Education Innovations through Mobile Learning Technologies for the Industry 4.0 Readiness of Tertiary Students in Malaysia

R A Karim¹, A H M Adnan², M S A M Salim¹, S Kamarudin¹ and A Zaidi¹
¹Universiti Teknologi MARA Perak Branch, Tapah Campus, 35400, Tapah Road, Perak, Malaysia
²Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus, 32610, Bandar Seri Iskandar, Perak, Malaysia

E-mail: feida16@uitm.edu.my

Abstract. The formal education sphere is one that is dynamic and ever-changing, even more so with current developments in technologies of teaching and learning. The process of education needs new innovations to keep pace with these rapid developments, particularly for tertiary students on the cusp of radical Industry 4.0 ‘disruptions’ that will permeate all social and personal domains in human societies around the globe. One area where innovation is happening is in the implementation of mobile learning technologies for tertiary college and higher learning institutions. The study examines why and how tertiary students utilize their mobile devices in the education setting as both a conduit and catalysts for e-learning. Tertiary students find the utilize of mobile devices easy and natural, thus helping them to learn anytime, anywhere. Today, the popularity of mobile practices amongst tertiary education is steadily growing and they are now able to utilize their mobile devices for a myriad of activities from developing websites to creating mobile apps to acquiring knowledge non-stop. Mobile application for learning is expected to be prevalent in forthcoming, as more devices procured by the younger generation. This study examines results from a survey on the perceptions and practices of mobile learning for Malaysian tertiary students. A quantitative research methodology was adopted to analyse data; results demonstrate that these students have positive perceptions towards mobile technology utilize in learning, and they actively and autonomously utilize mobile devices to enhance their experience of learning.

1. Introduction
Malaysia aims to become the industrial hub of 4.0 in Southeast Asia to enhance the country's productivity and employment opportunities. Industry 4.0 is influenced by mostly for the use of digital technology and big data analysis. These two factors are to enhance industries and enterprises. Therefore, without the provision of extensive internet access and due to the limited internet speed, this would have hampered the development of the Industry 4.0 revolution in Malaysia. However, one of the steps the Malaysian government can take is to implement comprehensive and well-planned policies that can be implemented gradually to secure cooperation and prepare the net for the 4.0 Industry Revolution in Malaysia. Besides that, the government also have made wide-ranging preparations in a fronting automation revolution. Moreover, a fundamental framework also is provided for improving the education system and school management and administration and enriches student learning outcomes through the utilization of technology. It indirectly proves the revolution and technological developments, especially among the younger generation have long been taken seriously.
The popularity of mobile devices is growing significantly every day, as many learners are using mobile technology for their learning [1]. The creation of the smartphone revolution of today is aimed at making it easier for users to communicate and even now smartphones can give users a chance to interact with family, friends and others. The evolution of mobile app technology has brought about major changes in our culture and everyday life. Even the power of information is now able to translate in audio and visual form through 3G technology mediators. All of these devices are powered by sophisticated mobile phone technology and are capable of moving with the advancement of cyber technology. Therefore, the existence of mobile phones is no longer a symbol of the lifestyle, it is a must for every individual. Its existence despite being considered mercy in the millennial era’s lifestyle still has many implications for society. In recent times, mobile devices have tremendous potential in today’s tertiary education system. A transformation from traditional conventional ways of teaching to a new innovative one involves technology [2]. Educators also examine the ways their courses and programs should be delivered using mobile technology or supporting the students’ learning. Therefore, the study aims to discuss the perspectives and the practices of mobile devices for Malaysian tertiary students in the 4th Industrial Revolution. We will fulfill this objective by answering the following questions to the research:

- Do Malaysian tertiary students learn by using mobile devices?
- What mobile devices are utilized by Malaysian tertiary students?
- Do mobile devices help tertiary students in learning?
- How do Malaysian tertiary students usually utilize mobile learning purposes?
- Are Malaysian tertiary students familiar with the term of Industry Revolution (IR 4.0)?
- Does mobile technology is highly connected to the Industrial Revolution 4.0 (IR 4.0)?
- Must Malaysian tertiary students learn using mobile technologies?

