Mobile Technology – An Innovative Instructional Design Model in Distance Education

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Abstract—This research aims to introduce and examine the innovative instructional design model with Mobile Technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University. Furthermore, it will evaluate the innovative instructional design model accordingly. The participants in the project comprised 30 undergraduates from the Information Science program, Thai Studies program, and English program who took the Science, Technology and Environment for Life course. They were selected through the cluster sampling technique. The research instruments comprised the innovative instructional design model, evaluation forms and the pre- and post- achievement tests. Included as well was the questionnaire on undergraduates' opinions towards the model. The data analysis used the mean, the standard deviation, and the t-test. In addition, the model contains distance learning lessons which have been developed by Mobile Technology, and have passed educational quality assurance measures. It has been categorized regarding content, educational technology, and assessment by experts in content, educational technology, and assessment. The innovative instructional design has also been rated as "most appropriate" by five experts in the areas of distance education, mobile technology, educational technology, assessment, and content. The undergraduates learning from the innovative instructional design model showed significant achievement at the .05 level and their satisfaction was rated at the "high satisfaction" level.

Keywords—mobile technology, innovative instructional design model, distance education, distance learning lesson

1 Introduction

Distance education provides educational opportunities to all to gain access to lifelong learning without exception. The development of a distance education system aims to continuously provide knowledge and academic experience to learners. Furthermore, it will decrease limits in terms of time and place [1]. Students are assisted to learn in accordance with their needs: they can quickly and conveniently acquire information via modern technology. Distance learning benefits learners and educational institutes, providing educational opportunities to all [2]. It has been found that online distance learning has a significant impact on learning success [3, 4]. Furthermore, online education via the Internet and web technology is used for supporting lifelong learning through

learning society of tertiary education [5]. Moreover, technological innovation assists teachers and staff to increase learning opportunities as well as educational outcomes for learners [5, 6].

Information and Communication Technology or ICT plays a vital role in education by interacting with the Internet, and embracing various technologies that enhance communication. It has been demonstrated that mobile technology is an important part of facilitating learning via the Internet through digital devices like tablets, PCs, and smartphones. In addition, ICT has a key role in changing teaching and learning methodology for the better, while enhancing and supporting education in all levels and systems. In the first quarter of 2018, a survey of National Statistical Office, Ministry of Digital Economy and Society was conducted on the utilization of information and communication technology in households in Thailand. It found that 89.6% of Thais aged 6 years and over (63.3 million citizens) had smartphones. And 80.8% of them had their own smartphones. The remaining 8.8% of this cohort shared smartphones with other household members. Regarding the 38.1 million citizens aged 15 years and over (and employed), 36.7 million of them (accounting for 96.3%) had smartphones. Notably, teachers were encouraged to use ICT to enhance their teaching and facilitate learners' comprehension via mobile technology [7].

There are a number of articles that present the theoretical and technological basis of adaptive e-learning systems, emphasizing the effectiveness of using learning styles for the adaptive learning process [8]. Moreover, the development of theoretical frameworks and digital platforms supports the educators who create and manage educational content for games, which can be customized. It meets the needs of students and enables them to maximize their adaptive learning potential [9]. Also, enthusiastic teachers with preteaching arrangements have an effect on teaching. This also supports the use of assistive technologies as potential mobile learning [10, 11].

Distance learning and teaching are not without drawbacks. A study discovered that learners often experienced problems receiving spontaneous interaction. This had a negative impact on learners' satisfaction. Since most of them were adults who were employed and had limited time, their level of patience with delays or prolonged waiting was relatively low. These findings are in line with similar research on difficulties related to distance learning and teaching. These studies indicated that feelings reported by isolated learners due to the lack of feedback and the social interaction, and the frequency of technical difficulties when using computers in learning, can all lead to students withdrawing from their studies at mid-term [12]. Distance education utilizes mobile technology to enhance and support learning and to enable learners to conveniently gain access to the content management system of learning resources. This underscores the potential and the expansion of learning opportunities offered via the use of appropriate technology [13]. Mobile technology can also be applied to support various learning activities. This is integral to learning in the 21st century, which emphasizes the development of necessary skills students need to reach their fullest potential before graduation [14].

The development of a distance education system has been done through the development of technology. Every single step of distance learning and teaching aims to promote learner autonomy, regardless of time and place. It provides educational service to

learners, adjusting the concepts of both comprehensive replacement and supplemental which support diverse curricula and cover channels to support learners through various programs and channels.

The School of Liberal Arts, Sukhothai Thammathirat Open University, offers three different bachelor's degree programs: 1) Bachelor of Arts program in Thai Studies, 2) Bachelor of Arts program in Information Science, and 3) Bachelor of Arts program in English. Currently, although learning and instruction in the Bachelor of Arts program in English is entirely online, there are still no official channels providing distance education via mobile technology. Textbooks, it should be noted, are still major tools for teaching and learning the Science, Technology and Environment for Life course. These are compulsory General Education courses for all three curriculums.

Despite Sukhothai Thammathirat Open University's support for learners by using various methods and channels, the number of dropouts has actually begun to increase. One of the reasons is that most learners have full-time jobs and thus have limited learning time. Consequently, the university seeks to develop technology and tools to support their learning. Mobile technology has been used to increase channels or alternatives that would support learner autonomy. However, concerning the studies and the development of distance education via mobile technology, there is still no overall comparison of undergraduates of the School of Liberal Arts, Sukhothai Thammathirat Open University. Research on the development of distance education through mobile technology, designed for students attending the School of Liberal Arts, Sukhothai Thammathirat Open University, will yield a prototype for distance education via mobile technology. Students at the university can benefit in terms of research and general studies with the assistance of distance education through mobile technology. By taking advantage of these techniques, learners' confidence in their ability to successfully complete their bachelor's degree will be enhanced.

The research problem of mobile technology in online education is to determine how mobile technology can be effectively used to enhance the learning experience and improve educational outcomes for students. This includes identifying the most effective ways to deliver educational content and assessments, as well as understanding how students interact with mobile technology in an online learning environment. There are 2 research questions/research hypotheses: 1) what are the key features of an effective model of distance education via mobile technology for undergraduates? / Developing a new model of distance education via mobile technology for undergraduates that incorporates the key features identified will lead to improved educational outcomes. 2) How do undergraduates perceive the use of mobile technology in their distance education experience? / Undergraduates who use the models of distance education via mobile technology will have a positive perception of the use of mobile technology in their distance education experience.

