International Journal of Computing and Digital Systems
ISSN (2210-142X)
Int. J. Com. Dig. Sys. 11, No.1 (Jan-2022)

https://dx.doi.org/10.12785/ijcds/110141

5G Technology Readiness in Education among Malay Bumiputera Students in Shah Alam

Mudiana Mokhsin[1], Amer Shakir Zainol[2], Nur Syahirah Addenan[2], Wan Adilah Wan Adnan[1], Mohd Husni Mohd Som[1] and Shariza Mohd Said[2]

[1]*Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA,40450 Shah Alam, Selangor*
[2]*Institute of Malay Thoughts and Leadership (IMPAK), Universiti Teknologi MARA,40450 Shah Alam, Selangor*

Received 31 Mar. 2021, Revised 14 Jul. 2021, Accepted 18 Nov. 2021, Published 20 Jan. 2022

Abstract: Technology evolved quickly over the decades through research and innovation. This latest technology is called 5G. Besides, the mobile technology has grown swiftly where the usage mobile technology tools such as smartphones, tablets computer, and laptops were increasing especially among students. Most of the students own mobile devices for educational purposes; during their learning process where to send/receive emails, download lecture notes, stream online videos. Consequently, mobile learning (M- Learning) takes place in providing new ways of learning. Apart from that, Augmented Reality (AR) also has becoming one of the technology tools used in education since it can access it anywhere this is because of the existence of mobile technology. Many studies show these technologies improved the students learning process and motivates them to learn more either inside or outside the classroom. However, there are some challenges to make full use of these technologies because of the current network technologies. For example, the challenges in mobile technology are Internet connection slow, network unreliability, and insufficient bandwidth. Meanwhile, for AR technology facing some challenges on providing real-time response and high latency. Therefore, with the help and support from new 5G technology may reduce and enhance the mentioned challenges. Malaysian Communications and Multimedia Commission stated that 5G implementation can improve the quality of life by providing better healthcare, transportation, smarter cities, and education all of which will enable Malaysians to be more productive for a longer period as life expectancy increases. Thus, it is imperative to investigate the readiness of Malay Bumiputera students before implementing 5G technology in education since the population of them in Shah Alam is huge. Hence, in this study an appropriate model was applied to identify the 5G technology readiness in education among 422 student UiTM Shah Alarm with four hypotheses by using Technology Readiness Index (TRI) model to carry out a regression analysis. The results of this study indicate that Optimism factor has a positive significant effect on the 5G technology, but Innovativeness, Discomfort and Insecurity factors has no significant effect. Thus, to improve the design of 5G technology readiness model for further improvement. Lastly, this study finds that implementing 5G leads to better learning performance and helps university to be prepared by leveraging on the 5G as it will be commercially used by 2021.

Keywords: 5G technology; Readiness; Education; Mobile Learning; Technology Readiness Index (TRI)

1. Introduction

Globally, the education sectors have witness unprecedented increase in the use of technology. Students around the world now mostly rely on mobile technology for sending and receiving email, download lecture notes, audio and video files, quizzes and may others for learning. As such, it has impacted the Malaysia wireless communication technology to respond rapidly through research and innovation to meet the current need of students learning

This has led to the technology called 5G. It is the 5th generation wireless network. According to Bernama, (2019) Malaysia is ready to deploy the 5th generation (5G) mobile technology. In the newspaper stated, Malaysia should expedite the deployment of 5G to be frontier like Singapore and South Korea countries since they are quite fast approaching. Besides, there are many use cases involved in 5G Technology demonstration projects. For example, the verticals in agriculture, digital healthcare, entertainment, manufacturing and education. At present, the number of use cases is 55 under the demonstration phase across 32 sites across 6 states.

In this modern age, mobile technology has become one of the powerful necessities that no one can ignore. Some of them use mobile technology such as smartphones, laptops and many others. for various purposes such as social interaction, entertainment and for the learning process. They do not know or can even imagine how life was without them. Students found streaming online videos and accessing

E-mail address: mudiana@tmsk.uitm.edu.my

e-learning tools such as Quizlet, Padlet and, Socratives through mobile technology are far more interesting and creative that attract their attention to study compared to books [1], [2]. According [3] with this technology, it provides opportunities for students to explore new pieces of information, issues, techniques that benefited their academic knowledge. In agreement with [4] the use of smartphones among students will increase collaboration and communication among classmates, encourage the participation of active learning, and so on. Unfortunately, as reported by [3] the usage of smartphones among Institute of Higher Learning (IHL) in Malaysia for the mobile learning process and education is only 7.78 percent compared to other factors. It shows that smartphones were not fully utilized for the learning process where students missed the chances that have been provided with mobile technology. Additionally, some limitations that need to be considered in mobile technology such as slow Internet connection, network unreliability, and insufficient bandwidth [5], [6], [7]. These limitations might lead to buffering videos and choppy applications that may reduce the quality of the learning process. Hence, 5G is significant since it can provide students with a seamless learning experience, allowing the students downloading high-quality, feature-length documentary in seconds and many more.

Furthermore, Augmented Reality (AR) contributed many benefits to education. AR is a technology that enables a new information delivery environment [8]. Based on the previous research, the authors identified 14 advantages of AR for instance student's motivation and attention increased, collaborative learning improved, as well as interactivity increased. [9]. Besides, the education sector needs technology adoption and a new approach to education to keep engagement levels high. The education sector and students can leverage the use of mobile technology combined with AR technology. In the end, the difference in the interest of students towards learning can be found. However, [10] stated AR unable to achieve collaboration with the current technology's limitations such as in bandwidth and latency. Besides, the authors added today's technology still facing some challenges in providing real- time response and big data size. Hence, with the support of 5G technology, there will be better service that are limited to today's technology. Malaysian Communications and Multimedia Commission (MCMC) mentioned that 5G implementation can improve the quality of life by providing better healthcare, transportation, smarter cities, and education all of which will enable Malaysians to be more productive for a longer period of time as life expectancy increases. MCMC also proposed some uses cases of 5G in education such as to provide the smart classroom by integrating AR and VR [11]. Not only that, Maxis has demonstrated the eKelas programme for digital learning initiative. Nonetheless, are the students ready with the implementation of 5G technology in education? Thus, it is imperative to investigate the readiness of student before implementing 5G technology in education. Hence, this research paper focus on investigating the contributors and inhibitors of 5G technology readiness among the focus group of students, the Malay Bumiputera.

