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A PROPOSED MODEL OF M-LEARNING FOR TECHNICAL AND VOCATIONAL EDUCATION TRAINING (TVET) STUDENTS

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ABSTRACT

Latest educational technology that called mobile learning or m-learning is a new style of learning as the development of mobile technology which can help to hold attention and make students more on self-study at anywhere and anytime. The paper focuses on a proposed model of m-learning for Technical and Vocational Education and Training (TVET) students in Malaysia. Development of the model is based on the user requirements from the TVET students in accordance to three aspects; device, user and social technology. The proposed model will be used as a guideline in the development of m-learning application which can improve teaching and learning quality and also motivate students to have interest on the learning.

Keywords: *Mobile Technology, Education Technology, Mobile Learning, Long-Life Learning, TVET*

1. INTRODUCTION

The model can be interpreted as a simplified description of a system or process to assist predictions. M-learning model is to give a clear picture in terms of functionality and features of the system to be built based on user requirements and will be used as a guideline in the development of m-learning system.

Malaysia is among the countries that are emerging in growing mobile technology. The quality of teaching and learning can be improved by the innovation of mobile technology applications especially in TVET field.

Based on the premelinary study found that TVET institutions in Malaysia are practice conventional or traditional teaching and learning. Also students do not fully capture the theory of certain subject in the classroom while it is essential for practical training. Due to the weakness of conventional learning, communication between teachers and students to be one-way communication or teacher-centered learning [1], students less focus entirely on teaching in the classroom [2]. The learning may be too slow or too fast, students will be less interested to learn [3], students will be left behind to understand the theory or concept of the subject in the classroom and students tend to skip or not attend the class [4].

Students need their own space and time to catch-up the learning. Also the learning process is less attractive because the students were from Z or digital native generation. This generation always in need of changes and tend to communicate with high-tech devices [5].

In the development of technology, electronic learning or e-learning is an alternative learning system in which students can access the learning materials through online. Due to the advance of mobile technology, students can also access or view the materials on the e-learning websites by using the mobile devices. However, the contents of e-learning that target to view in large monitors is limited to use on small devices [6]. Therefore there is a need to have m-learning application so that students can learn on mobile devices without the need for a conventional computer [7].

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The aim of this study was to produce a model of m-learning in TVET based on the students' needs and requirements. Objectives that support the goal of the study are; identify the user needs and requirements of the m-learning TVET, develop a model of m-learning TVET, and validate the model.

The premelinary study and final evaluation of data obtained from the target users who are TVET students in Multimedia Software Technology course, Industrial Training Institute (ILP) Kuala Langat Selangor, Malaysia.

Therefore, the proposed model will give an exposure to the students on the m-learning and lifelong learning and also beneficial to students' future career advancement, enhance good personality and knowledge [8].

2. LITERATURE REVIEW

2.1 Context of Learning

Traditional learning or conventional learning which means students attend the daily class and receive information from instructors. The conventional learning is more teacher-centered [2], as the instructor gives information in the classroom while the students takes down the notes, and sometimes they are not fully focused on the learning process [9].

M-learning is an innovation of e-learning which the learning features of m-learning are same with e-learning, such as access to learning materials, assignments, quizzes, discussion forums, messages between users, calendar, notification of current activity etc. [10].

Mobile devices are medium of mobile technology which come with features such as text and multimedia messaging, sending and receiving e-mail, applications with instant messaging service with combination of multimedia elements such as sound, images, animation and video [11]. These features help the learning process to be more effective. Based on the previous study [12], m-learning was implemented as the assessment quiz for students and they found that the learning is more effective, motivate and improve students' performance.

M-learning is to facilitate the online learning regardless of time and place where students can bring their mobile devices anywhere and anytime [13]. M-learning is also changing the teaching and learning process to meet the requirements of new generation of students by providing opportunities to students to use active learning in the context of self-learning [14].