Research aimed to 1) develop models of distance education via mobile technology for use by undergraduates of the School of Liberal Arts, Sukhothai Thammathirat Open University and 2) evaluate the models of distance education via mobile technology as applied by undergraduates of the School of Liberal Arts, Sukhothai Thammathirat Open

University. Models were analyzed by testing the research hypothesis that they are capable of achieving high-level quality performance. The conceptual framework of the research is as follows:

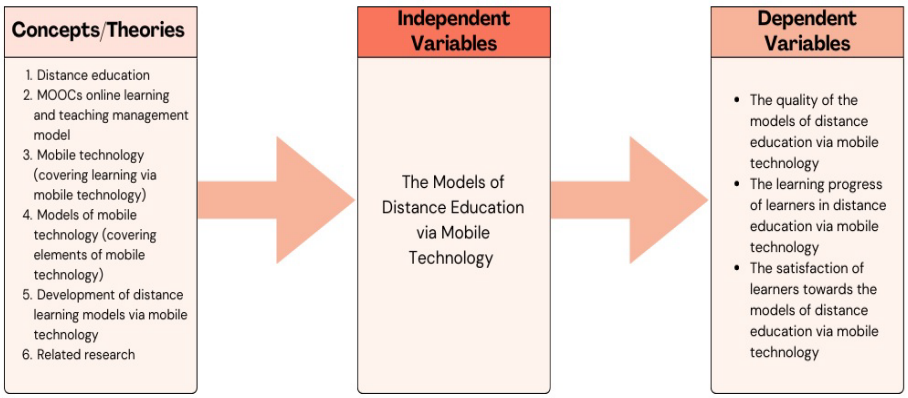

Fig. 1. The conceptual framework of the research

2 Literature review

2.1 Distance education

Distance Education, or distance learning, involves learning and teaching systems conducted without physical classrooms. It relies on multimedia: print media, radio broadcasting, remedial teaching, and educational service centers. It aims to enable learner autonomy no matter where they are. Distance education is a learning and teaching process between learners and teachers separated by physical distance. The system allows mass learning through the use of well-planned quality mediums, materials, and technology. The aim is to connect learners with learning and teaching to enable learners to function autonomously via various mediums. One particular medium serves as a comprehensive replacement; others provide supplementary material including print media, audio visual media, radio broadcasting, television media, remedial teaching programs, and other electronic media [15, 16]. Distance education refers to learning and teaching sessions without face-to-face interaction. Learners and teachers who are physically distant from one another make contact with the use of two-way communication through print media, computers, and electronic media [17].

Students in rural areas, low socioeconomic areas, and gender, and those with low English proficiency and technological skills are experiencing disparities in accessing and participating in online and distance education. Strategies that universities can implement to reduce social inequalities include policies and practices that enhance the comprehensive use of online and distance education programs for the best learning outcomes both now and in the post-COVID era [18].

According to a performance report made by Sukhothai Thammathirat Open University reform, it is an open university which utilizes a distance educational system. Its creation is outlined in a university reform plan, which is in line with the Sukhothai Thammathirat Open University Act 1978. It covers the implementation of a distance education system by developing technology suited to every single procedure relevant to a viable distance education system. The primary goal of such a system is to encourage learner autonomy regardless of time and place. The educational service provision for learners is centered on the conceptual modification of a comprehensive replacement, supported by supplementary assets designed to serve a broad range of curriculums. Sukhothai Thammathirat Open University has cooperation projects with Thailand Cyber University (TCU) as well. They aim to develop a grade transfer system for online courses on the Thai MOOC (Massive Open Online Courses) platform in order to meet applicable international standards. In addition, they will employ educational innovations and technology in online learning and teaching management specifically for open education. Distance education institutions are under the supervision of the Office of the Non-Formal and Informal Education, the Office of the Permanent Secretary, Ministry of Education. Their learning and teaching management in distance education program is structured to be in accordance with the government's policy on the country reform efforts to advance toward the Thailand 4.0 model.

2.2 The MOOCs online learning and teaching management model

Current e-learning systems are classified into two types: Massive Open Online Course (MOOC) platforms and Learning Management Systems (LMSs). The research examined current e-learning systems in terms of classification, architecture, functions, challenges, and current trends. MOOC has also the potential to disrupt traditional education due to their easy access and free or low cost content delivery. This is especially true when considering educational credentials as well as a micro credentials specialty or a degree from an accredited institution [19].

MOOC is an online learning and teaching management model which allows a large number of learners to access various curriculums through online channels. It contains learning activities with text, images, sound, and video. Learners can take tests, share their knowledge with peers and teachers on a Web board, and repeat the lessons as often as they like [12, 20, 21]. The massive numbers of participants on MOOCS reflect its determination to expand its original concept of furthering the development of open educational resources and open universities [22]. Massive Open Online Courses (MOOCs) are a very popular mode of learning in recent years especially since the outbreak of COVID-19 in late 2019, which has resulted in a significant increase in online learning related research [23].

The MOOC platform hosts massive open online courses which enables blended learning to facilitate learners' understanding and knowledge sharing as well as to serve the needs of both teachers and learners [24]. To design effective MOOC educational management and blended learning capabilities, the overall structure of learning design and the relationship between various elements needs to be taken into consideration [25]. It can be seen that MOOCs consist of an online interface. It covers instructional design

and related hardware. User-friendly curriculum design must take into account social and cultural differences [19].

Mobile technology allows a more convenient access and adds value to MOOC. New content is being created for people in various geographical and learning contexts. For example, FutureLearn and iSpot technology can effectively increase the access to MOOC [26]. Recent studies suggest that learners who gain knowledge through mobile technology are more committed to their learning goals and pay more attention to new learning media. As a result, they increasingly accomplish more from the courses they are enrolled in [27].

2.3 Mobile technology (covering learning through mobile technology)

University students are ready to learn on mobile technology and can monitor changes from using tablets. It can be seen that university students have a high level of readiness for learning via mobile phones [28]. The students were positively associated with their intention to use mobile learning applications. They recognize the benefits of mobile learning applications. Student adoption of mobile learning is critical to its success [29]. The students use mobile learning applications to understand, assess and have a curiosity in research and education. In addition, the use of mobile technology has a positive effect to influence students' scientific reasoning abilities and understanding of scientific research [30].