2. LITERATURE REVIEW

In this modern age, mobile technology has become one of the powerful necessities that no one can ignore, particularly in the education sector. The use of mobile technology such as smartphones, laptops and many others has been necessary in education for various purposes, such as social interaction, entertainment, mainly for the learning process. This usage of mobile technology, such as smartphones among students will increase the collaboration and communication among classmates, and encourage the participation of active learning. However, smartphones, laptops and many other mobile gadget cannot be use without active connectivity. Nevertheless, through connectivity students found streaming online videos and accessing e-learning tools, such as Quizlet, Padlet and, Socratives which are far more interesting and creative in attracting their attention to study compared to books. In light of this, The MCMC has proposed the usage of 5G in education in order to enhance the smart classroom through integration of Augmented Reality (AR). Hence, it becomes imperative to investigate the readiness of students before implementing 5G technology in education in Malaysia.

A. 5G Technology and its Significance

5G technology or 5th generation mobile communication network technology will become a new telecommunication revolution and many researchers mentioned 5G technology expected to be ready by 2020. The technology companies are racing to develop 5G products because it could generate trillions of revenues, hence it will significantly provide benefits to the economy [12]. Similarly, it is expected to provide high data rates for high-quality voice to high-definition video, long- lasting battery, and high network availability and reliability to consumers of all categories [13]. This will make it possible for them to download videos and movies with the best quality and high definition in seconds as the speed of 5G technology is quite promising [14]. Nevertheless, the 5G technology possess a bright future in adapting its relevant technologies to education where the educator and student will have an efficient learning experience personalization and interactive possibly collaborative [15].

As such, students will have the opportunity to participate and learn throughout long journeys in the class [16]. This trend of technology will bring a glowing future and especially strengthening the learning process or education specifically. Therefore, the purpose of the study is to investigate the significance of 5G technology readiness in education among Malay Bumiputera students in Shah Alam. As advocated by Massive Machine Time Communication (mTMC) shown in Figure 1.

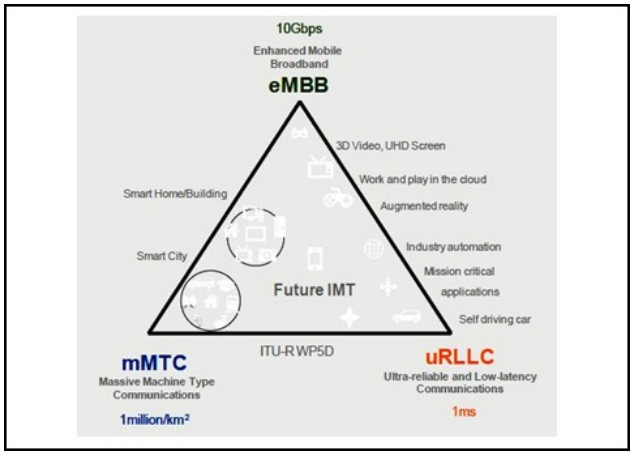

Figure 1. Figure 1. International Mobile Telecommunication (IMT) 2020 requirements

B. 5G Technology in Education

The technology has contributed to human and enhanced the socio-economic globally such as in mobile technology. [17] explained the mobile technology has emerged as one of the fastest technologies starting from 1G, 2G, 3G, 4G, and today expected 5G. The mobile phone has become more available, and it increasingly owned by the student. Their lifestyle has been changing because of the rapid growth of technology. The first generation of mobile technology used for voice call, and today it equipped with more new features such as communication, entertainment, videos, and internet access [18]. Students utilized the usage of the smartphone by downloading online lectures, emails, google drive, to create, upload, download and share academic resources among their friends. Besides, [19] added Information Communication and Technology (ICTs) growth is imperative in education for delivering the synchronous and asynchronous lesson in the teaching process. Today, it is common for the educator and student to access YouTube for educational contents and also accommodating web-based educational platforms such as the Moodle, Edmodo and Edsby [20]. The 5G also offers support for AR and virtual reality which are effective technology applicable to education and becomes an essential of future communications.

In 2015, the research conducted by Diegman et al. found that AR contributed to improving the learning curve and increased motivation up to more than 20 percent compared with other benefits mentioned. Additionally, the authors observed the AR applications affect student learning faster and easier compared to traditional learning method (non-AR applications). Also, it was explained that the AR-style game play and AR books have encouraged students to learn on their own, for example after class. Furthermore, it provide students satisfaction and increased their motivation. Thus, when the AR and VR technologies are supported by 5G, it will provide more benefit to education, such as creating smart education as shown in Figure 2 [19]. Besides, the Gokhan Ogut, Maxis CEO said the 5G has great potential to advance education in Malaysia and his company have demonstrated 5G virtual reality case for science learning in eKelas program and has been recognized by the Prime Minister, Tun Dr. Mahathir bin Mohamad.

