DIGITAL DIVIDE AMONG MALAYSIAN TERTIARY STUDENTS AND ITS IMPACT ON ONLINE LEARNING DURING THE COVID-19 PANDEMIC

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By

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ABSTRACT

Background: The term “digital divide” evolved from having a simple meaning of “have and have nots” of access to Internet and computers to an indication of disparity in motivational, material access and then to divide in digital skills, digital usage and outcomes of digital use. In this era of digitalisation, information and communication technologies are hailed as empowering and inclusive tools that facilitate and enhance education, economic, political, social and cultural dynamics, but it could not be denied that dependency on ICTs has created an additional new form of exclusion called digital divide. Consequences of digital divide on education is generally very profound, but the impact was felt more by students during the Covid-19 pandemic, as education institutions globally adopted online teaching and learning. Education was digitalized and remote learning was encouraged to accommodate the “new normal” and to facilitate the practice of social distancing, thus, the underlying issue of digital divide should be addressed, as it is a massive threat that could hinder and disrupt students’ online learning. Instances such as the hardship faced by fellow Malaysian student, Veveonah Mosibin’s and many others’ plight during the Covid-19 pandemic indicated that students in higher education institutions are prone to face digital inequality and its perilous consequences on their online tertiary academic journey.

Purpose: This study examined the extent of digital divide among students of higher education institutions in Malaysia and its impact on their online learning during the Covid-19 pandemic by using the framework of Three Levels of Digital Divide.

Method: Mean scores were used to measure the scope of digital divide among student respondents. Then, Partial Least Squares-Structural Equation Modelling (PLS-SEM) was employed to test the relationships between different levels of digital divide and their impact on online learning outcomes measured by perceived learning and learning satisfaction.

Findings: With an exception for motivational access in the first level, this study uncovered the presence of disparities in terms of material access, digital skills, digital usage and online learning outcomes, which indicates digital divide at all three levels among student respondents. Results have also unveiled contradictory findings on the relationships between constructs of digital divide and online learning outcomes. It was found that whilst most hypotheses proposed were supported, however, the relationships between motivational access and digital skills, material access and neither of the online learning outcomes, digital skills and both of the online learning outcomes, digital usage and students' satisfaction were not supported.

Implications: This present study uncovered the use of three levels of digital divide framework in the context of online learning. It highlights the importance of tackling digital divide at all three levels for Malaysian university students to attain fruitful online learning outcomes. Moreover, roles of multiple stakeholders were also discussed to bridge the gap of digital divide at all three levels among Malaysian tertiary students, with a great emphasis of efforts needed from governmental/political actors and policy-makers to tackle this grave issue.

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APPROVAL SHEET

This dissertation/thesis entitled "**DIGITAL DIVIDE AMONG MALAYSIAN TERTIARY STUDENTS AND ITS IMPACT ON ONLINE LEARNING DURING THE COVID-19 PANDEMIC**" was prepared by LATHA SUBRAMANIAM and submitted as partial fulfilment of the requirements for the degree of Master of Philosophy in Faculty of Accountancy and Management at Universiti Tunku Abdul Rahman.

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Latha

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(LATHA SUBRAMANIAM)

DECLARATION

I Latha Subramaniam, hereby declare that the thesis/dissertation is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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LIST OF ABBREVIATIONS

ADT	Adoption-Diffusion Theory
AVE	Average Variance Extracted
HCM	Hierarchical Component Model
HOC	Higher Order Construct
HTMT	Heterotrait-Monotrait Ratio of Correlations
ICT	Information and Communication Technology
LOC	Lower Order Construct
MCMC	Malaysian Communication and Multimedia Commission
MOE	Ministry of Education
MOHE	Ministry of Higher Education
MOSTI	Ministry of Science, Technology and Innovation
PLS-SEM	Partial Least Square- Structural Equation Modelling
RBT	Rekabentuk dan Teknologi Maklumat
SATUM	Spatially Aware Technology Utilization Model
SDG	Sustainable Development Goals
SEM	Structural Equation Modelling
UAE	United Arab Emirates
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UTAUT	Unified Theory of Acceptance and Use of Technology
NTIA	National Telecommunication and Information Administration
SCP	Netherlands Institute of Social Research

CHAPTER 1

INTRODUCTION

1.1 Background of Study

To get a glimpse of digital divide and its impact on education in Malaysia during the Covid-19 pandemic, one has to watch the YouTube vlog filmed by Veveonah Mosibin, a Sabahan student from a Malaysian tertiary institution who completed her online assessment by risking an attack from a hornet during the Covid-19 pandemic. She used a smartphone and climbed a tree to get better Internet connection to wrap up her online assessment. Her story is just one of the many stories that highlights the plight of tertiary students facing digital divide in the era of digitization in conjunction with Covid-19 pandemic in Malaysia.

Across the continent of Asia, which Malaysia is a part of, technology is playing a massive role in the sustenance and continuity of business, education, conveyance of public services, information transfer and sharing, and socialization (Paine, 2020). To avoid jeopardizing the growth or welfare of a nation in this digital age, the issue of digital divide should be addressed and thwarted. It is important to investigate the extent of this problem and studies should be conducted to investigate digital divide in Malaysia.

Amidst the wake of Covid-19 pandemic, the widening existence of digital divide has been highlighted. With millions of people across the globe in lockdown and accommodating the "new normal", there was an unprecedented rise in the adoption of digital technologies to accommodate the need of work from home, educational institutes conducting online classes, medical consultation through telemedicine and political leaders conducting virtual discussions. At the beginning of the pandemic cautious and technologically advanced Asian countries such as Taiwan, South Korea and Singapore used digital platforms to trace and detect the transmission of Covid-19. These reliance on digital tools and mediums, particularly during the Covid-19 pandemic has highlighted the urgency to address the issue of digital divide especially among the underprivileged and also a developing Asian country like Malaysia. United Nations Conference on Trade and Development's (UNCTAD) data indicates that in developing nations, only one in five has the capable resources to access Internet. This problem could negatively affect developing nations, as they could not tackle the full potential of digitalisation like the "developed" part of the world (Pandey, 2020).

The Internet Users Survey conducted by the Malaysian Communications and Multimedia Commission (MCMC) in 2020 showed that the percentage of Internet users in 2020 stood at 88.7 percent, a 1.3 percent increase from 87.4 percent in 2016. In comparison, in 2018 there was a 10.5 percent surge of Internet users in Malaysia from 2016. The 2018 report stated that the upsurge in the number of Internet users in the country was mainly driven by the growth in the mobile broadband segment, with wider access to 3G and 4G/LTE network coverage and improved network quality in Malaysia. Whereas the 2020 report detailed that, the upsurge of 1.3 percent of Internet users records an all-time lowest growth of Internet users since 2012. The report did not clearly encounter the reasons for the decline in growth but it did highlight that the occurrence is not unique to Malaysia, the global growth has also faced declination.

Digital divide is the disparity in access, skills, use and outcome of information and communication technology (ICT). Large portion of the world's developing nations are affected by it, whilst people in technologically developed nations enjoy the development provided by modern technologies. Besides that, it is important to address one of the very unfortunate outcomes of digital divide, its negative repercussion on equal educational efforts and opportunities worldwide. While digital technologies opens various opportunities for privileged students to effectively acquire large amount of information on wide array of topics, to communicate and to work efficiently and effectively than ever before, lack of digital accesses to underprivileged students takes a disadvantaged toll on their education (Tiene, 2002; Soomro et al., 2020).

Most studies have observed and preached on the beneficial potential of digital technologies in enhancing educational equality, which will facilitate the availability of broader range of educational resources among students (Chen et al., 2012). However, some studies argued that the existence of digital divide could bring new inequality to education and segregate students who are underserved (Cooper, 2006). Technology plays a crucial role in students' learning. The impact of Internet and digital means on education and also in every other aspects of a nation is generally profound. Digital divide prevents people from getting quality education. Bridging digital divide would have a positive influence on teaching-learning processes, as ICT is a basic right and an essential part of access to education (Mahmood, 2009)

The Covid-19 pandemic has urged countries to impose drastic measures to contain the Covid-19 transmission, massive lockdowns and the enforcement of "new normal" caused the closing down of educational institutions. Students were left with no choice but to attend online classes to continue their educational process to suppress the transmission of the deadly contagion. Although this drove educational institutions' to transition unto online learning in many countries including Malaysia, the challenges of digital divide, disproportionate accesses to devices and Internet remained and it posed as a grave threat that could hinder educational developments (Worldbank, 2020). To avoid the negative consequences and disruption on quality of education, digital divide among students should be addressed and its detriments on education evaluated.

1.2 Problem Statement

Digital technology plays an important role within the context of politic, economic and cultural aspects of every life on a global scale. These developments and expansion have rendered towards inequalities caused by fast-paced social and technological changes. Primarily, digital divide was seen as the disparity between those who have access to computers and Internet and those who do not. However, studies have indicated that the issue of digital divide is much more complex and multidimensional than that, it is the disparity in psychological access to digitalisation, acquirement of digital infrastructure, essential digital skills and the types of usages, which eventually leads to inequality in terms of digital outcome (van Deursen & Helsper, 2015; van Deursen et al., 2015; van Deursen & van Dijk, 2013; 2018; van Dijk, 2006; 2012; 2017).

The Internet Users' Survey 2020 was conducted by MCMC from 18th March to 4th May 2020 among 2401 Malaysian Internet users and 384 non-Internet. The report indicates that 20.5 percent of respondents are full-time Malaysian students, it was noted that the survey consisted of 8.4 percent rise of student representation from 2018. From the data, an assumption that adopting virtual learning among students in Malaysia during the Covid-19 pandemic were questionable. Additionally, the findings did not indicate the weightage of students who are Internet users and non-users. Thus, the survey does not truly reflect the reality of Internet accesses and the digital gap among students, particularly those in tertiary education. The report were inclusive of large group of student representation who uses Internet, nevertheless, having Internet access does not mean digital inclusion, other attributes of digital divide needs to be addressed to evaluate digital inclusivity. Having access to basic Internet is the bare minimum, students face challenges in terms of having lack of accesses to different types and quality of Internet connections, digital tools, inadequate digital skills to navigate the online learning mediums and limited digital utilization to gain fruitful participation in online learning, thus it is crucial for a study to highlight the of digital disparity wholly among students. It is also important to note that bridging the digital divide is not only about, investing and increasing Internet penetration rate, it is also about inseminating positive outlook on technologies, developing digital skills, encouraging diversity of digital usage and striving to achieve equal and beneficial tangible offline outcomes.

According to United Nations Educational, Scientific and Cultural Organization (UNESCO), over 60 percent of world's student population with 1.18 billion affected learners across 143 countries worldwide went into lockdown in massive quarantine measures during Covid-19 outbreak (UNESCO, 2020). The great lockdown prompted students to undertake remote learning and in a developing country like Malaysia, where it is a luxury unattainable by many underserved students. About a million of tertiary education students' education in Malaysia were affected by the Covid-19 pandemic (The Star, 2020). This number ultimately insinuates the magnitude of students affected by the overnight digitalisation of education amidst the Covid-19 pandemic.

In Malaysia, a developing nation, the existence of digital divide could have huge impact across all sectors during the pandemic, it especially could endanger the growth and transformation of future workforce and education, as the accessibility of the digital resources is limited. For instance, online learning is a luxury, especially for the B40 group who has low accessibility to ICT (The Star, 2020). Digital divide immobilise and segregate a group of student from accessing the full potential of digitalisation and online learning, therefore, rendering them to be digitally isolated and be at an educationally disadvantaged position.

Finally, over the years van Dijk's studies, which is the theoretical foundation of this present study, were mostly conducted and examined in the context Dutch (Netherlands') or European population. Netherlands, including many western European nations are developed countries characterized as nations with saturated amounts of broadband Internet access. In Netherlands especially, Internet use is advancing rapidly and it is progressively emulated upon the social, economic and cultural aspects of its offline world. A study in the context of developing countries, for instance Malaysia will provide new insights (van Deursen and van Dijk 2015). van Deursen and Helsper (2015) also proposed a new instrument, creating items for several forms of outcomes loosely related to fields or domains as defined by van Dijk (2005). These items were created corresponding to the eight fields and outcome domains were represented by two items or three items in some cases but the authors have also suggested that future studies could have an in depth look into each outcome domain and further establish conceptualization of the third level of digital divide. Thus, tackling online learning in this study would further expand the conceptualization of outcome divide in the domain of education.

The problems discussed above; digital divide as an issue wider than accesses to Internet and devices, insufficient data on the existence of digital inequality among students in Malaysia, the potential harm digital divide caused underserved students and the future of this budding country lay an extremely firm ground for this study to address digital divide among Malaysian tertiary students and the detriments it brought unto their online learning during the Covid-19 pandemic.

1.3 Research Objectives

RO1: To investigate the level of digital divide among students of Malaysian higher education institutions.

RO2: To assess the impact of digital divide on the effectiveness of online learning among students of Malaysian higher education institutions during the Covid-19 pandemic.

1.4 Research Questions

RQ1: What is the level of digital divide among students of Malaysian higher education institutions?

RQ2: How does digital divide affect the effectiveness of online leaning among students of Malaysian higher education institutions during the Covid-19 pandemic?

1.5 Research Gap

There is a lack of relevant studies and empirical evidence on the plight of digital divide and the immediate grave impact on education. To facilitate the process of online education the issue of digital divide needs to be addressed. UNESCO (2020) stated that there is widely regarded assumption that students in higher education institutions have an upper hand on digital inclusivity, but that remains an assumption. There is abundance of studies on theory formulation and the state of digital divide among general population, but there are limited studies on digital divide among students in developing countries, particularly in Malaysia. There are also many studies, which discussed and evaluated how ICT could enhance and develop education, but few studies tackled the barriers and challenges associated with it. van Dijk (2006) suggested that digital divide studies with multivariate regression with structural equation models are the way to move forward and unveil the issue of digital divide.

The Covid-19 pandemic brought forward the “new normal”, online education is undeniably a part of this “new normal”, a research on digital divide among students and its impact on online education is timely and important. Having proper digital facilities is rudimental in the conduct of online education during the age of Covid-19, with students and tutors restricted to attend physical classes and to obtain physical resources, digital equipment and platform provides a solace for them to meet their learning demand and educational rights. The presence of digital divide will disrupt the conduct of online education for the underprivileged. Physical access such as home Internet connections and broadband subscriptions is important towards the conduct of online learning and teaching activities. Possession of digital skills and actual usage of digital facilities are vital in driving students and educators to conduct online education. Students and educators should also feel empowered and use digital infrastructure or skills strategically to facilitate and to achieve their education goals (Devkota, 2021; Mathrani et al., 2021; Mossberger et al., 2003; UNESCO, 2020)

1.6 Theoretical Significance of the Study

van Dijk (2006) along with van Deursen and van Dijk (2015) stated that to have an in-depth understanding how the three levels of digital divide relate or interact with each other, testing of different constructs of digital divide (motivational access, material access, digital skills and outcomes of online learning) simultaneously is important. It would explain how different levels of digital divide coexist to form the digital divide phenomenon and affects tertiary students' online learning, specifically in a developing country like Malaysia. van Dijk (2006) also stressed that there is lack of interdisciplinary research for digital divide studies. Large amount of studies focused on the role of demographic factors on physical accesses, the sociological and economic stance of digital divide studies is also not rare. The contribution from digital divide studies in connection with psychology, communication and education implication is scarce.

Studies from Helsper et al. (2015) and van Deursen and Helsper (2015) has a generalized forms of Internet outcomes to determine the third level of digital divide, but in this study, the outcome of education will be given spotlight, more specifically the outcomes of online learning, which would be measured in terms of students' satisfaction and perceived learning. To evaluate the effectiveness of online learning, variables from educational studies was imported. These variables of effectiveness of online learning were previously utilized in evaluation of students' learning outcome in educational and pedagogical studies, especially the studies that had investigated the effectiveness of technology mediated learning methods such as e-learning, online learning, hybrid learning, among others. This study contributes in providing the evidence on the impact of digital divide on online learning effectiveness during the Covid-19 pandemic. This study would also play a role in paving the path for future studies to use the three level of digital divide framework to evaluate digital divide and its implication not only on education, but also on economics, politics, social and cultural aspects.

1.7 Practical Significance of the Study

Prominent academician Dr. Denison Jayasooria has urged the government to bridge the digital divide by start measuring digital inequality in Malaysia. Lack of studies on digital inequality will hinder proper allocation of development funds to overcome this issue. He has also associated digital divide with educational inequality which will have impacts from children to adults (Free Malaysia Today, 2020). In accordance with the fourth and the ninth pillars of United Nation (UN) Sustainable Development Goal (SDG), which are quality education and sustained investment in infrastructure, innovation and industry respectively. Digital divide is a huge hindrance in achieving the ninth goal, with more than 4 billion people in the world with no access to Internet and 90 percent of them are from the developing and under-developed world, bridging the divide will ensure equal access to information and knowledge as a consequence it foster a quality education, innovation and development. Digital inclusivity will be a step in the right direction for the quality education goal, as education is one of the powerful tools for a sustainable development (UN, 2015).This study will serve a purpose in providing insights on the how the barriers of the ninth goal will have an impact on the fourth.

Digital divide among the higher education students is given less attention, it is important that this issue is given a spotlight to be brought out, especially in unprecedented times such as the Covid-19 pandemic and to hinder further escalation of the issue post-pandemic. A lockdown or the practice of the "new normal" should not disrupt the educational process in the era of digitization. Quality of education is crucial for development and digital inclusion is important to facilitate the development of education. The adoption of online learning and teaching during the Covid-19 pandemic has highlighted the importance of digital equality between higher education students, digital disparity will only yield unfavourable and unequal academic outcomes among students.

Multiple parties including students, their family, society, educators, managements of educational institutions, government, institutional bodies, corporations and non-governmental organization collectively have a crucial role to play to curb this issue. This study would provide a fundamental tip-off for these parties, especially government, institutional bodies and corporations to collectively address digital divide and the associated detriments on education, plus it would also be a rudimental source for these parties to battle the issue.

If online learning is to be the main educational tool to sustain the functioning of tertiary education in unprecedented times such as the Covid-19 pandemic and the age of digitalisation, the detriments of digital divide must be taken into consideration. Its existence must be recognized, to facilitate smooth sailing of digitalisation, simultaneously remedial actions and support mechanisms should be strategized to help combat it even more intensely (UNESCO, 2020).

1.8 Delimitations

There are few delimitations imposed in this present study. First, for the third level of divide, which is also the outcome variables, in order to capture the effectiveness of online learning, only the educational aspect of “offline outcome” was given focus to in this study.

Secondly, this study solely focused on higher education students who were required to undertake online learning during the Covid-19 pandemic. Facing a deadly pandemic in the middle of digitalisation has accentuated the importance of tackling digital divide. Students from every educational levels were affected by the overnight changes made into their academic norms with virtual or remote learning methods. However, tertiary students were often excluded and assumed to have a leg’s up in the issue, than students from primary or secondary educations (UNESCO, 2020). It is obvious that more data, evidences and attentions are needed to approach and eradicate the issue. This study would also serve as a source to address and overcome the issue of digital divide which existed pre-pandemic, heightened in the pandemic but most threateningly would further widens post-pandemic if it was neglected and its detriments on education of the young and future generations.

Thirdly, the participants of the survey were selected from ten public and private higher education institutions in Malaysia, which covers almost every geographical region in Malaysia. The institutes selected for this study are ten of the prominent universities in Malaysia that share indistinguishable characteristics in terms of educational services offered and the magnitude of operational scales out of more than 100 institutions inclusive of universities, colleges, polytechnics and international campuses in Malaysia. Students from both private and public institutions from almost every geographical regions in Malaysia was represented in the study.

CHAPTER 2

LITERATURE REVIEW

2.1 van Dijk's Studies on Digital Divide

van Dijk and Hacker (2003) conducted a study to show the dynamic and complexity of the digital divide phenomena. In this early paper on digital divide, they highlighted how narrowed down the view of digital divide was in the beginning, digital inequality was purely assessed on the fact whether a person have a computer or a network connection, this view disregards the multifaceted complexity with the whole issue of digital divide. Having computer or network connection are only the tip of an iceberg in connection with digital divide, access to skills or meaningful usages were neglected or view as a problem with no long lasting effect at that point (Mason & Hacker, 2003; Kominski & Newburger, 1999; Thierer, 2000; Young, 1996).

Later on studies have categorized digital divide into few successive forms of disparity of accesses. The first types of access is ‘psychological access’ which handles inadequate digital experiences and motivation, then the second kind would be ‘material access’ which tackles on the problem of ownership of computers and network connections. The issue of insufficient digital skills would be the third kind of access, which has been widely regarded as a temporary problem at that time and then the final kind of access is usage access, which tackles on differentiated digital usage (van Dijk, 2002).

In early 2000's van Dijk has pointed out that the first two types of access were gradually diminishing and being riddled together with last two types of access in developed regions in America and Europe. He expected the widening of gaps in digital skills and digital usages in the future. Through data from America's Census Bureau and National Telecommunication and Information Administration (NTIA), then European Union's Eurobaroemter, and Netherlands Institute of Social Research (SCP), he was able to prove the persisting existence of those four types of access and factors that influences them such as age, education, income and gender. He has also pointed out that data on digital usage were still scarce and the problem was categorized as new at that point of time (van Dijk, 2002; 2006; 2012; 2017).

The issue of digital divide was highly debated, where social and political members has taken a few stands on the occurrence of digital divide. These parties were mostly in denial of the issue. They argued that whilst there are growing inequalities in digital usage, however, the overall digital divide gaps are indeed closing. The term of digital divide has caused "more confusion than clarification", first, a literal misconception of metaphorically taking digital divide as a problem of "haves and have-nots"; a simple divide between two group. Second, is another misunderstanding that the gap is unamendable and third is a misconception that digital divide is an absolute inequality that it is about those group who are included and excluded, it is more complex and multifaceted than that, digital divide is a relative kind of problem, where disparity is multidimensional. The final misunderstanding is that revolved around was that, digital divide is a static condition. It is important to note the issue is ever evolving. van Dijk has also stressed that digital divide is not an issue that is as new as the technologies, it is an occurrence that is tied with the same old inequalities based on socio-demographical and economics factors, thus the condition of digital divide is correctable, as it is in tandem with social mobility and introductions of effective policies that addresses the issue from the core (Bonfadelli, 2002; De Hans, 2003; Horrigan & Raini, 2002; van Dijk, 2006).

van Dijk (2006) again explored all distinctive kind of access namely, motivational, material, skills and usage. Motivational access is affected by mental and psychological factors, being technophobic and having computer anxiety influence an individual's pursuance of technologies. Inequality in physical or material access are caused by distribution of resources and an individual's positional characteristic in a society. He highlighted that research on digital skills is quite scarce, he has also distinguished digital skills into operational skills, informational skills and strategic skills. He has noted that digital usages vary according to social and cultural differences of societies. Lack of theory was still an issue in digital divide studies, there should be more causal model building in these research. He has also noted there was a lack of interdisciplinary research, qualitative researches and there was also a lack of studies on consequences of digital divide, and finally he has also noted that there was a lack of conceptual elaboration and definition (Brosnan, 1998; Goggin, 2007; Hargittai 2002; Lenhart, Horrigan &Lainie, 2003; Morey, 2007)

van Dijk (2012) uses an alternative option of viewing digital inequality, which is a relational or network approach. In this method, the elemental unit of analysing inequality are not individuals' choices but rather are based on individuals' demography, situations, environment, positions and the relationships between those. Here van Dijk noted that inequality are not caused by individuals' choices but it was rooted from categorical differences between socioeconomic conditions and demography among these groups. The categorical distinction between a person who is employed and unemployed, between male and female or between people developing and developed countries and etc. affect the extent of digital divide (Cheong, 2007; Fuch & Horak, 2008; Heeks, 2022; Sung 2016; Yu et al., 2018).

The relational view of inequality has induced the formation of resource and appropriation theory. In this theory, personal and positional categorical inequalities such as age, gender, income, race/ethnicity, level of intelligence, personality, health, labour position, education level, household backgrounds and development of nation could impact the distribution of resources, those resources are categorized into five types temporal, material, mental, social and cultural. Personal and positional categorical characteristics and distribution of resources are causes or factors of digital divide, that impacts the different kind of accesses namely, motivation, material, skills and usage (Conceição & Martin, 2016; Serrano-Cinca et al., 2018; van Dijk, 2012; Zhao et al., 2014).

The four different successive kind of access will explain individuals' participation in digital society. An individuals' access could also be influenced by the characteristic of ICTs, which depends on the affordability of technologies and involvement in ICT usages. Figure 2.1 below shows the Causal Model of Resources and Appropriation Theory by van Dijk (2012).

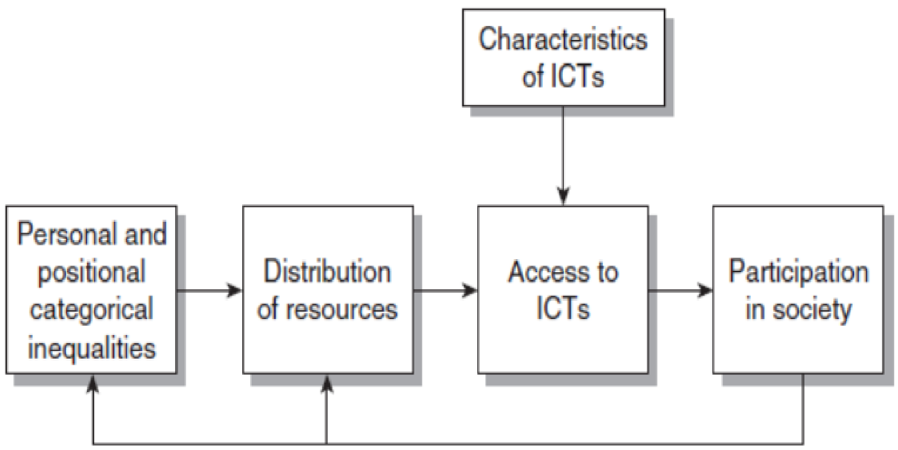


Figure 2.1: Causal Model of Resources and Appropriation Theory
Source: van Dijk (2012)

van Dijk (2006, 2012) explains the phenomena of digital divide through the "cumulative and recursive model of successive kind of access to digital technologies", in this model digital divide is explored in terms of different kind of access from motivational access to digital usage in a successive manner (Ertiö et al., 2014; Gutiérrez & Gamboa, 2010; Minghetti & Buhalis, 2010). According to van Dijk (2012) this model was constructed based on resource and appropriation theory. This theory could be summarized as follow, to appropriate a technology an individual should have the motivation to use it, then, with motivation one would have to gain physical and material access of technological tools and Internet. Consequently, proper and sufficient skills are needed to manoeuvre and utilize technological medium, then an individual with proper skills would have proper amount and diversity of usage. All of these types of access are heavily influenced by demographical and economical factors and characteristics (Chen et al., 2019; Lopez-Sintas et al., 2020; Park & Burford, 2013; Tusiime et al., 2020; van Deursen & van Dijk 2021). The whole process is shown in the Figure 2.2.

In his subsequent books, papers and studies, many of which were collaborated with fellow digital divide researchers, have further explored the issue of digital divide, its causes, instruments to measure digital divide indicators and the implication of digital divide. van Dijk collaborated with his fellow digital divide researcher van Deursen to conceptualize digital skills into six domains namely, operational, formal, information, content creation, communication and strategic, they implemented and conducted various task-based evaluation method to construct the framework and instrument for digital skills.