Learning with the aid of mobile technology is one significant element of educational innovation in tertiary education [31-34]. It has been successful in expanding learning capacity by shifting towards a learner-centered model [35]. Moreover, research related to mobile technology in online education has continuously been developed together with learning and teaching development [36]. A survey of the National Statistical Office in Thailand indicated that the growth of mobile technology doubled from 2004 to 2007. The use of mobile phones and the Internet can help improve communication which results in effective and efficient task completion [37]. Even though mobile technology is a promising learning tool, it is uncertain whether learning through distance education is demonstrably supported with various technologies and environment or not.

Learning with the aid of mobile devices (M-learning) can be done with an array of communication tools - be it personal smartphones, PDAs, or laptops. Although learners might not determine the learning venue beforehand, they can benefit from learning opportunities presented through mobile technology [38]. Additionally, there are various ways of learning through mobile technology: informal learning especially geared toward adult learners who want to pursue life-long learning outside schools and universities for career progress or development of specific skills. Technology should be designed to support learning needs to be accessible and convenient for daily usage [39].

Each learner has different mobile technology skills. Some modern mobile devices like the iPad might be suitable for a particular group of learners. There is no guarantee, however, that iPads can enhance learners' learning experiences. Thus, encouraging learners to use smartphones for learning through mobile technology does not ensure they will have similar learning experiences, or be presented with comparable learning opportunities [40]. Moreover, failures in assessing the suitability of devices used for

learning may lead to an inappropriate attachment to a particular mobile technology device. Therefore, the main focus should not be on device utilization, but rather on learners' comprehension of how to learn through mobile technology, along with efficient guidelines to support their learning experiences. Although modern mobile devices like the iPad can stimulate changes in learning methods, one crucial thing to keep in mind is the positive ongoing stimulation of learners' overall learning experiences. [40].

2.4 Models of mobile technology (covering elements of mobile technology)

There are various models of mobile technology engineered with different designs. Certain models emphasize learning control of the environment of smart classrooms. This is reflected in specialized ways of presentation. All are in line with holistic education goals, including learning through efficient technology. These models contribute to the practicality of learning through mobile technology, in view of the fact contemporary learning environments are complex and consist of combinations of various systems, which require the expertise and specific capabilities to maintain the quality standards of education [41].

A model of mobile technology called SPAT (Still Pictures, Audio and Text) focuses on designing content perception that fosters learning opportunities in each module through the application of appropriate technology. The lesson content which follows the SPAT model allows effective learning through mobile technology since the model can prepare the content background, one part at a time, on a mobile device. Each part is a combination of separate elements including still images, sound, and text. This study aimed to (1) extend the boundary of learning media through streaming videos onto SPAT and (2) develop content design prototypes for learning through mobile technology with SPAT. The SPAT design format consists of two parts: design process and design principles together with related guidelines for each principle. This model is expected to increase learning efficiency and be used as a guideline for a systematic and comprehensive design of teaching and learning [13].

The basic elements of learning through effective mobile technology are learners, teachers, environment, content, and assessment standards. According to widely accepted educational guidelines, most learning activities are centered around the learners themselves. Learning through mobile technology grew in response to learners' interests, experiences, and needs. Customarily, books and other educational resources collect and preserve learning data. Teachers then transfer information to learners within traditional learning environments. Increasingly, technology is now used for data collection. Students are encouraged to learn how access to information is thus improved. These changes in how knowledge is presented have led to changes in teachers' roles from being an expert to a presenter of the expertise of others, or functioning as advisors to students. To carry out this role properly, teachers should be able to identify learners' interests, connect these interests with related learning goals, offer opportunities for accomplishing these goals in accordance with learners' specific conditions, and stimulate learners' interest in activities in order to encourage interaction between group members. Finally, organizing assessment activities to evaluate the entire process is needed. Pro-

gress in mastering content might vary according to learners' needs and abilities. Learning environments need to be appropriately designed to enable learners to gain access to information and increase positive learning experiences. Efficiency assessment is one significant element of learning through mobile technology. It informs teachers about the level of efficiency learners have attained. The assessment should be done through database statistics, packaged software, online testing and chat room activity. Also, learners should be able to assess themselves as well as others [42].

2.5 Development of distance learning models through mobile technology

Online education research concerning mobile technology applications includes comparisons between electronic learning or e-Learning and mobile learning or m-Learning. Data indicates that m-Learning increases flexibility in learning venues and time. A 'push and pull' mechanism is used in determining a framework for teaching methods that encourage learners' to think reflectively and respond intelligently after learning through mobile technology. M-Learning can therefore help widen the range of advantages that e-Learning is capable of inspiring [43, 44]. The model of mobile learning technology contains mobile technology, user acceptance, and data success model. By building confidence that the implementation of m-learning in Higher Learning Institutions (HLI) will be successful, it is found that there are three key elements that make up an m-learning environment: academics, students, and mobile technology. Moreover, mobile technology, infrastructure, and the quality of the technical system has been added to the technology acceptance model and the success model of the information system [45].

Framework for the Rational Analysis of Mobile Education (FRAME) is used for examining the complexity of related mobile technologies which affect the perception and comprehension capabilities of Moodle online learners. Studies have found that mobile technology is the best alternative for online learners. The FRAME model consists of three significant elements: devices, learners, and interactive parts. This model illustrates the learning environment is best understood in a 360 degree view. For example, learners do not always complete learning activities on their own. They can use devices to help with the learning process. Learners should also be aware of the importance of interaction with others [46].

Education employing mobile technology enhances learner autonomy as well as boosting their access to online learning resources. There has been a lot of research related to distance education, e-Learning, and education through mobile technology. The consensus is that education through mobile technology will support learning and continuously increase learning interaction and engagement [47, 48].

Research into Mobile-Based Assessment (MBA) suggests it can be used as an additional learning assessment tool to reinforce paper-based or computer-based learning assessment. The wide-spread use of this type of assessment depends on the acceptance by users or learners of education through mobile technology. Research is also being conducted into Self-Determination Theory (SDT) of motivation, and the Technology Acceptance Model (TAM). What's more there is an assessment focused on mobile technology with Mobile-Based Assessment - Motivation and Acceptance Model (MBA-

MAM). This is a blended method that can explain and predict the behavioral tendencies of mobile technology users [49].

Literature examining education through mobile technology reveals that there are four categories identifying major elements of the draft of the model of education through mobile technology: input, process, output, and feedback. Input covers learners, teachers, academic support staff, environment, technology, and content/media. Process covers arrangement/ preparation, teaching methods, assignment/activities, and assessment. Output covers learning outcomes. Feedback deals with various forms. The model of education draft through mobile technology starts with analyzing learners. This is followed by outlining learning objectives must be informed, then details concerning teachers and academic support staff, environment, content/mediums, assignment/ activities, learning outcomes, assessment, and feedback.

