786 (0.347)	1.775 (.397)	0.102	0.554
Behavioral	1.984 (.322)	2.016 (.325)	-.354	0.725
Cognitive	1.832 (.403)	1.948 (.386)	-1.038	0.304
Social	1.759(.422)	1.876 (.217)	-1.233	0.225
Engagement	1.840 (.227)	1.904 (.194)	-1.063	0.293

Appendix J

Assumptions for ANCOVA for attitudes

Table J.1: Normality test for attitudes (Shapiro Wilka)

	Dimension	Statistic	Df	P
Control	Cognitive pre	.929	25	.083
	Behavioral pre	.932	25	.094
	Emotional pre	.962	25	.461
	Pre total	.940	25	.149
	Behavioral post	.921	25	.054
	Cognitive post	.929	25	.083
	Emotional post	.930	25	.085
	Total post	.925	25	.068
Experimental	Cognitive pre	.944	25	.188
	Behavioral pre	.968	25	.596
	Emotional pre	.963	25	.478
	Pre total	.940	25	.149
	Behavioral post	.959	25	.397
	Cognitive post	.968	25	.593
	Emotional post	.960	25	.424
	Total post	.958	25	.378

Table J.2: Levene's Test of Equality of Error Variances for attitudes

Dependent variable	F	df1	df2	Sig.
Total	.425	1	48	.518
Emotional	.346	1	48	.559
Behavioral	1.200	1	48	.279
Cognitive	1.210	1	48	.277

Note. Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

Dependent Variable: total post scores

Table J.3: Regression of slopes for attitudes

	Source	SS	Df	MS	F	P
Emotional pre	Group	1.025	1	1.025	4.219	.046
	group * emotional pre	.386	2	.193	.795	.458
	Total	11.170	50	.243		
Behavioral pre	Group	.332	1	.332	1.298	.260
	group * behavioral pre	.922	2	.461	1.802	.176
	Total	11.775	50	.256		
Cognitive pre	group	1.192	1	1.192	3.582	.065
	group * cog pre	.603	2	.302	.906	.411
	Total	15.315	50	.333		
Total pre	Group	.235	1	.235	.973	.329
	group * meanpre	.447	2	.224	.926	.403
	Total	11.109	50	.242		

Table J.4: T-test for attitudes scores before m-learning intervention

Component	Experimental *M*(*SD*)	Control *M*(*SD*)	*T*	*P*
Emotional	1.830 (0.658)	1.975 (0.546)	–0.848	0.401
Behavioral	2.312 (.391)	2.076 (.612)	1.622	0.112
Cognitive	2.131 (.685)	2.051 (.679)	0.414	0.680
Attitudes	2.142 (.324)	2.110 (.349)	0.346	0.731

Appendix K

Engagement and Attitudes themes percentage

Table K.1: Percentages of four engagement themes in m-learning

Category	themes	Codes	f	%
Social Engagement	Competition	Win, lose, need to be recognized	20	29
	Building community	Share, collaborate, participate in activity.	50	
	Mobile social interaction	Interact with instructional material, interact with mobile interface, discuss, Interact with classmates, interact with instructor	99	
	Developing relationship	Connect, become friends, out side class room	4	
	Sense of belonging	Close relationship with peers Close relationship with teachers		
Cognitive Engagement	Attention	Attention, stay focused	20	27
	Cognitive Strategies	Remembering, memorizing, analyzing	78	
	Metacognitive Strategies	Problem solving, evaluation, monitor their own progress, self-reflect.	30	
	Not feeling the time	immersed, state of flow	30	
	Curiosity	Asking question, interest	15	
Emotional Engagement	Excitement and enjoyment	I feel happy, I feel relaxed, I feel wonderful, I am excited, I was waiting for this class.	73	**%25**
	Instructor presence	Teacher presence makes a difference, the instructor encouraged and guided, she was supporting us, she was motivating	63	
	Motivation	I was motivated, I open the app at home frequently, enthused	27	
	Emotional Safety	Feel confident, express self, less shy		
Behavioral Engagement	Effort and time on task	Practice solving problems.	20	19
	Participation	Discuss, take part, comment.	43	
	Attendance	Attend classes	31	
	Positive behavior	Work effectively, Respect, privacy	28	