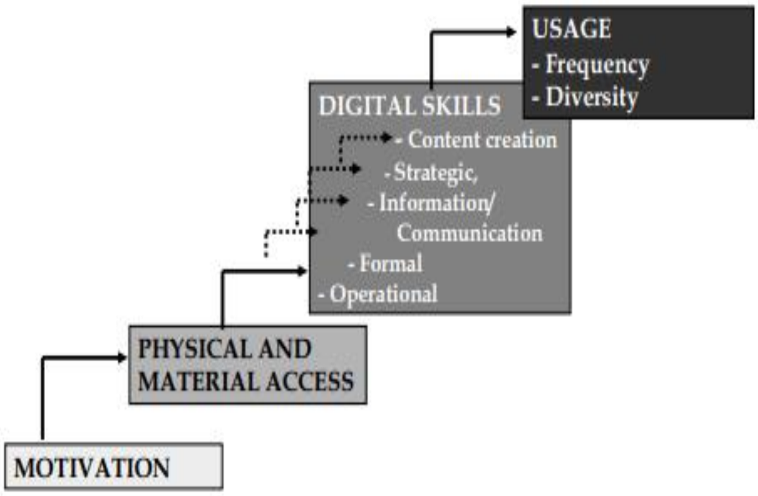


Figure 2.2: Successive Kind of Access to Digital Technologies
Source: van Dijk (2012)

Their studies also corroborate the relationships between demographic factor and digital skills (van Deursen & van Dijk, 2009a, 2009b, 2010, 2011, 2014). Study on digital usages has led unto conceptualization of diverse forms of Internet activities and disparity in digital usages between groups with different demographic characteristics (Helsper & Eynon, 2013; van Deursen & van Dijk, 2013; van Deursen et al., 2015).

van Deursen and van Dijk (2015) utilized structural equation modelling to study the dynamic and multifaceted model of digital divide. They have found that even when digital divide policies have moved on to focus on digital skills and usage, the gap in motivation towards technology and accessibility to digital technologies are still very relevant. The focus on every determinant and element of digital divide is important to tackle the issue. This particular study used structural equation modelling to capture the multidimensional appropriation model of digital divide from its determinant or causes which are personal and positional characteristics to diversity of digital usage. This study was inspired by the fact that multivariate analyses, particularly second-generation multivariate analyses like SEM are less common in digital divide studies as oppose to bivariate analyses. According to van Deursen and van Dijk (2015), by studying the complex model using SEM, it would really enhance the understanding of interaction between different access gaps and the determinants. They suggested to conduct this type of study in the context of developing countries, which may yield new insights.

Circling back to recursive nature of digital divide, it has been found that even in the age where Internet connection and technologies has become quite universal, inequality in terms of access to digital tools still persist, this was most prominently caused by rapid advancement of technologies, fast production of new technologies create inequalities and exacerbate existing forms of socioeconomic inequality. To determine material accessibility, not only ownership of devices and peripheral was used to measure it, determinants such as device opportunity and maintenance expenses of those devices was also included. The paper assessed and demonstrated the associations between material access, with Internet attitude, digital skills, Internet use diversity, Internet outcomes and personal and positional factors such age, gender, income, citizenship, employment status and educational level (van Deursen & Mossberger, 2018; van Deursen et al., 2021; van Deursen & van Dijk, 2018)

Pick and Sarkar (2016) compared and contrasted four theories to examine digital divide which are Adoption-Diffusion Theory (ADT), van Dijk's Theory of Digital Technology Access and Society Impact, Unified Theory of Acceptance and Use of Technology (UTAUT) and Spatially Aware Technology Utilization Model (SATUM). They have stated that van Dijk's theory is inclusive of complex, dynamic and multidimensional pathways of inequalities. The theory showcase a cycle of occurrence on socioeconomic, sociodemographic and political inequalities which eventually causes inequalities in accesses and which finally have unequal societal impacts and outcomes, which through feedback effect could yet again affect the personal and positional determinants.

This particular theory have the sole use and purpose of evaluating digital divide at an individual level of analysis. ADT and UTAUT theory both aim to evaluate technological use through adoption and diffusion of technological innovation and technological users' behaviour. SATUM, like van Dijk's has the sole aim to evaluate digital divide but it lacks the multilevel and multidimensional approach like van Dijk's, and most notoriously it lacks the consideration of psychological factors like motivation and attitudes (Pick and Sarkar, 2016).

The complex evolution of digital divide studies from mainly van Dijk's perspective throughout multiple years was discussed in this section. Digital divide's multifaceted nature was encapsulated, which captures the reality of digital divide in an individuals' life in the digitalizing world. That in combination of the three levels of digital divide framework would unveil the foundational theoretical underpinning of this present study.

2.2 Three Levels of Digital Divide Framework

Various studies have addressed the actuality of digital divide, in earlier studies, digital divide was explained entirely as the inequality in individuals' accessibility to computers and Internet (van Dijk, 2006). Further digital divide studies have highlighted how the emergence of digital society was causing a new social inequality. New technologies and digital platforms are becoming a vital part in the formation of economic, social, political and cultural dynamics, this new dependency on digital tools and platforms has rendered to the formation of a new form of social exclusion (Antonio & Tuffley, 2014). The emergence of digital society creates a form of uncertainty, on one hand it could contribute to liberation and independency but on another it could also create social inequality, domination and exclusion (Castells, 2001). During the 90s, the early studies on digital divide focused mainly on accessibility of digital technologies such as computers and Internet but contemporary studies digital divide have highlighted the multidimensional complexity of the issue, it can be categorised into three levels, namely the First, Second, and Third Levels of Digital Divide. The three levels of digital divide framework in the context of online learning was illustrated in the Figure 2.3.

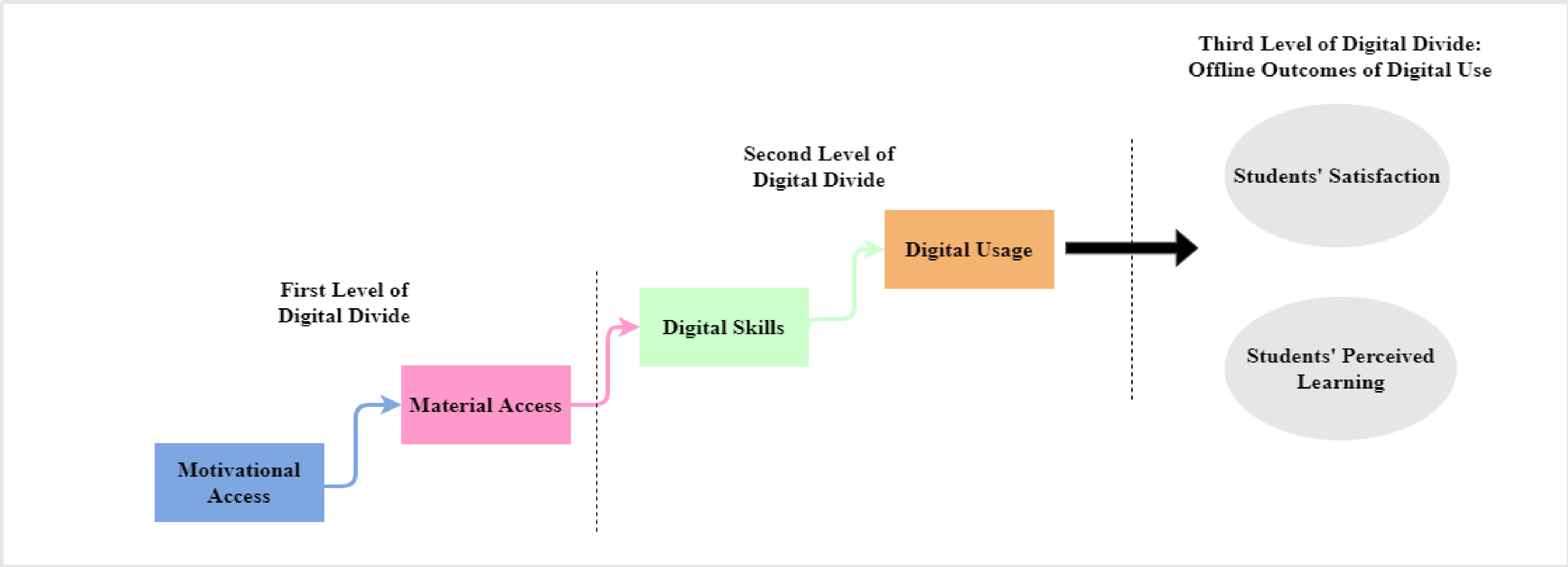


Figure 2.3: Three Levels of Digital Divide Framework

2.2.1 The First Level of Digital Divide

The First Level of digital divide highlights the first phases of appropriation of digital technology, which are motivational access and material access (van Dijk, 2012). Prior to acquiring material access one should have motivational access; it is the want or want not of Internet and technological devices in general. According to van Dijk (2006), the people's lack of motivation in computer or Internet usage could be attributed by no time or liking, inessentiality of the medium, lack of significant usage chances, non-acceptance of the instrument, financial instability and absence of digital competencies.

As the process of digitalisation was not equally distributed among the population, individuals from vulnerable groups who do not possess enough economic and financial resources to acquire expensive technological tools and local Internet connections are faced with inequality in terms of physical and material accessibility of technologies (Norris, 2000). The accessibility to ICTs is one of the criterion used to evaluate digital inequality between countries and within countries, for example, some countries which experienced high level of Internet penetration seems to have virtually connected their population, like countries in Europe such as Denmark, Netherlands and Luxembourg, the have almost effectively bridged digital divide in terms of accessibility. However, Bulgaria and Romania, European countries with low penetration rate compared to the other countries were showing a wide digital gap in the terms of accessibility of ICTs (Ragnedda & Kreitem, 2018). Development of technological maintenance theory by Gonzales (2016) focuses on the possible economics and financial impact of the cost of Internet accessibility and of the procurement and maintenance of technological devices. Robinson (2013) has reiterated that social, cultural, and economic constrains influence and inhibit access.

Internet, computer devices, smart-phones, tablets, and digital-based necessities are not accessible to everyone, at the same time, these digital tools play a very important role in every aspects of lives nowadays. They navigate the reach of education, entertainment, safety, health, employment and social activities. People without physical or material accessibility for ICTs would be left out of emerging digital world that is being built (EuroScientist, 2018).

The first level of digital divide gives attention to being motivated to use the Internet and on having Internet connection. Internet access is vital but the emergence of differences in other material access is also equally important. Without a proper material access, there is no use for Internet connections, material access plays a major role in continuing and expanding Internet access, as they are the main medium used to establish Internet connections in the first place. Having material access includes having access to diverse digital tools, such as computer devices, smart-phones, tablets, software which needs subscriptions, and peripheral equipment like mouse, printers and hard-drives. As the world is experiencing rapid advancement of technologies, there are new and broad variety of material accessibility to the general public but the harsh reality is that, rapid development of different kind of mediums cause inequality among people (van Deursen & van Dijk, 2018). Even when the access to Internet through fixed or mobile broadband has become ubiquitous, however, the possibility of exclusion caused by emergence of new technological facilities is still prevalent (Syvester et al., 2017).

As pointed out by van Dijk (2005) through resources and appropriation theory, it states that society's categorical inequality causes an unequal dissemination of resources and this would lead to inequality in the ability to access to the Internet. The masses' attitude towards Internet and the opportunity to have physical and material access is the starting point of process of appropriation. Appropriation process is heavily influenced by the social conditions such as age, gender, income, educational background and also by rapid technological advancement. This theory reinforces the fact that disparity in motivation and inequality in Internet access caused by unequal distribution of resources will hinder marginalized and underserved individuals' participation and development in the digital world.

2.2.1.1 Motivational Access

van Dijk and Hacker (2003) has explained that mental barrier is the first kind of access problem. Motivational access is the first in the four kind of successive access proposed by van Dijk (2006), he described it as the “want and want not” of ICTs. It refers towards an individual’s wish to be connected to ICTs or to have ownership of technologies. The determinants of motivational access are inclusive of both socio-cultural and psychological factors. Motivation, attitude and intention are crucial in acceptance of technology. The adversity of being a technophobic and having computer anxiety could impede computer and Internet access by individuals. Motivation is a crucial and important access in van Dijk’s theory, as it is the starting and vital point of the whole process of technological appropriation.

van Dijk (2006, 2012) has listed no time or liking, inessentiality of the medium, lack of consequential usage chances, non-acceptance of the instrument, financial instability and absence of digital competencies as main factors that hinder an individual’s motivation or attitude towards ICTs. van Deursen and van Dijk (2015, 2018) used motivation and attitude scale to measure motivational access. van Deursen and van Dijk (2015) has concluded that attitudinal issues such as being a computer anxiety have reduced but it still pose as a threat. Improvement in motivation and attitude would have a positive effect on material access, digital skills and an individual’s diversity of usage. In short, van Dijk

(2006; 2012; 2017) explained that to tackle the subsequent elements of digital divide one has to have a favourable or positive motivation and attitude. These psychological elements were combined to explain individuals' intentions and acceptance of technologies in their life.

2.2.1.2 Material Access

Material access includes the means or mediums to access Internet or ICTs in general. In early digital divide studies, digital inequality was assessed on the basis of whether an individual has access to technologies physically (van Dijk, 2002). Material access is having physical access of technologies or Internet connections and also cost and maintenance of hardware, software or ICT services (van Dijk, 2006; 2012). According to van Deursen and van Dijk (2015), with rapid ICT development, the quality and different types of connections and material accesses poses as threat. The wound of inequality in material access is reopening despite that it should be closing in the wake technological advancement, with the existence of inequality in material access still looming, it would be a challenge to address inequality in digital skills and digital usages. Mossberger et al. (2012) has stressed that the more access an individual has to different types of devices the more opportunities would be presented to them. Having material access is more than having Internet connection or not, it is about having diversity of access towards technologies, the expenses in acquiring them and also their functionality. van Deursen and van Dijk (2018) has said the age of digitalisation where Internet connections has become ubiquitous, fast-paced advancement of technologies reinforces divide in terms of material access. .

Inequality in material or physical access follows the flow of an S-curve of adoption and innovations as shown in Figure 2.4. In this path of S-curve, it showcase a divide and differentiated access to technology among groups. Norris (2001) made a contrast between stratification and normalization diffusion model. Normalization model which illustrated an ideal situation where there would be differences in adoption of technology among individuals in a society at the early stage, however, at the later stage the differences would disappear with saturated technological diffusion in the population. The opposite model of stratification highlights that there will be a tipping point at which the curve will converge into high and low social strata. At the later stage there would be a different point of arrival for those disadvantaged strata, this would cause the marginalized strata to never achieve 90 percent to 100 percent technological diffusion. Stratification models which highlight the reality, entails that individuals from disadvantaged backgrounds are prone to be faced with inequality in terms of material access where these underserved individuals could not acquire sufficient access of technological tools to participate in digital society (van Dijk, 2006, 2012; van Deursen & van Dijk 2018).

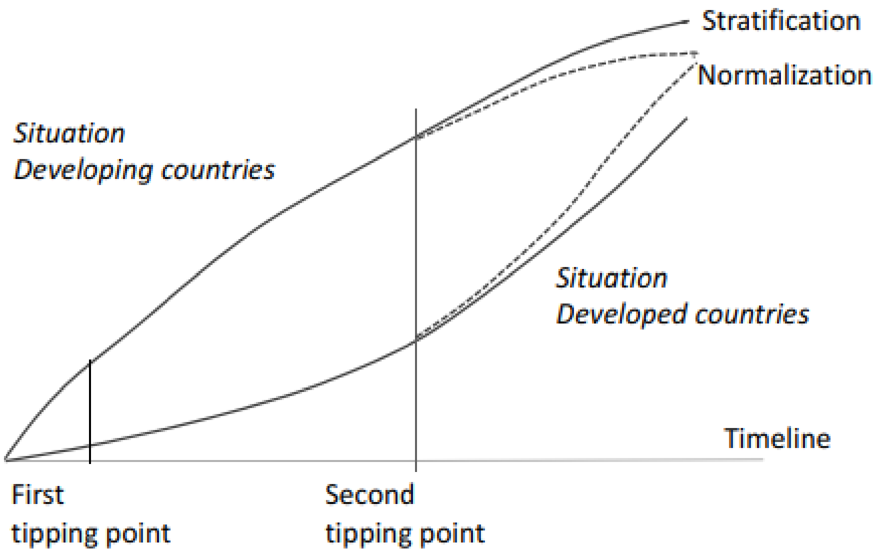


Figure 2.4: Evolution of the Digital Divide of Physical Access in Time
(line below: access of categories of low education, low income and higher age; line above: access of categories of high education, high income and lower age)
Source: van Dijk (2012)

2.2.2 The Second Level of Digital Divide

First Level of digital divide is important in analysing and determining digital divide, however, motivation to access technology, Internet connectivity with technological and physical access or ownership is not the only elements that should be taken into consideration in addressing digital divide, Internet penetration and digital tools accessibility are only couple portions on the big plate of digital divide. The Second Level of digital divide goes beyond motivation and physical access, it addresses skills and actual usage of ICTs. It focuses on the problem of disparity in digital skills, digital literacy and its usage

(Hargittai, 2002). This level highlights how digital technologies are being utilised, taking into consideration their motivations, material accessibility and also the digital skills and knowledge possessed to utilise it. Digital skill gaps highlight the lack of digital competencies and abilities needed to handle digital technologies (DiMaggio & Hargittai, 2001). The importance of education has also been highlighted as the important factor behind the performance of skills individuals with higher educational background tend to perform better on all their skills than individuals with lower educational background (van Dijk, 2012).

New conceptualization to address digital divide other than the motivation to use and accessibility to digital infrastructure and tools arose the need to highlight on the differences in the possession of digital skills. To accommodate changes in a society new skills are needed, especially to address and to close the gap of digital divide, and in this matter digital skills are vital. Digital skills were expressed as the capability to use the Internet and computer effectively and efficiently. At the beginning, digital skills were divided into two element; computer skills and Internet skills, even though they are both different set of skills but they are correlated, the first step in acquiring Internet skills is to have computer skills. The ignorance of either one of the skills will hinder the whole structure in the usage of ICTs (Hargittai, 2003). Computer skills is also defined as computer literacy, which has been described as means to take control of the computer technology with sufficient cognitive capabilities (Morgan,1998). To obtain computer literacy, an individual must have the ability to handle elementary tasks on computer for example, word processing and creating and analysing of data on spreadsheets (Lowell, 1997). Internet skills has been viewed as a vital element in the development of human capital because an individual who is highly skilled possess the capability to gain advantage from the Internet, it has been expressed they possess the ability to access, identify and utilize online facilities effectively. There are various actions or activities that are influenced by Internet skills such as online information retrieval, accessibility and download of resources online, online commerce and online communications (Hargittai & Shaffer, 2006). Digital literacy does not only involve an individual's ability to utilize or operate digital tools and software, it covers a complex mix of motor, cognitive, social and emotional skills (Eshet-Alkalai, 2004).

Hargittai (2005) have used an in-depth testing of skills which is by the observation of individual's time used to complete a certain tasks to evaluate people's digital skill which is similar to study by Zhong (2011), where Program for International Student Assessment survey questions was used to measure digital skills, the assessment includes adolescent individuals' assessment on their capability to finish certain tasks on computer and Internet. The survey was administered to 15 year olds, which measure their capabilities in reading, mathematics, science and ICTs, however, these approaches has been deemed as costly to acquire data for a large population. Asking people to measure their digital ability or their perception or attitude towards digital technologies is a commonly used method to measure digital skills; which is individuals' ability to successfully handle ICTs themselves.

Usage is the main purpose, which encompasses the whole picture of technology appropriation, having physical and material access and digital skills is compulsory but is not sufficient to encourage actual use. Even though the gap in in motivation and access may be diminishing but there is still gaps in digital skills and actual Internet use (van Dijk, 2005). The usage of Internet could be determined on the basis of length of time or the frequency of Internet is used, how it is being used, and the type of activities it is used. The amount and type of usage of Internet has been evaluated to determine how low education impact the usage of the Internet, using usage and gratification theory, the types of activities on Internet was classified for evaluation. It was concluded that education has a prevalent impact on the usage gap of Internet, similar to digital skills (van Deursan & van Dijk, 2013).

Despite having motivation, physical accessibility and skills to use digital tools and platforms, without actual or meaningful utilisation, the chasm of digital divide could not be sealed. According to van Deursen and van Dijk (2013), digital usage can be assessed in four distinct manner namely: usage duration and frequency, variety of usage applications, broadband or narrowband usage and on whether it is a creative or active usage. Digital usage is very much intertwined with pre-existing social, economic and demographic factors such as gender, age, education, income, and geography.

2.2.2.1 Digital Skills

Having appropriate attitude or motivation and material access would be a portion steps in closing the gap of digital divide, an individual's need to acquire sufficient skills to appropriate technologies and Internet is equally vital. Internet self-efficacy has been identified as an important element to manoeuvre ICT (Eastin & LaRose, 2000). Hargittai (2002) has stressed actual digital skills of individuals could be captured more in actual performance tests. van Deursen and van Dijk (2009a, 2009b, 2011, 2014) has conceptualized and operationalized Internet skills into two categories, medium related skills and content-related skill. Operational skills and formal skills are categorized under medium-related, which are the basic abilities needed to operate Internet and technologies and a basic competencies required to utilize Internet. Then information skills, communication skills, content creation skills and strategic skills, which are the competence of information seeking, the ability to exchange meaningful messages and calls, creation of quality content in the Internet and the ability to use utilize and strategize for attaining goals. van Deursen and van Dijk (2014) has stated that having Internet skills is crucial, lacking skills not only widens digital divide, it also creates social inequalities where employability and generally well-being of individuals were affected.

van Deursen and van Dijk (2009a, 2009b, 2010, 2012) developed the conceptualization of digital skills into different types of skills. The primary skill that is required would be 'operational skills' to operate digital mediums (van Dijk, 2012). The skills should be acquired with added literacy input and practices, so that, they could be mastered and used effectively to solve ICT related general problems. The development of required skills in the digital sphere are ever-evolving. Thus, the conceptualization of skills should also be in sync with that evolution.

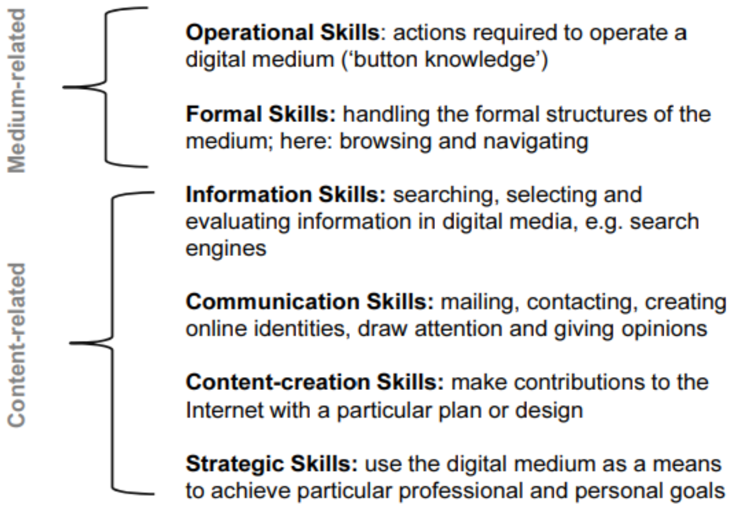


Figure 2.5: Types of Digital Skills
Source: van Dijk (2012)

Digital skills were conceptualize into six types through the conduct of large-scale surveys and performance test of digital tasks. There are 'medium-related' and 'content-related' skills as shown in Figure 2.5, former captures ability to handle digital technologies and latter addresses a more advanced sets of competencies needed to navigate through digital mediums.

Furthering into the studies on digital skills, the concept surrounding the types of skills further evolved in tandem with the digitalizing state of the world. To have a sufficient development of digital skills one has keep up with current needs and requirement. This has prompted improved classification of digital skills. van Deursen et al. (2014), categorized digital skills into five distinct categories and similar to previous studies it starts with exploring the most basic needs of skills to operate digital facilities. To adapt into recent climate of mobile devices boom, they have also included a category of skills, which investigate one's expertise in manoeuvring their mobile devices.

The descriptions in Table 2.1 below, shows the multidimensional characteristics of digital skills as studied by van Deursen et al. (2014):

Table 2.1: Types of Digital Skills

Digital Skills	Description
Operational Skills	Ability to operate digital medium through common "button knowledge".
Information Navigation	Technical competences to handle the process of browsing and navigating in online environment, the ability to search, select and retrieve information.
Social	Strategic and critical capability to liaise via social media, messaging platforms.
Creative	Propensity to create materials and resources online.

Mobile	Technical capabilities to utilize mobile technologies.

Source: van Deursen et al. (2014)

2.2.2.2 Digital Usage

According to van Dijk (2002), differentiated use of ICTs would cause most digital inequality. At earlier days, data on digital usage are scarce, because that is the point of where ICTs were picking up pace, and individuals were at very early stage of adopting ICTs and usage varieties were limited. van Dijk has managed noticeable differences of usage among personal computer users, where it varies across age, gender and educational levels. Digital usage is the final access on the stage of appropriation of technologies and it is the main goal that is to be achieved throughout the whole process (van Dijk, 2006). Digital usage can be measured in terms of usage frequency, number or diversity if usage applications, broadband or narrowband use and finally whether it is a creative or consumptive use (van Dijk 2006, 2012; van Deursen & van Dijk, 2014).

van Deursen and van Dijk (2013) implemented uses and gratification approach to operationalize diversity of online activities, which is digital usage. This particular approach uses the motivation to use digital media and the consecutive satisfaction from using it. Through that, multiple dimensions of digital usage were classified. Table 2.2 enlightens on categories of different types of online activities that was operationalized.

Table 2.2: Types of Digital Usage

Digital Usage	Description
Personal Development	Online activities that promotes individuals growth.
Leisure	Online activities that includes elements of entertainment and self-relaxation.
Commercial Transaction	Includes online engagements in e-commerce and monetary transactions.
Social Interaction	Online activities, which signifies communications and social engagements.
Information	Involvement in online activities for the purpose of knowledge seeking.
News	Seeking current affairs, broadcast or reports through digital medias.
Gaming	Engagement in online gaming activities.

Source: van Deursen and van Dijk (2013)

2.2.3 The Third Level of Digital Divide (Online Learning Outcomes)

The Third Level of digital divide how the successive flow of digital divide from motivation to usages empowers an individual to use ICTs to gain tangible beneficial outcomes for themselves. It specifically indicates inequality in beneficial outcomes gained from digital technologies and its usages. The focus is how even when one has overcame disparity in motivation, material accessibility, digital skills and usage of digital technologies, unequal distribution of benefits from digital participation and involvement could still be present (Ragnedda, 2017).

First two levels tackles the issue in motivation, accessibility of digital infrastructure, digital skill and usage gaps. However, study into Netherland, a nation with almost universal Internet accessibility and digital advancements, a very noticeable third level of digital divide was identified. Studies on the third of level of digital divide, has concluded that, even with individuals or communities with autonomous and unlimited use of digital infrastructure, they will face trouble on achieving their objectives via those digital facilities. It was found that even among a group of digital users who have accessibility, possess digital skills, and have diversity of Internet use, equal amounts of outcomes or benefits are unattainable among themselves, it highlights the existence of outcome inequality (van Deursan et al., 2014).