2.6 Related research

There is a lot of research about mobile collaborative learning taking advantage of augmented reality and mobile application development. Most of the studies were conducted in the field of computer science, electronic engineering, and artificial intelligence [50]. The expansion of workable learning activities makes use of up-to-date learning and teaching theories. Smartphones can provide certain types of support to learners, especially in a learner-centered classes. In addition, the Mobile Computer Supported Collaborative Learning environment (MCSCL) uses mobile technology to facilitate meaningful interaction and collaboration between learners [51, 52].

Motiwalla [44] stated that learners become confused by the excessive amount of data and interaction. The primary point of mobile technology is a user interface. Sharples, Taylor, and Vavoula [53] claimed that education through mobile technology will be examined against the following criteria: 1) the difference between values from learning theories in classrooms, workplaces, or lifelong learning; 2) the learners' consideration of moving their learning venues; 3) formal and informal education; 4) the systematic learning and social collaborative learning; and the analysis of learning through self-contained activities and technology-aided activities.

Education based on mobile technology concentrates on learners' behavioral patterns according to experience and usage. Medical students' behavioral patterns, for example, show the relationship between positive attitudes towards the use of mobile technology (which accounts for 57 percent) and the willingness to recommend the use of mobile technology in learning (which accounts for 40.5 percent). In conclusion, the awareness of the necessity of stimulating the use of modern technology can raise the quality of learning procedures and enable learners to benefit from the effective teaching. On a short-term basis, this can help encourage the use of available resources to the fullest extent through education via mobile technology [32].

The development of the research model underpinned by Innovation Diffusion Theory (IDT) and Model of Innovation Resistance (MIR) aims to examine factors influencing learners' refusal to, and their lack of attention in, using mobile technology for their learning. Furthermore, there is an additional focus on the lack of learners' enthusiasm to express their opinions when using unfamiliar mobile technological innovations

in the course of their learning [54]. M-learning is considered a valuable tool for supporting learners and instructors in distance education. It aims to assess educational methods which are likely to challenge and make use of the potential of learning through mobile technology. In the future, mobile technology is expected to support and enhance the effective learning in physical classrooms [55].

The instructional framework for learning through mobile technology can be categorized into four groups in accordance with types of usage: 1) high transactional distance socialized m-learning; 2) high transactional distance individualized m-learning; 3) low transactional distance socialized m-learning; and 4) low transactional distance individualized m-learning. Therefore, instructional designers of open and distance learning can apply this instructional framework to exploring the concepts of m-learning and methods that can more effectively combine mobile technology with instruction [56]. M-learning can be used for introducing learners to curricula or courses based on their profile or educational background. Searching for information through m-learning can determine whether activity objectives are in line with searching purposes. Then knowledge that meets their demands in relevant contexts can be transferred to the learners. Moreover, m-learning can determine the basic outlines of learning environments based on specific instructional frameworks or learning content [57].

3 Method

Research titled "The Development of the Instructional Design Model with Mobile Technology for Undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University" were developed according to research aims. The detail of participants, research tools, and research process are as follows.

3.1 Participants

Those taking part in the research were divided into three groups: 1) 10 experts who assessed the developed draft of the model; 2) three experts who assessed the developed lessons; 3) the undergraduates who enrolled in the 10141 Science Technology and Environment for Life course in the second semester of the academic year 2018 from three majors (Information Science, Thai Studies, and English), the School of Liberal Arts at Sukhothai Thammathirat Open University. They assessed their learning achievement within m-learning and their satisfaction regarding the model of distance education through mobile technology. These three groups participated in random sampling. It was done by selecting the groups with 10 members each.

3.2 Research tools

Research tools included 1) the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University; 2) The assessment form (for the experts) of the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai

Thammathirat Open University; 3) a multiple-choice pre-test and post-test to assess learners' academic progress both before and after the distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University; and 4) Questionnaires on learners' level of satisfaction with the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University.

3.3 Research process

The research process consisted of two steps as follows:

Step I: The development of the instructional design model with mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University can be divided into two parts:

- Part I: The elements of the draft of the model of distance education through mobile technology intended for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University
- Part II: Drafting the model of distance education through mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University

Step II: The assessment of the draft of the model of distance education through mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University is divided into two parts:

- Part I: Experts' assessment of the appropriateness of the draft of the model of distance education through mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University
- Part II: Learners' assessment of the learning achievement and satisfaction with the draft of the distance education model through mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University

4 Result

The research results derived from the first objective assessing the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University consisted of elements and steps of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University.

4.1 The elements of the model of distance education through mobile technology

The elements of distance education model through mobile technology cover (1) input, (2) process, (3) output, and (4) feedback.

Input covering 5 elements as follows:

- Learner analysis: the study of learners' needs and preparedness, technological devices used, and the Internet connection; determination of the standard of mobile technological devices; and the qualifications of learners who are eligible to study with the aid of mobile technology when their mobile devices' limitations and features when connected to the Internet are taken into consideration; an analysis of learners' background knowledge: such as their basic computer skills, their ability to have their smartphones and the Internet connections ready before learning and following the instructions.
- Determination of Learning objectives: learning objectives which are in line with learners' capabilities and the curriculum's program learning objectives; students' learning outcomes used for determining learning activities and types of knowledge that learners are supposed to learn, like content or process; setting learning objectives for each learning unit; behavioral objectives used for establishing outlines for learning and teaching in order to create lesson plans and assess learners, as well as standards for learning and teaching efficiency.
- Distance teacher, distance learner, and educational technology support staff: A distance teacher is required to be knowledgeable and understand technology; competent in carrying out teachers' roles, which include creating lesson plans to make sure that the lessons are in line with mediums; clear presentation of the core content, and determining learning guidelines. Then following up on learners' academic progress, preparing the learning environment, and facilitating learner autonomy. Distance learners must understand the importance of being responsible, enthusiastic, disciplined, engaged in self-determined learning, and prepare for and take charge of learning through mobile technology. Educational technology support staff get the system ready before class begins by working collaboratively with teachers in preparing lessons, granting students access to the class, submitting the students' attendance report to the teacher according to the time schedule, and solving learners' system access problems.
- The creation of a supportive learning environment of m-learning: to enhance learner autonomy should be done through the MOODLE course management system, which allows students the freedom to learn anywhere and anytime. To attract learners' attention, video clips of the lesson summary and content are provided for them to select and review. Internet access is provided for m-learning.
- The various learning media of distance education through mobile technology present a summary of each topic through 3-minute video clips. This allows learners to choose what to learn while boosting their motivation to learn. Fundamentally, the media options can support both learners and teacher's understanding of the model of distance education through mobile technology by fostering a greater awareness of learning environments, class time, and learners' behavior.