2.2 Previous Model of M-Learning

Based on Figure 1, Koole defines m-learning as a process resulting from the interaction of mobile technologies, human learning capacities, and the social aspects of learning. The framework for the rational analysis of mobile education (FRAME) that Koole recommended focuses on three main aspects of the m-learning which are device, user and social [15]. Aspect of the device refers to the specification of the devices, such as the physical, technical and functional of the device. Aspects of the user is related to mental model of the user that takes into account the cognitive abilities, memory, emotion, motivation and skills of technology. The social aspect refers to how user can interact with the system by using the mobile technology.

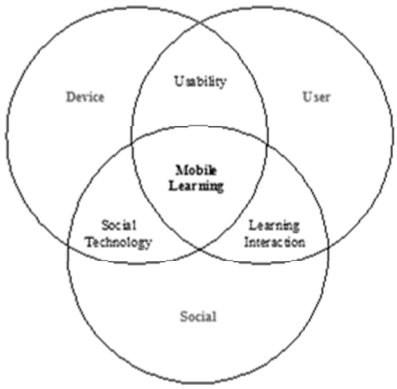

Figure 1: Framework For The Rational Analysis Of Mobile Education (FRAME) [15]

Hsu and Ching [16] reviewed the previous m-learning models which divided into several categories such as pedagogy and learning [17][1], acceptance of technology [18][19], and understanding of user behavior to the m-learning [20]. The previous m-learning models were being compared based on the aspects of FRAME that shown in Table 1. The comparison is to define any additional requirements which to improve the new proposed m-learning TVET model.

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Table 1: Comparison Of Previous M-Learning Models

	Abdullah et al. (2013)	Irwan Mahazir et al. (2015)	Chang et al. (2012)	Park et al. (2012)	Sha et al. (2012)
Method	Gilly Salmon	Performance Based	Technology Acceptance Model (TAM)	Technology Acceptance Model (TAM)	Self-regulated learning
Mental Model	Vygotsky ZPD	Rudric & Krulik	-	-	-
Usability	-	-	Usefulness, ease of use, satisfaction, convenience	Usefulness, ease of use, satisfaction, self-efficacy, accessibility	-
Device	-	-	-	-	-
User	Mastery learning	Process of learning	-	-	-
Social	-	-	-	-	Self-regulated
Additional Requirements	**Device** • Specifications **User** • Skills of digital technology **Social** • Data security • User guide • Learning activity • Automatic notifications • Messenger • File storage		Learning style Control activities		

Based on the comparison, Abdullah et al. [17] and Irwan Mahazir et al. [1] have focused on the aspect of the user which cover the learning styles by using the mental model of each; such as Vygotsky's theory - ZPD and problem-solving Rudric and Krulik model. Meanwhile, Sha et al. [20] focused on self-regulated learning for the aspect of social that can be adapted as an element for activities controller in the m-learning features. However, based on the comparison, the previous models are not explaining details on the aspect of the device.

Therefore, the proposed of m-learning TVET model is divided into four sections which are; specifications of the device, user's learning styles, skills of digital technology and m-learning features. The device aspect which is refers to the device specifications that owned by the user. For user's aspect, learning styles and skills of digital technology should be considered as user requirements. In addition, for aspects social are more to the m-learning features like activities control, data security system, user guide, automatic notifications, instant messenger and file storage.

Beside that, usability elements also are important in verifying the m-learning model. Based on the studies of Chang et al. [18] and Park et al. [19], the basic usability elements in Technology Acceptance Model (TAM) are usefulness, ease of use and satisfaction. Due to the target user for the proposed model, TVET students not been exposed to the online learning system yet, thus, the three elements of usability can be used in the validation of m-learning TVET.

2.3 Learning Styles of M-Learning

There are several learning style models such as Kolb, Honey and Mumford, and Felder and Silverman. Every learning style has different classifications. Felder-Silverman Learning Style Model (FSLSM) often used in the research of e-learning applications and web-based learning systems [21].