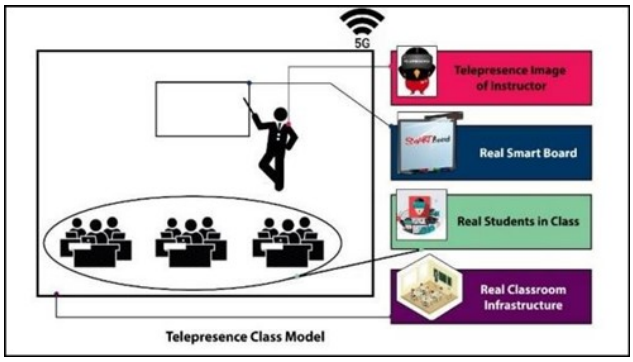

Figure 2. Figure 2. AR and VR applicable to Education

C. Mobile Learning in Education

Mobile technology has become a revolution in the 21st century, representing an era of learning. This is because, its emergence has inspired many educational organizations to integrate mobile learning into education so that student has the flexibility in learning. Mobile learning is also a new technology embraced in the educational environment. In general, it can be described as teaching and learning activities by using mobile [21]. As said by [22] students can access course materials from anywhere and anytime. Even more, the mobile learning through mobile devices can help to prepare the student in improving their communication skills before entering the working environments. Apart from that, mobile devices have become the important thing in our daily life and have contributing towards reshaping society, communications, and the global economy [23]. Similarly, the student can access the recent educational resources from the web and reach the expert in the field of their studies [22]. Nevertheless, the precautions cannot be taken lightly before implementing the mobile learning in education [22]. Besides that, [24] further posited that it is imperative to identify the readiness of student in adapting mobile technology in education.

Having said that, the author conducted a survey and the results revealed most of the Malaysian student were still moderately ready for mobile learning. This is because of a few factors such as cost issue, technological challenges and the restriction in the policy. Hence, the high educational organization must consider these factors so that the implementation of mobile learning in education will be smooth [25]. In contrast, a study conducted by [26] indicated most of the students at Universiti Teknologi Mara (UiTM) who studied Diploma program (97.7 percent) used their mobile device for learning and they preferred smartphone than other mobile devices for learning. In the same way, as reported [27] around 178 students at Network Education College, Shanghai used mobile learning for discussing

course content and exchanging questions and ideas among classmates about the course materials. As a result, there is still great potential and opportunities of mobile learning in education and the high educational organization have to be prepared in adapting and changing their curriculum so that educators and students can keep up with this fast pace of technology and also experience the benefits offered by mobile learning.

D. Augmented Reality (AR) in Education

The technological advancement has been known to provide opportunities and benefits in many fields which are healthcare, tourism and education over the past decades. Several studies are being conducted to improve and enhance technologies to cope with various issues, hence demands of consumers can be achieved. In this paper, the authors aimed to explore the benefits of AR in higher education learning and to develop applications based on AR called the "ARBrain". At the end of the results, it shows the students give positive feedback, and their motivation to learn increased [28]. Next, another research conducted by [29] examined the student impression and thought towards the capabilities of AR mobile games offered in the language learning process in terms of the use and design qualities. AR Mobile-game-based learning is a popular learning approach as it leverages on a fun and multimedia interactive learning that will facilitate students to be motivated in learning and exploring [30]. The results revealed that the student can take language learning outside the classroom and increased students' willingness to communicate. Moreover, [31] reviewed numbers of mobile AR tool for foreign language education (listening, speaking, reading and writing) paper. Based on the most paper reviewed, the AR was observed to promote foreign language by increasing learner motivation. Aside to that, different research paper focused on students' achievement, attitude and cognitive in English learning towards AR. The research has significantly resulted was positive as students are satisfied and convinced to use AR in their English learning [32].

E. Student Readiness

The process of learning and methods in education is becoming increasingly digitized over the years because of the existing variety of technology, such as mobile technology, network, and many more. Previous studies have shown that mobile learning plays an important role in education [33]. The educators and students using a smartphone to send and receive emails, access teaching materials, or supporting information and downloading instructional videos via the internet have become a regular occurrence in their daily life. Besides, as reported by MCMC, in 2018 the smartphone is the most popular for users to access internet 93.1 percent compared in 2016 is 89.4 percent which increased by 3.7 percentage [34]. This is because the smartphone has open doors to numerous new applications and functionalities, thus help the users to access the applications that can be used in learning anywhere and anytime. However, the readiness of students in Malaysia to use the smartphone for learning still remain unknown. [35] added that the smartphone is considered as the best tool to adopt with AR technologies. The study by [36], mentioned the readiness of Malaysia students as most students were found to already have access to smartphones and usage of 4G and 5G as the case maybe. However, there level of readiness for educational usage was not mentioned [37] further explained that the new 5G technology will play a huge role in supporting AR technology, thus beneficial to quality education and understanding-based learning. Additionally, the 5G will provides immediate access and response time without delay as the current network technology struggles to maintain the traffic required for AR. Also, the integration of 5G in AR will promote interactive learning, thus the student can collaboratively participate in creating and sharing information across time and place seamlessly. Besides, 5G offers better speed than 4G. For example, the video can be downloaded and shared at higher speed since the student has been exposed with video-based content inside and outside the classroom as part of their blended learning process [38]. Nevertheless, prior implementing new 5G technology in education or learning process, readiness is an imperative factor in determining whether this technology will be successfully implemented or not. The reason being that technology readiness has emerged from studies of how new technologies are adopted [39]. Some researchers believe the technology readiness model can be considered to study the respondents' propensity to adopt new technologies. This has been used by many previous studies, for example in mobile data services, distance education, and online insurance [40]. Therefore, the readiness level for the present study is referring to the student's readiness towards 5G technology, thereby focus on the student's beliefs towards 5G technology in the learning process or education.

F. Technology Readiness Index (TRI)

Technology Readiness Index (TRI) is a theory which relates to the technology execution. The behavior of people is different, and it reflects how people belief in technology. There are groups of people who believe that technology brings and facilitates their daily life. However, there are a group of people who believe that technology can cause problems. Besides, the TRI was defined by [39] as to how people believe and use the technologies to achieve their goals either at home or work. [41] added TRI is not for people to use the technology as a competition but it is for people's believe in technology. The TRI comprises of four parts, which are: optimism, innovativeness, discomfort, and insecurity and explained as below: - This template was designed for two affiliations.

1) Optimism

A positive view of technology and a believe that it offers people increased control, flexibility, and efficiency in their lives. Accordingly, if the students are optimistic means they believe technology is useful and they are not so bothered about the negative results of technology. They tend to accept the situation instead of running away from

the reality which the students are more willing to use new technologies. Hence, it leads to a more positive attitude.