Process covers three elements of teaching and learning processes as follows:

- Preparation goals for teachers and learners: preparing both teachers and learners to be aware of and understand learning objectives, instructional methods, and learning activities through mobile technology. An orientation file is created to inform participants of objectives, content, and instructional methods, as well as the need to test

the readiness of mobile technological devices and Internet connections. Learners ought to be able to schedule their study time to be in line with their daily personal timetables. This enables them to get ready and secure access to the lessons from anywhere and at any time.

- In-class activities: learning activities are designed based on learners' needs. Objectives and content are analyzed and then the content is designed to fulfill the objectives. Learners take a pre-test to determine their existing knowledge of the content and help them prepare for their selected learning content.
- Learning assessment: the assessment occurs after the lessons in order to evaluate learners' comprehension of completed lessons through distance education with mobile technology. There is also an assessment of learners' satisfaction with the performance of distance education through mobile technology.

Output covering two elements as follows:

- The assessment of learning achievement: evaluates the depth of learners' content knowledge after the lessons to determine what learners' have actually achieved in distance education through mobile technology.
- The assessment of the efficiency of the model of distance education through mobile technology: aims to determine learners' overall satisfaction with the model of distance education through mobile technology.

Feedback aiming to improve Input and Process based on the assessment of learners' achievement and degree of satisfaction in order to attain the predetermined learning outcomes.

4.2 Procedures of the model of distance education through mobile technology

The model of distance education through mobile technology consists of nine steps as follows:

Step 1 Learner analysis through the study of learners' needs and preparedness regarding technological devices and the reliability of Internet connections. These need to be in compliance with the regulations of technological devices, and the qualifications learners must meet to be eligible to study by distance education through mobile technology. Limitations and certain features of leaners' technological devices when connected to the Internet are taken into consideration. Learner analysis includes a review of learners' prior knowledge assessments.

Step 2 Setting learning objectives which are in line with learners' capabilities and the curriculum's PLOs. Known Learning outcomes are used to determine learning and teaching activities. The objectives of the activities determine what qualifications regarding knowledge are expected, including content (what learners are supposed to know from each learning unit), and process (a behavioral objective used for setting a class outline, and assessing learners as well as class efficiency).

Step 3 Distance teachers are required to be knowledgeable and understand technology. They must understand their various roles, which include creating lesson plans that ensure lessons are in line with designated types of media. Moreover, the plans ought to

present the core content, determine learning guidelines, follow up on learners' academic progress, prepare the learning environment, and facilitate learner autonomy. Distance learners will best succeed by being responsible, enthusiastic and disciplined. They need to play a major role in determining learning plans and objectives, and preparing for and taking charge of learning through mobile technology. Educational technology support staff gets the system ready before class begins by working collaboratively with teachers in preparing lessons, granting students access to the class, submitting the students' attendance reports to teachers according to the scheduled time, and solving learners' system access problems.

Step 4 The creation of a supportive learning environment for m-learning that enhances learner autonomy should be done through the MOODLE course management system, which allows learners' freedom to learn anywhere and at any time. To attract learners' attention, video clips of the lesson summary are provided for them to select and review the content. Internet access is provided for m-learning.

Step 5 One learning medium of distance education through mobile technology displays a summary of each topic by means of a three-minute video clip. This motivates learners to take a greater interest in learning by giving them the opportunity to choose what to learn. A multi-media approach can support both learners and teacher's understanding of the model of distance education through mobile technology. It works to enhance awareness of learning environments, class time, and learners' behavior.

Step 6 Three aspects of the teaching and learning process are as follows:

- The preparation of teachers and learners: preparing both teachers and learners to know and understand learning objectives, instructional methods, and learning activities through mobile technology. An orientation file is created to inform them of objectives, content, and instructional methods; and also to test the readiness of mobile technological devices and the Internet connection in each class. Learners are able to schedule their learning time according to their daily personal timetable. This enables them to get ready and gain access to the lessons from anywhere and at any time.
- In-class activities: learning activities are designed based on learners' needs. Objectives and potential content are analyzed. Then content is chosen and designed to fulfill the objectives. Learners take a pre-test to determine their level of existing knowledge of the content, and then help them prepare for their selected learning content.
- Learning assessment: assessments take place after the lessons in order to evaluate students' learning achievement attained through distance education with mobile technology. There is also an assessment of learners' satisfaction with the model of distance education through mobile technology.

Step 7 Assessing learners' achievement level when evaluating their content knowledge after lessons are completed. This is to determine whether learners' comprehension goals have been met in distance education through mobile technology.

Step 8 Efficiency assessments of the model of distance education through mobile technology, which aim to determine learners' satisfaction with the model of distance education through mobile technology.

Step 9 Feedback aiming to improve Input and Process based on the assessment of learners' learning achievement and their satisfaction, in order to ensure they attain the predetermined learning outcomes.

4.3 The development of lessons in distance education through mobile technology

Another important element is the development of lessons in distance education through mobile technology that covers assessments of lessons' quality. This would concern aspects of the content, educational technology, in addition to assessments by experts in educational technology and experts in assessment (see Tables 1, 2, and 3).

Table 1. Mean and Standard Deviation of Quality Assessment Outcomes of the Content of Distance Education Lessons through Mobile Technology

List	M	SD	Quality level
1. Content is in line with the objectives.	4.00	1.00	Good
2. The order of the content is logical, continuous, and easy to follow.	4.00	0.58	Good
3. Content is useful and practical.	4.00	0.58	Good
4. Content explanation is clear.	4.00	0.58	Good
5. Content and illustrations are in harmony.	5.00	0.58	Very good
6. Content is appropriate for learners.	4.00	0.58	Good
7. Content structure is clear.	4.00	0.58	Good
8. Language is appropriate for learner.	5.00	0.58	Very good
9. Font size, font color and background color are appropriate.	4.00	1.15	Good
10. Image and video in the lessons are in harmony with content.	5.00	0.58	Very good
Total	4.30	0.68	Good

On the whole, the quality of the lessons' content in distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University is rated as good. Some suggestions include carefully checking the use of arrows and clearly specifying scientific formulas. The researcher has already made adjustments according to the suggestions.