Table K.2: Themes and subthemes of attitudes towards m-learningpercentages

Themes	Sub-themes	Agreement	Disagreement	Neutral
Cognitive Component	Personalized learning	88	4	8
	visualizing learning	95	2	4
	Percentage	92		
Behavioral component	Flexible learning	96	0	0
	Enhancing participation	92	0	8
	Learning on familiar devices	93	0	0
	Social interaction	96	4	12
	Gender stereotype and equity access	80	20	0
	Percentage	91		
Emotional component	motivation	88	12	0
	Self-concept	72	14	14
	Fewer learning frustrations	92	6	2
	M-learning fun	92	5	3
	Percentage			
			86	

Appendix L

Two way ANCOVA of engagement due to the effect of the interaction between gender and groups

Dimension	Source	SS	df	MS	F	P	η_p^2
Total	pre_total	.353	1	.353	3.141	.083	.065
	Group	21.956	1	21.956	195.140	.000	.813
	Gender	.153	1	.153	1.360	.0250	.029
	group * gender	.087	1	.087	.773	.0384	.017
	Total	477.155	50				
Cognitive	Cognitive	.867	1	.876	1.893	.176	.040
	Group	37.756	1	37.756	82.432	.000	.647
	Gender	1.352	1	1.352	2.952	.093	.062
	group * gender	.586	1	.586	1.279	.264	.028
	Total	522.924	50				
	Emotional	.065	1	.065	.358	.553	.008
	group	31.060	1	31.060	170.041	.000	.791
	gender	.277	1	.277	1.516	.225	.033
	group * gender	.234	1	.234	1.283	.263	.028
	Total	488.738	50				
	Social	.156	1	.156	.519	.475	.011
Social	group	22.732	1	22.732	75.764	.000	.627
	gender	.412	1	.412	1.374	.247	.030
	group * gender	.267	1	.267	.890	.350	.019
	Total	508.303	50	Total			
Behavioral	Behavioral	.845	1	.845	4.412	.120	.053
	Group	8.067	1	8.067	2.518	.000	.348
	Gender	1.401	1	1.401	4.177	.047	.085
	group * gender	.821	1	.821	2.447	.125	.052
	Total	402.504	50				

Appendix M

Two way ANCOVA of engagement

Table M.1: Two way ANCOVA of engagement and its dimension due to the interaction of technical skills and groups

Dimension	Source	SS	Df	MS	F	P	η_p^2
	Cognitive	1.687	1	1.687	5.275	.027	.109
	Group	25.380	1	25.380	79.349	.000	.649
	Skills	2.527	2	1.264	3.951	.027	.155
	group * skills	3.669	2	1.834	5.735	.006	.211
	Total	527.383	50				
Emotional Dimension	emotional	.048	1	.048	.248	.621	.006
	group	19.404	1	19.404	100.763	.000	.701
	skills	.164	2	.082	.425	.657	.019
	group * skills	.517	2	.258	1.341	.272	.059
	Total	488.738	50				
Behavioral Dimension	Behavioral	1.148	1	1.148	2.988	.091	.065
	Group	3.629	1	3.629	9.444	.004	.180
	skills	.779	2	.390	1.014	.371	.045
	Total	498.320	50	.130	.339	.714	.016
Social Dimension	social	.001	1	.001	.002	.961	.000
	group	14.268	1	14.268	54.559	.000	.559
	skills	.912	2	.456	1.744	.187	.075
	group * skills	1.860	2	.930	3.556	.037	.142
	Total	508.303	50				
Total Dimension	Group	14.216	1	14.216	144.121	.000	.766
	Skills	.750	2	.375	3.802	.030	.147
	group * skills	1.182	2	.591	5.992	.005	.214
	Total	477.155	50				

Table M.2: Estimated marginal means of social dimension due to the interaction of technical skills and groups

Technical skills	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Weak	3.063[a]	.299	2.460	3.665
Good	2.939[a]	.117	2.704	3.174
Strong	3.528[a]	.170	3.185	3.870

Note. Dependent Variable: social post

Appendix N

Means for attitudes

Table N.1: Means for attitudes scores after m-learning and its componentMeans for attitudes scores after m-learning

Group	Experimental *M* (*SD)*	Control *M* (*SD*)
Emotional	3.110 (0.662)	1.830 (0.658)
Behavioral	3.343(0.654)	1.936 (0.512)
Cognitive	3.325 (0.640)	2.131(0.685)
Attitudes	3.302(0.593)	2.050 (0.443)