Most of the learning style models classified student into many groups, while Felder and Silverman presented the learning style more details on the preferences into four dimensions. Based on the instrument that develop by Felder and Silverman, the learning style was explained in four dimensions; active and reflective, sensing and intuitive, visual and verbal, and sequential and global.

Graf et al. [21] elaborated the details of each learning style in the FSLSM based on the students' activities and interests. First dimension is determining how students process the information either in active or reflective. Active students are categorized in the group who like to learn by trying,

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applying, explaining and discussing. They also like to work in group and prefer leanring inside classroom and also outside of the classroom. While the reflective students like to learn by thinking, validating the options and analysing the informations. They also like to work alone and prefer learning only inside classroom.

Second dimension is learning style of sensing versus intuitive. Sensing students like to learn facts, solve the problems with standard approaches and patient with details. They also like hands-on activities. Intuitive students prefer to learn abstract or conceptual, able to solve problems with new approaches, less cautious and hurried.

Third dimension is to determine how students remember the informations either in visual or verbal. Visual students are good in remembering if the learning material in graphical presentation. In contrast, verbal students tend to remember in textual representations, regardless of whether in written or spoken.

In the fourth dimension, students are characterized according to their understanding. Sequential students more interested in the details that arrange in order such as from easy to difficult or follow logical stepwise paths. In contrast, global students understand the information in overviews either arrange in order or not, able to solve complex problems and correlate with different areas.

FSLSM is often used within adaptive learning and m-learning systems that adaptable to the individual learning style (Özyurt et al. 2013). The previous studies that used FSLSM as the learning style for the systems are CS383 system for Computer Science course [22], e-teacher [23] for Artificial Intelligence course, and adaptive e-learning portal by intergration of existing e-learning management system like Moodle to determine students' preferences of each dimension in FSLSM [24].

There were also previous studies on m-learning systems that used FSLSM as learning style such as intelligent tutoring mobile system [25] and mobile context-aware learning schedule (mCALS) [26]. Therefore, learning styles are important due to adapt into the different mobile devices capability, specifications and also differences of user's learning styles in application or system [27].

Table 2: FSLSM used in the previous studies

Author (Year)	Learning application system	FSLSM usefulness
Carver et al. (1999)	CS383 hypermedia courseware	Students easy to adapt the learning material
Schiaffino et al. (2008)	E-teacher	Compatible system to the students' preferences
Barać et al. (2011)	Adaptive e-learning	Determine students' learning styles for the e-learning
Cabada et al. (2011)	Intelligent Tutoring mobile system	Adaptable learning materials for students
Yau (2011)	Mobile context-aware learning schedule (mCALS)	Determine students' capabilities and preferences for the system

2.4 Skills and Experiences of Digital Technology Applications

The learning process through digital technology applications is encouraging students to use all the senses and help to improve the method of teaching and learning. For example, the learning material in the form of multimedia format such as graphics, text, audio, video or animation helps students to strengthen further of their understanding [28]. Thus, developer needs to know the students' skills level of digital technologyapplication to develop the application that compatible to their skills and experiences level.

Van Deursen et al. [29] proposed five elements for measuring the level of user's skills of digital technology applications; operational, information navigation, social, creativity and mobile. Operational element is to measure proficiency of the user in handling digital media. Information navigation skill is selecting and evaluates information in the digital media. Social element refers to the user's ability to determine the sharing of information and the right rules of knowledge sharing with others. Creativity is a skill in creating a personal environment and technology services. Mobile element is to measure proficiency of the user in using the mobile devices. The skills level of these five elements need to measured and determined tendency skills to develop m-learning based on the user's requirements and needs.

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2.5 M-Learning Features

Learning management system (LMS) is a system of integrating technology and pedagogy in virtual learning element. LMS's features are standard used in e-learning to enable teachers and students to manage teaching and learning through online. However, the features of LMS can be also implemented in m-learning to expose students to the mobile learning technology.