Table 2. Mean and Standard Deviation of Quality Assessment Outcomes of the Educational Technology of Distance Education Lessons through Mobile Technology

List	M	SD	Quality level
1. Infographic pages			
1.1 Infographic pages are attractive	4.00	0.00	Good
Illustrations in Infographic are comprehensible.	4.00	0.00	Good
1.3 Fonts in Infographic are clear and easy to read.	4.00	0.00	Good
1.4 Content in Infographic is appropriate.	4.00	0.58	Good

List	M	SD	Quality level
1.5 Layout of content presentation is easy to understand.	4.00	0.58	Good
1.6 Infographic pages are useful, educational, and practical.	4.00	0.00	Good
Total	4.00	0.19	Good
2. Video clips			
2.1 Video clips are attractive.	4.00	0.00	Good
Illustrations in video clips are easy to understand.	4.00	0.00	Good
2.3 Fonts in video clips are clear and easy to read.	4.00	0.00	Good
2.4 Content in video clips is appropriate.	4.00	0.58	Good
2.5 Content separation in video clips helps improve understanding.	4.00	0.00	Good
2.6 Background music in video clips is appropriate.	4.00	0.00	Good
2.7 The instructor gives clear and understandable explanations in video clips.	4.00	0.00	Good
2.8 Lessons in video clips are useful and practical.	4.00	0.58	Good
Total	4.00	0.15	Good

On the whole, the quality of educational technology of the distance education lessons through mobile technology for undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University is quite satisfactory. Some suggestions include having more illustrations than text in Infographic pages, and encouraging more interaction between teachers and learners. The researcher has already made adjustments according to the suggestions.

Table 3. Mean and Standard Deviation of Quality Assessment Outcomes of the Quality Assessment of Distance Education Lessons through Mobile Technology

List	M	SD	Quality level
1. Pre-test			
1.1 The pre-test is in line with behavioral objectives.	4.00	1.00	Good
1.2 The test items are clear.	4.00	1.00	Good
1.3 The test items do not give too many hints to the correct answers.	4.00	1.00	Good
1.4 Distractors in the choices are effective enough.	4.00	1.00	Good
1.5 Language used in the test is clear and unambiguous.	4.00	0.58	Good
1.6 The number of test items is appropriate.	4.00	0.58	Good
1.7 The test's level of difficulty is appropriate for learners	4.00	1.00	Good
2. Post-test			
2.1 The post-test is in line with behavioral objectives.	4.00	1.00	Good
The test items are clear.	4.00	1.00	Good
2.3 The test items do not give too many hints to the correct answers.	4.00	1.00	Good
2.4 Distractors in the choices are effective enough.	4.00	1.00	Good
2.5 Language used in the test is clear and unambiguous.	4.00	0.58	Good
2.6 The number of test items is appropriate.	4.00	0.58	Good

List	M	SD	Quality level
2.7 The test's level of difficulty is appropriate for learners.	4.00	1.00	Good
Total	4.00	1.76	Good

On the whole, the quality of the assessment of the lessons in distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University is quite satisfactory. Some suggestions include making appropriate adjustments in the tests. The researcher has already made adjustments according to the suggestions.

The assessment of the quality of the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University was undertaken by five experts. See Table 4 for details.

Table 4. Mean and Standard Deviation of the Quality of the Model of Distance Education through Mobile Technology

List	M	SD	Quality level
The Quality of Input			
1. Learner analysis by studying their needs and preparedness regarding technological devices and the Internet connection.	4.60	0.55	Highest
2. The determination of the learning objectives which are in line with learners' capabilities and the curriculum's PLOs.	4.60	0.55	Highest
3. Distance Teachers, Distance Learners, and Educational Technology Support Staff			
3.1 Distance teachers covering teaching roles, lesson plans, following-up on learning progress, the advance of mobile technology, and the learning assessment.	4.60	0.55	Highest
3.2 Distance learners' comprehension of learning roles, the ability to use mobile technology, responsibility, discipline, and attention in class.	4.60	0.55	Highest
3.3 Educational technology support staff understanding preparedness standards of related facilities and technology by working collaboratively with teachers.	4.40	0.55	High
4. The creation of a supportive learning environment and relevant technologies.			
4.1 MOODLE course management system.	4.60	0.55	Highest
4.2 Social networking through LINE group.	4.40	0.55	High
5. Mediums of distance education through mobile technology.			
5.1 Infographic pages.			
5.1.1 Infographic pages are attractive.	4.60	0.55	Highest
5.1.2 Illustrations in Infographic are easy to understand.	4.60	0.55	Highest
5.1.3 Fonts in Infographic are clear and easy to read.	4.60	0.55	Highest
5.1.4 Content in Infographic is appropriate.	4.40	0.55	High
5.1.5 Content in Infographic is accurate.	4.60	0.55	Highest
5.1.6 The order and separation of the content of the presentation in Infographic enhances understanding.	4.60	0.55	Highest
5.1.7 Infographic pages are useful and practical.	4.60	0.55	Highest

List	M	SD	Quality level
5.2 Video clips.			
5.2.1 Video clips are attractive.	4.60	0.55	Highest
5.2.2 Illustrations in video clips are easy to understand	4.60	0.55	Highest
5.2.3 Fonts in video clips are clear and easy to read.	4.80	0.45	Highest
5.2.4 Content in video clips is appropriate.	4.60	0.55	Highest
5.2.5 Content in video clips is accurate.	4.60	0.55	Highest
5.2.6 The order and separation the content of the presentation in video clips helps understanding.	4.60	0.55	Highest
5.2.7 Background music in video clips is appropriate.	4.20	0.84	High
5.2.8 The instructor gives clear and understandable explanations in video clips.	4.40	0.89	High
5.2.9 Video clips are useful and practical.	4.60	0.55	Highest
The Quality of Process			
6. Learning and Teaching Process			
6.1 Step 1: Preparedness of Teachers and Learners			
6.1.1 Publication /orientation of class objectives and activities through email, MOODLE, and LINE	4.60	0.55	Highest
6.1.2 Preparedness of technological devices and the Internet connection	4.60	0.55	Highest
6.2 Step 2: Learning Activities			
6.2.1 Pre-test: Learners are informed of their pre-test scores prior to learning for self-development	4.60	0.55	Highest
6.2.2 Selected Lesson Summaries			
6.2.2.1 Lesson summaries through video clips	4.80	0.45	Highest
6.2.2.2 Lesson summaries through infographic pages	4.80	0.45	Highest
6.2.3 Post-test: Learners are informed of their post-test scores after learning which ones illustrate their academic progress; then they are able to review the lessons and retake the test.	4.80	0.45	Highest
7. Step 3: Assessments			
7.1 Knowledge assessment derived from 30 question items taken from three learning units.	4.80	0.45	Highest
7.2 Assessment of satisfaction with the model of distance education through mobile technology	4.60	0.55	Highest
The Quality of Output			
8. Assessment of learning achievement of distance education through mobile technology. Knowledge assessment is done through 30 question items from three learning units. The results showed that the learning achievement was higher with statistical significance at the .05 level.	4.80	0.45	Highest
9. Concerning the efficiency of the model of distance education through mobile technology, the satisfaction of undergraduates of School of Liberal Arts at Sukhothai Thammathirat Open University with the model of distance education through mobile technology was at the highest level.	4.80	0.45	Highest
The Quality of Feedback			