2. The Mobile Technology Revolution

Education 4.0 will be the latest trend in higher education and it will generally take account of digital technology. In the digital technology world, mobile devices are the most used ICT approaches [3]. In reality, the average person who uses a mobile phone per day has risen over the last ten years, and it has been labeled as the decade of the smartphone. Regardless, the evolution of mobile phones has been a really stimulating journey. Mobile technology development has been spread rapidly in our modern society. Mobile technology is becoming progressively prevalent in the tertiary education setting. Thus, educators must embrace and exploit the utilization of mobile skills in order to remain significant. Smartphone use is gaining popularity among students. This device has provided users with advanced computing structures and erudite applications compared to mobile phones. In addition, smartphones also use operating systems that provide a platform for application development. Smartphone has a great effect on every student who uses it, both positively and negatively. Among students, the use of smartphones with internet access can help their learning process especially, when looking for reference materials. Through smartphones, students can do browsing materials for their learning using the internet access. Then, the students will be able to do their research and complete their projects given by their lecturers. Therefore, the students have the abilities to utilize the internet to get the materials by using their devices comprehensively. Nevertheless, Traxler [4] offers a different definition of m-learning, a sort of realizing which incorporates remote, advanced gadgets and innovations. In 21st century learning, the mobile device makes teaching and learning process for tertiary level students simpler access to advanced education. Mobile learning has various definitions or names such as m-learning, u-learning, learning while versatile, universal learning, and handheld learning. According to [5], this type of learning uses a digital electronic tool and media and by analogy. Furthermore, this kind of learning is also expected to have great potential in the future as we can see there is an increasing number of mobile device users all over the world. In this case, most of the studies especially the educators observed that mobile devices have an exceptional potential to replace other e-learning devices in the learning setting.
Today, many institutions in tertiary level are widely using mobile devices. They mostly use in instructions process as it increasingly adaptable for the students’ learning condition [6]. The questionnaires were administered for 120 university students in a selected higher institution in Malaysia [7]. The results showed that the mobile learning is an operational strategy for the students. Besides, the mobile phones usage encouraged the students to communicate with each other. According to [8], mobile learning can improve students’ affective traits. In higher education, there are already various kinds of M-Learning solutions including the commercial ones and so educators should analyze the opportunity of incorporating mobile application at universities. Figure 1 shows the three notions of mobile learning mobility; (1) technology, (2) learning, and (3) learner, that adapting particularly in tertiary education condition.

![Figure 1. Three notions of mobility](image)

The effective formation of higher learning institutions’ training relies upon the keyword of mobility. The keyword is utilized with regards to the context of the tertiary education system. Each concept is supporting with one another to deliver the implementation of mobile technology for tertiary level students. From all the mentioned studies, it can be summarized that the students and instructors in higher education institutions (HEIs) had supported positively towards this idea implementation. Hence, it indicated that the acceptance of mobile application in Malaysia is very promising.

3. IR. 4.0: Modelling a New Era
Starting in 2016, the terms Industrial Revolution 4.0 (IR 4.0) were actively enunciated globally. This era of Industry 4.0 expresses of the industrial revolution that involved every stage of the revolution. At the latest, it is more about the advanced technology era which predominantly involves digital technology. Therefore, all parties need to support and facilitate the development of this revolution. Smart homes, smart cars, smartphones, and many other smart elements are translated into smart technology through Industry 4.0.