2) Innovativeness

A tendency to be a technology pioneer and thought leader. It refers to openness of students towards new technologies. They are likely an early adopter when they are more innovative and believe that they would lose benefits without trying the new technology. In general, the students enjoy trying new technologies and have a positive impression.

3) Discomfort

A perceived lack of control over technology and a feeling of being overwhelmed by it. Anxiety created when an individual has such perceived lack of control by technology. This depict when the students are not comfortable with technology whereby, they believe the technology is controlling them. Henceforth, they have anxiety in using technology.

4) Insecurity

Distrust of technology, stemming from skepticism about its ability to work properly and concerns about its potentially harmful consequences. It is described as when the students lack of trust in technology because they believe that some certain technology does not function properly. They always think that they are at risks when using new technologies, hence they always tend to feel insecure towards new technologies.

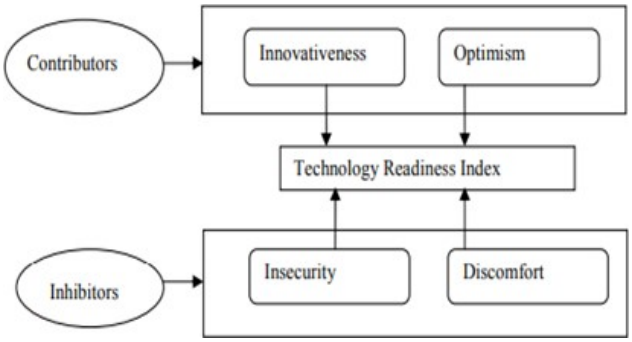

Figure 3. Figure 3. Technology Readiness Index (TRI)

From the forgoing, it shows optimism and innovativeness acts a "motivators" which are positive drivers to the use of technology. Meanwhile, the discomfort and insecurity are the opposite of motivators which may cause the delay acceptance and adoption of people towards technology. In the research conducted by [42], it was mentioned that the higher level of TRI in optimism and innovativeness, the more people a r e comfortable using technology. Meanwhile, the lower level of TRI, the more people feel uncomfortable using technology. In this study, several theories have been discussed on how each of the models works, including what are the possible factors to measure people's readiness. For example, TRA, TPB and TAM are known as technology acceptance model which investigate the acceptance of user towards the new technologies [42]. Since TRA has limitations, therefore the TPB came into the picture to resolve it by adding one more variable which is perceived behavioral control. However, based on the comparisons many researchers confirmed that TAM is easy to use and apply across different research settings compared to TRA and TPB [42]. Also, most of the study uses TAM combined with TRI to identify individual's acceptance of new technologies [43]. However, the current study will only use it to investigate the students' readiness before proceeding with the acceptance. Thus, in this study, the Technology Readiness Index (TRI) by Parasuraman has been chosen to examine and measure the student's readiness towards 5G technology according to which factors contribute to their readiness. This model helps to investigate the user's tendency to use new technologies. Furthermore, the identified model used in this research was based on the model developed by [41] and it is suitable with the current study as the model was designed to investigate the contributors and inhibitors that particularly leads to 5G technology readiness. Nevertheless, the research model for the present study was adopted from the TRI. Although there are many other theories and models available to measure readiness. However, this study choose TRI as it referred to the individual beliefs and not individual ability to use the new technology. Also, TRI model is able to differentiate between the people who want to use and who do not want to use the new technology by investigating the contributors and inhibitors.

Additionally, TRI based model able to identify whether the 5G Technology is ready to implement or not in education. Lastly, the TRI is chosen for this study based on the proposed model by [41]. Figure 5 shows the research model in this study.

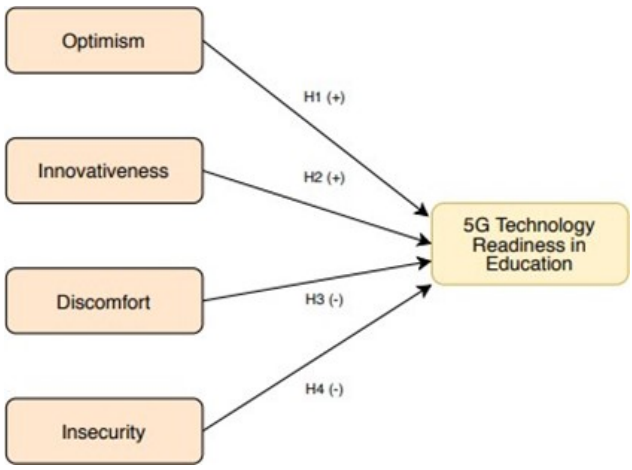

Figure 4. Figure 5. Research Model

3. METHODOLOGY

The present study was designed to investigate the contributors and inhibitors of 5G technology readiness in education. The study employed the four phases to plan, design, collect data and document findings as shown in Figure 4.

Figure 5. Figure 4. Research Framework

In order to achieve this, the quantitative method survey method was used, and the questionnaires were distributed randomly to UiTM students at Shah Alam, since UiTM is one of the universities in Malaysia that has a Malay Bumiputera population of students.

The respondents chosen is random regardless of courses, faculty, or department. The experiment cross across several subjects, such as English in Communication, ICT convergence, Problem Solving, IT infrastructure, Entrepreneurship, Introduction to ecommerce, Web technology, Mobile technology, IT in Business, Ethical, social and professional issues in ICT. The instrument employed is survey which included the tested and validated instruments developed by Parasuraman which is TRI. Besides, the updated edition of the instruments in TRI 2.0 is 16 items, and 11 items were from the original of 36 items [44]. The 16 items scale used in this study to measure four dimensions of TRI, which include optimism (4 items), innovativeness (4 items), discomfort (4 items), and insecurity (4 items). Besides, these four dimensions act as the independent variables towards the 5G technology readiness in education. Next, the reason for selecting the survey method is that the survey is cost-effective, suitable for this research, the type of data needed for this study, population characteristics, and available resources. Furthermore, TRI items were measured on a Likert scale from 1 to 5, with a rating indicating strong disagreement and a 5-rating indicating strong agreement. Next, the instrument for the dependent variable was adopted from [45] which consists of two items and the Readiness (RD) items are used as an outcome in order "to identify the explained variance of self-perceived technology readiness" in the sample. In the end, this dependent variable shows the results of student readiness towards 5G technology in education. Based on the TRI model, the following hypotheses have been developed as per below: -

Hypothesis 1: Optimism has a positive significant effect on the 5G Technology readiness in education among Malay Bumiputera UiTM students.