List	M	SD	Quality level
10. Feedback on learning achievement of distance education through mobile technology for teaching and learning improvement.	4.60	0.55	Highest
Overall Quality	4.61	0.55	Highest

Table 4 shows that generally, the experts' assessment of the quality of the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University was at the highest level (M = 4.61). Among the top seven elements with the highest scores, the element with the highest quality level was 1) video clips which contained clear and easy to read texts, followed by 2) and 3) the selectable summaries through video clips and Infographic pages, 4) post-test results which informed learners of their academic progress so that they could review the lessons and retake the test, 5) knowledge assessment through 30 question items from three learning units, 6) the use of 30 question items from three learning units to assess the learning achievement of distance education through mobile technology, and 7) the proficiency and suitability of the model of distance education through mobile technology. Meanwhile, the element with the lowest quality level (M = 4.20) was background music in video clips.

Previously, the research results concerning the second objective were presented during the academic conference on "eLearning and Software for Education." The assessment of learners in distance education through mobile technology showed significant achievement at the .05 level, and their satisfaction was at the "high satisfaction" level. Moreover, the assessment on learning achievement using the model of distance education through mobile technology showed that learners' average test scores after the lessons in distance education through mobile technology were higher than the scores prior to the lessons with statistical significance at the .05 level.

Finally, here are some research findings related to research aims:

Research aim 1: Develop models of distance education via mobile technology for use by undergraduates. The research finding 1: The current models of distance education via mobile technology being used by undergraduates have some strengths, such as providing flexibility and convenience for all input, process and output; but also have some weaknesses, such as less explanation in video clips, lack of interactivity, and difficulty in providing real time collaboration. The research finding 2: Key features of an effective model of distance education via mobile technology for undergraduates include interactive and personalized content, real time feedback and communication, and the ability to track progress and performance. And the research finding 3: A new model of distance education via mobile technology for undergraduates that incorporates these key features can be developed and implemented, which will lead to improved educational outcomes.

Research aim 2: Evaluate the models of distance education via mobile technology as applied by undergraduates. The research finding 1: The models of distance education via mobile technology are effective in improving educational outcomes for undergraduates, as evidenced by improved test scores and increased student engagement. The

research finding 2: Undergraduates who use the models of distance education via mobile technology have a positive perception of the use of mobile technology in their distance education experience, citing increased flexibility and convenience. And the research finding 3: Factors that influence the effectiveness of the models of distance education via mobile technology for undergraduates include the level of interactivity and personalization in the content, the availability of real time feedback and communication, and the ability to track progress and performance.

5 Discussion

Concerning the development of the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University, a look at the discussion results revealed that the experts affirmed the model's appropriateness was at the highest quality level. Among the top 7 elements with highest scores, the element with the highest quality level was 1) video clips which contained clear and easy to read texts, followed by 2) and 3) the selectable summaries through video clips and Infographic pages, 4) post-test results which informed learners of their academic progress so they could knowledgeably review the lessons and retake the test, 5) knowledge assessment derived from 30 question items from three learning units, 6) the use of 30 question items from three learning units to assess learning achievement objectives of distance education through mobile technology which showed that the learners' academic progress was greater with statistical significance at the .05 level, and 7) the efficiency of the model of distance education through mobile technology which disclosed that the learners' satisfaction towards the model was at the highest level. In contrast, the element with the lowest quality level turned out to be background music in video clips. Beneficial modifications would include designing background music which does not interfere with teaching, but instead enhances learning achievement in distance education through mobile technology [55].

According to the assessment of the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University, the academic progress of learners in distance education using mobile technology was greater with statistical significance at the .05 level. Behind this progress are salient factors including systematically designed lessons in accordance with learning objectives and examined by experts with experience in distance education. Another factor is selectable lesson summaries recorded on video clips and Infographic pages which allow learners to apply knowledge from the lessons. This is in line with Yousuf's idea [48] that learning utilizing mobile technology can support learning and encourage learner autonomy, as well as learners' continuous engagement in learning.

In the case of learners' satisfaction with the model of distance education through mobile technology of undergraduates of the School of Liberal Arts at Sukhothai Thammathirat Open University, every measurement reached the high satisfaction level. Reexamining the top four categories with highest scores, the element with the highest average scores was learner analysis which explores learners' need and preparedness in

terms of technological devices and Internet connections; this is followed by the determination of learning objectives which are in line with learners' capabilities, appropriate lesson content in Infographic pages, and content order as well as content separation in Infographic pages which enhance learners' comprehension. These developments meet learners' current needs when lesson summaries with clearly understandable illustrations enable them to grasp the main points in a short period of time. In contrast, the element with the lowest average scores are selectable lesson summaries on video clips. This is due to learners' familiarity with reading books or texts rather than using video to review the main points. However, the use of video lesson summaries is likely to increase as the growth of mobile technology continues.