Recently, Industry 4.0 stimulates technology revolution for instructional approaches that is Education 4.0. One of the Education 4.0 objectives is to develop the digital technologies’ competencies. This objective is mainly to develop the utilization of digital technologies in the education structure. Moreover, the IR 4.0 plays a major role in changing the education technology setting. All higher institutions in Malaysia prepares to familiarize and renovate the educational plan with the objective in helping graduates to fit in jobs [9]. In other words, Malaysian tertiary students need to be trained for today’s industrial operation. According to [10], the IR 4.0 appropriated the new
model of education and changed the scholastic setting for the future. Prompt technical and technological developments of the 4th Industrial Revolution industrialization provides a generation with technological involvement. This is expected to be fully exploited by the higher education system [11]. The higher education should proceed with their functions forcefully [12]. Figure 2 illustrates the three fundamental functions of a higher education institution namely; teaching (Function 1), research (Function 2) and Service (Function 3).

![Diagram: Higher Education Institution Major Functions versus Solutions of Teaching in the Industrial Revolution 4.0. Source: Xing & Marwala, 2017](image)

The diagram shows teaching as the first function which is the compulsory responsibility that HEIs need to carry out to educate their stakeholders. Thus, each institution must implement suitable teaching approaches and programmes for effective learning and lifelong learning assertiveness. For this function, the teaching methods such as virtual reality, massive open online courses (MOOCs), humanizing innovative talent and generalized blended learning are innovative and new technologies that can transform instructional environments for higher learning institutions. For the second function, it includes digital innovation, evolutionary and radical innovations, modern technical technology drive research and development and shortens the higher education system. Thus, the higher education needs to expand its technological system in the higher institutions by encouraging more innovators and researchers to provide advanced technology towards the success of the Industrial Revolution 4.0. The final function of the higher education institution is service which described University-as-a-Platform (UaaP) for its own business platform opportunity in the higher education system. Next, this function also stimulates Education-as-a-Service (EaaS) which is works as a parameter for discovering innovative and more advanced approaches to survive with ever-increasing public obscurity. Building various kind of institutional collaborations locally and internationally are also needed for developing a connected system allowing study programmes to be taken in different locations. Moreover, the e-learning system can be implemented in achieving these universities linkages. Thus, all these three functions will support to reform of a university. It is progressing and all the university’s procedures will be prepared in varied way.
4. Data Collection
This is a descriptive study and it focuses on Malaysian tertiary students’ perceptions of mobile practices in the institutions of higher learning. A quantitative research methodology which is a questionnaire method was employed for this study. It was disseminated to students through online. The questionnaire was made through a technology Google form. Then, the questionnaire was disseminated by using social media. The respondents of the study involved 130 tertiary students who are studying in higher educational institutions in Malaysia. The subjects completed a 10-item survey questionnaire online. The questionnaire asked about the students’ background information, the mobile technology ownership, mobile learning practices and their perspectives on the 4th Industrial Revolution (IR 4.0). Through quantitative data analysis, information regarding frequency and Malaysian tertiary students’ perceptions of mobile practices in the 4th Industrial Revolution was obtained.

4.1. Demographical information
A total of 130 answered the questionnaire. Table 1 shows the demographic information for this research study.

| Classification | Frequency | Percentage |
|----------------|-----------|------------|
| Gender         |           |            |
| Male           | 43        | 33.1%      |
| Female         | 87        | 66.9%      |
| Age            |           |            |
| 17-19 years    | 32        | 24.6%      |
| 20-22 years    | 75        | 57.7%      |
| 23–25 years    | 12        | 9.2%       |
| 26 years and above | 11   | 8.5%       |
| Race           |           |            |
| Malay          | 110       | 84.6%      |
| Chinese        | 1         | 0.8%       |
| Indian         | 15        | 11.5%      |
| Other          | 4         | 3.1%       |

The students’ demographic profile is examined in terms of gender, age, and race group. As shown in Table 1, (43) 33.1% were male and (87) 66.9% were female. The majority of students (75) 57.7% were aged between 20-22 years while the least students were aged 26 years and above were 11(8.5%). The students were aged between 17-19 years were 32 (24.6%) and only 12(9.2%) students were aged between 23-25 years. In terms of race, most of the students 110 (84.6%) were Malay students followed by 15 (11.5%) were Indian students. Only 4 (3.1%) and 1(0.8%) students were from other races and Chinese students.