Hypothesis 2: Innovativeness has a positive significant effect on the 5G Technology readiness in education among Malay Bumiputera UiTM students.

Hypothesis 3: Discomfort has a negative significant influence on the 5G Technology readiness in education among Malay Bumiputera UiTM students.

Hypothesis 4: Insecurity has a negative significant effect on the 5G Technology readiness in education among Malay Bumiputera UiTM students.

4. RESULT AND DISCUSSIONS

A. *Descriptive Analysis*

The Statistical Package for the Social Science (SPSS) version 23 was used in the present study. Figure 6 demonstrates a summary of the descriptive analysis of participants by gender. From the table it revealed that the majority of the respondents were female, making up 52.3 percent of the respondents, with the remaining 47.7 percent were male.

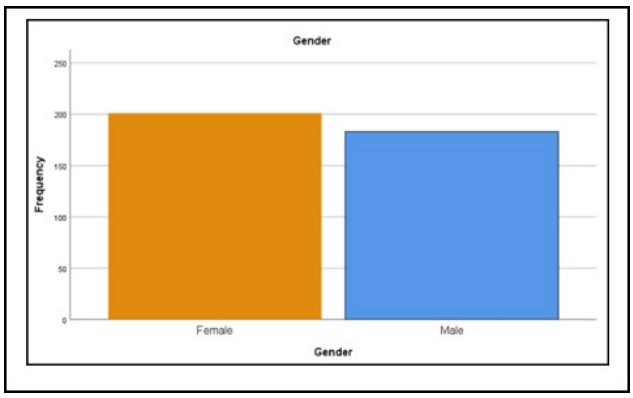

Figure 6. Figure 6. Example of an image with acceptable resolution

B. *Reliability Analysis*

The reliability analysis was also carried out on the final questionnaire in identifying whether it was accepted or rejected. Consequently, reliability testing using Cronbach Alpha formula of SPSS tool was applied again to test the reliability of the scales adopted for the present research as it was suitable for multi-point-scaled items. Table 1 below demonstrate the value of the results of Cronbach Alpha after it was calculated. The result shows the values are .7 or above at most items. This shows that the reliability analysis used in this research can be good and further analysis can be undertaken.

TABLE I. RELIABILITY RESULTS

No. Of Items	Items Code	Cronbach's Alpha
4	OPT	0.861
4	INN	0.845
4	DIS	0.828
4	INS	0.761
2	RD	0.741

C. Pearson's Correlation Analysis

Pearson correlation refers to a technique that describes the extent of the relationship between variables. The higher value of correlation, the stronger its relationship. Besides, according to [46] a correlation coefficient that fall between (0.10 to 0.29) or (-0.10 to -0.29) are generally considered to be weak, (0.30 to 0.49) or (-0.30 to -0.49) is medium and (0.50 to 1.00) or (-0.50 to -1.00) is strong. Meanwhile, if the correlation coefficient value is 0, then it is found not to be significant or has no relationship. The Pearson correlation was selected and used in this study to investigate the correlation between dependent and independent variables. Table 2 below tabulates a detailed correlation analysis between Gender and Technology Readiness Index (TRI) variables. Based on the analysis result, it indicated that gender has no relationship, OPT has a medium relationship, whilst the rest have a weak relationship. Although it was weak, yet still having a relationship among each variable except for gender.

TABLE II. PEARSON'S CORRELATION ANALYSIS

N=384	Dependent Variable:RD	
hline Independent Variables	Pearson Correlation	Sig. (2-tailed)()
Gender	0.022	0.667
OPT	0.357**	0.000
INN	0.165**	0.001
DIS	0.140**	0.006
INS	0.160**	0.002

D. Multiple Linear Regression (MLR) Analysis

A multiple linear regression analysis was performed after all the assumptions are tested, satisfied and not violated. This model is a statistical tool used to predict one dependent variable and a group of independent variables. MLR analysis examines relationships between these predictor variables (independent) and the single outcome variable (dependent), whether predictor variables can significantly predict the single outcome variable [47]. Thus, MLR analysis is used in the present study to investigate the 5G technology readiness in education. Table 3 expose the model summary result of multiple linear regression of the present study. The value of Adjusted R Square is 0.121, which indicates that only 12 percent of factors which are Optimism, Innovativeness, Discomfort and Insecurity contributing to higher 5G technology readiness.

TABLE III. MODEL SUMMARY

R	R Square	Adjusted R Square	Sig. F Change
0.361	0.130	0.121	0.000

On the same note, the results of multiple linear regression analysis of TRI are presented in Table 4. Only one single predictor out of four independent variables is positively significant in the regression.