Table N.2: Analysis of covariance (ANCOVA) summary table for attitudes and its component scores by group condition

DV	Source	SS	Df	MS	F	Sig.	$^2\mu_p$
Emotional post	Emotional pre	3.967	1	3.967	10.981	.002	.189
	group	22.409	1	22.409	62.039	.000	.569
	Total	346.469	50				
Behavioral post	Behavioral pre	.135	1	.135	.557	.459	.012
	Group	23.840	1	23.840	98.106	.000	.676
	Total	361.737	50				
Cognitive post	Cognitive pre	.502	1	.502	1.531	.222	.032
	Group	20.912	1	20.912	63.753	.000	.576
	Total	358.577	50				
Total post	Total pre	.011	1	.011	.045	.834	.001
	group	24.288	1	24.288	98.870	.000	.678
	Total	361.737	50				

Table N.3: Estimated Marginal Means of attitudes scores and its component

Source	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Total post	experimental	3.251[a]	.099	3.051	3.450
	Control	1.855[a]	.099	1.656	2.055
Cognitive Post	experimental	3.183a	.115	2.952	3.413
	Control	1.887a	.115	1.656	2.118
Behavioral Post	Experimental	3.262[a]	.100	3.061	3.463
	Control	1.844[a]	.100	1.643	2.045
Emotional post	Experimental	3.144[a]	.121	2.902	3.387
	Control	1.796[a]	.121	1.553	2.038

Appendix O

Two Way (ANCOVA) summary table for interaction of gender on attitudes scores and its components by group condition

DV	Source	SS	Df	MS	F	P	$^2\mu_p$
Emotional post	Emotional pre	2.935	1	2.935	8.425	.006	.158
	group	20.064	1	20.064	57.601	.000	.561
	gender	.030	1	.030	.085	.772	.002
	group * gender	1.301	1	1.301	3.736	.060	.077
	Total	346.469	50				
Behavioral post	Behavioral pre	.117	1	.117	.380	.541	.008
	group	20.448	1	20.448	66.314	.000	.596
	gender	1.414	1	1.414	4.585	.038	.092
	group * gender	.698	1	.698	2.262	.140	.048
	Total	404.760	50	Total			
Cognitive post	Cognitive pre	.012	1	.012	.029	.865	.001
	group	12.956	1	12.956	30.807	.000	.406
	gender	1.125	1	1.125	2.675	.109	.056
	group * gender	.521	1	.521	1.239	.272	.027
	Total	411.204	50				
Total post	Total pre	.029	1	.029	.104	.748	.002
	group	13.972	1	13.972	49.426	.000	.523
	gender	.001	1	.001	.002	.963	.000
	group * gender	.154	1	.154	.545	.464	.012
	Total	397.057	50				

Appendix P

Two way ANCOVA of interaction between technical skills and groups

Table P. 1: Two way (ANCOVA) summary table for interaction of technical skills on attitudes scores and its components by group condition

DV	Source	SS	Df	MS	F	P	η_p^2
Emotional post	Emotional pre	3.506	1	3.506	10.408	.002	.195
	Group	19.831	1	19.831	58.866	.000	.578
	Skills	1.615	2	.807	2.397	.103	.100
	group * skills	.773	2	.386	1.147	.327	.051
	Total	346.469	50				
Behavioral post	Behavioral pre	.898	1	.898	2.442	.125	.054
	Group	50.916	1	50.916	138.496	.000	.763
	Skills	2.127	2	1.064	2.893	.066	.119
	group * skills	.013	2	.007	.018	.982	.001
	Total	498.320	50				
Cognitive post	Cognitive pre	.006	1	.006	.029	.865	.001
	Group	21.866	1	21.866	113.329	.000	.725
	Skills	6.592	2	3.296	17.083	.000	.443
	group * skills	1.317	2	.658	3.412	.042	.137
	Total	357.017	50				
Total post	Total pre	.025	1	.025	.088	.768	.002
	group	18.445	1	18.445	64.269	.000	.599
	skills	.087	2	.043	.151	.860	.007
	group * skills	.379	2	.189	.660	.522	.030
	Total	397.057	50				

Table P.2 : Estimated margin for post cognitive scores of ANCOVA (Interaction of technical skills and group with cognitive component of attitudes as a dependent variable

Technical skills	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Weak	2.200[a]	.104	1.990	2.409
Good	2.468[a]	.094	2.279	2.657
Strong	3.224[a]	.141	2.940	3.509

Covariates appearing in the model are evaluated at the following values: cognitive pre = 2.0914.