As discussed in the comparison previous studies of m-learning models, social aspect refers to the m-learning features such as m-learning activities, automatic notifications, messaging, file storage, data security systems, user guide and manage activities. These features are same as e-learning features which allow students to register to the learning system, choose the course, calendars, reminders, notifications updates, download and upload learning materials, assignments and discuss with peers and teachers [30].

To ensure the data is secured, m-learning have a registration system which the student need to sign in. In addition, m-learning can help students to enroll a course so that they can easily receive the information about the course. If students are experiencing problems when using the m-learning, they can use the user guide to help them to fix the problem of usage the m-learning.

Students also can manage and organize their own learning schedule and add as reminder in calendar. In addition, students also can receive notification, such as deadline of submission of the assignments or the date of the exam. Automatic notifications will be received through their mobile device to alert the students for the latest informations or annoucements. M-learning can help students to discuss with their peers or teachers through messaging either individually or group. In addition, acceptance and user satisfaction are the importance key to ensure that the m-learning is used continuously.

3. USER REQUIREMENTS ANALYSIS

In ISO 13407 standard, user-centered design begins with an understanding of the needs and requirements of the users [31]. The important stage of the design is to analyze user requirements [32]. Therefore, it is essential to understand user requirements in order to increase productivity, enhance quality of work, reduce support and training costs, and improve user satisfaction [33].

In collecting the data of premelinary study, the survey was conducted on the TVET students who are the target user of the system. The questionnaire was distributed to 45 TVET students at the Industrial Training Institute (ILP) of Kuala Langat Selangor. The questionnaire consists of five sections regarding to the proposed requirements: specifications mobile device, learning styles, skills of digital technology, and the m-learning TVET features.

3.1 Learning Styles

Table 2 shows that the learning styles of TVET students according to four dimensions in Felder and Silverman Learning Style Model (FSLSM) [34]. The highest percentage of each dimension is active, sensing, visual and sequential.

Table 2: Learning Styles of TVET Students

Dimension	Learning Style	Response
First (Information Processing)	Active Reflective	69% 31%
Second (Learning)	Sensing Intuitive	60% 40%
Third (Remembering)	Visual Verbal	84% 16%
Fourth (Understanding)	Sequential Global	60% 40%

Second dimension shows TVET students tend to learn facts, solve the problems with standard approaches, patient with details, and like hands-on activities. In fourth dimension, they understand something in details in sequence order. However, both dimensions are focused to the contents of learning adaptable to the development of learning content management system.

First dimension shows TVET students tends to work in group and dislike just learn in the classroom. Third dimension shows that the students good in remembering the graphical learning rather than text. Both dimensions are support the features and interface of m-learning system and adaptable to the development of learning management system.

3.2 Mobile Device Facilities

The result of analysis for mobile device facilities shows that 100% of students have mobile devices. The type of mobile device that they have is

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93% of smartphones. The platforms of the device are 7% of iOS and 93% of Android. About 81% of the students have the mobile devices's facilities such as internet access, 3G service, and memory card.

Therefore, the result shows that the students are ready towards the m-learning application.

3.3 Skills and Experiences of Digital Technology Applications

In the daily learning process, students have chances to use their senses. Therefore, digital technology applications are important to use in the teaching and learning process such as internet and multimedia elements to strengthen students' understanding [35].

There are five characteristics of skills in technology digital applications which are operational, information navigation, social, creative and mobile [29].

Regarding to the result shown in Figure 2, the students are 80% more skillful at operational, social, and mobile than 20% information navigation and creativity.