5. Results and discussion
The quantitative results are ascertained using descriptive statistics. The results were reported into seven sections; (1) mobile practices, (2) mobile devices, (3) mobile devices help for learning, (4) mobile learning purposes, (5) familiarity with IR 4.0, (6) mobile technology is highly connected to IR 4.0 and (7) students must learn using mobile technologies.

5.1. Mobile practices
Figure 3 illustrates the number of students’ learning practices through mobile. Today, mobile learning is preferably practiced by students because this type of learning is more flexible and time-saving.
Moreover, students can access various information and support different knowledge through their mobile devices.

Figure 3. Mobile practices

The chart above showed that most of the students (96.2%) utilized their mobile devices for their regular learning. Only 3.8% disagreed and this result showed that the mobile learning ecosystem is highly engaged among Malaysian tertiary students. This finding is supported by previous studies in the perspective of the mobile language learning. It is possible to integrate mobile application into writing skills in the classroom [13]. Furthermore, the outcomes of the study on the revealed that the use of mobile learning improved the undergraduates’ essay writing [14].

5.2. Mobile devices

A list of mobile learning devices is recorded in this study. Figure 4 displays the ranges of mobile learning devices that the students utilized frequently. The majority of students used smartphones (79.2%) for their learning. Then, it followed by mobile phone (16.9%), other (1.5%), Personal Digital Assistance (1.5%) and tablet (0.8%). The findings indicate that almost all of the students have their own smartphones. Through learning 4.0, students feel that smartphones are a necessity today. They need smartphones for collaborative learning through social media, downloading mobile applications and downloading and uploading sources from the internet. Smartphone ownership was therefore prevalent among students irrespective of demographic factors. Nevertheless, academic status, age, and gender played a significant role. Smartphones have demonstrated as very influential devices for language learning [15]. Generally, with smartphones, students can access online materials related to their area of discipline. Other than that, the smartphone also could help students to search for information from the internet and applications by using data or wireless networks to surf the internet from the device such Google or Yahoo that had been installed in the system of smartphones. Therefore, students mostly selected smartphones as the most popular types of mobile device for this study. As technology becomes increasingly mainstream, mobile learning is only set to increase in popularity. Mobile devices specifically the smartphones equipped with various collaborative contents are extensively used for many purposes.
5.3. Mobile devices help students for learning

Figure 5 shows the students’ responses on whether the mobile device helps them in learning or not. The majority of students (97.7%) agreed that the mobile device helped them in learning. Only 2.3% of the students answered the mobile device did not help them for learning. The finding has shown that mobile learning practices is vital and it will become more accessible for the tertiary education system. With technology turning traditional learning techniques on their head at a rapid pace, mobile learning is shaping the future of education. According to Mango [16], there was a positive result in research on the use and adoption of tablets among students. The students showed a positive engagement in their learning when they used their tablet. A study was done by [17] also revealed that tablets and iPads had positive impacts on the teaching and learning process as they learned by themselves and act responsively. Mobile device is an innovative technology that can aid in writing instructional approaches and make it more exciting [18].
5.4. Mobile learning purposes

As shown in Figure 6, the results show the various reasons that mobile learning devices helped students in their studies. The study aims to discover the practices of mobile devices for Malaysian tertiary students in their learning. The study found that the students mostly utilize their mobile tools for doing research and searching for information online. A total of 73.8% of the students answered this statement. In addition, 8.5% of the students utilize their mobile for accessing and downloading learning materials, whereas 6.9% of the students use their mobile for studying via YouTube videos. Another reason that they utilize their mobile device is for using mobile applications for their learning. For this reason, only 5.4% of the students had answered for this reason. Besides that, students also used their mobile device for taking photos and video lectures in class. The results revealed that only 3.8% of the students need their mobile devices for this reason. From the chart, the results showed that the minority of the students (1.5%) participating in discussion forums using their mobile. In addition, [19] stated that the mobile devices usually used by students for social, entertainment, work, and study. Based on these findings, it can be inferred that the mobile device is very helpful and useful specifically for tertiary students in doing and completing their assignments and research projects for their courses. Thus, the mobile devices are needed to be used for getting information and doing research online. The study also revealed that most of the students practice their mobile devices for downloading materials that are needed for their assignments and research projects. Hence, the mobile device is very essential device for supporting tertiary students’ learning in HEIs.