Strategic use of digital infrastructure or skills, will enable individuals who uses Internet to achieve offline returns or outcome which will eventually benefit them, for example they would be able to earn a return then use it to further development of their skills or accessibility. It was described people who use online facilities and resources to perform strategic goals, would be able to gain benefits from greater economy's feedback effect, which will eventually promote further development and improvement in the digital world (van Deursen & Helsper, 2015).

van Deursen and Heslper (2015) conducted a study which measures benefits attained from the use of Internet across various facet of life and how the benefits gained could facilitate the formation of certain sociodemographic groups. They have conducted the study on large scale, which covers a huge population and has stressed that, studies on Internet benefits has never been conducted in a large scale before. A huge coverage will contribute to a broader understanding. They have highlighted that some studies were solely focused quantifying opportunity divide, which focuses on studying the different types of Internet use rather than, evaluating the "offline outcome" that these Internet uses generate. To achieve their objectives they extracted different offline outcome and conceptualized it into different domains like social, politic, economic, and education.

In the Third Level, it shows inequality of return within a population with similar digital usage levels and skills. People, who consistently utilise their Internet use to morph it into offline returns such as income, will have an upper hand from 'feedback effect' where the resources they earned could help them further their Internet or digital skills. Third level of digital divide highlights the fact that, there need to be strategic use of digital infrastructure and skills to achieve an expected outcome to empower an individual. As shown in Figure 2.6, benefits gained from the digital inclusion indicators empower individuals by providing feedback into their offline status and thus enabling them to gain advantage on the digital inclusion factors displayed. However, studies have also indicated that even among users who possess access and skills of digital infrastructure there would be difference in outcome and returns, thus this widens the gap of digital divide (van Deursan & Helsper, 2015).

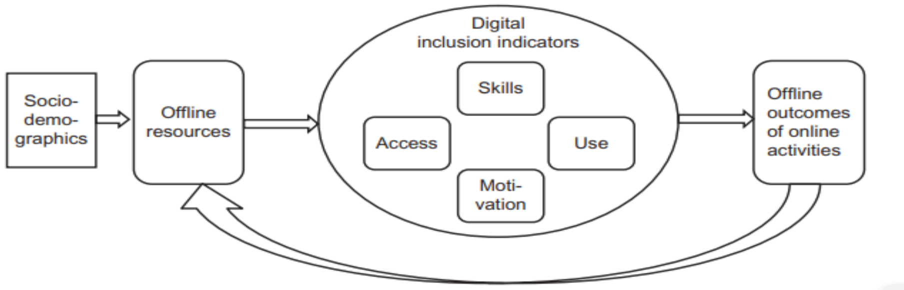


Figure 2.6: A Model for Replications of Inequalities in a Digital Society
Source: van Deursen and Helsper (2015)

2.2.3.1 Online Learning Outcomes (Third Level of Digital Divide)

Helsper et al. (2015) encompassed more comprehensive study on the “offline outcome”, in which they considered outcome in the form of things that individuals have achieved and also their satisfaction gained through that outcome. Studies used student satisfaction and perceived learning as measures of students’ effective learning outcome in either traditional educational system or online education, they were also prominently used to evaluate the effectiveness of e-learning outcomes (Eom & Ashill, 2016).

Students’ satisfaction is often used in educational studies as quantifiable outcome of online learning. Students’ satisfaction with learning activities is suitable to serve as predictor variable in studies of distance education, technology-mediated learning and online learning (Alavi, 1994; Arbaugh, 2000). Student satisfaction with online courses, will presumably ascertain their fulfilment in taking courses through that medium. If students were dissatisfied with the learning environment or method, they will probably be reluctant to take courses in those respective mediums (Arbaugh, 2000).

Learning effectiveness is measured either by grades received or perceived leaning outcomes. According to Hiltz (1994), "the quality of education provided by a course should be measured by how much a student learns, retains, and later uses as a result of taking the course". The conduct of academic exams, coursework as well as students' academic reports in a way portray their learning proficiency and measure their mastery of knowledge. Sher (2009) has expressed that both student course grades and student perceived learning can interchangeably be adapted as indicators of mastery of skills in learning courses. McCroskey et al. (1996) asserted that students "generally have a good sense of what they learned;" therefore, it is acceptable to use students' perception of learning as a measure of learning achievement.

2.3 Digital Divide and Online Learning

Information and communication technology has brought about big differences in education for decades. Internet and computer accesses improve students' learning processes and the efficient use of technology could further enhance students' learning experience and outcomes. Internet connections are being utilized to gain and learn new skills through long distance learning. Internet has been used to acquire resources and as a communications medium among students, educators and parents. Students with digital skills could access unlimited educational information, materials and other resources that are available online. Unfortunately, unequal distribution of digital facilities and access which is digital divide has hindered the development of education equally (Bomah, 2014).

Digital divide restricts the development of education, particularly in underdeveloped regions, as it affects peoples' right for access to education (Mossberger et al., 2003). ICT has the ability to empower learners and educators, facilitate policies and skills surrounding education, improve current process of learning and teaching, learning activities inclusive for all students, deepen students interest in learning, and ease communication barrier between students and educators (Alammary, 2012).

Yu (2018) designed a comprehensive survey to study the third level of digital divide impact on the English teaching and learning in China and the factors that drive third level divide. The survey covers the students' digital abilities and skills, and their individual empowerment to achieve their educational goals and result. It concluded that third level of digital divide plays a huge role in assessing progress of English teaching and learning in China, factors like gender, economics status and educational level does have an impact on the third level of digital divide. Another study by Eynon (2009), which evaluated the level of Internet use and its impact on learning opportunities, at which online learning opportunities were categorised into three parts, namely, formal learning or training, current affairs and internet search and finally "fact-checking"; which is to use Internet to look up for doubt clearance. Through a bivariate analysis it was concluded physical access of tools like Internet have prevalent impact on learning opportunities in Britain.

Although during the Covid-19 pandemic it is assumed that households with higher education student are more likely to have connectivity, but the riskiness of that assumption is high as it could not be guaranteed that all of them have effective connectivity and access when they returned home. The abrupt interruption of face-to-face learning activities now heavily relies on digital environment that many students have to rapidly familiarise with. The newness of virtual education is a fact that is hard to digest by many but with the barrier in terms of lack in digital infrastructures, and the lack in diversity of access to connectivity, virtual education would be a burden. Provision of sufficient bandwidths for connection needed to be allocated adequately, as they are crucial factors in manoeuvring distance online learning effectively. Digital gap needs to be bridged to avoid the formation of academic gap among students (Tadesse & Muluye, 2020; UNESCO, 2020).

Higher education institutions play a crucial role in finding the most appropriate combination of technologies and resources to improve the pedagogical impact. Migration to virtual mode involve a very significant risks of widening the effects of the digital divide through abandonment of underserved students whose homes have no access to quality equipment or resources or connectivity necessary to take advantage of the distance online education supported by technological mediums (UNESCO, 2020).

Even when a university has vigorous online learning facilities with educators who can facilitate online teachings with ease, if students lack the necessary aid to access technological mediums such as Internet, laptops/tablets or functional phones, then they are evidently excluded from learning in a digital environment (Filius et al., 2019). A qualitative study found that the key barrier to technology mediated learning among higher education students was the access to technology, poor replacement for non-technology mediated learning, usability issue, learning difficulties using technology and “missed communication”. In the interview process, it was found that the most significant concern for students is their access to technology and whether using the Internet and ICT will provide equitable access and outcome for all students (Waycott et al., 2010)

In a perfect world, higher education should be a space where any forms of social inequalities were diminished. However, different types of pre-existing social inequalities and the issue of digital divide impedes students from accessing distance online leaning equally and effectively, thus in a rapid cycle, inequalities were yet again reinforced through these institutes (Devkota, 2021; Kasinathan & Ranganathan, 2020). Covid-19 pandemic in a way has highlighted the existence of digital divide, it has emphasized the importance of inclusive development in this rapid digitalising world. Divide in terms of motivation, access to technological tools, essential digital skills, digital utilization and outcomes of digital use should assessed and addressed to combat digital divide and its subsequent impact on education (Mathrani et al., 2021; Wei et al., 2010).

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1 Hypothesis Development

The following sections would divulge into the relationships among constructs of digital divide in the three levels of digital divide framework of this present study. These discussions were subsequently used in the construction of conceptual model in this present study.

3.1.1 Motivational Access and Material Access

van Dijk (2005) explained that motivational access is the attitude or motivations towards technology. van Deursen and van Dijk (2015; 2018) clarified that having motivational access is the prerequisite towards physical and material acquisition of ICT. Negative attitude towards Internet and technologies will reduce an individual’s chance to access ICT. Even in the era of digitisation at which people were deemed more accepting of ICT, it is important to measure the role of Internet attitude and motivation in material accessibility. (van Dijk, 2012; 2017).

H1: Motivational access has a positive relationship with material access.

3.1.2 Motivational Access and Digital Skills

Internet attitude assist in Internet skills acquisition (van Deursen and van Dijk, 2015; Ferro et al., 2011; Helsper 2012). van Deursen and van Dijk (2015) have found that there is direct relationship between motivational access and Internet skills in general. Motivational issues or attitudinal problems could have adverse impact on acquisition of digital skills. Ghobadi and Ghobadi (2013), Dutton and Residorf (2015) and Lebeničnik and Istenič Starčič (2020) through their studies have demonstrated a significant and positive relationship between motivational access and digital skills.

H2: Motivational access has a positive relationship with digital skills.

3.1.3 Motivational Access and Digital Usage

Motivational access or Internet attitude has a direct relationship with Internet use (van Deursen & van Dijk, 2015). Having sufficient motivation is one of the important factor of digital use (van Dijk, 2006; 2012; 2017). van Deursen and van Dijk (2013) stressed that motivation in uses and gratification theory is clear indication that motivation play an important role in facilitating digital use. Uses and gratification theory has assisted in conceptualization of digital usages and in that theory motivation to use is the main factor that drive an individuals' digital utilization and eventually obtaining their desired outcome.

H3: Motivational access has a positive relationship with digital usage.

3.1.4 Motivational Access and Online Learning

Al-Khaldi and Al-Jabri (1998) has explained that the ownership of computer in tertiary institutions influence students' computer attitude. Teo (2008) examined the correlation between students' ownership of computers and their attitude towards it, a lower degree of computer anxiety is associated with students who has the ownership of computer at home. The ground of whether a student will accept or reject the computer in their leaning does have a relationship with their attitude towards it (Teo, 2008). Liaw (2002) has stressed that a successful implementation of ICTs was determined by a positive attitude towards ICTs. Motivation boost the confidence in Internet and computer self-efficacy of students, which will have positive effect on their online learning outcome. Individual, social and national factors like being technophobic, the cost of getting physical or material access and the policy regulation surrounding an individual, defines their motivation to acquire digital technologies. Study on primary school students have found that motivational factor does have an impact on digital inclusion and learning outcomes (Ghobadi &Ghobadi, 2013).

According to Chen and Chen (2007), motivation and access to technology has a positive and significant relationship with student satisfaction level and performance. Student's motivation to use technology is a critical parameter to think of, because a high motivation could render them a greater opportunity in the pursuit of studies using technological mediums and capture their attention, thus encouraging them to achieve a fruitful academic outcome (Kahveci, 2010).

Students having a positive attitude or a positive motivation towards ICTs are important in achieving effective learning, especially in this technological age. Covid-19 pandemic has further insinuated that technologies are important in moving forward during the challenging time and beyond, thus having a positive attitude or opinion on technologies is important in manoeuvring online activities effectively to achieve offline outcomes. A negative attitude would tarnish an individual's outlook on the whole aspect of ICT, it would render them digitally segregated and excluded. A perception of deeming ICTs as harmful would yield a negative relationship with online learning, students would be wary of online learning if they perceive ICTs in a negative light, their want or want not of ICTs as described by van Dijk (2006, 2012) would determine on how effective online learning would be for them. Students who look ICTs in the bad light would risk the chance or opportunity of their educational growth especially if the learning is conducted in a technologically mediated environment.

van Deursen and van Dijk (2015) has stressed that to have a beneficial outcome offline in any aspect no matter economics, personal development, social or education, having a upper hand on motivation is important. As explained in many of van Dijk's studies and by other digital divide researchers, motivation is the access that should be conquered by everyone to achieve beneficial outcomes in a digital society.

H4: Motivational access has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H5: Motivational access has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

3.1.5 Material Access and Digital Skills

Material access is the medium, which enables the acquirement of digital skills. According to Mossberger et al. (2012), different devices provide different function, thus having a diversity of devices or technologies will improve acquisition of digital skills especially medium related skills, then more opportunities would be explored for content related skills (van Deursen & van

Dijk, 2015). They have also reiterated that a person with various device opportunities will have higher chances to expand their digital skills. van Deursen and van Dijk (2018) explained that material access will encourage acquisition of digital skills.

H6: Material access has a positive relationship with digital skills.

3.1.6 Material Access and Digital Usage

Mossberger et al. (2012) has also stressed that diverse access to devices and technologies is crucial, as various tools will provide more usage opportunities and functions. van Deursen and van Dijk (2015) has found that having material accesses encourage individuals to participate in various forms of digital usages and activities. van Deursen and van Dijk (2018) has reaffirmed that point by stating that having varied types of material access is related to participation in diversity of Internet uses.

H7: Material access has a positive relationship with digital usage.

3.1.7 Material Access and Online Learning

Dani et al. (2018) have explained in their study, as the number of Internet users are in the rise in India, therefore one of the very significant factor affecting students' perception of online learning is their accessibility of technologies. The impact of rapid growth of ICTs has provided opportunity for students who are residence in small town or cities to acquire learning resources from not only their own nation but across the world. With increasing usage of mobile phones, laptops and tablets; technological tools has become useful in expanding education. Thus, a very basic step of having physical or material access of ICTs encourages and gives students opportunities to perform academically well online.

When students have the ability to own their personal technological tools they would also have the ease to acquire and access online study materials or resources. Students with lack of access to technology are potentially facing inequality in education, they would not be able to go online and had to find other alternatives to access information to study and communicating with fellow classmates (Jones, 2002). To conquer the notion of becoming a "computer person", students need to have access to technology itself. Students need to have access to physical technological equipment such as computers, peripheral and also Internet access (Goode, 2010). Hussein et al. (2020), have explained that very few students has selected the option of "technology and Internet connectivity" as barrier in their online learning in United Arab Emirates (UAE), those few participants were facing that issue because most of members of their family have to consecutively shares same devices and Internet for work, classes and other activities amidst the pandemic. The reason that technology and Internet connectivity were only an issue to a few student respondents' online learning in UAE because of the fact that UAE is a rich country which has near universal technological accessibility and Internet connectivity.

Students with no or a limited material access of ICTs are at an academic disadvantage than their fellow students who owns a various Internet connectivity, diverse array of digital devices such as laptops, smartphones, tablets, and personal computers and peripherals such as printers, scanners, webcam, and microphones etc. are essential. According to van Deursen and van Dijk (2018), a diverse medium of material accessibility offers more opportunities for individuals than a limited amount of it. The pandemic has induced an unprecedented rise in the need of access to technological tools, as it is the medium that has been used to facilitate the new normal which was needed for learners' online learning, tutors' online teaching and work from home. In the case of online learning, students' educational welfare would be affected with inequality in material accesses and without material access; underprivileged students will be at the negative receiving end of online learning.

H8: Material access has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H9: Material access has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

3.1.8 Digital Skills and Digital Usage

According to van Deursen and van Dijk (2013; 2015), sufficient digital skills are crucial in encouraging more digital usage. Bonfadelli (2002) has stressed that Internet usages does not rely solely on availability of various technologies, possession of sufficient skills are also important. Mossberger et al. (2012) has stated that a broad spectrum of Internet skills could encourage more participation in Internet activities. Development of digital skills motivate engagement in digital or online activities (Correa, 2016; Helsper & Eynon, 2013; Helsper et al., 2016; van Deursen, Helsper, Eynon, & van Dijk 2017; Ojo et al., 2018).

H10: Digital skills has a positive relationship with digital usage

3.1.9 Digital Skills and Online Learning

Possession of digital skills by students are crucial to operate online activities. The acquisition of digital skills could effectively integrate technology to be part of curriculums and thus promote a healthy learning and teaching enviroment. To utilize the elements of ICT, related digital skills are necessary (Hillier, 2017). The availability of technologies and ability to operate those devices are likely to improve the learning experience and outcomes (Bailey et al., 2012). Students with high ICT self-efficacy will develop their skills to achieve their targeted academic goal. This could boost their learning performances and magnify their satisfaction with significant achieved results (Alqurashi, 2019). ICT literacy skills could make changes in students' learning practice and it will contribute positively to skill development, knowledge acquisition and overall learning outcomes (Adhikari et al., 2017).

Fidalgo et al. (2020) have stated that one-third of student respondents in UAE does not willingly engage in online learning because they were not confident enough of their technological competencies. Bradley, et al. (2017) studied the relationship between the degree of a student's self-efficacy and the amount of completed online courses by undergraduate students in a small university in Georgia. Students who have successfully completed their online courses are more likely to possess the necessary capabilities (Internet self-efficacy) than students who are not successful in the context of online learning.

The Covid-19 pandemic has highlighted the importance of students having digital skill so that they can operate ICT platforms to have meaningful and effective use of ICT for online learning and to achieve their desired academic goals. Students who lack digital skills may not be able to explore full potential of online learning and that would render a negative online learning outcome for them. Following van Dijk's cumulative and recursive model of successive kind of access to digital technology model, digital skills is an important element to be tackled to encourage digital participation and to achieve successful offline outcome, in the case of online learning. Students' possession of digital skill is vital for them to obtain their desired academic achievement in online learning during the challenging period of Covid-19 pandemic.

H11: Digital skills has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H12: Digital skills has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

3.1.10 Digital Usage and Online Learning

Wenglinsky (1998) argued that it is not only about the frequency of usage of ICT but how and what they are being used for are factors that will result in academic achievements. Students' ICT usage is not only solely focused on fulfilling academic need but also other activities such as entertainment and socializing. The time they allocated to be spent on ICT and the dimension of usages will directly render to their academic performances (Tien & Fu, 2008). The usage of ICTs effectively could propel students' learning efficiency and it could also improve the quality of curriculum (Morrison & Lowther, 2009). If technologies' full potential is utilized and taken advantage of, everyone could become lifelong learners and gain new knowledge in a more efficient manner (Fletcher, 2003).

According to Sun and Metros (2010), to students, technology use is important in bridging digital divide, if students' are restricted or limited to the use of ICT, it could negatively affect their learning abilities. According to Britt et al. (2015), on their paper on how to improve online engagement of students with strategic online solution, the authors have explained that students could use "adult learners" method to improve their online education. It means that they have to independently explore and utilized resources in ICT environment, through digital engagement to enhance their learning journey online.

The pandemic has shone an important light on students utilizing ICTs to achieve learning requirements and academic goals. Lack of digital usage could deteriorate students' online learning, as they would not have the adequate online engagement or utilization experience to enhance their online learning experience. For example, a student who actually use ICTs, would be in an advantageous position in online learning than those who do not. The statement was reiterated by van Deursen and van Dijk (2013), as they have stated in their study that Internet usage activities provides beneficial and advantageous outcome for Internet users than non-Internet users. There are activities that will provide more opportunities and resources for an individual's advancement in career, education or their societal position.

H13: Digital usage has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H14: Digital usage has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

3.2 Conceptual Model

As discussed in the previous sections, this study adapted the three levels of digital divide framework to investigate digital divide among Malaysian tertiary students and its impact on their online learning during the Covid-19 pandemic. This framework addresses digital divide through three successive levels. The first level tackles on motivational access and material access, the second level dives into the gaps in terms of digital skills and usage, the third level takes on the outcome inequality, which in this case would be students outcome on online learning. Jointly, the concept of Successive Kinds of Access to Digital Technologies by van Dijk (2006; 2012) was employed to map the phenomena of digital divide in this study, from motivational access to digital usage.

In conjunction with that, A Model for Replications of Inequalities in a Digital Society by van Deursen and Helsper (2015), which expanded the notion of successive kind of access by van Dijk with an addition of inequality in terms of beneficial offline outcome, comprehended the sequential process of digital divide across all three levels. To investigate the outcome inequality of online learning, two prominent variables that were used in pedagogical or educational was adapted. Students' satisfaction and perceived learning are befitting to evaluate online learning outcomes in this study and both these variables were incorporated into the third level of digital divide to assess the whole three levels of digital divide phenomenon in the context of online learning during the Covid-19 pandemic.

The part of hypothesis development, which discussed on the relationship between digital divide indicators and online learning outcomes were visually represented in conceptual model, Figure 3.1. The theories and concepts explained have also inspired the visualization of the conceptual model.

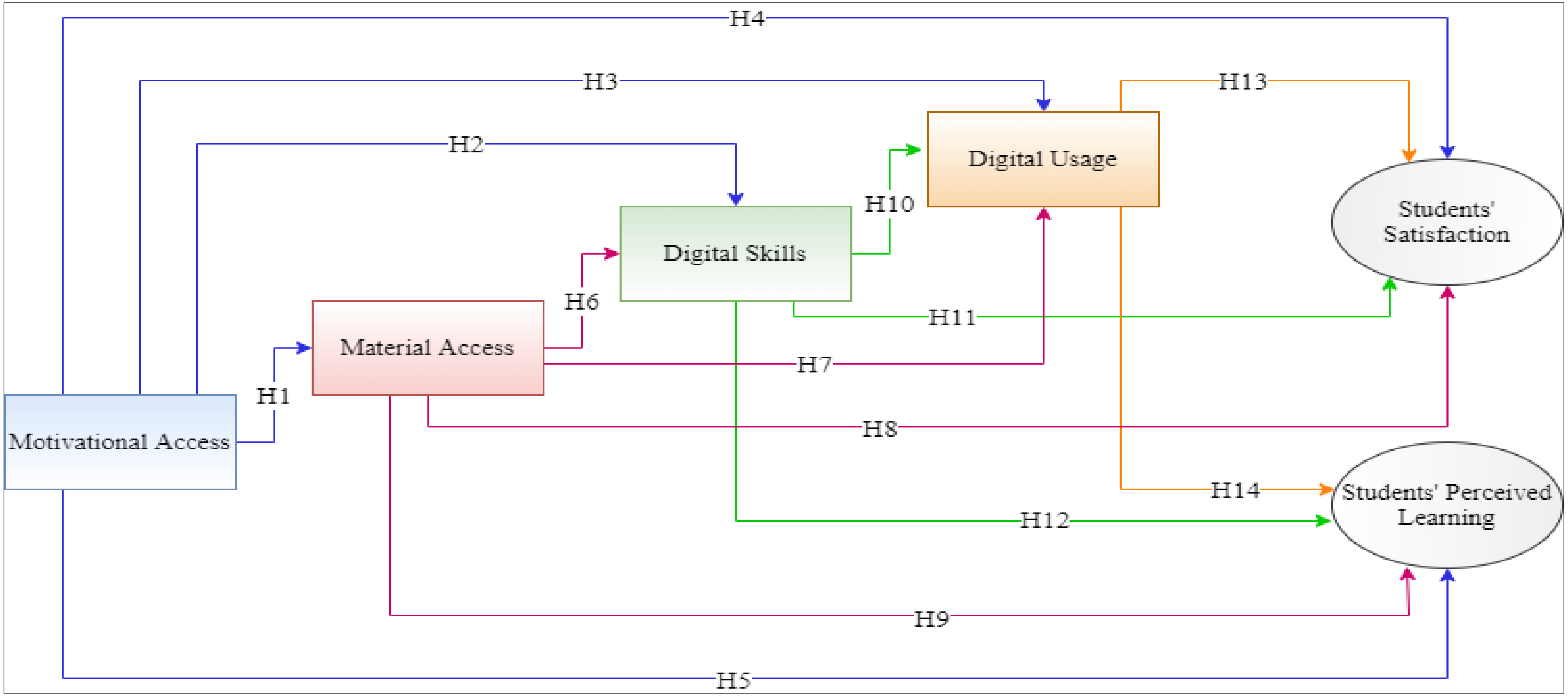


Figure 3.1: Conceptual Model

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Research Design

This study adopted a positivist research paradigm, Saunders et al. (2019) describes positivism as a research work that entails social reality which are observable to prompt "law-like generalizations". A positivist research would uncover observable and measureable facts of a phenomena leading to the attainment of data, which are credible and meaningful. Positivist studies would generally seek causal relationships via the data collected. Development of hypotheses through existing theories that could be examined and confirmed are rudimental process in a positivist research. Researchers using the philosophy of positivism could implement either deductive or inductive reasoning in conducting study. The authors have also pointed out that positivist researchers implement a well strategized methodology to facilitate future replications.

Saunders et al. (2019) has highlighted that a study begins with theory as base often through the exploration of academic literatures and strategized based on testing of theory, uses a deductive approach. This study employs the three level of digital divide framework as a foundation to generate hypotheses for further analyses, thus deductive reasoning was implemented. Deductive reasoning incurs through the derivation of logics via theories which eventually prompts the generation of conclusion through statistical analyses. One of the crucial characteristics of deductive approach is that the concepts need to be operationalized in a quantifiable way. Generalization is another important element in deduction, it is vital that an inference made based on the target sample are implementable to the general population.

This study adopted a quantitative research design, where data were collected through cross-sectional questionnaire surveys distributed to student samples. The survey was administered through online medium called Google Form to collect responses. Cross-sectional survey entails that the data is collected at one point of time (Creswell & Creswell, 2018). Mertler (2002) observes that online survey is an efficient and convenient alternative to the more traditional method of gathering information from students, teachers and parents in his study. First of all, online surveys enable a rather short time frame for collection of responses, also the method is time and cost saving. Online survey also gives researchers access to a large and diverse population with the potential of huge amounts of data. Some researchers even argue that using a web survey guarantees a potentially better response rate (Ilieva et al. 2002). This method is the most appropriate method considering the restrictive climate of Covid-19 pandemic which encourages “new normal” and to maintain social distancing standard of procedures set by Malaysian public health policy guidelines.

4.2 Sampling Procedures

4.2.1 Target Population

The target population for this study are Malaysian citizens, who are students enrolled in higher educational institutions. In addition, the students must have been involved in online learning conducted by their respective higher education institutions during the Covid-19 pandemic.

4.2.2 Sample Size

Sample size plays an important role in the estimation and interpretation of SEM results. According to Barret (2007), a sample of less than 200 for structural equation modelling analyses should be rejected for publication unless the population which the sample size was derived from is small or restricted in size, for example in the case of medical studies. The matter of interest here would be how well a small sample size might be able to contain diverse members of the specified population. A rule of thumb explained by Kline (2005), is that a sample size less than 100 is considered small, a sample size between 100 and 200 is medium and a large sample is which consist of more than 200. Bagozzi (2010) is of the view that sample size should be at least 100 but preferably above 200.

Hair et al. (2017a) stated that sample size consideration play a very important role in PLS-SEM application. A common rule of thumb that was implemented to determine sample size in PLS-SEM application is that the size should be 10 times the number of arrows pointing at a latent construct in the constructed PLS-SEM model. While this rule does provide a guideline for researchers to determine minimum sample size required, but PLS-SEM method as similar to other statistical techniques requires a consideration of contrast between sample size against model and data characteristics. To specify, sample size needs to be determined by the medium of power analyses. They suggested the use of power analyses software such as G*Power to determine minimum sample size requirement for studies. Hair et al. (2019) has yet again reiterated that researchers should use power analyses tools, which considers structure of the model, significance level and anticipated effect size to determine minimum sample size required. They have assured that PLS-SEM does provide analyses for large datasets regardless of previous researchers' overlooking this fact.

Through the computation using G*Power software version 3.1 as explained by Memon et al. (2020); with effect size at 0.15, probability error set at 5 percent, statistical power set at 80 percent and 5 predictors in the model, the minimum estimated sample size to be tested would be 92. In accordance with the explanation, this study's sample size was set to be at 400 student respondents.