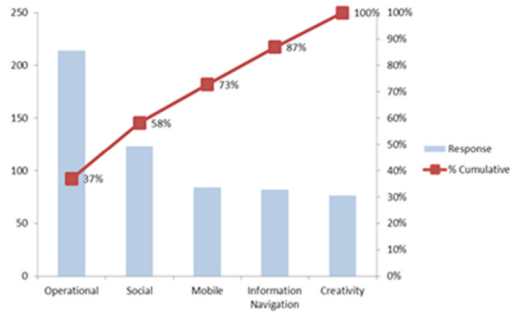

Figure 2: Pareto Analysis of Skills and Experiences of Digital Technology Applications

Therefore, the results can be used as a guide to develop the system that suitable to the level of user's skills and experiences in using the digital technology.

3.4 User Perceptions of Mobile Technology Application in Learning Context

The user perceptions are important to support the needs of M-Learning in TVET area. The result of analysis shows that 95% of students agreed to the mobile technology applications towards mobile technology applications in context of learning.

3.5 TVET M-Learning Features

The most important requirement in designing the system is the features of the system. Table 2 shows the m-learning TVET features which based on the standard Moodle Mobile features.

Table 2: TVET M-Learning Features

No	Features	Response
1	Syllabus	93%
2	Learning Materials	98%
3	Forum Discussions	96%
4	Email Peers and Instructors	96%
5	Live Chat Sessions	93%
6	Assignment / Project	98%
7	Calendar	98%
8	Digital Storage	98%
9	View Grades/Marks	98%
10	Download and upload document, audio and video	98%
11	Latest Announcement	98%
12	User Login	98%
13	Auto-notification	96%
14	Track Progress	98%
15	Interface colour options:-	
	a. Warm	73%
	b. Cool	89%
	c. Neutral	80%

The results of analysis shows that more than 90% of the students agreed with the features and 89% of students choose the cool colour for the interface. Compilation of the analysis from the survey is shown in Table 3.

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Table 3: User Requirements for M-Learning TVET

Section	User Requirements
Device specifications	• Smartphone • Android • Internet access, 3G services and memory card • Read and open digital files
Learning styles	• Active • Visual
Digital technology skills	• Operational • Social • Mobile
M-learning features	**Learning activity** • Syllabus • Learning Materials • Assignment / Project
	Social communication • Discussions • Message Peers and Instructors
	Activity control • Calendar • Track Progress
	Latest notification • Latest Announcement • Auto-notification
	File storage • Digital Storage
	Data security • User Login
	Help • User Guide

4. PROPOSED MODEL OF M-LEARNING FOR TVET

The model is developed that shown in Figure 3 based on the user requirements. Specifications of the device are divided into four parts, which are type of device; platform; facility; and functionality of the device. The requirement for the type of device is smartphones with Android platform. Basic facilities that available in the smartphones are internet, 3G and memory card. The smart phones also have basic functionality for reading and opening digital files.

According to Graf et al. [21], Felder and Silverman learning styles have four dimensions. For m-learning system, we decided to use first and third dimension of learning style. The first dimension shows how students process the information while using the system. Learning styles of this dimension is divided into active and reflective. TVET students are more likely to be active learning which they like to learn in social learning rather than as reflective in individual learning. The third dimension is the tendency of students in the easiest way to use m-learning. Learning styles of this dimension is divided into visual and verbal. The students are tendency to remember things in visual rather than verbal. Thus, the interface of m-learning system should be featured in graphics or icons to attract students compared to text only.

According to Van Deursen et al. [29], skills of digital technology are basic to the usage of system. System development should be compatible with the level of user's skills. The students are skillful at operational, social and mobile in using the digital technology.

The features of m-learning TVET from the user requirements are categorized according to data security, user guide, learning activities, activities controller, latest notification, social communication and file storage.

Data security allows students to login which to ensure data and information stored securely in the system. The user guide is provided to facilitate students how to use m-learning TVET as their reference. Learning activities that will be used by students is the basic activities such as access the syllabus, notes and tasks.

In addition, students can control the activities for reminder activities in calendar and track the progress of activities. Students also will receive automatic notification such as announcements for the latest information sent by instructors, so that students are always ready to accept and carry out the learning activities. If students need help from instructors or peers, they can use messenger to communicate, either individually or group.