It should be noted that teachers who put the model of distance education through mobile technology into practice need to be aware of the following:

1. They need to emphasize the importance of nine steps of distance education through mobile technology, especially the first four steps. They begin with learner analysis, which is necessary for preparing the environment and technology together with distance teachers, distance learners, and educational technology supporting staff. This can help decrease the workload of teachers, such as answering the same questions repeatedly when there is a large number of learners who have enrolled in the course. It can also help learners to be better prepared before beginning to study the learning materials.
2. For the effective use of the model of distance education through mobile technology, it is necessary to get fellow teachers and staff's cooperation and recognition of the model's significance. When there are multiple instructors teaching the same course, there should be meetings to keep them informed and make sure they understand about the significant ideas of distance education through mobile technology. Regular communication is needed as well to raise awareness of teachers, related staff, and learners about benefits and the importance of putting the model of distance education through mobile technology into practice in educational institutions prior to using the model.
3. When distance teachers, distance learners, and educational technology supporting staff are fully prepared, a particular course with a large number of learners enrolled is possible. A larger number of students means an increase in teachers' workloads which can affect their performance concerning marking assignments and advising learners.
4. Social networking can be used by teachers as a tool for communication, prompt question-answering for mutual understanding, notifying learners of assignment deadlines, and allowing learners opportunities to share their opinions and help teachers answer their peers' questions concerning the course.
5. The learner-centered approach must be applied with great care. Teachers should encourage learners to participate in making learning and problem-solving plans. This will boost learners' confidence and contribute to desirable behaviors that have a positive impact on their learning and work.

According to the research findings, the new model of distance education via mobile technology that incorporates key features such as interactive and personalized content,

real time feedback and communication, and the ability to track progress and performance, is effective in improving educational outcomes for undergraduates. This contributes to new knowledge in the field of distance education as it suggests that mobile technology can be effectively used to enhance the learning experience and improve educational outcomes for students. Additionally, the finding that undergraduates have a positive perception of the use of mobile technology in their distance education experience, and that factors such as interactivity and personalization in the content, real-time feedback and communication, and the ability to track progress and performance influence the effectiveness of the models, contribute to new knowledge in the field by providing insights into how mobile technology can be effectively used to support distance education. Furthermore, the study also provide insight into how mobile technology can be used to increase access to education for underrepresented and disadvantaged populations.

In summary, the study's findings contribute to new knowledge in the field of mobile technology in distance education by providing insights into how mobile technology can be effectively used to enhance the learning experience and improve educational outcomes for students, and how to design effective distance education models using mobile technology.

6 Conclusion

In conclusion, the results of the research on The Development of the Model of Distance Education through Mobile Technology are directed to two research objectives: the model of distance education covering four interrelated elements which include input, process, output, and feedback. Input covers (1) learner analysis, (2) determination of learning objectives, (3) distance teachers and learners, and educational technology support staff, (4) the creation of a supportive learning environment for m-learning to enhance learner autonomy, and (5) the various learning media developed for distance education through mobile technology. Process covers (1) the preparation of teachers and learners, (2) in-class activities, and (3) learning assessment. Output covers (1) the assessment of students' learning achievements and (2) assessing the efficiency of the model of distance education through mobile technology. Feedback aims to improve pertinent aspects of learning and teaching. Process of the model of distance education through mobile technology consists of 9 steps: (1) learner analysis, (2) determination of learning objectives, (3) distance teachers, distance learners, and educational technology supporting staff, (4) the creation of a supportive learning environment and associated technology, (5) learning materials applicable to distance learning through Mobile Technology, (6) learning and teaching activities, (7) undergraduates' learning achievements, (8) effectiveness of distance learning through mobile technology, and (9) feedback for teaching and learning improvement from experts in distance education, in mobile technology, in educational technology, in assessment, and in content.

The assessment of the model of distance education through mobile technology showed that the model was of the highest quality. Regarding the second objective, the academic progress of learners who studied with the model of distance education

through mobile technology was greater with statistical significance at the .05 level. Learners' satisfaction with the model of distance education through mobile technology was, generally, at the high satisfaction level.

Based on the research findings, the conclusions of this study presented the new model of distance education via mobile technology that incorporates key features such as interactive and personalized content, real time feedback and communication, and the ability to track progress and performance, is effective in improving educational outcomes for undergraduates. This suggests that mobile technology can be effectively used to enhance the learning experience and improve educational outcomes for students. Undergraduates have a positive perception of the use of mobile technology in their distance education experience. This suggests that mobile technology can be effectively used to support distance education and increase access to education for underrepresented and disadvantaged populations. Factors such as interactivity and personalization in the content, real time feedback and communication, and the ability to track progress and performance are important for the effectiveness of distance education models via mobile technology. This provides insights into how mobile technology can be effectively used to support distance education. To further improve the effectiveness of distance education models via mobile technology, further research should be conducted to investigate the use of other features such as multimedia and gamification, and how they can be incorporated into distance education models. The study also suggests that it would be beneficial to conduct more research on different student populations and settings, to determine how generalizable the findings are.

From a present and future perspective in the field, this research emphasized distance education through mobile technology with the focus on alternative lessons, Infographic pages, and video clips. If there is further research on other alternative lessons, learners will likely have more choices in distance education through mobile technology. Also, the samples in this research were limited just to undergraduates of the School of Liberal Arts.

Based on the research findings, the recommendations for educational practice include incorporating interactive and personalized content, real time feedback and communication, and the ability to track progress and performance into distance education models via mobile technology to improve educational outcomes for undergraduates. Encouraging the use of mobile technology in distance education to increase access to education for underrepresented and disadvantaged populations and to improve student engagement; providing training and support for educators on how to effectively use mobile technology in distance education, including how to incorporate interactive and personalized content, real time feedback and communication, and the ability to track progress and performance; encouraging educators to continuously evaluate and adapt their distance education models via mobile technology to ensure that they are meeting the needs of their students; encouraging educational institutions and organizations to invest in mobile technology and infrastructure to support distance education; and encouraging educational institutions to conduct research studies to assess the effectiveness of their distance education models via mobile technology and to continuously improve them are needed.

The limitations of this study include a lack of information on setting of the research, which makes it difficult to determine the generalizability of the findings. Additionally, the study only focuses on the use of mobile technology in distance education for undergraduates and it would be beneficial to conduct research on the effectiveness of mobile technology in distance education for other populations such as graduate students and non-traditional students. Recommendations for future research include conducting research with a larger sample size to increase the generalizability of the findings. Investigating the use of mobile technology in distance education for other populations, such as graduate students and non-traditional students; examining the use of multimedia and gamification in distance education models via mobile technology and how they can be incorporated to improve the effectiveness of the model; examining the long-term effects of mobile technology-based distance education on students' educational outcomes, and their perception of the technology in the long run; and exploring the potential of mobile technology-based distance education in increasing access to education for underrepresented and disadvantaged populations are also recommended.

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