Besides, Optimism has the highest regression coefficient at 0.187. The final model of the research presents in figure 7. The significance value of each variable OPT (=0.000), INN (=0.444), DIS (=0.812), and INV (=0.534) are represented towards the 5G Technology readiness in education among students. Next, is to investigate the contributors and inhibitors of 5G technology readiness in education among Malay Bumiputera students at UiTM Shah Alam. First, Optimism dimension of TRI has a positive significant effect on the 5G Technology readiness in education among Malay Bumiputera UiTM students as the results showing (=0.187, =0.000). This indicates student's belief that 5G technology offers efficiency and flexibility in their lives and they have a strong interest in implementing 5G Technology in mobile technology and AR technology. The findings are similar to previous studies by [41] which OPT has a positive significant effect on the Virtual Learning Environment (VLE) readiness in higher education. Second, Innovativeness dimension of TRI has no significant effect on the 5G Technology readiness in education among Malay Bumiputera UiTM students as the results showing (=-0.022, =0.444). This indicates students do not tend to be the first using 5G technology in their education. This finding equivalent to [48] whereby Innovativeness factor is not significant in measuring E-health technology readiness in Libya. However, it was different from previous studies by [41] which reported INN has a positive significant effect on the VLE readiness in higher education. Lastly, both Discomfort and Insecurity dimension of TRI has no significant effect too on the 5G Technology readiness in education among Malay Bumiputera UiTM students as the results showing (=-0.007, =0.812), and (=0.019, =0.534). The findings are different from previous studies by [41] which stated both DIS and INS have a negative significant effect on the VLE readiness in higher education. Aside to that, based on [48] paper the results indicates that Discomfort has no significant and Insecurity is significant in determining E-health readiness technology in Libya. Overall, based on the results, it can be seen that Optimism have the highest contributors in 5G technology readiness in education among Malay Bumiputera students at UiTM Shah Alam. Noted that, students have interest to embrace the 5G in mobile learning and AR. Meanwhile, the rest dimensions do not have any significant effects on 5G technology readiness. To conclude, the results of the study showed that the Innovative, Discomfort and Insecurity were slightly different and also supported from previous studies.

TABLE IV. MULTIPLE LINEAR REGRESSION ANALYSIS FOR TECHNOLOGY READINESS INDEX (TRI)

Model		Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig
1	(Constant)	5.363	0.455		11.800	0.000
	OPT	0.187	0.030	0.377	6.286	0.000
	INN	-0.022	0.028	-0.050	-0.766	0444
	DIS	-0.007	0.029	-0.016	-0.238	0.812
	INS	0.019	0.031	0.038	0.623	0.534

Hence, these dimensions should be examined in future studies.

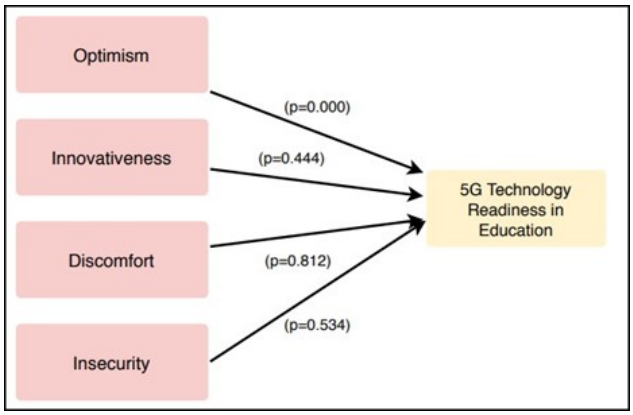

Figure 7. Figure 7. Result of the study based on research model

5. Conclusions

Based on the Multiple Linear Regression Analysis results of the research, optimism has a positive significant effect on 5G technology readiness in education whereas Innovativeness has no significant effect. Besides, both Discomfort and Insecurity have no significant effect on 5G technology readiness in education too. The findings in the study were based on a quantitative basis only, thus conclusion on Malay Bumiputera student's readiness towards 5G technology is not confident enough to be generalized. It may require further investigation by conducting a qualitative study. Besides that, the respondents in this study only focused on Malay Bumiputera students form UiTM only which perhaps lead to the higher inaccurate sample data. Thus, it may need other higher institutions either private or public to participate in the study. Moreover, since the three factors which are Innovativeness, Discomfort and Insecurity was rejected hence these factors should be examined deeper in the next future studies by adding more models or theories to support it. Finally, the 5G technology is new and has not yet launched officially thus the awareness and knowledge of 5G was limited among Malaysian, especially the students. This may lead to an understanding significance of 5G technology implementation in education lower. On top of that, the possible future work is to enlarge more of the focused groups instead of UiTM students only, it could be a student from other public and private universities in Malaysia. Hence, from the results, able to differentiate which students from the universities are the readiest to embrace 5G technology. Next of recommendations are required to improve the identified model by adding another model, such as Technology Acceptance Model (TAM) were to identify the student intends to use the 5G technology in education, thus the student's readiness can be measured more accurately. Moreover, to create awareness by investigating the importance implementation of 5G technology in education since this technology is lack of awareness among Malaysian. Overall, although student is optimistic however their perceptions pertaining to innovativeness, discomfort, and insecurity towards the 5G technology still need to be primarily examined in future studies. Lastly, the university need to focus how they can implement 5G technology in their education as student's belief that 5G technology offers efficiency and flexibility in their lives and they have a strong interest in implementing 5G Technology in education. In summary, this study proved that mobile technology makes the learning process more interactive for students and gives an impact in the field of education. The same goes for augmented reality technology which also has become an interesting topic in education as it improved the students learning process and motivates them to learn more either inside and outside the classrooms.

Acknowledgment

The acknowledgment goes to Research Management Centre (RMC), Universiti Teknologi MARA, Shah Alam for the financial support from MyRA Research Grant (Grant No. 600-RMC/MyRA 5/3/LESTARI (008/2020). The appreciation also goes to Faculty of Computer and Mathematical Sciences (FSKM) and Institute of Malay Thoughts and Leadership (IMPAK) UiTM for giving a moral support in the production of this paper.

References

[1] W. N. Lim, "Improving student engagement in higher education through mobile-based interactive teaching model using socrative," in *2017 IEEE Global Engineering Education Conference (EDUCON)*, 2017, pp. 404–412.

[2] S. N. Sailin, N. F. Alias, B. A. Jusaini, H. Ishak, L. Yang, and G. Chong, "Integrating quizlet for improving students' understanding of the science subject," *Practitioner Research*, vol. 1, pp. 53–67, 2020. [Online]. Available: http://e-journal.uum.edu.my/index.php/pr/article/view/8183

[3] S. S. A. Rahman, J. Idris, S. S. Suhaimi, and S. Nadzri, "The determinants of smartphone usage among students in institute of higher learning"," 2017, pp. 978–967.