For digital storage, memory card are basic thing for any mobile devices. However, students do not have to worry about the limited size of the memory either in the device or memory card because m-learning TVET provides file storage in the cloud.

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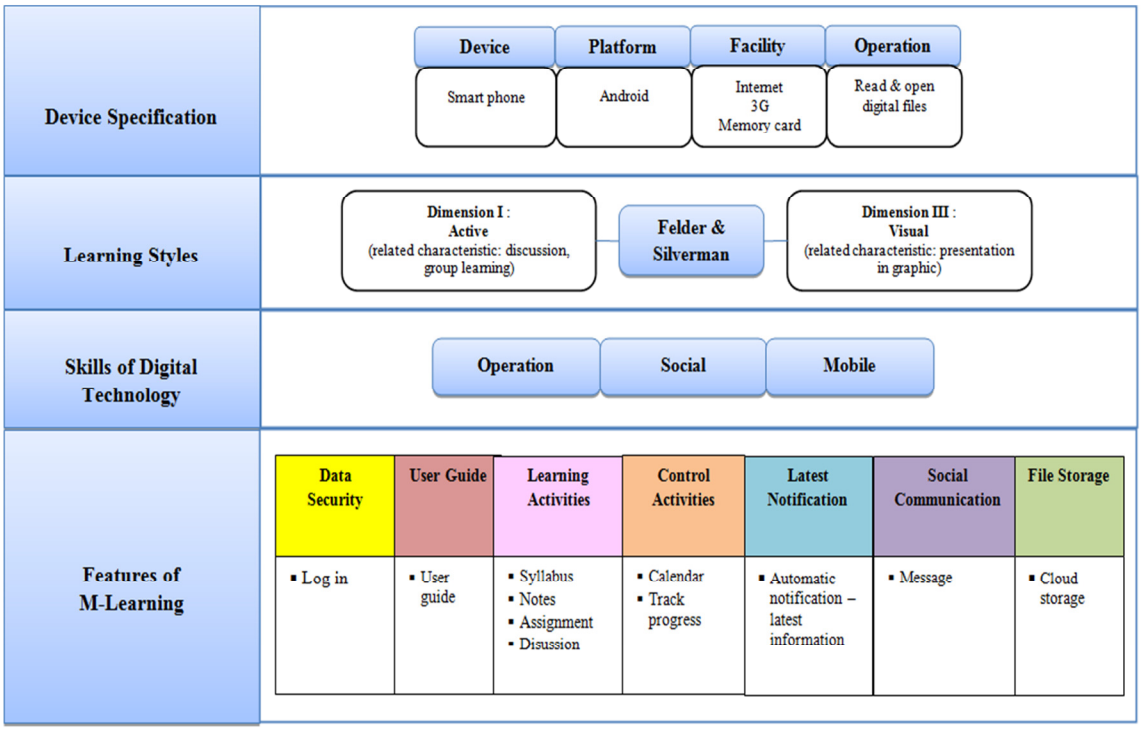

Figure 3: M-Learning TVET Model

5. VALIDATION MODEL OF M-LEARNING FOR TVET

Based on the system prototype that developed based on the proposed model of m-learning TVET that shown in Figure 4. A usability evaluation is carried out to validate the proposed model of m-learning TVET.