4.2.3 Sampling Technique

4.2.3.1 Quota Sampling

Quota sampling was implemented to establish representations of particular characteristics in a population to a fixed range (Acharya et al. 2013). In this study, quota sampling was used to derive private and public higher education institutions, ten from each category of higher education institutions was selected. The private and public higher education institutions selected are representative of almost every geographical regions in Malaysian, namely; northern, central, southern regions of peninsula Malaysian and both the Bornean regions; Sabah and Sarawak. The selected private and public higher education institutions are as displayed in the Table 4.1.

Table 4.1: Selected Malaysian Higher Education Institutions

Regions	Public Higher Education Institutions	Private Higher Education Institutions
Northern	University Science Malaysia (USM), Penang Campus	AIMST University, Kedah Campus
Central	University of Malaya (UM), KL Campus	Universiti Tunku Abdul Rahman (UTAR), Sg. Long Campus
Southern	University Tun Hussein Onn (UTHM), Pagoh Campus	Multimedia University (MMU), Melaka Campus
		INTI International University, Nilai Campus

Sabah/Sarawak	University of Malaysia Sabah (UMS), Kota Kinabalu Campus	Curtin University Malaysia, Miri Campus
	University of Malaysia Sarawak (UNIMAS), Kota Samarahan Campus	

Quota sampling will also be used to derive the amount of students respondents from each institutions selected. Since the targeted sample size for this present study is 400 respondents, thus 40 students from each institutions was limited to participate in the survey. Conditioning of forty respondents from each selected higher education institutions was implemented, through the utilization of add-on feature of “form-ranger” in Google Form.

4.2.3.2 Snowball Sampling

According to Berg (2006), snowball sampling is a non-probability sampling method used to recruit respondents, when a qualified participant shares an invitation with other potential participants who fulfil similar characteristics and criteria required of the targeted sample for the study. In this study, snowball sampling was used to recruit potential participants through student representative societies, student organizations in the respective institutions and via related social network of student allies, contacts, and connections from the selected higher education institutions. Due to privacy protection and higher education institutes' rules and regulation, approaching students through snowball sampling method is the most suitable. Participants was kindly encouraged and requested to share the link of the questionnaire survey through social media, group chats and online text messages to their fellow qualified students, peers, course mates and friends from their higher education institutions.

The implementation of snowball sampling for selection of student participants provides ease and assurance in gathering data of the targeted samples of higher education students from the selected higher education institutions. Snowball sampling is a cost-efficient method for collecting samples. Researchers can obtain large amount of data by collecting information from the link of connections formed from social networks and previous participants. However, snowball sampling is subjected sample selection bias because people are more likely to associate with others like themselves, for example, male participants are more likely have male friends, but a large sample size could reduce the impact of this biasness (Chan, 2015).

Four filtering questions were implemented to ensure that only eligible sample participated in the survey. The filtering criteria were; students are to be of Malaysian nationality, full-time or part-time students actively enrolled in Malaysian higher education institutions, and required by their higher education institutions to use online learning platform to continue the process of their tertiary education during the Coivd-19 pandemic. If a respondent meet all the filtering criteria, they will be allowed to proceed with the survey. In the event that a respondent does not meet any of the filtering criteria, the Google Form has a feature to “submit” the form, instead of moving on to the next section of the questionnaire. The participants was also filtered based on whether they are enrolled in any of the ten selected private and public higher education institutions, students from other than the ten selected institutions would also be prompt to “submit” the survey instead of progressing to the next section.

4.3 Variables and Measurement

4.3.1 Motivational Access

Motivation is the will for users to actually utilize digital tools and infrastructure and is a crucial factor in bridging digital divide. According to van Dijk (2006, 2012), motivation could be influenced by an individuals' need, availability of consequential usage opportunities, perceptions of technological instruments (the Internet and computer games may perceived as 'dangerous'), availability of money and possession of relevant skills. Studies by van Dijk (2012; 2017) coined the terms attitude towards technology and intention to accept it as parts of the motivational access, as they shape motivation, those terms were explained as motivating factors that induce individuals to welcome ICTs into their lives. Similarly, Heslper et al. (2017) has constructed motivation and attitude scale to evaluate motivational access. van Deursen and van Dijk (2018) explained that attitude towards technology is what sculpts motivational access; negative attitude towards technology signifies negative motivational access, thus the motivation and attitude scale developed by Heslper et al. (2017) assist in capturing motivational access.

To measure motivational access, motivation and attitude scale was adopted and adapted from Helsper et al. (2017), it was measured by four items and it was also adopted and used by van Deursen and van Dijk (2018). Five-point Likert scale was used for measurement, which ranges from “strongly disagree” to “strongly agree”.

4.3.2 Material Access

Despite intention, attitude towards technology or motivational access, the first level of digital divide also discusses the importance of the accessibility of Internet and digital infrastructure (van Dijk, 2017; van Deursen & van Dijk, 2018). To investigate material accessibility of technologies by Malaysian tertiary students, the questionnaire inquired on the respondents’ accessibility to Internet services and digital devices and peripherals (van Dijk, 2006; van Deursen & van Dijk, 2018). The measurement of material access was conducted based on types of devices and peripherals owned (van Deursen & van Dijk, 2018). The types of Internet used was adapted from Malaysian context, in accordance with types of services offered by telecommunication service provider in Malaysia namely; fixed broadband, mobile data plans and wireless broadband. The measurement for material access was set in dichotomous question format of “yes” or “no” indication.

4.3.3 Digital Skills

A very important element in the second level of digital divide is digital skills, it tackles on an individual digital competencies and computer literacy to effectively utilize ICTs or technologies in general (van Deursen & van Dijk, 2014). van Deursen et al. (2014) constructed a comprehensive and simplified framework and items to measure an individual's digital skills. The authors examined thoroughly the reliability and validity of the scale, thus, recommended to use it to evaluate digital skills of the general population. Another reason for selecting this scale to measure digital skills is that, the items of the scale are products of elaborate theoretical and empirical studies done by van Deursen and van Dijk (2009a; 2009b; 2010; 2014). The construction of the scale was also based on the evolution of digital skills up until the most recent status. The framework constructed by Deursen et al. (2014), categorized digital skills into five dimensions namely, operational, information navigation, social, creative and mobile skills.

Five-point Likert scale was used to measure respondents' self-reported digital skills. The responses ranges from statements being "not at all true of me" to "very true of me" with an option of "I do know what this means" added in the scale, in tandem with the study conducted by Deursen et al. (2014). Additionally, the negatively worded items of information navigation were reverse coded prior to data analysis.

4.3.4 Digital Usage

Digital usage is also a component of second level of digital divide. According to van Deursen and van Dijk (2013) Internet usage can be determined by frequency and length of times the Internet is being used and also in terms of the activities that are being performed using it. van Deursen and van Dijk (2013) have conceptualised and classified a variety of Internet usage activities into categories of personal development, leisure, commercial transaction, social interaction information, news, and gaming. The authors used the theoretical grounds contributed by usage and gratification theory to determine individual motives and their subsequent usage. This correlation between motives and usage enabled the classification to be done with valid justifications instead of indeterminate defence.

This digital usage scale by van Deursen and van Dijk (2013) was adopted and adapted to determine the digital usage among Malaysian students and five-point Likert scale was used for measurement, which ranges from “never” to “always”. As for the frequency of usage, the hours of daily usage was inquired, the classifications of usage times were adopted similar to duration of daily use of Internet employed in The Internet Users Survey 2018 by MCMC.

4.3.5 Students' Satisfaction and Perceived Learning

Ideally, in a conducive learning climate, satisfied students would emanate efforts in terms of engagement, motivation and responsiveness that would render them achievements in learning to higher levels. However, dissatisfied students in a learning environment would extend to situations where instructors and students themselves would have difficulty achieving effective learning outcomes (Dziuban et al., 2007). Strong et al. (2012) who studied students' satisfaction in e-learning courses used items constructed by Short et al. (1976) to measure satisfaction. Similarly, satisfaction scale has been used in previous studies by Cobb (2009) and Richardson and Swan (2003) to evaluate the effectiveness of online courses. Five-point Likert scale was used for measurement, which ranges from "strongly disagree" to "strongly agree".

According to Rovai and Baker (2005), students' self-reported perception of learning should reflect their view of the educational effectiveness of a course. Numerous studies have efficaciously adapted perceived learning as a measure of learning attainment by students (Sher, 2009). Six reliable and validated items of perceived learning was adapted from Sher (2009) and Hiltz (1994). Five-point Likert scale was used for measurement, which range from "strongly disagree" to "strongly agree".

As discussed in previous in previous chapters, the reason for adapting students' satisfaction and students perceived learning in this study is to evaluate outcomes or effectiveness of online learning, both of this indicators have played crucial roles in pedagogical and education studies to evaluate students' learning outcomes. Alqurashi (2019) has drawn a distinction between both of these indicators, student satisfaction assess students' fulfilment from their learning experiences, whilst, students' perceived learning captures their view on the knowledge or skills that they have gained after the learning experience has occurred. These valuable outtakes of satisfaction and perceived learning has made it relatable to the study of tangible outcome from digital use by Helsper et al. (2015). The digital divide researchers categorized outcomes into several aspects, but the one that is given spotlight in this study is education. To evaluate tangible outcome, the author utilized indicators like achievement and satisfaction; the former signifies consequence of certain digital uses and the latter assess contentment with certain digital uses. Students' satisfaction and perceived learning corresponds with the ideology behind satisfaction and achievement in digital use by Helsper et al. (2015), thus further proving satisfaction and perceived learning as appropriate measures to capture effectiveness of learning via digital use or in an online environment.

Alqurashi (2019) has implied that, both students' satisfaction and perceived learning are able to investigate online learning outcomes. Thus, with that notion this study adapted students satisfaction scale from Strong et al. (2012)

and students' perceived learning scale from Sher (2009), at which both studies used these indicators to measure learning outcomes in an online environment. Therefore, both adapted items are able to accurately measures effectiveness of online learning as well as the third level of digital divide.

4.3.6 Control Variable: Students' Prior Online Learning Experience

Tertiary students' prior experience with online learning is the statistical control for this study. Atinc et al. (2012) stated that the usage of control variables were deemed as a mean that could diminish the impact of any possible confounded effect that restraint the explanatory power of a model. Statistical control are a way for researcher to take into consideration the repercussions of any existing confounding elements that could impact the explanatory variables other than the proposed independent variables. Control variables are means for researchers to consider into account the confounding effects. Atinc et al. (2012) explains that in a way, statistical controls are also components that have the potential to impact dependent variable similarly to the predictors in the model.

Becker et al. (2015) recommended that an inclusion of control variables should be backed by clear theoretical justifications, proper reporting and interpretation of results. Failure to do so would demean the inclusion of statistical control, as it could raise issues like difficulty in interpreting parameter estimates, induce mistakes in inferences and stunts scientific progression of a study. Carlson and Wu (2011) explained that control variables are sometimes named "nuisance" variance, as they broadly captures extraneous effects. They stressed that statistical control are used to source out the potential confounding influences during the designation of research, thus control variables are used as a representation of confounding elements during data collection and analysis.

Whilst digital divide impacts students' online learning effectiveness, prior online learning experience of students also has a confounding impact on the outcomes of online learning, this means students who undertook online learning prior to the Covid-19 pandemic are generally well equipped to tackle online learning than their peers who do not. Montgomerie et al. (2016) through qualitative semi-structured interview has found that having previous exposure towards online learning enabled a student to effectively manage study loads. Students with previous online learning experience were able to manoeuvre online programmes effectively and has better progression academically than their peers who lacks prior online learning experiences.

Shen et al. (2013) in tandem with Jan (2015) has pointed out that students with prior exposure are more likely to be susceptible and satisfied with the notion of online education. A lack of prior experience in online learning has negative relation with the student's chances of completing online programme (Moore, 2002). Kim and Frick (2011) has also stressed in the context of self-directed e-learning, having prior experience in online leaning directs a smooth sailing for learners to undertake their e-learning. Learners' prior experience with online learning influences their choice on whether this medium would facilitate their educational journey online.

Control variable plays a pivotal role in a research design and analysis, omission of statistical control would be detrimental to data analysis as this enable the influence of potential confounding variables. For this study, tertiary students' prior experience with online learning was set as control. Researchers have expressed that having prior experience with online learning would influence the effectiveness of online learning. Students with prior online learning exposure would be well equipped to undertake the online courses in future with lack of prior experiences. Thus, students' online learning experiences prior to the Covid-19 pandemic would affect the effectiveness of online learning during the pandemic. Students was enquired on their prior experience with online learning with a dichotomous "yes" or "no" question in Section F of the questionnaire.

4.3.7 Demographic Information

The collection of demographic information of respondent will provide a clear understanding of subgroups among students. As previous studies have discussed, digital divide is an issue, which had originated from socioeconomic and sociodemographic inequalities. Thus, the gathering of demographic details below would immensely assist in dissecting the origination of the issue of digital divide among Malaysian tertiary students.

- Name of Higher Education Institution Students Enrolled in (Cover Pages/Filtering Question)
- Gender
- Ethnicity
- Household Income per Month
- Types of Programmes Enrolled
- Field of Study
- Nature of Place Online Learning was Accessed from during the Covid-19 Pandemic (Home, Campus, etcetera.)
- Name of State in Malaysia, Online Learning was Accessed
- Name of Village/Town/City in Malaysia, Online Learning was Accessed

4.4 Pre-test and Pilot Study

Pre-testing and pilot study are crucial steps in questionnaire design before the advancement into data collection. These procedures avoid the potential arousal of any issues during data collection, so that it could be curbed early on. Memon et al. (2017) have described that both pilot test and pre-testing serves distinctive purpose in ensuring a well-designed questionnaires. Pre-testing of questionnaires would correct flaws that may hinder the process of data collection and reduces biasness (Sekaran, 2003). Absence of pre-testing during survey design may lead to below par data quality and deletion of indicators during measurement model assessment. Kumar et al. (2013) has explained that the actual respondents should be approached to conduct pre-testing, as this would be representative of the sample in main data collection of the study. Academicians and actual target respondents of the study, who also participated in pilot test of this study were approached for pre-testing. Their feedbacks were curated to improvise the proposed questionnaire for main data collection.

Pilot testing for this study was conducted from 26th November 2020 till 13th December 2020, for a duration of 18 days. Fifty eligible student respondents from ten selected private and public tertiary institutions participated in the pilot study. Memon et al. (2017) stated that a sample size more than 30 respondents are commended, because more than 30 respondents would fulfil the distributional assumption of Central Limit Theorem, which ought to establish that any target samples' mean would approximately equate to that of the population. Thus, the gathered 50 respondents for pilot study, as shown in Table 4.2 is sufficient The demographic details of respondents of pilot study was also recorded in Table 4.3. Cronbach's alpha was derived through SPSS to assess internal consistency reliability of items of constructs; motivational access, digital skills, digital usage, students' satisfaction and perceived learning.

Table 4.2: Number of Responses (Pilot Study)

Types of Responses	**n**
Total Responses	52
Total Eligible Responses based on Filtering Questions	50

4.4.1 Demographic Information (Pilot Study)

Table 4.3: Demographic Information of Student Respondents (Pilot Study; n=50)

Demographic Details	**n**	**%**
Prior experience of undertaking online learning/classes before Covid-19 Pandemic		
Yes	11	22
No	39	78
Gender		
Female	31	62
Male	19	38
Ethnicity		
Malay	15	30
Chinese	13	26
Indian	13	26

Others	9	18
Household Income per Month		
Below RM1000	5	10
RM1000-RM2000	6	12
RM2001-RM3000	8	16
RM3001-RM4000	5	10
RM4001-RM5000	12	24
RM5001-RM6000	4	8
RM6001-RM7000	1	2
RM7001-RM8000	5	10
More than RM8000	4	8
Tertiary Educational Institution Enrolled in (Quota Sampling)		
University of Malaya (UM), KL Campus	5	10
Universiti Malaysia Sabah (UMS), Kota Kinabalu Campus	5	10
Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan Campus	5	10
Universiti Sains Malaysia (USM), Penang Campus	5	10
Universiti Tun Hussein Onn Malaysia (UTHM), Pagoh Campus	5	10
AIMST University, Kedah Campus	5	10
Curtin University, Miri Campus	5	10
INTI International University, Nilai Campus	5	10
Multimedia University, Melaka Campus	5	10
Universiti Tunku Abdul Rahman (UTAR), Sg.Long Campus	5	10
Types of Programmes		
Matriculation / Foundation Studies or equivalent	6	12
Diploma or equivalent	1	2
Undergraduate	40	80
Postgraduate	3	6
Field of Study		
Accountancy/Business/Management	17	34
Engineering	10	20

Health Science	6	12
Science	8	16
Others	9	18
Place of Access to Online Learning during the Covid-19 Pandemic		
Campus	2	4
Home	44	88
Hostel	4	8
For selection other than campus, State online learning was accessed during the Covid-19 Pandemic		
Kedah	6	12
Penang	3	6
Perak	5	10
Terengganu	1	2
Pahang	2	4
Selangor	13	26
Johor	2	4
Melaka	4	8
Negeri Sembilan	3	6
Sabah	1	2
Sarawak	6	12
Federal Territory of Kuala Lumpur	4	8
Labuan	0	0
Putrajaya	0	0
Rural/Urban Classifications		
Urban	50	100
Rural	0	0

4.4.2 Reliability Test (Pilot Study)

Table 4.4 show the Cronbach's alpha coefficient for variables of motivational access, digital skills, digital skills, students' satisfaction and perceived learning. Alpha coefficient values of most constructs are more than 0.7, which is the threshold value that signifies internal consistency reliability. Cronbach's alpha value of motivational access is 0.357, which is less than 0.7, the output indicated that the deletion of item number three would render a better alpha value. Thus the original items of "I feel that people pressure me to be constantly connected" was amended into "My friends/people around me encourage me to use technologies such as the Internet to be connected" for main data collection.

Next up, the construct of mobile under digital skills has a lower than threshold amount of coefficient alpha value, at 0.676. It was indicated that the deletion of item number three would render better internal reliability. The third items was changed from "I know how to keep track of the costs of mobile app use" to "I know how to keep track of the costs of mobile app use (e.g. in-app purchases for mobile games, mobile Spotify/Netflix/iflix/Viu subscriptions, etc)" .

On the hand, the reliability test also indicated that one dimension of digital usage which is personal development has a coefficient alpha value of 0.605, which is lower than 0.7 and the output indicated the deletion of item number four would improve its internal consistency reliability. Consequently, the original item of "Find vacancies/applying for jobs" was changed to "Finding study material through online resources".

Table 4.4: Cronbach's Alpha Value of Lower Order Constructs (Pilot Study)

Construct	**Cronbach's Alpha**
Motivational Access	0.357
Digital Skills*	
Operational Skills	*0.936*
Information Navigation	*0.944*
Social	*0.942*
Creative	*0.937*
Mobile	*0.676*
Digital Usage*	
Personal Development	*0.605*
Leisure	*0.727*
Commercial Transaction	*0.893*
Social Interaction	*0.798*
Information	*0.805*
News	*0.757*
Gaming	*1.000*
Students' Satisfaction	0.959
Students' Perceived Learning	0.955

**Higher Order Constructs*

4.4.3 Material Access (Pilot Study)

Table 4.5 demonstrates material accessibility of pilot study student samples, the number indicate that gap of physical and material access of digital infrastructure and facilities among the samples exist and is quite prominent with only mobile data plans, laptop/notebook and smartphone have a technology diffusion rate of more than 90 percent. All the other elements of material access has a diffusion of below 90 percent, at which the existence of material access divide persists.

Table 4.5: Frequency of Material Access (Pilot Study)

Material Access	Yes		No	
	N	***%***	***n***	***%***
Internet				
Fixed Broadband (e.g. UNIFI, Streamyx, etc)	33	66	17	34
Mobile Data Plans	48	96	2	4
Wireless Broadband	44	88	6	12
Devices				
Personal Computer/Desktop	19	38	31	62
Laptop/Notebook	50	100	0	0
Tablet	12	24	38	76
Smartphone	49	98	1	2
Smart TV/ Television	38	76	12	24
Game Consoles	6	12	44	88
Peripherals				
Printer	35	70	15	30
Scanner	32	64	18	36
Webcam	34	68	16	32
Docking Station	0	0	50	100
Computer Microphones	36	72	14	38

4.4.4 Digital Usage Hours (Pilot Study)

As shown in Table 4.6, respondents of pilot study have a prominent daily Internet use with more than 50 percent of them, who use Internet for more than 9 hours daily.

Table 4.6: Hours of Daily Internet Use (Pilot Study)

Hours of Internet Use Daily:	***n***	***%***
Less than 1 hour	0	0
1-4 hours	2	4
5-8 hours	10	20
9-13 hours	22	44
4-18 hours	10	20
More than 18 hours	6	12

4.5 Survey Design

Table 4.7, displays the arrangements and design of the survey questionnaire that was used for data collection in this present study.

Table 4.7: Design of the Questionnaire

Sections	**Items/Variables**	**Source**
Cover Pages	Introduction, Filtering Questions and Selection of Higher Education Institution	-
Section A	Motivational Access	Helsper, Smirnova and Robinson (2017)
Section B	Material Access	van Deursen and van Dijk (2018)
Section C	Digital Skills	van Deursen, Helsper and Eynon (2014)
Section D	Digital Usage	van Deursen and van Dijk (2013)
Section E	Students' Satisfaction	Strong, Irby, Wynn and McClure (2012)
Section E	Students' Perceived Learning	Sher (2009)
Section F	Demographic Information	-

4.6 Data Analysis Procedure

This section includes discussions on data analytical procedures that were carried out in this study to assess the proposed research objectives.

4.6.1 Preliminary Analysis

The dataset was first prepared, primed and cleaned to continue with descriptive analysis and PLS-SEM.

4.6.1.1 Outlier

According to Hair et al. (2010), the assessment of outliers help in checking the extreme case scores which might have significant effect on the result where it is either too low or too high or have a unique combination of values, which cut across several of the variables in the model. Usage of multivariate analysis will necessitate the identification and treatment of outliers. Mooi and Sarstedt (2011) has described outlier as an extreme response to a single question or to every questions. To deal with outlier, firstly, it needed to be identified. Hair et al. (2017a) has stated it is crucial to identify outliers before running PLS-SEM, and has advised that these extreme responses should be removed from the data set.

4.6.1.2 Normality

Hair et al. (2017a) explained that normality is prerequisite when implementing CB-SEM, whereas PLS-SEM is a non-parametric analysis software, thus it does not require the assumption of normal data distribution. Distributional assumption of normality is favoured when working with CB-SEM, whereas PLS-SEM does not makes the assumption of normality in data distribution. The authors have pointed out that in regards to violation of normality assumption; non-parametric approach of PLS-SEM is appropriate than CB-SEM. Hair et al. (2017a) also reiterated that normal distribution is seldom attained in social science researches thus PLS-SEM is appropriate in this case. It was also pointed out that PLS-SEM has fewer limitation on the utilization of ordinal and binary scales, albeit if coded adequately.

Hair et al. (2017a) stressed that it is crucial to assess and report normality even when the assumption is not required; this is to ensure that the distribution is not problematic by being extremely non-normal, which could have an impact on significances of relationships. They have emphasized that non-normality of data distribution does not hinder the robustness of bootstrapping procedures, but since they are limited direction onto what degree does non-normal distribution exhibits extremeness, thus skewness and kurtosis are two measures that are suggested for researches to utilize.

Memon et al. (2017) explained that PLS-SEM was dubbed as "soft-modelling" because of its flexibility on data non-normality, multivariate skewness and kurtosis should be checked despite the robustness of bootstrapping procedure. Commonly researches in the past rigorously examine non-normality of univariate data, and potential non-normality of multivariate is left unattended. Meta-analysis conducted by Cain et al. (2017) stressed that it is important to examine data normality and in the case of non-normality, the extent of it should be reported. In past studies skewness and kurtosis are rarely explored, Cain et al. (2017) in their study tackles this by suggesting ways to assess univariate and multivariate skewness and kurtosis. This present study employed Webpower tool to conduct normality assessment, both univariate and Mardia's multivariate skewness and kurtosis are reported as suggested by Alosani et al. (2020) and Ramayah et al. (2017). Prior to conducting analysis in PLS-SEM, this assessment was conducted and reported, Mardia's multivariate skewness and kurtosis, the approach of not only assessing univariate but also multivariate skewness and kurtosis is also suggested by Memon et al. (2017).

4.6.1.3 Common Method Bias

Mackenzie and Podsakoff (2012) have emphasized that respondents must have both ability and motivation to answer in order to reduce bias. They stated that selecting respondents with enough expertise to answer survey questions is crucial, clear languages must be utilized and all response options should be labelled clearly. In this present study, students' motivation to answer the questionnaire were induced through reassurance of the responsibility and purpose of the study and how the collected data would be used to provide an impact. To overcome common method bias, the explained precautions were taken care of, this was further facilitated by the exclusion of ambiguity, vague, unfamiliar and complicated terms in the adapted items of the questionnaire survey.

Mackenzie and Podsakoff (2012) have also stressed that it is important that respondents must be assured of anonymity and confidentiality of their data collected, that there are no right or wrong answers, and that they should answer as honestly as possible. It would also be beneficial to assure participants that their responses will be used only for research purposes, will be aggregated with the responses of others and that no one will see their individual responses.

Common method bias is a common issue that plagues self-report questionnaires; the reported data could have inaccurate correlations if the survey respondents were inclined to provide consistent and similar responses to questions (Fuller et al., 2016). Thus, to evaluate common method bias prior to further data analysis, Harman's single factor test was conducted, a value below the threshold level of 50 percent would indicate the lack of critical common method bias in the data collected.

4.6.2 Descriptive Analysis

To study the first research question, descriptive analysis was used. The levels of digital divide, which is also the extent of gaps in motivational access, material access, digital skills, digital usage and online learning outcome among tertiary students was analysed descriptively. The variables were individually analysed to make a conclusion about the extent of digital divide among students. Descriptive analysis was conducted using SPSS to summarize and analyse the demographic information and the constructs of digital divide.

To determine the extent of digital divide indicators; which are motivational access, material access, digital skills, digital usage and online learning outcome; students' satisfaction and students' perceived learning, responses from the multiple items was averaged. Since five-point Likert scales was used for the listed variables, the mean score value of more than 4 will indicate respondents' level of agreement to the corresponding items. Thus, variables with mean score value of more than 4 will illustrate that the respondents does not face that variable of divide and vice versa for mean score value of less than 4 (Hadiyanto et al., 2013; Ojo et al., 2018).

For material access, which is a categorical variables in dichotomous yes or no question format, frequency analysis was used to evaluate the extent, result was presented in terms of percentage of the particular groups in the variable.

Using the S-curve theory explained by Norris (2001) and van Dijk (2006; 2012) through Figure 2.4: Evolution of the Digital Divide of Physical Access in Time; 90 percent to 100 percent would indicate a populations' saturated technological diffusion. A value below 90 percent would display the lack of technological diffusion, thus to determine the extent of material access this concept would be implemented. For example, a 90 percent to 100 percent of ownership laptops in this study would indicate that the diffusion of that particular device has reached saturation and the gap of inequality in material is closing among students in the sample.

4.6.3 Structural Equation Modelling in Digital Divide Studies

Structural equation modelling was used to test the second research question using Smart-PLS 3 and to test the research hypotheses. Due to its ability to account for measurement error and manage multiple endogenous constructs, structural equation modelling (SEM) has become a commonly used tool for theory testing (Steenkamp & Baumgartner 2000).