[4] N. F. A. Rahman and M. S. Shahibi, "The growth of smartphone usage among student"," *RESEARCH HUB*, vol. 2, no. 1, pp. 64–68,, 2016.

[5] A. Baratè, G. Haus, L. Ludovico, E. Pagani, and N. Scarabottolo, "5g technology and its application to e-learning," in *EDULEARN19 Proceedings*, ser. 11th International Conference on Education and New Learning Technologies. IATED, 1-3 July, 2019 2019, pp. 3457–3466.

[6] R. A. Alhajri, "Prospects and challenges of mobile learning implementation: A case study," *Journal of Information Technology & Software Engineering*, vol. 6, pp. 1–8, 2016.

[7] T. Hartsell, S. Yuen, and Y. Yuen, "Video streaming in online learning," *AACE Journal*, vol. 14, pp. 31–43, 01 2006.

[8] N. H. M. Azhar, N. Diah, S. Ahmad, and M. Ismail, "Development of augmented reality to learn history," *Bulletin of Electrical Engineering and Informatics*, vol. 8, no. 4, pp. 1425–1432, 2019. [Online]. Available: https://beei.org/index.php/EEI/article/view/1635

[9] P. Diegmann, M. Schmidt-Kraepelin, S. V. den Eynden, and D. Basten, "Benefits of augmented reality in educational environments - a systematic literature review," in *Wirtschaftsinformatik*, 2015.

[10] J. Orlosky, K. Kiyokawa, and H. Takemura, "Virtual and augmented reality on the 5g highway," *Journal of Information Processing*, vol. 25, pp. 133–141, 2017.

[11] MCMC, "National 5g task force report 5g key challenges and 5g nationwide implementation plan 2019," Tech. Rep., 2019.

[12] J. C. Gallagher and M. E. Devine, "Fifth-generation (5g) telecommunications technologies: Issues for congress 2019," *Congressional Research Service*, pp. 1–29, 2019.

[13] P. W. G.R. Patil, "5g wireless technology," *International Journal of Computer Science and Mobile Computing A Monthly Journal of Computer Science and Information Technology*, p. 203–207, 2014.

[14] A. K. Jain, R. Acharya, S. Jakhar, and T. Mishra, "Fifth generation (5g) wireless technology "revolution in telecommunication"," in *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, 2018, pp. 1867–1872.

[15] N. Javaid, A. Sher, H. Nasir, and N. Guizani, "Intelligence in iot-based 5g networks: Opportunities and challenges," *IEEE Communications Magazine*, vol. 56, no. 10, pp. 94–100, 2018.

[16] A. Sutton, "5G network architecture. the ITP (institute of telecommunications professionals," *Journal*, vol. 12, no. 1, pp. 9–15, 2018.

[17] H. C. Leligou, E. Zacharioudakis, L. Bouta, and E. Niokos, "5g technologies boosting efficient mobile learning," 2017, copyright - © 2017. This work is licensed under http://creativecommons.org/licenses/by/4.0/ (the "License"). Notwithstanding the ProQuest Terms and conditions, you may use this content in accordance with the terms of the License; Last updated - 2020-10-07. [Online]. Available: http://search.proquest.com.ezaccess.library.uitm.edu.my/conference-papers-proceedings/5g-technologies-boosting-efficient-mobile/docview/2039331989/se-2

[18] S. N. Zulkefly and R. Baharudin, "Mobile phone use amongst students in a university in malaysia: Its correlates and relationship to psychological health"," *European Journal of Scientific Research*, vol. 37, no. 2, pp. 206–218,, 2009.

[19] B. O. D.K. Dake, "5g enabled technologies for smart education," *International Journal of Advanced Computer Science andApplications*, p. 201–206, 2019.

[20] B. Gros, "The design of smart educational environments," *Smart Learn. Environ.*, vol. 3, no. 1, Dec. 2016.

[21] N. F. Taharim, A. Mohd Lokman, W. A. R. Wan Mohd Isa, and N. L. Md Noor, "A relationship model of playful interaction, interaction design, kansei engineering and mobile usability in mobile learning," in *2013 IEEE Conference on Open Systems (ICOS)*. IEEE, Dec. 2013.

[22] M. Ally and J. Prieto-Blazquez, "What is the future of mobile learning in education?" *RUSC. Revista de Universidad y Sociedad del Conocimiento*, vol. 11, p. 142, 01 2014.

[23] M. Mokhsin, U. Kamarulzaman, A. Zainol, S. Q. Binti Mohd Samsir, M. Samsir, Ummu, and H. Nazarudin, "My-peribahasa: An interactive mobile application for learning malay proverb (pima)," 08 2016.

[24] I. Ismail, S. N. Azizan, and T. Gunasegaran, "Mobile learning in malaysian universities: Are students ready?" *International Journal of Interactive Mobile Technologies (iJIM)*, vol. 10, p. 17, 07 2016.

[25] W. A. R. W. M. Isa, Z. A. Zulkipli, and M. Mustapa, "A conceptual framework of blended learning for self-directed learners in the social context: Case of mobile learning," *Social and Management Research Journal*, vol. 24191, no. smrj, pp. 5279,, 2017.

[26] R. A. Karim, A. G. Abu, A. H. M. Adnan, and A. D. J. Suhandoko, "The use of mobile technology in promoting education 4. 0 for higher education"," *Advanced Journal of Technical and Vocational Education*, vol. 2, no. 3, pp. 34–39.

[27] M. Wang, R. Shen, D. Novak, and X. Pan, "The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom," *British Journal of Educational Technology - BRIT J EDUC TECHNOL*, vol. 40, pp. 673–695, 07 2009.

[28] A. Okolo, S. Rampat, and P. Ramsamy, *Exploring the Benefits of Augmented Reality in Higher Education Learning*, 2015-11, pp. 0–10,.