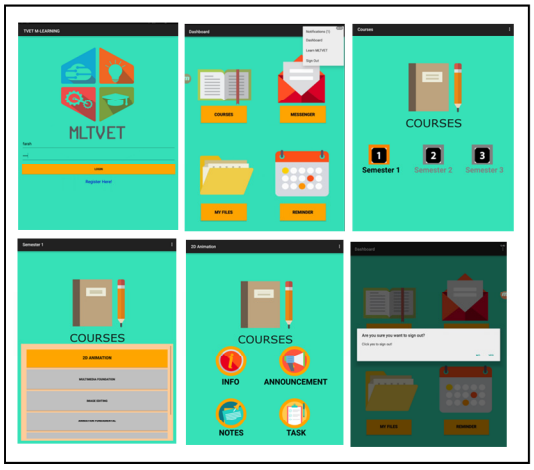

Figure 4: M-Learning TVET System

The evaluation for usability of m-learning TVET is implemented in ILP Kuala Langat, Selangor Malaysia to 30 students of Multimedia Software Technology course. The questionnaire is used to measure the usability of the four elements which are; the usefulness of the system, easy to use, easy to learn and user's satisfaction.

There are five steps are taken for usability evaluation. First, prepare a discussion room and evaluation tools such as video camera, mobile device, note book, questionnaire, and a list of tasks of learning activities. The evaluation is done individually so that the observation can be more focus.

Second, before starting the evaluation, a brief about the evaluation is given to the student. Third, the student performed the learning activities by using the m-learning TVET. The actions are been observed and recorded by video camera. Also the the actions in the device are recorded using Mobizen application. Fourth, after completed the activities in the m-learning TVET, the student is

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answering the questionnaire to evaluate the usability of m-learning.

Fifth, analyze the evaluation by measuring the mean score for each of usability elements; usefulness, ease of use, easy to learn and satisfaction. Table 4 shows the mean scores for usability of m-learning TVET.

Table 4: Usability of M-Learning TVET

USABILITY OF M-LEARNING TVET							
Usefulness		**Ease of use**		**Easy to learn**		**Satisfaction**	
Item	**Mean Score**	**Item**	**Mean Score**	**Item**	**Mean Score**	**Item**	**Mean Score**
Q1	4.43	Q8	4.53	Q16	4.63	Q23	4.37
Q2	4.57	Q9	4.33	Q17	4.57	Q24	4.43
Q3	4.40	Q10	4.27	Q18	4.50	Q25	4.50
Q4	4.30	Q11	4.40	Q19	4.40	Q26	4.23
Q5	4.33	Q12	4.47	Q20	4.43	Q27	4.53
Q6	4.57	Q13	4.30	Q21	4.47	Q28	4.60
Q7	4.60	Q14	4.23	Q22	4.53	Q29	4.57
		Q15	4.37				
Min	**4.46**	**Min**	**4.36**	**Min**	**4.50**	**Min**	**4.46**

T-test one sampel was run to find out whether the level of usability of m-learning TVET model is significant at high level. The result of t-test showed that the usability of m-learning model at a high level that was significant level of 5% (t (29) = 5:05, p <0.001). Thus, the results showed that the model of m-learning TVET is acceptable and can be used as a guideline of m-learning TVET system development.

6. CONCLUSIONS AND FUTURE WORKS

One of the positive impact of m-learning is it can give a high chance to the TVET students for acceptable in the employment and adapt in the industry. M-learning can improve the effectiveness of teaching and learning in terms of saving time and create a student-centered learning. M-learning also can brings new changes in the process of learning which is from individual learning to social learning [36]. Also, activities of sharing and exchange information can be maximized by using the mobile devices in the learning process regardless of time and place [37].

The main goal of the study is to produce an m-learning learning model that can be adopted and used in the development of m-learning system according to user requirements and needs. The study has achieved the goal with the support of the three objectives. The first objective is user requirements were collected and identified from the preliminary study. The second objective is m-learning TVET model was built based on the user requirements. The third objective is validation of the model with conducted an evaluation of usability of m-learning TVET system. The analysis found that the average of mean score of usability is at a high level and the t test result confirmed that m-learning TVET model can be adopted and used.

The finding shows that the main contribution of this study is a proposed model of m-learning in TVET based on the TVET students requirements that need a basic platform for future learning. Some suggestions for further works are; improving on the user interactions with content of learning materials, add other learning modules such as check result exam, scope further work for TVET instructors and special module to meet the needs of disabled individual.

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