Min (2010) has stated the advantage of using structural equation modelling was that it could increase the reliability of the measurements. For example, there were six dimensions of Internet skills in the study, and it would have not been easy to find whether six dimensions does reliably stand for Internet skills using conventional regressions. Min (2010) has discovered through using

SEM that Internet use of an individual for politics is unequal depending on the characteristics of skills and motivations. This study opposes the view that the role of technology will further democracies, it was found that there are factors such as Internet skills and motivations that are important in inducing an effective and meaning technological use for politics other than relying on accessibility to technologies. An overall tackling of digital divide indicators are crucial in overcoming democratic divide.

van Deursen and van Dijk (2015) used structural equation modelling to test the hypothesized relationship between digital divide variables (accesses) and their determinants. They have highlighted the importance in addressing the divide present in motivational and material access, digital skills and usage, as a gap in one indicator will affect another in a compounded way. According to Byrne (2013) structural equation modelling indicates two important characteristics in the procedure, one, the causal relationships studied are being represented by a series structural regression equations, two, the pictorial model established under the structural relation, covey a clear conceptualization of the studied theoretical model.

van Deursen et al. (2017) utilized structural equation modelling to study digital inequality on how digital skills and Internet usage or activities provide beneficial outcome. The study used the domains of economic, social, cultural, social and personal to analyse the manifestation of digital inequality among the

Dutch population. The usage of SEM has indicated a direct and indirect relationship between offline resources, digital skills, digital usage and the tangible outcomes. The findings of the study have suggested that digital inequality is a multidimensional phenomenon that is sequentially compounded through divide in motivation, access, skills, usage and outcomes.

Ojo et al. (2018) used PLS-SEM to study the factors associated with differences in individual usage of Internet in Malaysia. This explorative study wrapped up by stating the AMO framework does infer the same conclusion as major digital divide theories such as van Dijk's. It was found that there is no significant relationship between intrinsic motivation and Internet usage. The authors explained that Internet usage are mostly utilised for fulfilling instrumental or materialistic needs and the Internet usages in this study included items from various domains, intrinsic motivation may have played major role if the usages were specified only into social networking or entertainment domains, since those are the activities that majorly induce individual satisfaction (intrinsic motivation).

Chen et al. (2020) adopted the approach of structural equation modelling to determine level of digital divide and its impact on political participation in Taiwan. They have found that educational background and socioeconomic status plays a major role in providing digital opportunities. People with higher educational background and higher income are more likely to have accessibility to digital information and higher tendency to engage in citizen participation such as voting. The study has concluded that since the establishment and promotion of digital education in 1990s the Taiwanese government has achieved remarkable achievements in digitization.

4.6.4 Hierarchical Component Model

Hierarchical component model (HCM) is established to test structural models, which are complex and could be operationalized in higher orders of abstraction. The building of higher order models, HCM, commonly involves the testing second or higher orders structures that contains two layers of latent variables. In this study, both the variables of digital skills and digital usages, contains multiple other sub-constructs or dimensions that measures and captures the characteristics of both variables. For digital skills there are five dimensions; operational skills, information navigation, social, creative and mobile. For digital usage, there are seven dimensions; personal development, leisure, commercial transaction, social interaction, information, news and gaming. This proves that, it is suitable to operationalize both digital skills and digital usage at two orders of abstraction and it also renders to a more parsimonious modelling in this study. All the dimensions mentioned were operationalized at lower order whereas digital skills and digital usage at higher order (Hair et al., 2017b).

As described by Hair et al. (2017b), HCM reduce the amount of relationships in the structural model, which makes the PLS path model to be more parsimonious and have easier comprehension. They have also explained that the establishment of HCM requires studies to build and implement a suitable operational definition for the variables that is being studied. This would facilitate the relevant lower order constructs (LOCs), which capture distinct and unique components being associated with the higher order constructs (HOCs). With that the measurement nature of relation among LOCs and HOCs were clarified. In this study, the relation between HOCs digital skills and digital usage and their respective LOCs were represented in formative mode, whereas all LOCs in this study were specified reflectively, as demonstrated in Figure 4.1. Therefore, the HCM constructed for this study would be Type II: reflective-formative HCM.

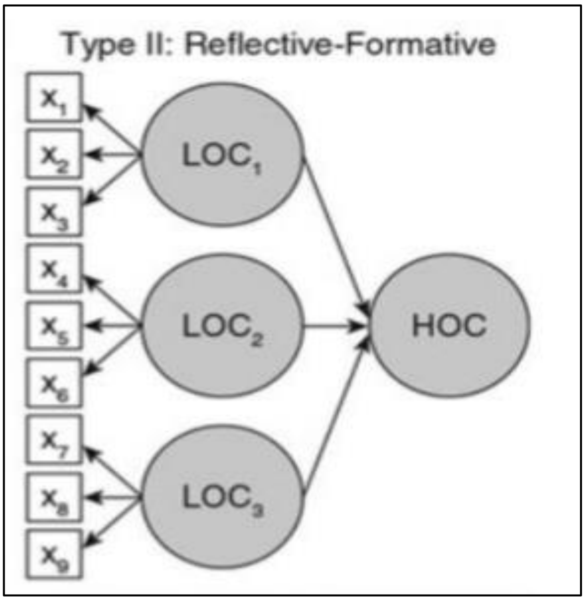


Figure 4.1: Type II: Reflective-Formative HCM
Source: Hair et al. (2017b)

The rationale for specifying the model as Type II: reflective-formative were that, at the lower order, multidimensional constructs of digital skills and usage encompasses items with similar concepts, they in essential are interchangeable, the omission of any indicators in the constructs would not alter the ultimate meaning of the LOCs. The establishment of measurement model validity of LOCs in part 5.8.1 solidifies the stance of reflective specification. As for the HOCs, the reasons for formative specification were that the LOCs are non-interchangeable among themselves, each LOCs captures distinct characteristics and concepts that have unique attributes to each digital skills and digital usage and theoretically all the LOCs does not correlate with one and another (Becker et al., 2012; Hair et al., 2017a; 2017b). For instance, the dimensions or LOCs of digital skills, could not substituted among each other. A grasp of operational skills will demonstrate better possession of digital skills; however, it would not necessarily indicate a rise in skills in information navigation, social, creative or mobile.

Embedded two-stage approach was implemented to evaluate the Type II: reflective-formative HCM. In the first stage, a repeated indicator approach was used to assign HOCs with indicators of its LOCs. Then, with the latent scores obtained from the former stage, the analysis of measurement validity of HOCs and structural model assessments were conducted in the second stage (Sarstedt et al., 2019). Becker et al. (2012) noted that this approach offers an estimation with more parsimony that encapsulate the notion of higher-level models.

Both Hair et al. (2017a) and Sarstedt et al. (2019) have stated that both measurement model of HOCs and LOCs should be evaluated before proceeding to structural model assessment. Since it is a reflective-formative HCM; internal consistency reliability, convergent and discriminant validity was assessed for the LOCs. As for the HOCs, collinearity issues, significance of outer weights and loadings were examined. Considering the multidimensionality of HOCs, convergent validity is not required to establish measurement validity.

4.6.5 Measurement Model Assessment of LOCs

4.6.5.1 Internal Consistence Reliability (Cronbach's Alpha and Composite Reliability)

In this study, the internal reliability of the survey instrument will be assessed using Cronbach's alpha and composite reliability. Baek et al. (2010) used Cronbach's alpha coefficient to assess the internal reliability for all items of each constructs. Cronbach's alpha is a traditional assessment of internal consistency, Hair et al. (2017a) stated that the estimates that Cronbach's alpha provide are based on the observed indicators' inter-correlations. Cronbach's alpha has an assumption that every indicators have same outer loadings in the construct, but PLS-SEM necessitates evaluation of indicators based on their individual reliability. Thus, composite reliability takes the different outer loading of the indicators in a construct into account. So, Hair et al. (2017a) has suggested that to evaluate internal consistency reliability both Cronbach's alpha and composite reliability should be taken into consideration. Values of Cronbach's alpha and composite reliability of more than the recommended value of 0.7 signifies internal consistency reliability.

4.6.5.2 Convergent Validity

Convergent validity measures the extent of measures in a construct positively correlate with each other. Convergent validity means that an item of a construct is similar or related to another theoretically. This approach is dominantly used on reflective construct, as the reflective indicators show a high number of variance. To assess convergent validity, both indicator outer loading and average variance extracted (AVE) should be considered (Hair et al., 2017a).

High outer loadings of indicators in a construct suggest that the indicators are associated and have common characteristics. The threshold value outer loading value of reflective indicators is 0.708 or higher. High outer loadings value will encourage communality of an item, which would induce the square of outer loadings that represent the magnitude of variation in indicators, average variance extracted (AVE) explained by the constructs. According to Hair et al. (2017a), the rule of thumb to establish convergent validity is to have average variance extracted value of 0.50 or higher, this would indicate that the half of the variance in the items were explained by the constructs.

4.6.5.3 Discriminant Validity

Discriminant validity is important for model fit also. According to Hair et al. (2010), discriminant validity means that an item of a construct is unique empirically from the other construct in the SEM. Discriminant validity signifies that each constructs are capturing their own unique characteristic instead of being represented by another construct in the model.

Discriminant validity measures the extent of measures in a construct distinctive from each other. Discriminant validity is measured in two ways, one, is by the examination of cross loading of indicators. The cross loading signifies that outer loadings of an indicator with an associated construct have to higher than the other constructs' loading. A higher cross loading than outer loading of indicators display discriminant validity. Second way to assess discriminant validity is using Fornell-Larcker criterion, it is the comparison between square root of AVE value and correlation of a latent variable. The square root of AVE should be more than the highest correlation with other constructs (Hair et al., 2017a).

Recent study has criticised that both approaches of cross-loadings and Fornell-Larcker criterion as not reliable to examine discriminant validity. Thus, heterotrait-monotrait ratio (HTMT) has been proposed to assess discriminant validity. This particular approach estimate the correlation between two constructs, to determine the perfect reliability between them. A HTMT value of below 0.85 would suggest the lack of discriminant. Another way is through bootstrap confidence interval, the value could obtained via estimated parameters of HTMT statistic after bootstrapping, when the value of 1 is not in the range of confidence interval, this suggest the establishment of discriminant validity (Hair et al., 2017a).

4.6.6 Measurement Model Assessment of HOCs

4.6.6.1 Collinearity

Outer variance inflation factor (VIF) of less than five, is a yardstick used to examine the collinearity among formatively specified items of HOCs. Collinearity issue among formative constructs could cause incorrect estimation of outer weight, which attributes to false conclusion. Formative indicators in the second stage with outer VIF values of more than five, which demonstrates collinearity, should be eliminated. This would ensure the establishment of measurement model validity of HOCs in the model.

4.6.6.2 Significance of Outer Weights and Loadings

Significant outer weight of an indicator, which differs from zero signifies its role in the formation of a construct. Significant outer weight concludes the validity of a formative constructs (Hair et al., 2017a; 2017b). Before the removal of formative indicator with an insignificant outer weight, one should assess the outer loading of the supposed indicator. An indicator with significant loading should be retained.

4.6.7 Structural Model Assessment

There is a few steps involved in structural model assessment, the subsequent sections explores the procedures respectively as stated by Hair et al. (2017a).

4.6.7.1 Collinearity Assessment

The first step is to assess collinearity. The aim of this assessment is to examine the extent of distinction or interaction between the exogenous constructs in the model. To evaluate collinearity variance VIF value would be used, inner VIF value of more than 5 would indicate critical collinearity issues among constructs.

4.6.7.2 Structural Model Path Coefficient

The second step is to extract structural model path coefficient. The path coefficient of all the hypothesized relationship would be displayed in the output. Path coefficient value ranges from -1 and +1. Value close to +1 signifies a strong positive relationship, which would commonly be significant and vice versa for values close to -1. The path coefficient values of close to 0 suggest a weak relationship among constructs, a low value nearing 0 also would showcase an insignificant relationship.

For the bootstrapping procedure in this study, bootstrap samples would be set at recommended 5,000 subsample and one-tailed test, since the directions of relationships among variables were proposed in Chapter 3. Following bootstrapping, the *t* values and p values of relationship in the model would be presented. When *t* value is larger than critical values, it could be concluded that the relationship and coefficient is statistically significance at a certain imposed probability error. For one-tailed test, the critical values are as follow; for 10% significance level its 1.28, 5% significance level its 1.65 and for 1 significance level its 2.33.

Another way of determining significance is through p values. When a p value is lesser than the percentage of respective significance level 0.10, 0.05, and 0.01 respectively, then the null hypothesis will be rejected and vice versa for p value more than the significance level of 10%, 5% and 1%. The final way of observing relevance of significant relationships is though confidence interval. If the confidence interval between 5% and 95% does not contain the value of 0, the null hypothesis is rejected and alternative hypothesis is supported. To evaluate relevance of significant relationships in the path model, *t* value, p value and bootstrap confidence interval need to be evaluated and reported.

4.6.7.3 Coefficient of Determination (R^2)

Third step is to assess coefficient of determination, R^2 value. It is often used to evaluate a model's predictive power and is measured by deriving the squared correlation between a particular endogenous construct's actual and estimated values. It represent the exogenous constructs' aggregated impact on the endogenous variables. The R^2 value ranges from 0 to1, with higher amount suggesting a higher level of predictive accuracy. Hair et al. (2017a) explains that it is not easy to provide a rule of thumb for satisfactory R^2 value, this highly depends on the research field and the complexity of model. They have indicated that R^2 value of 0.20 is considered high in some disciplines. They have noted that a model selected on the basis of R^2 value is not a good approach, as the number of endogenous variables and number of path relationship could impact R^2 value.

4.6.7.4 Effect Size (f^2)

Other than R^2 value, the fourth step is to assess f^2 value, which is effect size. It evaluates the margin in R^2 value, when an exogenous variable is excluded from the model and it is also used to assess whether the excluded construct has a considerable effect on endogenous constructs. The threshold values on determining effect sizes is that the values of 0.02, 0.15 and 0.35 signifies a small effect, medium effect and large effect respectively. The f^2 value of below 0.02 suggest that there is no effect.

4.6.7.5 Predictive Relevance (Q^2)

The fifth and final step in structural model assessment is to assess predictive relevance, Q^2 value through blindfolding procedure. Stone-Geisser's Q^2 value measures model's "out-of–sample" predictive power. Hair et al. (2017a) explains that when a path model shows predictive relevance, it precisely predicts data that are not used in the model estimations. The criteria is that when Q^2 value is more than 0 for a particular endogenous construct, this signifies the predictive relevance of specific endogenous constructs.

CHAPTER 5

RESULTS

5.1 Data Preparation

Data for this study was collected through online survey; Google Form was utilized for this purpose. The data collection period was from 27th December 2020 until 8th March 2021, which is a duration of nine weeks. Prior to starting data analysis, responses collected were coded in Microsoft Excel in accordance with the literatures the respective survey items were adopted and adapted from. Subsequently, the coded data was imported into SPSS version 25 and Smart PLS version 3.3.3 to be analysed.

5.2 Response Rate

Based on Table 5.1 below, total respondents who tried to attempt the survey was 460 and the targeted number of respondents for this study was set at 400. Sixty individuals are ineligible as they responded with “No” for filtering questions and they are also students who were not enrolled in the selected higher education institutions of this study as shown in Table 5.2. These categories of ineligible participants who does not fulfil the conditional question was prompted to submit the form instead of moving further into the questionnaire. Nevertheless, target of 400 eligible students from ten selected higher education institutions was attained.

Table 5.1: Number of Respondents

Respondent Classifications	**n**
Total Number of Attempting Individuals	460
"No" for Filtering Questions	20
Students from other institutions which are not included	40
Total Eligible Respondents	*400*

5.3 Demographic Information

Table 5.2 displays the demographic background of the respondent. Quota sampling was imposed to recruit student respondents from ten selected public and private tertiary institutions, 40 students participated in the survey from each institution. Additionally, it could be observed that more than 60 percent of students does not have any prior experience enrolling in online learning or classes before the Covid-19 pandemic. Majority of the respondents participated in the survey are female students, 279 of them are female and the remaining 121 are male students. More than 50 percent of the student respondents are of Indian and Chinese descent, at where 37.50 percent are Indians and 24.75 percent are Chinese. It could also be seen that, more than 60 percent of respondents have a household income per month of lower than RM 4000.

Furthermore, 90.75 percent of student respondents are enrolled in undergraduate programmes in their respectively higher education institutions. Twenty-four percent of respondents are enrolled in engineering programmes, and 20.75 percent of respondents are in accountancy, management and business related tertiary programmes. Majority of respondents, which is 90 percent of them accessed online learning from their home during the Covid-19 pandemic.

Table 5.2 shows that majority of respondents, which is 19.5 percent accessed online learning from the state of Selangor. Respondents' answers on the towns, villages and cities their online learning was accessed from, has been classified into rural and urban area. This classification was done based on Department of Statistic Malaysia's definition of urban area ("which had a combined population of 10,000 or more at the time of the Census 2010") and the population data was acquired from the DOSM. Area with population of more than 10,000 based on census data of 2010 was classified as urban and vice versa (DOSM, 2010). In regards to that, 96.75 percent of respondents accessed online learning from urban areas as defined by Department of Statistics Malaysia.

Table 5.2: Demographic Information (Respondents = 400)

Demographic Characteristics	**n**	**%**
Higher Education Institution Enrolled		
Public Higher Education Institutions:		
University of Malaya (UM), KL Campus	40	10
Universiti Malaysia Sabah (UMS), Kota Kinabalu Campus	40	10
Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan Campus	40	10
Universiti Sains Malaysia (USM), Penang Campus	40	10
Universiti Tun Hussein Onn Malaysia (UTHM), Pagoh Campus	40	10
Private Higher Education Institutions:		
AIMST University, Kedah Campus	40	10
Curtin University, Miri Campus	40	10
INTI International University, Nilai Campus	40	10
Multimedia University (MMU), Melaka Campus	40	10
Universiti Tunku Abdul Rahman (UTAR), Sg.Long Campus	40	10
Prior experience of undertaking online learning/classes before Covid-19 Pandemic		

Yes	124	31.00
No	276	69.00
Gender		
Female	279	69.75
Male	121	30.25
Ethnicity		
Indian	150	37.50
Chinese	99	24.75
Malay	81	20.25
Iban	9	2.25
Dusun	7	1.75
Others	54	13.50
Household Income per Month		
Below RM1000	69	17.25
RM1000-RM2000	60	15.00
RM2001-RM3000	64	16.00
RM3001-RM4000	53	13.25
RM4001-RM5000	30	7.50
RM5001-RM6000	37	9.25
RM6001-RM7000	18	4.50
RM7001-RM8000	24	6.00
More than RM8000	45	11.25
Types of Programme		
Matriculation/Foundation Studies or equivalent	3	0.75
Diploma or equivalent	25	6.25
Undergraduate	363	90.75
Postgraduate	9	2.25
Field of Study		
Engineering	96	24.00
Accountancy/Business/Management	83	20.75
Health Science	49	12.25
Science	46	11.50
Social Science	19	4.75
Arts and Humanities	18	4.50

Others	89	22.25
Place of Access to Online Learning during the Covid-19 Pandemic		
Home	356	89.00
Campus	27	6.75
Hostel	13	3.25
Friend’s Home	2	0.50
Others	2	0.50
State online learning was accessed during the Covid-19 Pandemic		
Selangor	78	19.50
Sarawak	49	12.25
Johor	48	12.00
Kedah	33	8.25
Perak	31	7.75
Melaka	30	7.50
Negeri Sembilan	28	7.00
Federal Territory of Kuala Lumpur	26	6.50
Sabah	22	5.50
Penang	21	5.25
Pahang	21	5.25
Kelantan	7	1.75
Terengganu	4	1.00
Perlis	1	0.25
Federal Territory of Labuan	1	0.25
Rural/Urban Classification		
Urban	387	96.75
Rural	5	1.25
Not Specified	8	2.00

5.4 Descriptive Statistics for RO1

As displayed in Table 5.3, the mean score value of all motivation and attitude scale items of variable motivational access is more than 4, this explains that the respondents generally agree with the statements of motivation and attitude, thus this signals that there is no gap in terms of motivational access among tertiary student respondents.

Next, the mean score for multidimensional items of digital skills is 3.981, which is less than 4, this demonstrates that student respondents does not sufficiently possess the listed abilities under digital skills, thus, there is an inequality in terms of digital skills among student respondents. Detailed insights into all the dimensions of digital skills shows that operational, social and mobile skills have a means score value of 4.514, 4.444 and 4.513 respectively, since it is more than 4, these values implies that respondents generally does possess these types of digital skills. As oppose to that, information navigation and creative skills has a mean score of less than 3, which indicates that the sample does not possess these groups of digital skills.

Following Table 5.3, it could be observed that overall mean score for all digital usage items are 3.854, this value is less than 4, thus it signifies that respondent seldom engages in a diversity of digital usage activities, this result implies that there is a divide in terms of digital usage among respondents. A thorough look into different types of digital usage activities showcases that with a mean score value of 4.250 and 4.390, respondents frequently use ICTs for social interaction and information seeking. With a mean score value of 2.990, student respondents least engages in digital gaming activities. Personal development, leisure, commercial transaction and news activities have a mean score value of 3.960, 3.874, 3.443 and 3.533 respectively; this indicates that respondents have average engagement with these categories of digital activities.

Moreover, the table shows that student respondents' satisfaction in undertaking online learning or classes has a mean score value of 2.873, which implies that the respondents generally disagree with the items of students' satisfaction. Likewise, all the items of students' perceived learning has a mean score value of 3.290, it is lower than the value of 4 and the findings suggest that respondents generally have a negative response towards those items. It is quite evident from these mean score of students' satisfaction and perceived learning that third level of digital divide among student respondents in terms of educational outcome exist and respondents are not satisfied with online learning, in conjunction with that student respondents also deem that they have not achieved successful attainment of knowledge through online learning during the Covid-19 pandemic.

Table 5.3: Mean Score of Variables

Description	Mean Score	Standard Deviation
Motivational Access	4.141	0.936
Digital Skills	3.981	0.730
Operational Skills	*4.514*	*1.031*
Information Navigation	*3.449*	*1.144*
Social	*4.444*	*0.882*
Creative	*3.300*	*1.063*
Mobile	*4.513*	*0.892*
Digital Usage	3.854	0.539
Personal Development	*3.960*	*0.773*
Leisure	*3.874*	*0.854*
Commercial Transaction	*3.443*	*1.029*
Social Interaction	*4.250*	*0.800*
Information	*4.390*	*0.716*
News	*3.533*	*1.019*
Gaming	*2.990*	*1.288*
Students' Satisfaction	2.873	1.014
Students' Perceived Learning	3.290	0.910

In accordance to the theoretical explanation in Chapter 2: Literature Review (part 2.2.1.2 Material Access) and Chapter 4: Research Methodology (part 4.6.2 Descriptive Analysis), a technological diffusion between 90 percent to 100 percent would indicate a population's saturated technological diffusion, thus a value lower than 90 percent will explain the existence of divide in terms of material access. Following that, Table 5.4 encompasses material accessibility among student respondents, from the table it could be seen that only mobile data plans, laptop/notebook and smartphones have achieved a more than 90 percent of diffusion among the sample of this study. All the other technological equipment and facilities has a diffusion rate below 90 percent, thus this finding suggest that there is divide in terms of material access among student respondents.

To conduct the process of learning in online environment, students requires a very basic of material access, which are either types of Internet connection and either equipment from the subgroup of devices; which are laptop/notebook or smartphone. A deeper dissection through cross-tabulation displays that, none of the students lacks all three types of different crucial accesses. Three students does not have neither facilities of Internet connection, but they do have access to laptop/notebook and smartphone. One student does not has access to either laptop/notebook or smartphone, yet that student does possess the facility of Internet connection via fixed broadband.

Table 5.4: Frequency Analysis of Material Access

Descriptions	**Yes**		**No**	
	n	**%**	**n**	**%**
Internet				
Fixed Broadband (e.g., UNIFI, Streamyx, etc)	269	67.25	131	32.75
Mobile Data Plans	363	90.75	37	9.25
Wireless Broadband	76	19.00	324	81.00
Devices				
Personal Computer/Desktop	116	29.00	284	71.00
Laptop/Notebook	390	97.50	10	2.50
Tablet	100	25.00	300	75.00
Smartphone	393	98.25	7	1.75
Smart TV/ Television	241	60.25	159	39.75

Game Consoles	47	11.75	353	88.25
Peripherals				
Printer	296	74.00	104	26.00
Scanner	230	57.50	170	42.50
Webcam	269	67.25	131	32.75
Docking Station	27	6.75	373	93.25
Computer Mircrophones	259	64.75	141	35.25

van Deursen et al. (2013), indicated that length of time Internet was used is one way to measure digital usage, for descriptive analysis of digital usage, hours of daily Internet use by respondent was collected. As in Table 5.5, more than half of the respondents use Internet for more than 5 hours per day; at which 19 percent of respondents use Internet for 5 to 8 hours per day, 39 percent for 9 to 13 hours per day, 23.5 percent for 14 to 18 hours per day and 12.25 percent use it for more than 18 hours daily. Internet Users Survey 2020 by MCMC categorized these durations into the groups of regular and heavy users, Internet user who spent 5 to 12 hours per day on the Internet were labelled as regular users and more than 14 hours a day as heavy users. This result highlights that majority of student respondents do have significant duration of daily digital exposure.

Table 5.5: Frequency Analysis of Digital Usage

Hours of Daily Internet Use	n	%
Less than 1 hour	0	0.00
1-4 hours	17	4.25
5-8 hours	76	19.00

9-13 hours	156	39.00
14-18 hours	94	23.50
More than 18 hours	57	14.25

5.5 Data Verification

Prior to data analysis, missing value analysis, evaluation of outlier, normality, common method bias and correlation were conducted.

5.5.1 Missing Value Analysis and Outlier

Hair et al. (2017a) has explained that missing data issue is common in social science researches. As for this study, Google Form was used to collect survey responses, the occurrence of missing data was expected to not be an issue, as the online survey contains features which necessitate participants to respond, in spite of hat, missing vale analysis was conducted to prevent omissions caused by entry or other human errors. Outlier is the case of extreme responses, for this study outliers were also checked to avoid entry errors made during data coding (Hair et al., 2017a).

Missing value analysis and the detection of outliers were conducted using SPSS. Missing value analysis established that there are no missing value in the data sets. Before conducting further analysis, the data collected was checked for outlier, this identification was done using SPSS's box plots, the output generated indicated that there are no outliers; the values are in accordance with codes that were assigned to the responses.

5.5.2 Normality

Hair et al. (2017a) have recommended the use of skewness and kurtosis to assess the extent of data's deviation from normality. They reiterated that the statistical properties of PLS-SEM provides a robust estimation of model with data of both normal and extremely non-normal distributions in terms of skewness and kurtosis. The rule of thumb for kurtosis is that, a value greater than +1 indicates a peaked distribution and less than -1 implies a flat distribution. As for skewness, number of more than +1 and less than -1 demonstrate a positively and negatively skewed distributions respectively.

Meta-analysis study conducted by Cain et al. (2017) suggest that it is crucial to examine and report multivariate skewness and kurtosis as a measure of normality, alongside univariate skewness and kurtosis which are extensively reported in past researches. They have explained that multivariate skewness and kurtosis similarly examine distributional shape characteristic as in a univariate instance. The difference is that in the case of multivariate skewness and kurtosis, the comparison is made of distribution from several combined variables against a multivariate normal distribution instead of the comparison of a single variable distribution against a univariate normal distribution. Alosani et al. (2018) and Ramayah et al. (2017) has utilized Webpower tool by Zhang and Yuan (2018) to conduct the normality assessment.