[29] A. Shea and J. Shin, "Student perceptions of a mobile augmented reality game and willingness to communicate in japanese"," *English Teaching Forum*, no. : 2, pp. 2– 13,, 2006.

[30] B. Juin, N. M. Diah, M. Ismail, and N. L. Adam, "Eye tracking parameters for measuring learnability in mobile-game-based learning," in *2017 IEEE Conference on e-Learning, e-Management and e-Services (IC3e)*. IEEE, Nov. 2017.

[31] Z. Shenglan, "Augmented reality in foreign language education: A review of empirical studies," *", Journal of Technology and Chinese Language Teaching,"*, vol. 9, no. 2, pp. 116,, 2018.

[32] S. Kucuk, R. Yilmaz, and Y. Goktas, "Augmented reality for learning english: Achievement, attitude and cognitive load levels of students *," *Eğitim ve Bilim*, vol. 39, pp. 393–404, 10 2014.

[33] J. Cheon, S. Lee, S. M. Crooks, and J. Song, "An investigation of

mobile learning readiness in higher education based on the theory of planned behavior",," *Computers & Education*, vol. 59, no. 3, pp. 1054–1064,, 2012.

[34] MCMC, "Internet users survey 2018: Statistical brief number twenty-three. internet users survey 2018," Tech. Rep., 2018.

[35] A. Ahmad Fauzi, K. Ali, and R. Amirudin, "Evaluating students readiness, expectancy, acceptance and effectiveness of augmented reality based construction technology education," *International Journal of Built Environment and Sustainability*, vol. 6, pp. 7–13, 01 2019.

[36] I. Yosser, S. Z. Syed Idrus, and A. Ali, "Technology readiness index 2.0 as predictors of e-health readiness among potential users: A case of conflict regions in libya," *Journal of Physics: Conference Series*, vol. 1529, p. 032009, 04 2020.

[37] M. M. E. Mirzamany, A.Neal, "5g and education," *Jisc*, 2019.

[38] M. Mohd Kamal, A. Adnan, N. Azamri, K. Idris, N. Zuraimi, and M. N. Yusof, 2019.

[39] A. Parasuraman, "Technology readiness index (TRI) a multiple- item scale to measure readiness to embrace new technologies," *", Journal of Service Research*, vol. 2, no. 4, pp. 307–320,, 2000.

[40] S. Summak, M. Baglibel, and M. Samancioğlu, "Technology readiness of primary school teachers: A case study in turkey," *Procedia - Social and Behavioral Sciences*, vol. 2, pp. 2671–2675, 12 2010.

[41] A. A. Ahmed, A. H. Elmi, and N. H. Zakaria, "An evaluation of virtual learning environment readiness in higher education institutions (HEIs)"," *Journal of Information Systems Research and Innovation*, vol. 2, pp. 86–94,, 2012.

[42] R. Walczuch, J. Lemmink, and S. Streukens, "The effect of service employees' technology readiness on technology acceptance," *Inf. manag.*, vol. 44, no. 2, pp. 206–215, Mar. 2007.

[43] G. D. M. Samaradiwakara and G. Chandra, "Comparison of existing technology acceptance theories and models to suggest a well improved theory/model," *International Technical Sciences Journal*, vol. 1, pp. 21–36, 01 2014.

[44] K. M. Kuo, C. F. Liu, and C. C. Ma, "An investigation of the effect of nurses' technology readiness on the acceptance of mobile electronic medical record systems"," *BMC Medical Informatics and Decision Making*, vol. 13, no. 1, p. 1.

[45] A. P. Parasuraman and C. Colby, "An updated and streamlined technology readiness index: Tri 2.0," *Journal of Service Research*, vol. 18, pp. 59–74, 01 2014.

[46] S. A. Taylor, K. Celuch, and S. Goodwin, "Technology readiness in the e-insurance industry: An exploratory investigation and development of an agent technology e-consumption," *Journal of Insurance Issues*, pp. 142–165,, November.

[47] J. Cohen, "A power primer," *Psychol. Bull.*, vol. 112, no. 1, pp. 155–159, Jul. 1992.

[48] J. Jaccard, V. Guilamo-Ramos, M. Johansson, and A. Bouris, "Multiple regression analyses in clinical child and adolescent psychology"," *Journal of Clinical Child and Adolescent Psychology*, vol. 35, no. 3, pp. 456–479,, 2006.

Mudiana Mokhsin Mudiana Mokhsin is a senior lecturer from Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA. Her research interests are on IT Infrastructure, Immersive Technology and computing ethics. Currently she is holding a post as a fellow in Institute of Malay Thoughts and Leadership, Universiti Teknology MARA, Selangor Malaysia.

Amer Shakir Zainol Amer Shakir Zainol is a Professor from Faculty of Art and Design, Universiti Teknologi MARA. His research interests are on Arts and Design Psychology. Currently, he is holding a post as a Director in Institute of Malay Thoughts and Leadership, Universiti Teknology MARA, Selangor Malaysia.

Nur Syahirah Addenan Nur Syahirah Addenan is a student in Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA. Currently, she is pursuing his study in Master Science of Information Technology (MscIT). In 2018 to 2020 worked as Tech Lead in Digi Telecommunications Sdn. Bhd.

Wan Adilah Wan Adnan Abdel-Wan Adilah Wan Adnan is an Associate Professor from Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA. Her research interests are on Human Computer Interaction related research with particular interest in information visualization. and personalization.

Mohd Husni Mohd Som Mohd Husni Mohd Som is a research officer in Institute of Malay Thoughts and Leadership, Universiti Teknology MARA, Selangor Malaysia. His research interests are on Malay culture and socioeconomic.

Shariza Mohd Said Shariza Mohd Said is an IT officer in Infrastructure and Infostructure Development Office in Universiti Teknology MARA, Selangor, Malaysia. Her research interests are on IT infrastructure and Computing Technology.