![Figure 6. Mobile learning purposes](image-url)
5.5 The term of Industry of Revolution 4.0 (IR 4.0)
As shown in Figure 7, the collected data indicated that 56.9% of the students heard about the term IR 4.0. Whilst, 43.1% of the students did not hear about this term.

![Figure 7. The term Industry Revolution 4.0 (IR 4.0)](image)

This result indicated that many tertiary students were still not concern about the 4th Industrial Revolution (IR 4.0). The higher education instructors are ready to apply learning technologies at such a critical time in human history due to the interferences and indecisions brought by Industry Revolution 4.0 [20]. Thus, the higher education institutions and educators should put more effort into sharing knowledge and information about the importance of the Industry 4.0 in our education system. Tertiary education is suitable to adapt to Education 4.0. The undergraduates who are ready to fit the job need to strengthen their skills and elements of IR 4.0 after they finished their studies.

5.6 Mobile technology is highly related connected to Industrial Revolution (IR 4.0)
The study also sought to ask the students’ views on the relationship between mobile technology and the IR 4.0. Figure 8 shows the students’ responses to this question. Most of the students (96.9%) said that mobile technology is highly connected to the IR 4.0. In contrast, 3.1% of the students disagreed with this statement. The mobile technology is an attractive means to maintain literacy and gain easy access to the information. They are easily affordable and distributed as well, to reach the maximum number of users or learners. The core of IR 4.0 possibly will perform as a standard and policy to expand the existing instruction in our education system [21]. From the results, it can be seen that most of the students had realized that the future of mobile learning lies in its main potential. Mobile devices will be the mass assimilation into the world instructional approaches. Moreover, it provides a much broader range of opportunities for gathering and exchanging information with other learners.
Figure 8. Mobile technology is highly connected to Industry Revolution (IR 4.0)

5.7 Students must learn using mobile technologies

In Malaysia, the application of mobile technology practice is prevalent in schools and tertiary levels of education. Figure 7 shows the results about the importance of mobile technology in facing the Industry 4.0 age. The results showed that most of the students (96.9%) responded positively and they strongly agreed that mobile technology must be learned by the tertiary students for the Industry 4.0 readiness. Only 3.1% of the students answered “No” for this statement. According to [22], mobile devices helped the students to develop their skills. Moreover, the advanced programmes need to be implemented for facing the challenges of this era in the future [23]. Thus, the results confirmed that mobile technology has a great potential in innovating education for the tertiary students in facing the revolution of Industry 4.0.

Figure 9. Students must learn using mobile technologies
6 Conclusion
In conclusion, mobile can be used as feasible devices for instructional activities in today’s society. Malaysian tertiary students had positive perceptions toward mobile learning practices, and they actively and autonomously utilize mobile devices to enhance their experience of learning. Generally, Malaysian tertiary students agreed that the utilization of mobile as an education tool is very essential in supporting them for facing the Industry 4.0. This survey has also shown that the tertiary students are generally supported and believed that mobile technologies are highly connected to 4th Industry Revolution. Furthermore, they also confirmed that mobile technologies should be learned and practised by tertiary students for more effective learning. It is hoped that the study will contribute new knowledge to the area of this study for further research. Therefore, the higher education institutions and every educator need to encourage and give support towards innovating education via mobile technologies for Industry 4.0 in Malaysia. Besides that, the policymakers also should provide insights regarding the issue of the study and reviews the strategic direction on the potential of mobile applications in our education structure. The issue of the study is highly recommended to be carried out for future research.

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