Table P.3: post hoc test for ANCOVA (Interaction of technical skills and group with cognitive component as a dependent variable.

I) technical skills	(J) technical skills	Mean Difference (I-J)	Std. Error	P	95% Confidence Interval for Difference[b]	
					Lower Bound	Upper Bound
Weak	Good	-.268	.140	.184	-.616	.079
	Strong	-1.025*	.177	.000	-1.464	-.585
Good	Weak	.268	.140	.184	-.079	.616
	Strong	-.756*	.170	.000	-1.181	-.332
Strong	Weak	1.025*	.177	.000	.585	1.464
	Good	.756*	.170	.000	.332	1.181

Appendix Q

Certificate of acceptance of the research extracted from the dissertation

Research title: University Students' Engagement in Mobile learning.

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جامعة النَّجاح الوطنيَّة
كليَّة الدّراسات العليا

تطبيق التكنولوجيا النقالة: أثر تطبيقات الهاتف الذكي في التعلم على أنماط الانخراط واتجاهات التعلم لدى طلبة التربية التكنولوجية

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رهام أحمد محمد سلحب

إشراف
أ. د. وجيه ضاهر

قدمت هذه الأطروحة استكمالا لمتطلبات الحصول على درجة الدكتوراه في التعلم والتعليم، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس – فلسطين.

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إعداد

رهام أحمد محمد سلحب

إشراف

أ. د. وجيه ضاهر

الملخص

لقد أدى تطور تكنولوجيا المعلومات والاتصالات إلى إحداث تغير في عمليات التدريس والتعلم في مؤسسات التعليم العالي حيث غزت التطورات التكنولوجية الهائلة والمبتكرة مع أدواتها وتطبيقاتها نظامَ التعليم الحديث. وتهدف هذه الدراسة إلى استقصاء أثر التعلم النقال على انخراط واتجاهات طلبة التربية التكنولوجية، ولتحقيق ذلك استخدمت الباحثة عينة مكونة من خمسين طالب وطالبة من قسم التربية التكنولوجية والمسجلين في مساق تكنولوجيا التعليم، وقد تم استخدام المنهج المختلط بين المنهجين الكمي الذي تمثل بالتصميم الشبه التجريبي والكيفي الذي تمثل بالدراسة الظاهريتية. وقد تم جمع البيانات من المجموعة التجريبية والمجموعة الضابطة ثم إجراء مناقشات جماعية بؤرية مع ثلاث مجموعات، و خمس وعشرين مقابلة شبه منظمة مع الطلبة الذين استخدموا التعلم النقال. وقد تم استخدام الاختبار الإحصائي ANCOVA (تحليل التباين المغاير)، وأظهرت النتائج وجود أثر للتعلم النقال في اتجاهات و انخراط الطلبة. بعد ذلك تم إجراء تحليل المحتوى الاستقرائي والاستنباطي، ونتج عنه ظهور فئتين وهما: سبع عشرة فئة فرعية للانخراط، وأربع فئات رئيسة متمثلة في: التفاعل الاجتماعي والاستراتيجيات المعرفية وما وراء المعرفية والإثارة والسعادة، وحضور المعلم، والمشاركة. بالنسبة للاتجاهات كان هناك إحدى عشرة فئة فرعية تنبثق من ثلاث فئات رئيسة تشمل الفئات الفرعية: التعلم المشخص، دافعية التعلم، وتقليل إحباط التعلم، وتعزيز المشاركة، والتعلم على الأجهزة المألوفة، والتفاعل الاجتماعي.

نظراً لأن التعلم النقال لا يزال في بداياته، توصي الباحثة مؤسسات التعليم العالي بالالتزام بمجموعة من المبادئ التوجيهية عند إنشاء سياسات التعلم بواسطة الهاتف المحمول، علاوة على تخصيص بيئة التعلم بواسطة الهاتف

المحمول بمستويات أعلى من التفاعل لتلبية احتياجات الطلبة وأنماط التعلم ممـــا يثـــري مشـــاركتهم ويحســـن اتجاهاتهم تجاه التعلم بواسطة الهاتف المحمول.

الكلمات المفتاحية: التعلم النقال، التكنولوجيا النقالة، التعلم، المشاركة، الاتجاهات.