The results from Webpower tool's skewness and kurtosis calculation showed that the univariate skewness range from -2.887 to 0.134 and univariate kurtosis ranges from -1.065 to 10.209. Furthermore, Mardia's multivariate skewness and kurtosis output demonstrate that the null hypothesis of normality was rejected as $\beta = 65.486$, $p < 0.001$ and $\beta = 409.467$, $p < 0.001$. These results consequently verify the existence of data non-normality, thus cementing the ground to utilize PLS-SEM.

5.5.3 Common Method Bias

The collected data was assessed for the issue of common method bias. Harman's single factor test was implemented to evaluate the percentage of factors accounting to variance of constructs. A value below the threshold level of 50 percent would indicate the lack of common method bias. Following Harman's single factor test conducted using SPSS with the setting fixed as no rotation and extraction method set to principal axis factoring, the output indicates that the first factor accounts for 21.24 percent of variance, the value is below the threshold value of 50 percent, which implies that common method bias is not a critical concern for this study.

5.5.4 Correlation Matrix

Table 5.6 demonstrates the degree of association and expected directions among the latent variables in the model. It could be observed that, motivational access has a positive and significant association with digital usage, material access, students' satisfaction and perceived learning. Whereas it has an insignificant association with digital skills. On the other hand, material access has positive and significant correlation with digital skills and usage, its correlation with both students' satisfaction and perceived learning is insignificant.

Moreover, digital skills has a significant positive correlation with digital usage and negative association with students' satisfaction and perceived learning. Meanwhile, digital usage has a positive and significant correlation with all other latent variables except students' satisfaction.

Table 5.6: Correlation among Latent Variables

Constructs	Digital Skills	Digital Usage	Material Access	Motivational Access	Students' Perceived Learning	Students' Satisfaction
Digital Skills	1.000	-	-	-	-	-
Digital Usage	0.277***	1.000	-	-	-	-
Material Access	0.224***	0.242***	1.000	-	-	-
Motivational Access	0.041^{ns}	0.301***	0.155***	1.000	-	-

Students' Perceived Learning	-0.074*	0.124***	-0.001^{ns}	0.160***	1.000	-
Students' Satisfaction	-0.148***	-0.010^{ns}	0.014^{ns}	0.122**	0.680***	1.000

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, ^{ns} = not significant

5.6 Descriptive Statistics of Indicators

As shown in Table 5.7, there are four indicators adopted and adapted for the construct motivational access. Mean value for the indicators ranges from 4.04 to 4.12. Kurtosis are more than +1, the distribution is peaked and the skewness of less than -1 shows that the distribution is negatively skewed toward the left tail.

There are five dimension for the variable of digital skills namely, operational skills, information navigation, social, creative and mobile. The mean for each indicators ranges from 2.82 to 4.62. The kurtosis of indicators for operational skills, social and mobile are more than +1, thus the distribution is peaked. Whereas, for information navigation and creative, there were indicators with kurtosis more and less than -1, this indicates they the distribution is narrow and normal respectively. All the indicators are negatively skewed towards the left tail.

There are seven dimensions for the variable digital usage. The mean value for all indicators ranges from 2.99 to 4.37. The kurtosis for all indicators exhibit a normal distribution except for an indicator in gaming (flat distribution), personal development and information (peaked distribution). For all indicators except a few indicators of social interaction and information are symmetrical and skewed towards the left tail. Social interaction and information have indicators, which are negatively skewed towards the left tail.

Mean values for the indicators of students' satisfaction ranges from 2.69 to 2.99. The kurtosis for all indicators except "StudentsSatisafction7" indicates that they are normally distributed with value below -1. The skewness value implies that the distribution is symmetrical. Mean for the indicators of students' perceived learning ranges from 3.22 to 3.36. The kurtosis for all indicators except that they are normally distributed with value below -1. The skewness value indicates that the distribution is skewed towards the left tail

Table 5.7: Indicators of Constructs

Constructs	**Indicators**
Motivational Access	InternetAttitude1-InternetAttitude4
Digital Skills	*OperationalSkills1- Mobile3*
Operational Skills	*OperationalSkills1- OperationalSkills10*
Information Navigation	*InformationNavigation1_Reverse - InformationNavigation8_Reverse*
Social	*Social1-Social6*
Creative	*Creative1-Creative8*
Mobile	*Mobile1-Mobile3*
Digital Usage	*PersonalDevelopment1- Gaming*
Personal Development	*PersonalDevelopment1- PersonalDevelopement4*
Leisure	*Leisure1-Leisure3*
Commercial Transaction	*CommercialTransaction1- CommercialTransaction3*
Social Interaction	*SocialInteraction1-SocialInteraction3*
Information	*Information1-Information2*

News	*News1-News2*
Gaming	*Gaming*
Students' Satisfaction	StudentsSatisfaction1-StudentsSatisafction7
Students' Perceived Learning	StudentsPerceivedLearning1-StudentsPerceivedLearning6

5.7 PLS-SEM Model

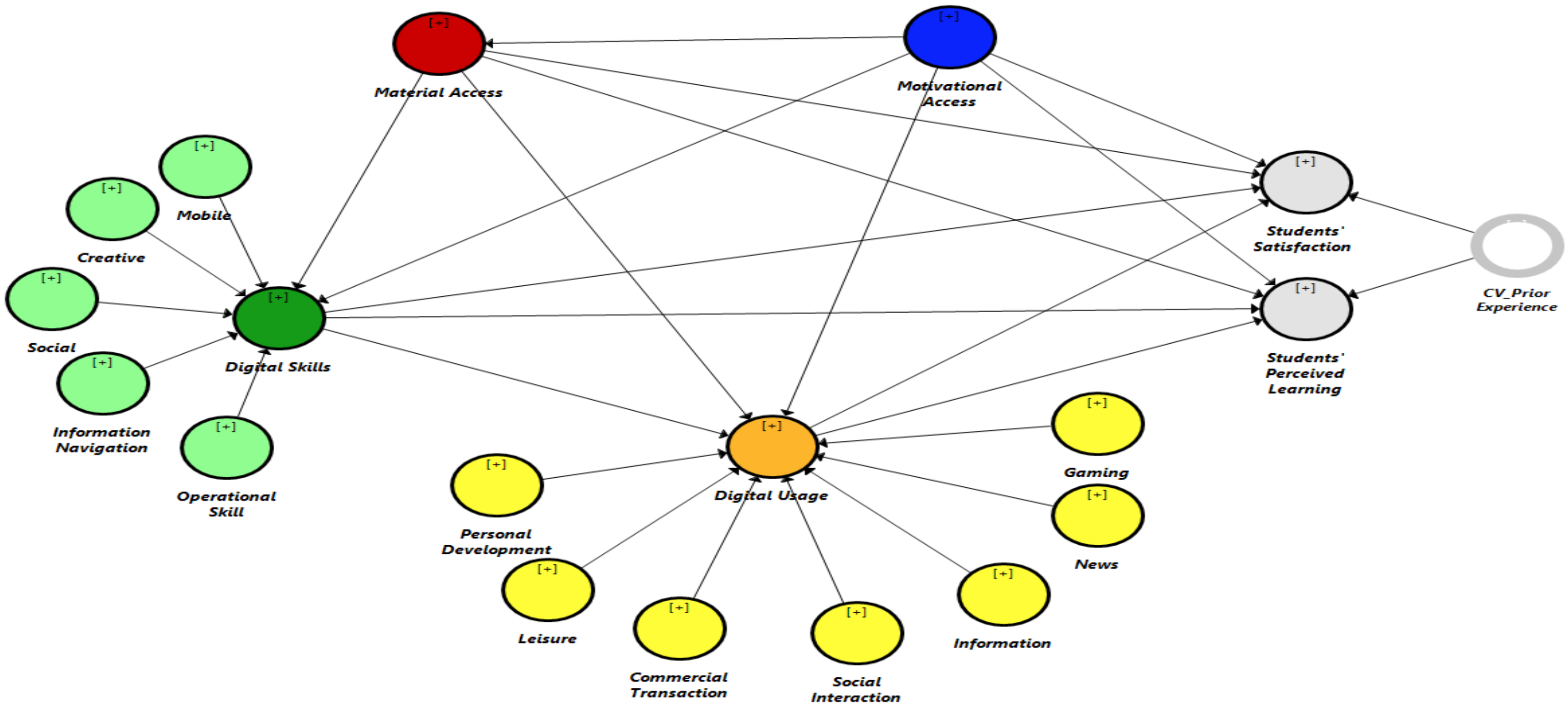


Figure 5.1: PLS-SEM Model of this Study (Stage 1)

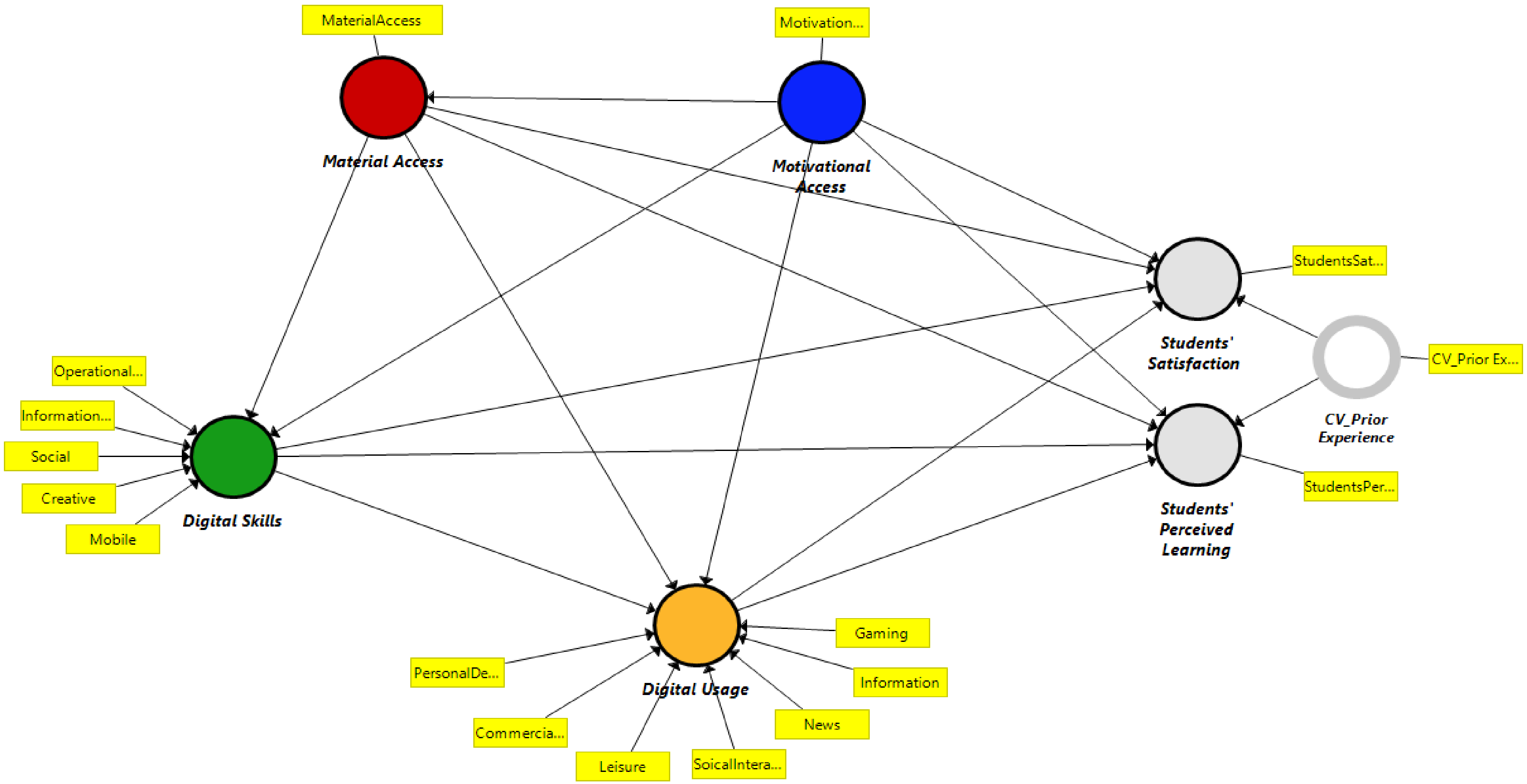


Figure 5.2: PLS-SEM Model of this Study (Stage 2)

5.8 Measurement Model Assessment

5.8.1 Reflective LOC Measurement Model Assessment

Table 5.8 shows the results of outer loadings of each reflective indicators, Cronbach's alpha, composite reliability and average variance extracted (AVE) values of each latent variables. The variable of material access was excluded for these evaluations since it is a dichotomous variable. The values displayed indicates that the each outer loadings of every reflective indicators are more than 0.7, these high outer loading suggest that indicators of constructs do have common characteristic and they do encompasses the meaning of the constructs (Hair et al., 2017a). In addition, the output also shows that Cronbach's alpha of every constructs are more than 0.7 and the same rule of thumb applies for composite reliability and all the values are all also more than 0.7, thus indicating the achievement of internal consistency.

Average variance extracted (AVE) is the measure used to assess convergent validity, which is the extent a certain indicators correlates with the alternate indicators of the same construct. A high proportion of variance should be specified for reflective indicators of constructs. The rule of thumb is that the AVE value should be more than 0.5. The value would signify that the more than 50 percent of the indicator variance could be explained by the constructs. In accordance with that explanation, from Table 5.8 it could be observed that the

AVE value of all reflective construct of this study is more than 0.5. The results obtained demonstrates that internal consistency reliability and convergent validity were established for reflective lower order constructs in the model.

Table 5.8: Reflective Lower Order Constructs' Reliability and Validity

Constructs	**Reflective Indicators**	**Outer Loadings**	**Cronbach's Alpha**	**Composite Reliability**	**Average Variance Extracted (AVE)**
Motivational Access	InternetAttitude1	0.912	0.933	0.952	0.833
	InternetAttitude2	0.924			
	InternetAttitude3	0.888			
	InternetAttitude4	0.926			
Digital Skill					
Operational Skill	OperationalSkills1	0.925	0.976	0.979	0.826
	OperationalSkills2	0.921			
	OperationalSkills3	0.818			
	OperationalSkills4	0.936			
	OperationalSkills5	0.941			
	OperationalSkills6	0.937			
	OperationalSkills7	0.922			
	OperationalSkills8	0.948			
	OperationalSkills9	0.811			
	OperationalSkills10	0.916			
Information Navigation	InformationNavigation1_Reverse	0.795	0.942	0.951	0.710
	InformationNavigation2_Reverse	0.829			
	InformationNavigation3_Reverse	0.816			
	InformationNavigation4_Reverse	0.855			
	InformationNavigation5_Reverse	0.875			
	InformationNavigation6_Reverse	0.880			

	InformationNavigation7_Reverse	0.837			
	InformationNavigation8_Reverse	0.849			
Creative	Creative1	0.792	0.920	0.933	0.636
	Creative2	0.809			
	Creative3	0.757			
	Creative4	0.761			
	Creative5	0.801			
	Creative6	0.839			
	Creative7	0.827			
	Creative8	0.792			
Social	Social1	0.917	0.958	0.966	0.826
	Social2	0.916			
	Social3	0.916			
	Social4	0.900			
	Social5	0.924			
	Social6	0.880			
Mobile	Mobile1	0.963	0.915	0.947	0.857
	Mobile2	0.954			
	Mobile3	0.855			
Digital Usage					
Personal Development	PersonalDevelopment1	0.735	0.789	0.862	0.609
	PersonalDevelopment2	0.757			
	PersonalDevelopment3	0.823			
	PerosnalDevelopement4	0.805			
Leisure	Leisure1	0.709	0.734	0.850	0.655
	Leisure2	0.866			
	Leisure3	0.844			
Commercial Transaction	CommercialTransaction1	0.926	0.891	0.933	0.822
	CommercialTransaction2	0.875			
	CommercialTransaction3	0.918			

Social Interaction	SocialInteraction1	0.871	0.849	0.908	0.767
	SocialInteraction2	0.891			
	SocialInteraction3	0.866			
Information	Information1	0.914	0.827	0.920	0.852
	Information2	0.932			
News	News1	0.963	0.912	0.958	0.919
	News2	0.954			
Gaming	Gaming	1.000	1.000	1.000	1.000
Students' Satisfaction	StudentsSatisfaction1	0.852	0.950	0.958	0.767
	StudentsSatisfaction2	0.852			
	StudentsSatisfaction3	0.894			
	StudentsSatisfaction4	0.891			
	StudentsSatisfaction5	0.903			
	StudentsSatisfaction6	0.921			
	StudentsSatisafction7	0.920			
Students' Perceived Learning	StudentsPerceivedLearning1	0.850	0.954	0.963	0.812
	StudentsPerceivedLearning2	0.904			
	StudentsPerceivedLearning3	0.936			
	StudentsPerceivedLearning4	0.876			
	StudentsPerceivedLearning5	0.917			
	StudentsPerceivedLearning6	0.920			

5.8.2 Discriminant Validity (Heterotrait-Monotrait Ratio)

Discriminant validity indicates the magnitude of which a particular construct differs from other constructs in the model empirically. The demonstration of discriminant validity would signal that a construct is unique and it measures phenomena exclusive from others constructs in the model. Heterotrait-monotrait ratio (HTMT) of correlation is used to establish the existence of discriminant validity. A HTMT value of 0.90 would indicate that there is no discriminant validity; a stricter threshold value would be 0.85. By running bootstrapping (5,000 subsamples), HTMT distribution could be derived to solidify the existence of discriminant validity, a confidence interval with the lack of value 1 in between would also display the establishment of discriminant validity (Hair et al., 2017a).

Table 5.9 demonstrates that discriminant validity has been established between latent constructs motivational access, digital skills, digital usage, students' satisfaction and students' perceived learning, as the HTMT values are all below 0.85 and the confidence intervals lacks the value 1 between them.

Moreover, in this present study, discriminant validity has been established between all the lower order and higher order constructs in model. The output has also denoted that the discriminant validity among all lower order constructs has been established with HTMT values of below 0.85 and the absence of value 1 between confidence intervals further defends the HTMT outcome.

Table 5.9: Discriminant Validity of Latent Variables

Constructs	Digital Skills	Digital Usage	Motivational Access	Students' Perceived Learning	Students' Satisfaction
Digital Skills	-	-	-	-	-
	-	-	-	-	-
Digital Usage	0.323	-	-	-	-
	[0.260-0.443]	-	-	-	-
Motivational Access	0.086	0.334	-	-	-
	[0.075-0.169]	[0.250-0.441]	-	-	-
Students' Perceived Learning	0.120	0.149	0.168	-	-
	[0.103-0.198]	[0.119-0.240]	[0.082-0.263]	-	-
Students' Satisfaction	0.154	0.128	0.127	0.722	-
	[0.115-0.237]	[0.127-0.197]	[0.061-0.213]	[0.674-0.767]	-

5.8.3 Formative HOC Measurement Model Assessment

Table 5.10: Collinearity of LOCs

Higher Order Constructs	Lower Order Constructs	VIF
Digital Skills	Operational Skill	1.771
	Information Navigation	1.205
	Social	2.462
	Creative	1.303
	Mobile	2.338
Digital Usage	Personal Development	1.317
	Leisure	1.444
	Commercial Transaction	1.305
	Social Interaction	1.437
	Information	1.543
	News	1.219
	Gaming	1.123

Following Table 5.10, with VIF values of lesser than five there are no critical collinearity issues among formative indicators of digital skills and digital usage. On the other hand, the bootstrapping procedure as shown in Table 5.11, revealed that all outer weights of lower order constructs are significant with an exception for LOC of gaming. In this instance, to establish validity of gaming, the significance of outer loading was examined.

Table 5.11: Outer Weights of LOCs

Descriptions	Outer Weight	Standard Error	*t* Values	P Values	5.0%	95.0%
Digital Skills						
Operational Skill -> Digital Skills	0.257	0.037	6.996	0.000	0.196	0.313
Information Navigation -> Digital Skills	0.193	0.050	3.901	0.000	0.108	0.269
Social -> Digital Skills	0.299	0.038	7.920	0.000	0.243	0.366
Creative -> Digital Skills	0.262	0.049	5.354	0.000	0.185	0.343
Mobile -> Digital Skills	0.326	0.031	10.681	0.000	0.278	0.377
Digital Usage						
Personal Development -> Digital Usage	0.283	0.038	7.395	0.000	0.218	0.342
Leisure -> Digital Usage	0.254	0.036	7.084	0.000	0.195	0.314
Commercial Transaction -> Digital Usage	0.237	0.041	5.832	0.000	0.170	0.301
Social Interaction -> Digital Usage	0.268	0.035	7.684	0.000	0.209	0.322
Information -> Digital Usage	0.273	0.037	7.292	0.000	0.211	0.333
News -> Digital Usage	0.187	0.040	4.687	0.000	0.121	0.251
Gaming -> Digital Usage	0.090	0.058	1.558	0.060	-0.004	0.181

As shown in Table 5.12, the outer loading of gaming is significant. Thus, these concludes the corroboration of measurement model validity for higher order constructs.

Table 5.12: Outer Loading of LOC (Gaming)

Description	Outer Loading	Standard Error	*t* Values	P Values	5.0%	95.0%
Gaming -> Digital Usage	0.228	0.088	2.595	0.005	0.082	0.368

5.9 Structural Model Assessment

5.9.1 Collinearity Assessment (Variance Inflation Factor)

Table 5.13: Variance Inflation Factor of Constructs

Constructs	Material Access	Digital Skills	Digital Usage	Students' Satisfaction	Students' Perceived Learning
Motivational Access	1.000	1.025	1.025	1.116	1.116
Material Access	-	1.025	1.080	1.106	1.106
Digital Skills	-	-	1.055	1.170	1.170
Digital Usage	-	-	-	1.258	1.258

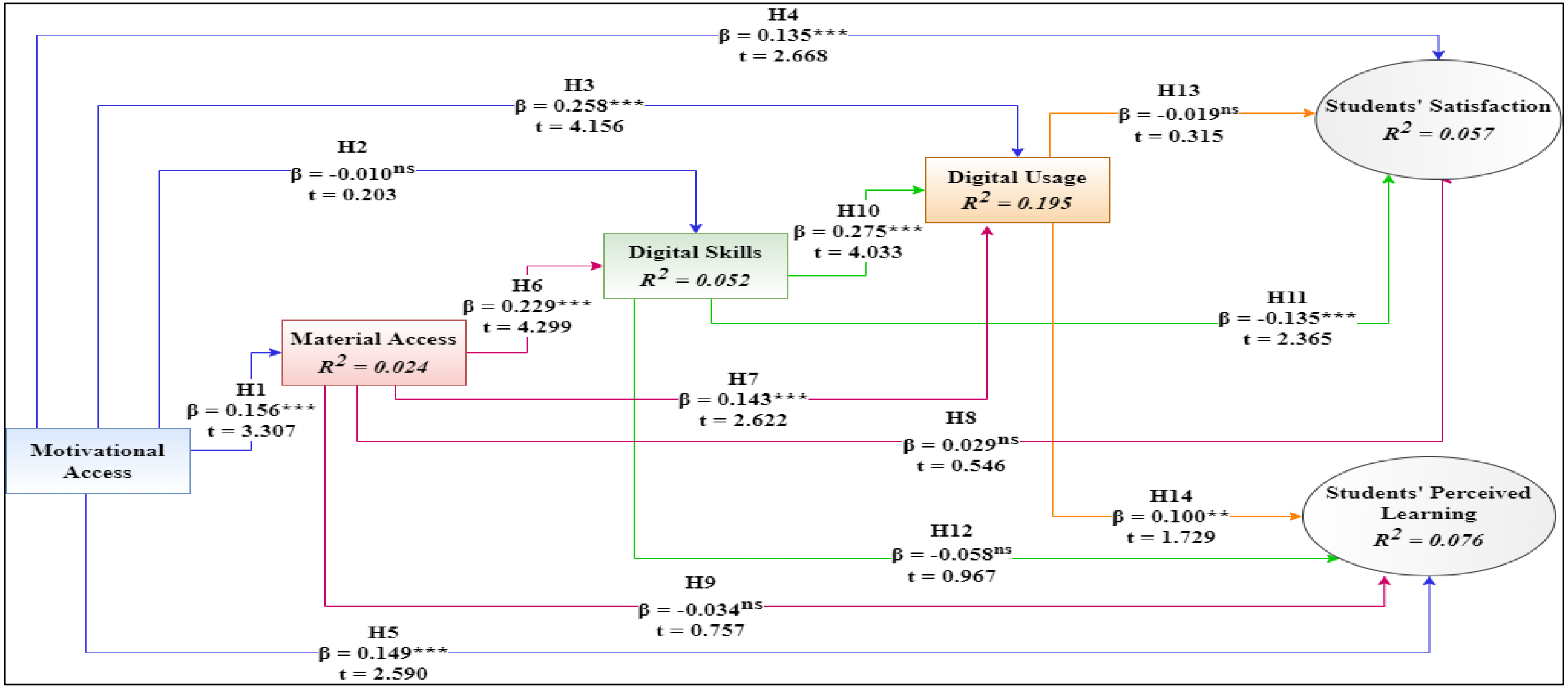
Hair et al. (2017a) explained that the extent of interaction among exogenous constructs could affect the outcome of relationship between them. Collinearity assessment using variance inflation factor (VIF) could indicate the extent of those relationships, VIF threshold value of more than 5 would indicate the issue of critical collinearity. From Table 5.13 it could be observed that all the VIF values between exogenous constructs in the model are below the threshold value of 5. This finding demonstrate that there is no critical collinearity issue among exogenous constructs in the model.

5.9.2 Structural Model Path Coefficient (Hypothesis Testing)

Table 5.14: Structural Model Path Coefficient Result of Hypothesized Relationships

Hypothesis	Description	Beta Coefficient	Standard Error	*t* Values	P Values	5.0%	95.0%	Decisions
H1	Motivational Access -> Material Access	0.156	0.047	3.307	0.000***	0.077	0.234	Supported
H2	Motivational Access -> Digital Skills	-0.010	0.050	0.203	0.419^{ns}	-0.086	0.080	Not Supported
H3	Motivational Access -> Digital Usage	0.258	0.062	4.156	0.000***	0.157	0.362	Supported
H4	Motivational Access -> Students' Satisfaction	0.135	0.050	2.668	0.004***	0.052	0.216	Supported
H5	Motivational Access -> Students' Perceived Learning	0.149	0.058	2.590	0.005***	0.055	0.245	Supported
H6	Material Access -> Digital Skills	0.229	0.053	4.299	0.000***	0.142	0.313	Supported
H7	Material Access -> Digital Usage	0.143	0.055	2.622	0.004***	0.050	0.232	Supported
H8	Material Access -> Students' Satisfaction	0.029	0.053	0.546	0.293^{ns}	-0.057	0.115	Not Supported
H9	Material Access -> Students' Perceived Learning	-0.034	0.045	0.757	0.224^{ns}	-0.109	0.041	Not Supported
H10	Digital Skills -> Digital Usage	0.275	0.068	4.033	0.000***	0.170	0.395	Supported
H11	Digital Skills -> Students' Satisfaction	-0.135	0.057	2.365	0.009***	-0.225	-0.038	Not Supported
H12	Digital Skills -> Students' Perceived Learning	-0.058	0.060	0.967	0.167^{ns}	-0.148	0.049	Not Supported
H13	Digital Usage -> Students' Satisfaction	-0.019	0.060	0.315	0.376^{ns}	-0.114	0.082	Not Supported
H14	Digital Usage -> Students' Perceived Learning	0.100	0.058	1.729	0.042**	0.005	0.196	Supported

Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, ^{ns} = not significant



Note: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, ^{ns} = not significant

Figure 5.3: Structural Model Path Coefficient Result of Hypothesized Relationships

Table 5.14 and Figure 5.3 shows path coefficient significance to investigate the hypothesized relationships, specifically the second research objective of the study. A p-value of less than 0.01 (***), 0.05 (**) and 0.10 (*) implies that the relationship between constructs is significant at 1 percent, 5 percent and 10 percent levels respectively. The absence of the value 0 between confidence interval further clarifies the significance of hypothesized relationships. The result was extracted through bootstrapping procedure in PLS-SEM (5,000 subsamples and a one-tailed test).

From the result, it could be observed that motivational access has a positive and significant relationship with material access, digital usage, students' satisfaction, and students' perceived learning as proposed, whereas the output displayed that the relationship between motivational access and digital skill is not significant. Material access has a positive and significant relationship with digital skills and digital usage, whereas it have insignificant relationships with students' satisfaction, and students' perceived learning. The result implies that there is positive and significant relationship between digital skills and digital usage, but digital skills have a significant negative relationship with students' satisfaction and insignificant relationship with students' perceived learning. The table shows that there is positive and significant relationship between digital usage and students' perceived learning, but an insignificant relationship between digital usage and students' satisfaction.

5.9.3 Coefficient of Determination (R^2)

Coefficient of determination (R^2 value) is widely used to evaluate predictive power of a structural models. It was calculated based on the squared correlation between the actual and predicted value of a particular endogenous construct. Hair et al. (2017a) stated that it is difficult to specify rules of thumb for an acceptable R^2 value, as this highly depends on the complexity of models and the research discipline. There is certain agreeable R^2 value and Hair et (2017a) have suggested that a R^2 value of more than 0.20 is considered high in certain disciplines. A low R^2 value could be explained by the explorative nature of studies and the research discipline. Table 5.15 display the R^2 value and adjusted R^2 value (which is a criterion used to avoid biases in complex model) of all endogenous constructs in the model. The value are all below 0.20, as explained low values should not used to deem that the model is less parsimonious, this could be contributed from the complex and multifaceted nature of the study. Hair et al. (2017a) has also highlighted that selecting a model solely based on R^2 value is not an excellent approach.

Table 5.15: Coefficient of Determination of Endogenous Constructs in the Model

	R Square	R Square Adjusted
Material Access	0.024	0.022
Digital Skills	0.052	0.047
Digital Usage	0.195	0.189

Students' Satisfaction	0.057	0.045
Students' Perceived Learning	0.076	0.064

5.9.4 Effect Size (f^2)

Effect size, f^2 value indicates a change in R^2 value when a particular exogenous construct is excluded from the model. f^2 value is used to measure whether the omission has a considerable impact on the endogenous constructs. Hair et al. (2017a) has explained that an effect size of below 0.02 indicate that there is no effect, effect sizes of more than 0.02, 0.15 and 0.35, shows a small effect, medium effect and large effect respectively. Following that based on Table 5.16, it could be seen that, motivational access has a no effect on digital skills, and small effect on material access, digital usage, students' satisfaction and students' perceived learning. Material access has no effect on students' satisfaction and students' perceived learning, small effect on digital skills and digital usage. Digital skills has no effect on students' satisfaction and students' perceived learning, small effect on digital usage. Digital usage has no effect on students' satisfaction and students' perceived learning.

Table 5.16: Effect Size on Endogenous Construct in the Model

Constructs	Material Access	Digital Skills	Digital Usage	Students' Satisfaction	Students' Perceived Learning
Motivational Access	0.025 *Small Effect*	0.000 *No effect*	0.081 *Small Effect*	0.017 *No effect*	0.022 *Small Effect*

Material Access	-	0.054 *Small Effect*	0.024 *Small Effect*	0.001 *No effect*	0.001 *No effect*
Digital Skills	-	-	0.089 *Small Effect*	0.017 *No effect*	0.003 *No effect*
Digital Usage	-	-	-	0.000 *No effect*	0.009 *No effect*

5.9.5 Predictive Relevance (Q^2)

Stone Geisser's Q^2 value is a step in assessing endogenous construct's predictive accuracy. Hair et al. (2017a) explained that, when a PLS path model shows predictive relevance, it precisely predicts data not implemented or omitted in a model estimation. Q^2 value of more than 0 for a specific reflective latent construct highlights a PLS path models' predictive relevance. Q^2 value was extracted through blindfolding process. Table 5.17 shows that the Q^2 value for all endogenous constructs is more than 0, thus this showcase that PLS path model has predictive relevance for all the endogenous constructs in the study.

Table 5.17: Predictive Relevance of Endogenous Constructs in the Model

Constructs	Q^2
Material Access	0.023
Digital Skills	0.025
Digital Usage	0.067
Students' Satisfaction	0.009
Students' Perceived Learning	0.047

5.9.6 Control Variable

Table 5.18 display the impact of control variable, which is students' prior experience of undertaking online learning on student's satisfaction and perceived learning. The output indicate that prior experience does have a significant impact on student's satisfaction and perceived learning. Effect size, which is f^2 value demonstrates that prior experience have no effect on students' satisfaction with 0.020 and a small effect on students' perceived learning with 0.038

Table 5.18: Path Coefficients of Control Variables with Online Learning Outcomes

Description	Beta Coefficient	Standard Error	*t* Values	P Values	5.0%	95.0%
CV_Prior Experience -> Students' Perceived Learning	0.190	0.048	3.953	0.000	0.108	0.266
CV_Prior Experience -> Students' Satisfaction	0.139	0.051	2.718	0.003	0.053	0.222

CHAPTER 6

DISCUSSIONS

6.1 Recapitulation of the Study

This study has two research objectives to be fulfilled; one is to investigate the extent of digital divide among Malaysian tertiary student and the second is to study the impact of digital divide on online learning effectiveness during the Covid-19 pandemic.

To study the first research objective, three levels of digital divide framework was utilized along with descriptive analysis. The descriptive results indicated that with an exception for motivational access, first level of digital divide perseveres with material access. Second level of digital divide with indicators of digital skills and digital usage persist. Finally, with respondents general disagreement with statements of students' satisfaction and students' perceived learning, there is also a wide gap in third level of digital divide in the scope of online learning outcome. This result cemented that there is digital chasm among Malaysian tertiary students at all the three levels of digital divide.

In addition, to fulfil the second research objective, the impact of digital divide on online learning effectiveness among Malaysian tertiary students during the Covid-19 pandemic was assessed. Partial least square-structural equation modelling was implemented to conduct the assessment. The structural model path coefficient indicated that motivational access is a positive and significant predictor of material access, digital usage, students' satisfaction, and students' perceived learning, it is an insignificant predictor of digital skill. As oppose to the proposed hypothesis, material access has an insignificant relationships with students' satisfaction and students' perceived learning, whereas a positive and significant relationship with digital skills and digital usage. The statistical output ascertained that digital skills have a positive and significant relationship with digital usage, but significant negative relationship with students' satisfaction and insignificant relationship with students' perceived learning. From the results obtained it is also evident, that digital usage is a significant predictor of students' perceived learning, but an insignificant predictor of students' satisfaction.

6.2 Discussion of Results for RO1

RO1: To investigate the level of digital divide among students of Malaysian higher education institutions.

Through descriptive analysis conducted, the answer for the first research objective was attained. The first purpose of the study is to determine the extent of digital divide among Malaysian tertiary students. The concept of three level digital divide was implemented on top of the descriptive statistics to determine the severity of the issue of digital divide among Malaysian tertiary students.

The descriptive result implies that for first level of digital divide, the gap in motivational access is narrowing. While with low technology diffusion rate among different types of Internet, device and peripheral accesses, the divide in material access persist among tertiary students in Malaysia. With mean scores below the value of four for digital skills and digital usage, second level of digital divide exist among respondents. The result also indicated that in conjunction with first and second levels, the third level of digital divide in terms of online learning outcome persist. Respondents' general disagreement toward the statements of satisfaction and perceived learning in online learning during the Covid-19 pandemic signifies the absence of beneficial outcome. The following subsections hold a detailed explanation of results obtained for first research objective.

6.2.1 The First Level of Digital Divide

The section dissect into first level of digital divide, which is inclusive of two indicators of digital divide, which are motivational access and material access. Average mean score of motivational access is more than four, which is 4.141 on five-point measurement scale. This indicates that the gap of motivational access among tertiary students is narrowing. The average score also signifies that majority of students agrees with the items of motivational access in the questionnaire and display a positive attitudes towards technology. Covid-19 pandemic has accelerated the process of digitalisation, the urgency of people to carry on with their everyday life via the virtual or online environment has driven people to have a positive attitude or outlook on digital technologies. Vogel et al. (2020) from Pew Research Centre have reported that more than half of American adults think that Internet has been a necessity for them during the Covid-19 pandemic. Majority of those adults perceive that Internet does have positive impacts and nine out of ten of them stressed that Internet has been their lifeline during the Covid-19 outbreak. Park and Lee (2015) discussed the role of individual attitude and its impact on smartphone divide. People who fear or have negative ideology about technologies faced difficulty to adopt smartphone into their daily lives. An individual's environment, capability and intrinsic psychological factors are drivers of their motivation or attitude towards technology.

Frequency analysis of material access revealed that only mobile data plans, laptop/notebook and smartphone indicated a saturated technological diffusion of more than 90 percent, other types of Internet, devices and peripheral accesses have not reached a saturated technological diffusion. On this front, it is important to note that students can undergo online learning with the basic access to at least one type of Internet access with access to device of either laptop/notebook or smartphones. A detailed cross-tabulation analysis exposed that, three students do not have any type of Internet access but they do have accesses to laptop/notebook and smartphone. One student does not have access to both laptop/notebook and smartphone; however, that student had connection to Internet via fixed broadband.

The findings of material access, highlights the existence of digital divide in terms of material access among Malaysian tertiary students. The divide in access to Internet, devices and peripheral with an exception to mobile data plans, laptop/notebook and smartphone emphasizes a very dire predicament between students with underprivileged socioeconomic and demographic status. Students from a privileged background possess access to a diversity of material to travel through their online learning journey, but underprivileged students have either the bare minimum or none at all to undertake online learning. Access to diversity of Internet services, devices and peripherals is luxury that is unreachable for underserved students.

van Deursen and van Dijk (2018) stated that the level of material resources like income is unequivocally related to inequality in ownership of devices and peripheral. A closer look into the demographic information collected shows that more than half of the students respondents have a household income per month of less than RM4000, which the Malaysian Statistics Department categorized as below 40 (B40), this categorization highlights that majority of students are from lower income group. With more than 50 percent of students from the lower income group, it could be clearly seen the reason for only three types of material accesses achieving saturated diffusion rate. As explained by van Dijk (2006; 2012; 2017), structural inequality is the foundation of digital divide issues and van Dijk has explained it in his multiple digital divide studies and through resources and appropriation theory. His studies implies that a lack of addressment of structural and systemic inequalities like income inequality would eventually cause the persistence of digital divide in a society.

6.2.2 The Second Level of Digital Divide

Descriptive analysis for the second level of digital divide, which encompasses digital divide indicators of digital skills and digital usage, underlines the continuation of digital divide in the second level. For both digital skills and digital usage, the average mean score, which are inclusive of different types of skills and usages are 3.981 out of the five-point measurement scale and 3.854 out of the five-point measurement scale with an extra option of "I don't know what this means" respectively. The mean score values are below the value of four and this indicates that student sample do not relate to the items of the self-reported digital skills and rarely engages in diversity of digital usages. These entail that Malaysian tertiary students are not in possession of sufficient digital skills and their digital usages are restricted and not diverse enough.

Diving deep into the types of the digital skill, operational, social and mobile skills has mean score of more than four whilst information navigation and creative skills have a mean score of less than four. This implies that the former three digital skills generally reflect the types of skills possessed by the student respondents and the latter two skills are not reflection of the skills possessed by majority of student respondents. It could be clearly seen that, student respondents do have basic digital skills like operational skills or "button knowledge".

The digital skills conceptualized by van Deursen et al. (2014) is a comprehensive view of a general population's requirement to function in an online environment. Digital skills could be affected by a myriad of socio-demographic and economic factors, age, gender, race, education level, Internet usage time, previous experience of enrolling in online courses, location of Internet use and physical access to digital facilities (van Deursen & van Dijk, 2011, 2018; van Dijk, 2017). In the case of this study, a large number of student sample has a very limited material access and majority of them are from lower income group, thus, these maybe the contributing factors behind students' insufficient digital skills.

Next up is digital usage, which was studied in two ways in this study; one through frequency and diversity of digital activities and second is via daily Internet usage time. Primarily, findings imply that more than 50 percent of Malaysian tertiary students uses Internet for more than 5 hours per day. This usage duration, according to Internet Users Survey 2020 by MCMC were categorized in the group of regular and heavy users, as MCMC have operationalized Internet users who spent 5 to 12 hours per day on the Internet as regular users and more than 14 hours a day as heavy users. van Deursen and van Dijk (2013) concluded that individuals living in urban used Internet for a longer duration than those who are living in rural areas, this could be the driving factor for student respondents to be the regular or heavy category users, as vast majority of student respondents, which is 96.75 percent of them are from urban areas.

Following daily usage time, another way to study digital usage is the diversity of Internet or online activities indulged or engaged by an individual. For this study, items from van Deursen and van Dijk (2013) research was adopted and adapted, there are seven different types of Internet activities conceptualized by the researchers. Activities categorized in social interaction and information have a mean score of more than four, these values insinuate that students often times engages in these activities. For activities labelled under personal development, leisure, commercial transaction, news and gaming, the mean score is below value of four, this signifies that students rarely or never engages in these types of digital activities.

Lunn et al. (2020) suggested that social distancing measures and lockdown has stopped people from engaging in physical social activities, thus social interaction via digital means is the way people stay connected throughout the breakdown. Naeem (2020) explained the source of individuals gaining insight on what is happening in unprecedented times are yet again through the Internet. Even though misinformation and malinformation did seep through in the age of infodemic, it could not be denied the pivotal role digital mediums played to deliver necessary information to the general population. These explains the reason students' regular engagement in these digital activities.

Students' rare engagement in digital activities such as personal development, leisure, commercial transaction, news and gaming, could be caused by pre-existing socio-demographic factors, the economically crippling state of the pandemic and their limited material access. A student from low-income group or with limited access to necessary material access could not possibly engage in leisurely or self-improving activities as frequently as the privileged students from higher income group, with ownership of diverse array of material access (van Deursen & van Dijk, 2013; 2015; 2018; van Dijk, 2017).

6.2.3 The Third Level of Digital Divide

Helsper et al. (2015) argued that digital engagement would not always end up to be beneficial, the authors pointed out that there need to be a clear distinction between engaging in digital activities online and its eventual tangible outcomes that contribute to remunerative offline resources. That is what the third level of digital divide covers, the beneficial outcome of digital use. One could not be only stressing about access to motivation, infrastructure, skills and use, without discussing the need or objective of going through that hassle. Without reaping the benefits of digital outcome, the whole discourse of mending digital divide becomes pointless. The whole motive of closing the gap of digital divide is to achieve the final goal that is a beneficial outcome (Scheerder, et al., 2017). In the context of this study, the main issues raised are the gaps in motivational access, material access, digital skills and digital usage needs to be addressed for tertiary students to have beneficial and effective online learning outcome.

Helsper et al. (2015) in their study captured the whole ordeal of tangible outcome by using Dutch population's satisfaction of them engaging in a digital use, along with the achievement that they have gained from the engagement to evaluate outcome. The authors clarified both these concept are different, an individual could have achieved whatever they have set to do but they may not be satisfied with it. Another important thing to note is that, outcome in this study is solely focused on the online learning unlike in Helsper et al. (2015), at which they have covered the digital outcomes from the domains of political, economic, social, health, political and institutional front.

Following the footsteps of Helsper et al. (2015), students' satisfaction and students' perceived learning was used to evaluate the outcome of online learning. Alqurashi (2019) highlighted the distinction between students' satisfaction and students' perceived learning, the former assessed students' fulfilment of their learning experience and the latter was used to evaluate their attainment on the level of skills or knowledge before and after a learning experiences. According to Alqurashi (2019) both these indicator are studied to investigate and assess students learning outcome or effectiveness, in the paper the author used these indicators to evaluate learning in an online environment among students in higher education institution. Students' satisfaction and perceived learning corresponds with the concept of satisfaction and achievement used in Helsper et al. (2015), thus rendering to investigation of third level of digital divide in the scope of online learning outcomes.

The descriptive findings suggest that Malaysian tertiary students neither are satisfied nor perceive that they have attained a good learning, with mean scores of below four out of five-point measurement scale for both satisfaction and perceived learning. The mean scores indicates that students generally disagree with the items of students' satisfaction and perceived learning in the questionnaire. van Deursen and Helsper (2015) has explained that inequality in socioeconomic status and demographic factors could directly impact digital outcomes. Members of privileged group are able see more beneficial outcome than those from less privileged background. The authors stressed that, socioeconomic and sociodemographic inequalities are reflected in offline outcome achieved through digital use.

6.3 Discussion of Results for RO2

RO2: To assess the impact of digital divide on the effectiveness of online learning among students of Malaysian higher education institutions during the Covid-19 pandemic.

Through partial least square-structural model path analysis, proposed hypothesis of this present study was tested. The statistical output highlighted several interesting contradictory outcomes with the hypothesis proposed. The result cemented that, motivational access has a significant and positive relationship with material access, digital usage, students' satisfaction and perceived learning, nevertheless, it has an insignificant relation with tertiary students' digital skills. The output indicated that, with exception to students' satisfaction and perceived learning, material access is a significant predictor of digital skills and digital usage. Digital skills has significant positive relation with digital usage, an opposing significant negative relationship with students' satisfaction and an insignificant relationship with students' perceived learning. In tandem with the proposed hypotheses, digital usage is a significant predictor of students' perceived learning, but in contrary, it is an insignificant predictor of students' satisfaction. Succeeding subsections hold detailed discussions on the findings and the factors that may have influenced relationships between digital divide indicators and online learning outcomes leading to several distinct outcomes.

6.3.1 Motivational Access and Material Access

H1: Motivational access has a positive relationship with material access

In this study the statistical output, is in tandem with the proposed hypothesis, H1 as the relationship is positive and significant at $\beta = 0.155$ with 95 percent confidence level. The result solidifies the notion that students' motivational access positively influence their acquirement of material access. van Dijk in multiple studies have reiterated that motivational access of individual are one of the first elements to tackle, that could bridge the gap of digital divide and often times in digital divide studies motivational access is referred to as "want or want nots". A positive outlook, intention and attitude towards technology is rudimental to overcome the issue of material access, a negative attitude would lower an individuals' opportunity to have physical ICT access (van Deursen & van Dijk, 2015; 2018). A lack of motivational access towards digital technologies lessen an individual's chance to procure digital equipment and willingness to accept digital advancement.

Ghobadi and Ghobadi (2013) cleared up that deficiency of interest in ICT related exploration and insufficient motivation to assimilate recent technological development would irrefutably obstruct access to ICTs, which is material access. Vadenbroeck et al. (2008) explained that whilst practices like exposures to computers in home could reduce technophobia, increasing motivation but

Kvasny and Keil (2005) stated that issues of low Internet speed and high cost ICT acquisition would still hamper motivation and access to ICTs.

Yu et al. (2018) investigated digital inequality among Chinese rural-urban migrant workers, considering China's well adaption into digitalisation, workers who migrate from less developed rural areas to advanced cities are the most vulnerable to face digital divide. The authors stressed that even though the workers motivational access were high, their intentions to purchase material access were high; financial, educational, interpersonal and cognitive resources constraint impedes their material accessibility. In layperson's terms, a lack of household income, limited availability of informal educational resources like community awareness, narrow social capital with absence of tech-savvy friends or relations and high illiteracy with lack of critical thinking skills to understand ICT are the main reason for Chinese migrant workers with high motivational access to have difficulty in material access. Through this explanation, it is agreeable that student respondents do have certain extent of financial, educational, interpersonal and cognitive resources to facilitate their high motivational access and material accessibility, despite the existence of divide in material access, with 90 percent of technology diffusion rate only attained in mobile data plans, laptop/notebook and smartphone.

Motivation and eagerness for Internet access and utilization among Malaysian youth is beneficial to develop a knowledgeable and technology driven youth which would lead to growth and development of the nation (Shariman, et al., 2012). Evidences from van Deursen and van Dijk (2018) suggest that Internet attitude has an impact on unequal devices and peripherals ownership among the Dutch samples. They further explained that Internet attitude plays a major role than socioeconomic factors to encourage physical technological acquisition; it is also important to set off the process of technology appropriation. The authors warned that even in midst digitalisation, the importance of motivation or Internet attitude in first level of digital divide should not be devitalized, the psychological part still is relevant for material accessibility of technologies and to mend the gap of digital divide.

This present study established a significant positive relationship between tertiary students' motivational access and their material access, which is in harmony with previous literatures studied. Students' positive attitude and intention unequivocally render them to acquire material access. Even amidst digitalisation with rampant technological advancement, psychological factors like motivation and attitude towards technology plays a vital role in propelling material and physical accessibility of technologies.

6.3.2 Motivational Access and Digital Skills

H2: Motivational access has a positive relationship with digital skills.

The statistical results for this study indicated that there is no positive and significant relationship between motivational access and digital skills. This result implicates that tertiary students' attitude towards ICT in general does influence the digital skills that they possess. This opposing phenomenon could be explained by the notion that to encourage the acquirement of digital skills, motivation does play a part at a very individual or autonomous level, but educational and structural support or encouragement to induce the possession of digital skills is extremely crucial. Students' positive motivation towards technology would lead to nothing in the context of gaining digital skills; as to acquire the necessary skills to thrive in digitalisation or in the scope of this study, online learning; a very complex cognitive, societal and policy changes are required.

To overcome the gap in digital skills, an individual's motivation would not suffice or become inessential, as it requires educational, social and systemic changes and assistance. Eynon and Geneits (2015) explained that this could be achieved by the inclusion of digital literacy in curriculums, after-school activities and community-oriented programmes, this approach would encourage digitally excluded youths or students to break-through the digital skills "paradox" that assumes young people to develop the essence of digital skills via self-motivated or self-encouraged learning experiences. The notion that assumes young people to rely on themselves to gain digital skill, rejects the support young individuals' need to sharpen and develop their digital skills. Other than young people's motivation, lack of support offered by formal organizations like educational institutions or government interventions influence digital skill developments.

Al-Kumaim et al. (2021) stressed that there are three sources of motivation to overcome the plights of inadequate digital skills and online leaning during Covid-19 pandemic. First and second source is self motivation from student themselves and support from people around them, as were examined from the motivation and attitude scale used in the questionnaire of this study. The third source is an institutional factor, more particularly, university support programmes, education institutions have a crucial role to play in inducing motivation. Student support services could assist students who lacks technical knowledge, thus this type of technical support from their education institution would also be a source of positive motivation, other than having their own autonomous motivation.

Studies from Ghobadi and Ghobadi (2013), Dutton and Residorf (2019) and Lebeničnik and Istenič Starčič (2020) have a contradictory findings and explanation in relation to the result obtained in this present study, the three papers indicated a significant positive relationship between motivational access and digital skills. Ghobadi and Ghobadi. (2013) stressed that lack of motivation induce negative attitudes towards technology discourages technological acquisition and the development of digital skills. Motivation is the element that drives people to develop their ICT related skills. Dutton and Residorf (2019) explained that individual’s belonging in certain Internet cultural group shapes their motivation and attitude towards technology. A digital doubter may exhibit negative attitude, which have adverse effect on their skill developments. Lebeničnik and Istenič Starčič (2020) stated that their correlational output is in consistent with van Dijk (2017), at where individuals who are less motivated would have lower interest in gaining digital skills.

Following the discussion, the reason for insignificant relation between motivational access and digital skills in the present study is that autonomous or individual or group motivation are insufficient to attain digital skill. Ghobadi and Ghobadi (2013), Dutton and Residorf (2019) and Lebeničnik and Istenič Starčič (2020) discussions and items of motivational access is not inclusive of institutional, policy or governmental supports or encouragements. Institutional and policy supports and encouragements also plays a pivotal role in encouraging motivational access for students to acquire, learn and develop digital skills, as stressed by Eynon and Geneits (2015) and Al-Kumaim et al. (2021), the consideration of those factors into motivational access is rudimental to drive the development of digital skills.

6.3.3 Motivational Access and Digital Usage

H3: Motivational access has a positive relationship with digital usage

With the statistical result of $\beta = 0.268$ with 99 percent confidence interval, the relationship between motivational access and digital usage is supported, there is significant positive relation between them. This outcome is in accord with the theoretical explanations from digital divide studies and the third proposed hypothesis. Reisdorf and Groselj (2015) emphasized that attitudes towards technology play a very pivotal role in reasons provided for Internet non-use, as non-users of Internet generally displays negative attitude towards technology. Socio-economics drivers such as age, gender, race, income and education are factors that influences attitude towards technology and barriers to access. They have explained that those with negative attitude towards technology would more likely be less motivated to use the Internet. Policies should address motivations and attitudes towards technology that prevent individuals from spending time online and have diverse digital engagement, instead having a narrow focus on solely tackling it from socioeconomics factors, infrastructure and skill gaps perspectives.

According to van Deursen and Dijk (2013), individuals having motivation is one of the elements that propels digital usage. By the implementation of uses and gratification theory the relation between motivation and ICT usage was captured; this theory exemplify that motivation drives utilization which inherently provide a sense of fulfilment from the usage. This approach highlights the reason for people's adoption and usage of ICT, from a psychological context. The statistical result and explanation clearly indicates that motivational access plays an important role in inducing Malaysia tertiary students' digital usage.

Heslper and Reisdorf (2016) conducted a longitudinal study spanning years 2005 to 2013 to examine the reasons for Internet non-use among British and Swedish samples and how the identified reasons change for non-use over the course of time for Great Britain. Throughout years 2005-2013, British and Swedish sample implied lack of interest as one of the essential reasons for their Internet disengagement. In 2013 only, lack of interest is the main reason for Internet non-use and ex-users for both sample. The study identified a significant increment of lack of interest as the reason for Internet non-use, during this period also social isolation was recognized among Internet non-users. Elders and individuals with lower educational background indicated a lack of interest that lead to being offline. The authors urged lack of interest would be a more prominent cause of Internet non-use interventions need to address motivational issue as one of the integral part to tackle digital disengagement in societies.

Dutton and Reisdorf (2019) explained that "digital doubters" are liable to remain offline. Study on 1224 Dutch respondents revealed that motivational or attitudinal issues are still in existence but they are reducing, thus it attract individuals to engage online. Improvement in the aspect of attitude has induced the likelihood of people engaging in wider range of Internet use (van Deursen & van Dijk, 2015).

Ojo et al. (2018) studied impact of intrinsic and extrinsic motivation on Internet usage among Malaysians and found that only extrinsic motivation significantly enables Internet usages and intrinsic motivation does not. Intrinsic motivation entails perceived enjoyment and extrinsic motivation denotes perceived usefulness. The authors reasoned that study's deficiency in inclusion of diverse Internet usage is cause of insignificance of intrinsic motivation. They suggested that that factors like education and economic backgrounds could influence a person's motivation, which subsequently impacts a person's engagement in Internet activities, thus this factors could contribute whether an individual engage in activities to fulfil utility purposes or for their enjoyment.

Present study demonstrated a positive and significant relation between motivational access and digital usage, is in tandem with previous literatures studied (Dutton & Reisdorf 2019; Helsper & Reisdorf 2016; Reisdorf & Groselj 2015 van Deursen & Dijk, 2013; 2015). Since motivational access in this study is inclusive of both intrinsic and extrinsic motivation it could be deduced that the outcome is half in accordance with study by Ojo et al. (2018), on the matter of motivational access and digital usage.

6.3.4 Motivational Access and Online Learning

H4: Motivational access has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H5: Motivational access has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

Students' motivational access encourages effective online learning, both in terms of their satisfaction and perceived learning during the Covid-19 pandemic, this is the fourth and fifth proposed hypotheses in this study. Both the hypotheses were supported by the statistical result, at which both relationships are positive and significant at $\beta = 0.139$ with 99 percent confidence and $\beta = 0.149$ with 95 confidence interval respectively. Studies have indicated that students' attitude towards ICTs would influence their online learning. A positive motivation towards technology boost students' confidence on technology and subsequently encourage a beneficial online learning outcome. Students' satisfaction and learning performance in a digital environment are dependent of their technological attitudes and motives. (Chen & Chen 2007; Teo, 2008; Ghobadi & Ghobadi, 2013).

van Deursen and van Dijk (2015) has also stressed to have a beneficial offline outcome from online activities, motivation is an important factor that drives it. van Dijk (2017) reiterated the importance of motivational access to gain beneficial outcomes from digital use, the author stated that even digitally excluded elderlies, overcame their scepticism and alter their attitude towards computer age to be able to have beneficial communication with their family and friends. Similarly, van Deursen et al. (2017) emphasized that a strong motivation towards technological involvement would surpass the disadvantageous divide in material access or skill for individuals to achieve beneficial offline outcomes. Alqurashi (2019) stated that motivation highly influences student dropout rates, as students' demotivation affect their online learning satisfaction. Student who have positive outlook and attitude would have boosted confidence to perform in online learning environments.

Attitude or an individual's reaction towards technology is the primary factor that affects a student's way of learning and adaptation of technology in education. Unfavourable attitudes towards technology would render negative learning outcome for students. Attitude towards technology is a significant predictor of satisfaction and perceived learning outcome of university students (Novita & Widuri, 2019).

Chun et al. (2021) reported that some TVET (Technical and Vocational Education and Training) Chinese and Canadian students who are enrolled in courses that accentuate on practical activities, was greatly affected by the Covid-19 pandemic as online learning, a passive method of engagement in learning greatly affect students' motivation. It took time for them and their educators to adapt online learning, Finnish TVET students has also reported that they online learning became burdensome for them and this greatly demotivate them, thus eventually affect their learning. Demotivation among students contribute to increased risk of dropout from learner from TVET programmes, and that contribute to an ineffective online learning.

Previous studies by Chen and Chen (2007) Teo (2008), Ghobadi and Ghobadi (2013), van Deursen and van Dijk (2015), van Deursen et al. (2017), van Dijk (2017) has affirmed that motivational access is indeed an important predictor of beneficial outcome of digital use, specifically for online learning outcomes in the case of this present study. Novita and Widuri (2019) and Chun et al. (2021) explained that motivational access drives students to achieve an effective learning outcome in a technologically enhanced environment. These literature studies demonstrates a similar notion as the statistical output acquired in this study, at which motivational access has a positive and significant relationship with tertiary students' satisfaction and perceived learning.

6.3.5 Material Access and Digital Skills

H6: Material access has a positive relationship with digital skills.

Without having physical or material digital equipment or instrument, acquirement of digital skills would be impossible, as having material access is a medium that enable the procurement and development of digital skills. The statistical finding obtained reiterated that material access does have a significant positive relationship with digital skills, with $\beta = 0.223$ at 99 percent significance level. Digital divide studies have explained that having appropriate and sufficient material accesses is important to acquire and develop digital skills. (van Deursen & van Dijk, 2015; 2018). Mossberger et al. (2012) has also stressed the importance of having a variety material access towards technology is also crucial for learning and developing digital skills.

van Dijk (2017) explained the possession of physical access to technologies, would grant an individual opportunity to learn digital skill, thus having material access of technologies helps one to obtain digital skills. The result of this study highlights that material access play a major role for students' attainment of digital skills. van Deursen and van Dijk (2015) reiterated through path analysis that material access is irrevocably relevant in propagating Internet skills. Individuals with the privilege of diversity of material access and Internet connection have greater opportunities to developed and possess wide range of digital skills. van Deursen and van Dijk (2018) stressed through study conducted among Dutch samples that physical and material access of ICTs are related to Internet skills.

Hargittai et al. (2019) discovered that American low-income older adults are less likely to own devices like smartphone; they have lower autonomy of use thus having lower level of Internet skills. Cabello et al. (2021) physical access to cell phone and multiple devices from ubiquitous modalities that means flexible access point or location is a significant predictor for digital skills of Chilean children and adolescents.

Beaunoyer et al. (2020) suggested that one of the reason individuals have restrained set of digital literacy to face the virtual alternatives during Covid-19 pandemic is their inaccessibility to Internet and other material technologies. A significant and positive relationship between material access and digital skills was ratified through this present study which in consistent with Mossberger et al. (2012), van Deursen and van Dijk (2015; 2018), Hargittai et al. (2019) and Cabello et al. (2020). This establishment of outcome suggest that tertiary students' access to diversity of material access facilitates their acquirement and possession of necessary digital skills.

6.3.6 Material Access and Digital Usage

H7: Material access has a positive relationship with digital usage.

Students having material access positive influences their digital usage. Mossberger et al. (2012) has again stressed that variety of digital devices and equipment are pivotal for digital utilization. van Deursen and van Dijk (2015; 2018) has stated in their papers that material access propels people to participate in diversity of Internet uses or online activities. van Deursen and van Dijk (2013) explained that, digital usage is the last stage and whole purpose of technology appropriation, having material access is one of the component that facilitate the whole process of appropriation that ends in last stage which is digital uses.

An investigation among university educators of multiple disciplines in Pakistan concluded that physical access at universities is a significant predictor of faculty's instruction usage of ICTs. Physical access at university was reported as the strongest predictor of educators' instructional usage among other digital divide indicators. Access to Internet and computers in the campus office or labs propels educators to utilize digital technologies to conducts their teaching and to fulfil professional responsibilities (Soomro et al., 2020). Cabello et al. (2020) also found that the access of Internet via cell phone and multiple other devices is a significant predictor of digital use.

Tsetsi and Rains (2017) explained that American adults from disadvantaged and marginalization groups do benefit from access to smartphones for social, economic and political use but the access to single device that is limited in capacity did not fulfil their other usage needs, thus limiting their online activities. American from white, higher educated and higher income are more likely to be multimodal user, thus this privileged group of people benefit from using multiple devices to access Internet, which unequivocally provide them with diversity of usage opportunities. Beaunoyer et al. (2020) emphasized to ensure that population have optimal access to digital equipment and network connections, which is the fundamental way to tackle digital inequalities during the Covid-19 pandemic. Digital deserts, lack of devices and socioeconomics needs to be surpassed to tackle individuals' gap in technology use.

Malaysia tertiary students' material access positively affect their digital usage at $\beta = 0.149$ with 99 percent confidence interval and this signifies the notion that having devices and technological equipment facilitates students' digital usage activities. Studies by Beaunoyer et al. (2020), Cabello et al. (2020), Soomro et al. (2020), Tsetsi and Rains (2017) van Deursen and van Dijk (2013; 2015; 2018) have also stressed the importance of having diverse material access to gain a upper hand on variety of digital usage activities.

6.3.7 Material Access and Online Learning

H8: Material access has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H9: Material access has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

Material access is one of the important element in van Dijk's construction of digital divide theory, the availability of resources at an individual level leads to the very starting point of process of technological appropriation; the ability to gain physical or material accessibility of ICTs. This is a mean for one to further their journey into digitalisation, without the material means, would be impossible for an individual to initiate into their digital journey. Numerous studies have reported the beneficial impact of technologies on education, but a simple introduction of new digital equipment into pedagogy by educators and policymakers without proper integration framework would not bring forward the positive changes that abundant of papers justified. It is true incorporation of technologies bring in a wealth positive impactful educational reforms but it should be accompanied by a successful technology integration (Jhurree, 2005). The statistical output ascertained that by displaying insignificant relation between material access with both students' satisfaction and students' perceived learning in online learning during the Covid-19 pandemic.

The result achieved through data analysis is opposite of what has been proposed in eight and ninth hypothesis. This oddity can be explained through the issue of technology integration; that is often time overlooked in the hassle of digitalisation. Technology integration itself is very complex and multidimensional, a holistic approach to address and integrate technology in education is important, as proper plan and design by educators and policy makers could ease and facilitate an effective teaching and learning (Atman, 2019). The role of successful technology integration for online learning relies heavily on the hands of educators and policy makers. According to Mourlam et al. (2020) even though educational technologies are quite common in schools and learning institutions, but its integration into teaching and learning were limited because educators mainly utilized these technologies for administrative works.

In order to have a successful technology integration in pedagogy, educators needs the support of their educational organizations and beyond. For an effective technology integration in classrooms, both teachers' and school's readiness needs to be tackled. Educators readiness is evaluated based on their belief that technologies in education is rewarding for both teaching and learning, on top of that educators needs to have confidence that they possess adequate skills to utilize these technologies for teaching. An education institution's readiness, or in the context of their study school readiness is the perceived priority of technology for education, the vision to achieve effective outcomes, a supportive leaders in administration and adequate infrastructure in the respective schools. They insinuated that school readiness influences teacher readiness and the implementation of educational technology in classrooms (Petko et al., 2018).

Investment in technology integration includes device adoption, development of professionals, allocations of cloud computing software and community partnerships. An incomplete technology integration prior to the Covid-19 pandemic among K-12 posed a threat to equitable distance learning. Even with divide in device accessibility among students were solved with blended distance learning, an unequal embracement of technology among teachers before the pandemic hampered the preparedness of distance learning and teaching (Peterson et al., 2020).

In contradiction with the statistical result obtained, Hussein et al. (2020) pressed that Internet connectivity, access to technological tools are crucial to facilitate students' online learning processes. Apuke and Iyendo (2018) stated that a lack of Internet facilities and digital infrastructures inhibited students from universities in north-eastern Nigeria to undertake their academic responsibilities. Zhai et al. (2019) found that the adoption of mobile technologies to assist conventional classes improves learning achievements of high school students. Similarly, the use of digital equipment in education like mobile device boost learning outcomes of students (Babu et al., 2014; Compton et al., 2018; Dani et al., 2019). van Deursen and van Dijk (2018) stated that people with access to diverse array of material accesses have an advantage to acquire better digital opportunities than those with limited or no access.

The Covid-19 pandemic and its devastating predicament has obviously highlighted the importance of material access, especially for online leaning. However, without proper technology integration in teaching and learning, the physical possession of technological instrument does not bring much meaning in online learning, this was affirmed by Jhurree (2005), Atman (2019), Mourlam et al. (2020), Petko et al. (2018) and Peterson et al. (2020). Thus, to conduct achieve an effective online learning outcome, other than access to technologies, a proper and effectual technology integration in higher education teaching and learning is equally important.

6.3.8 Digital Skills and Digital Usage

H10: Digital skills has a positive relationship with digital usage.

Digital divide studies have classified digital skills and digital usage as the second-level digital divide, and van Dijk has explained that digital skills and usage access is the two final step to complete the process of appropriation. Without digital skills, utilization of ICTs would be restricted and meaningless. An individual need to have sufficient digital skills to drive their digital usages, possession of various digital skills is one of the factor that encourages more Internet usages (Bonfadelli, 2002; Mossberger et al., 2012; van Deursen & van Dijk, 2013; 2015). This fact was supported by the statistical output with $\beta = 0.233$ with 99 percent confidence interval.

Heslper and Eynon (2013) through path analysis on data from Oxford Internet Survey (OxIS) 2011 discovered that more than one specific types skill is crucial to engagement in an online activity. For example, social skills was found to be pertinent for social engagement but creative skills also play a significant role in social engagement. The authors concluded by emphasizing different forms of online engagement requires different array of digital skill, at where the path analysis model was more fit when one skill was mapped a variety of digital engagements.

Correa (2016) found that digital natives who are skilful and mostly educated uses social media platform, Facebook in their daily lives in an eloquent and strategic manner. People with high socioeconomic status tend be more in possession of digital skills to use Facebook for educative and simulative purposes. van Deursen and van Dijk (2015) ascertained that relevant skills are essential for a general population to function in digitalizing world, usage would be badly affected by the divide in digital skill as it requires the privilege of cognitive ability and knowledge. Helsper and Reisdorf (2017) reported that in 2013, after lack of interest, lack of skills is the second most important predictor of Internet disengagement or non-use in Britain and Sweden.

van Deursen et al. (2017) found that Internet skills are related to different usages. The study conducted among Netherland's adult samples found that women, elderlies, individuals with lower educational background and those unemployed lack Internet skills, which subsequently limits their engagement in diverse online activities. Ojo et al. (2018) through their study Malaysian samples found that digital skills is the most significant predictor of Internet usage, which was followed by opportunity and extrinsic motivation. The authors reiterated that cognitive differences like digital skills encourages Internet usage, it is not just an issue of individual usage accessibility.

Establishment of significant and positive influence of digital skills on digital usage insinuates that tertiary students' possession of sufficient digital skills encourages their engagement in diverse online activities. Previous literatures by van Deursen and van Dijk (2015), Correa (2016), Helsper and Residorf (2017), van Deursen et al. (2017), Ojo et al. (2018) support the result obtained.

6.3.9 Digital Skills and Online Learning

H11: Digital skills has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H12: Digital skills has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

The statistical outcome from what have been proposed in eleventh and the twelfth hypotheses, which are reversed and contradictory; highlights the existence of difficult predicament between students' digital skill and its impact on their online learning outcome during the Covid-19 pandemic in terms of satisfaction and perceived learning. The result signifies an odd negative relationship between digital skills and students' satisfaction and insignificant relationship between digital skills and students' perceived learning during the Covid-19 pandemic. What this means is that students' digital skills negatively affects their satisfaction and does not have implication on their perceived learning during the Covid-19 pandemic. Therefore, a tertiary student with high self-reported digital skills did not attain the element of satisfaction and vice versa; on the other hand, their grasp digital skills does not influence their perception of their knowledge or skill attainment.

Study by Bergdahl et al. (2020) have indicated that the negative relationship between digital skills and students' satisfaction could be caused by students' disengagement in online learning. They have stressed the importance of digital skills for people to unlock multiple facets of the digitalizing society, but studies exploring the scope to which digital skill is assisting learning abilities is dissonant. There are claims that digital skills have no relationship with academic performance.

Bergdahl et al. (2020) pointed a very important issue, which is students regardless of their level of possession of digital skills, could disengage from their learning. In their study, they have found that students with high level of digital skills do engage in technologically enhanced learning environment, they are satisfied with technology-enhanced learning but on the other students with low level of digital skills does not showcase any disengagement in technology-enhanced learning either. This study brought forward a very complex reasoning at which students can be disengaged from technology-enhanced learning with or without sufficient digital skills, thus this influence their satisfactory level on technology-enhanced learning.

Chiu (2021) through interview with teachers and students found that online learning environment focuses primarily on academic needs and often neglect students' emotional engagement. Students feels excluded and lacks sense of belonging in online learning environment. Online interactions in comparison with face-to-face classes lacks emotional attachments, has a less expressive and warm environment which obstructs students engagement despite their level of technological competence or technical skills. Differences in pedagogies in both physical classrooms and online learning may have caused students' disengagement through teachers' lack of online teaching proficiencies. Instructors' insufficient proficiency in online learning and teaching could also render students to be emotionally disengaged from online learning and subsequently their competence in online learning.

In opposition to the statistical result attained, studies highlighted that the importance of digital skills to facilitate and improve students' learning process and outcomes. Digital competencies of students drives them to thrive in online learning (Adhikari et al., 2017; Alqurashi, 2019; Fidalgo et al., 2020). Albeit, these studies did not tackle on the possibility of students with sufficient digital skills to disengage from online learning because of probable emotional exclusion, instructors' lack of online teaching proficiency or their lack of grasp in digital competencies. Thus, digital skills without engagement in online learning from students would not have a positive and significant relationship with online learning outcomes; factor of disengagement from online learning should be given focus to utilize the full potential of digital competencies to attain positive online learning outcomes.

6.3.10 Digital Usage and Online Learning

H13: Digital usage has a positive relationship with students' satisfaction in online learning during the Covid-19 pandemic.

H14: Digital usage has a positive relationship with students' perceived learning in online learning during the Covid-19 pandemic.

The statistical output reveals that contradictory result between both sets of relations for digital usage and online learning outcome, where there is an insignificant relationship between digital usage and students' satisfaction, whereas a significant positive relationship between digital usage and students' perceived learning at $\beta=0.099$ with 95 percent confidence interval. As explained by Alqurashi (2019) students satisfaction is their reflection of the particular learning experience and perceived learning is their opinion on the learning that have occurred. The distinction is that the former evaluate their fulfilment and the latter looks into their contrast of knowledge and skill level before and after a learning experience.

The result implies that students' diversity of digital usage have positive impact on their perception of the skills or knowledge that they learned but has no significant impact on their satisfaction in online learning during the Covid-19 pandemic. The reason for this complex paradox is that diversity of digital usage causes disruption in the form of digital distraction, which eventually renders digital usage to have an insignificant impact on student satisfaction. At the same time digital usages, provide them a wider scope of material or resources for learning which then positively influence their opinion or judgement of the learning experiences based on their views on skills and knowledge gained.

Flannigan and Babchuck (2020) explained that digital distraction divert students learning by severing the relationship between students and educators, as instructors usually have ways to reciprocate and deter students' distraction, this in the end have an impact on the instructor, then affecting students' behaviour and emotion, thus severing their bonds and cause a tense learning environment. This hostile environment also affects an instructors' teaching capability. Thus, in this case it could be seen that digital usage does not influence student satisfactions but rather causes a distraction, which then divert students from experiencing learning and greatly affect instructors' satisfaction; the authors described digital distraction as an obstacle to effective teaching and learning. Taneja et al. (2015) and Deed (2011) prompts that digital distraction also encourages apathetic behaviour, an emotionless state at which students does not put in effort or expects challenge or constructive critiques in their academic undertakings. This situation creates a problem where digital usage is redundant when it comes students' satisfaction

Hanif et al. (2018) suggested that digital usages enables digital learners to look of technological resources when they perceive they could benefit from these resources. Henderson et al. (2015) stated that students' perceptions of what make a good university environment includes their ability to complete their academic work via usage of digital technologies. From this perspective, it could be seen that diverse usage of digital technologies is looked as students' support systems, which enhances and improves their learning experience and academic wellbeing by providing them with additional knowledge and skills.

Studies have accentuated that students engagement in ICT drives their academic performances, supports their educational ventures and positively affect online learning (Tien & Fu, 2008; Sun & Metros, 2010; Britt et al., 2015). In parallel, digital divide study by van Deursen and van Dijk (2013) also supports that notion which explained that engaging in diverse online activities would generate beneficial offline outcomes. Individuals' engagement in online activities translates into achievement of specific beneficial outcomes (Kuhn & Mansour, 2014; van Deursen & Helsper, 2015).

The explanations brought forward a complex contradiction where, digital usages does positively affect students' enrichment in learning, whist it also renders an insignificant relationship with their satisfaction. This paradox highlights that digital usage may cause digital distraction that affects its relationship with tertiary students online learning satisfaction (Deed, 2011; Taneja et al., 2015; Flannigan & Babchuck, 2020). Nevertheless, digital usage is an important source for students to enrich their perceived learning, for them to acquire knowledge and skills (Henderson et al., 2015; Hanif et al., 2018).

CHAPTER 7

CONCLUSION

7.1 Theoretical Implications of the Study

Digital divide studies have unequivocally evolved from looking at digital gaps in binary lens of “have and have-nots” of physical and material access into looking it from a multifaceted and multidimensional lens, it is not just an issue of divide in physical and material access; the problem is much larger and complex than that. Contributions from digital divide researchers such as van Dijk, van Deursen, Helsper, Eynon, Hargittai and others have greatly assisted in investigation of the issue of digital divide in three successive levels. However, abundant of these researches had been covered in the context of rich, advanced and developed nations. It is important, specifically in the age of digitalisation, for this issue to be addressed in the scope of developing nations. It could not be denied that digital inequality still persist in the developed part of the world, still the deficiency of studies tackling the issue of digital inequality in the developing part of the would have disastrous and detrimental impacts on the underserved nations. It would extensively hinder the development of the less developed nation and further push them onto the negative end of the whole spectrum of global inequalities. To overcome the issue of scarcity in implementation of three levels of digital divide framework in the setting of developing nations, this present study has addressed and investigated the topic of digital divide in Malaysia, a developing nation and its impact on online learning, explicitly among the Malaysian tertiary students.

Present study established a comprehensive conceptual model to study the interrelation between first, second and third levels of digital divide. It specifically focused the sequential flow of digital divide from first to the third level in the context of online learning. It entailed the whole process of how different elements of digital divide compounds to have an impact on online learning. An important getaway from this investigation is that, this particular structure of concept could also be used to investigate other domains or aspects of outcomes.

This study has also accomplished a multidisciplinary discourse by coalescing prominent educational and pedagogical outcome variables into the evaluation of third level of digital divide. The adaption and integration of outcome variables, students' satisfaction and perceived learning from different disciple connotes that different variables could be investigated in different context to capture beneficial outcomes or return of digital use. This cements the importance of cooperation among different disciples to tackle and thwart the issue of digital divide.

Finally, certain contradictory and opposing results obtained had suggested that educational and pedagogical factors play equally vital roles along with digital divide variables to facilitate effective online learning among students. As discussed in part 6.3 the relations among these variables are not as straightforward as it pose to be. These findings instilled the ground for the discussed factors to be taken into account to particularly assess the interrelations among digital divide variables and its subsequent impact on online learning outcomes.

7.2 Practical Implications of the Study

The blooming fourth industrial revolution and the digital revolution since pre-pandemic days has prompted individuals, corporations, policy-makers, government and multiple other stakeholders to come out with innovative and transformative policy ideas to facilitate, strategize and nurture the process of digitalisation. Nevertheless, the emergence of the Covid-19 pandemic has in a way accelerated digitalisation; people, corporations and governments were scrambling for the support of technology to sustain and carry on with everyday lives amidst the recent pandemic. Covid-19 pandemic has frequently been described as unprecedented, and it is true, considering the escalation and unparalleled nature of the pandemic in the modern day, the description is apt. Sweeping the world by surprise, the pandemic has unravelled the real state of the world, which was plagued by inequalities, crumbling healthcare system, inefficient public policies, profound structural problems, social issues and economic calamity.

Amidst the aggravation of the all the issues mentioned, there are parties that argued that the devastating pandemic has its brighter side, as the saying by Albert Einstein goes “in the midst of crisis, lies great opportunity”. While the proponents of looking at the brighter side of pandemic pointed out digitalisation as the glimmer of light at the end of dark tunnel. However, with digital divide, that light would literally mean nothing for the underprivileged or marginalised people. Digital divide is a grave threat that hinder digitalisation and individuals who are socially marginalized, would also be digitally excluded and would yet again be suffering the repercussion of inequalities.

It is important that institutional bodies, policy-makers, education organizations and educators are well-acquainted with the devastating impacts of digital divide and the factors that affects online learning effectiveness. Digitalisation would continue blossoming throughout the pandemic and post-pandemic, it is crucial that risk with digital divide and issues with online learning to be nipped in the bud, to ensure that none is left out to face the storm of inequalities in general.

Through present study, it could be observed that digital divide among Malaysian tertiary students does exist and students' online learning is not as effective and impactful. A few contradictory relations among digital divide indicators and online learning outcome during Covid-19 pandemic were also found in this study. The findings hold a very dispiriting predicament, as education is one of the crucial pillars for growth and prosperity and this pandemic cause the state of education to be hanged by an extremely delicate thread. Addressing the existence of digital divide among tertiary students and its impact is the first step to overcome the issue. Nevertheless, the subsequent step would be the co-operation of multiple stakeholders to heal the wound of digital divide and to facilitate an effectual online learning.

7.2.1 Tertiary Students, Family and Society

The findings of the study highlighted a dire extent of digital divide among tertiary students at all three level with only the gap in motivational access of first level of digital divide showed an indication of narrowing. With that in mind, bridging the gap in remaining other elements and levels of digital divide is equally crucial to thwart the issue of digital divide, Malaysian tertiary students, their family and members of society around them play a vital role in overcoming the dire state of digital divide among them.

van Dijk (2006; 2012; 2017) through resource and appropriation highlighted that digital divide did originate from the existing structure of inequalities in a society. The persistence of income, gender, racial, and other sociodemographic or socioeconomic categories of inequalities are the determining factor for whether an individual in the society would eventually have the resources, then motivation to access digital tools and subsequently embarking on acquirement of skills and engage in digital usages to participate in digital society. In is undeniable that, personal and positional inequalities translates into digital divide, privileged students would have an upper hand on digital inclusion than underprivileged students.

Considering that, inequitable access to resources by students is a barrier for them to acquire material access, digital skills, digital usage and their online learning outcomes even with narrowing motivational access. This fact were cemented through this study with majority of student being females, racial minorities and from lower income groups, which van Dijk classified as digitally excluded demography. It is evident that those factors does induce the gap of digital divide among Malaysian tertiary students. With structural inequality it is true that the issue of digital divide is outside of the students' control. However, with the limited digital inclusionary access that students possess they could take a minor first step to bridge the gap of digital divide through having the will and tenacity to learn ever-evolving digital skill and having active, critical and strategic involvement in online activities (Mancho-Chavez et al., 2020). Students could also tackle and address the psychological and physical source of digital disengagement and distraction to facilitate an effective online learning rendezvous.

Next, familial support is equally important to narrow the gap of digital divide and to smoothen the process of online learning. It is yet again unquestionable that, demographic factors like household income and parents' educational level does influence the gap of digital divide among Malaysian tertiary students. Nonetheless, parents and other members of the family could ensure students' sustenance in online learning by providing emotional support to induce their motivation for them to achieve academic goals (OECD, 2020). This emotional abutment would prevent students from discouraged by the adversity of digital divide, the secluding and autonomous nature of online learning and from the lack of peer support in a virtual environment. To adapt to digital age, parents could also provide their children from a younger age with the opportunities to develop their skill and competencies. Nonetheless, realistically these efforts would be more practical for those from a privileged background since parents who are of lower income or educational backgrounds does not have sufficient resources to undertake these ventures. Thus, in this case governmental supports play a huge role in uplifting these groups of underprivileged parents.

Similarly, communities surrounding the students also play important roles to extenuate the hardship of digital divide and alleviate the process of online learning. Peers and community surrounding students should chip in emotionally or financially to these underserved individuals to overcome the detriments caused by digital divide and to ease up the strain of online learning. Community members could organize a fundraiser to gather used or new material access, workshops or training to teach digital skills and promote online engagements among young individuals. Supports from peers are one of the fundamental way students thrive in educational environment, the peer effect promotes a sense of emotional engagement for students' to thrive academically. Online peer learning is gaining momentum with current autonomous climate of online learning, these initiatives provide positive peer influences that encourages more digital participation and subsequent beneficial outcomes and it does ease students' online learning processes, engagement and outcomes (Wei et al., 2021).

7.2.2 Educators and Higher Education Institutions

In light of the unprecedented nature of the Covid-19 pandemic, it is laudable on the overnight changes tertiary educators and their respective higher education institutions adapted, to accommodate the transition from face-to-face classes to online teaching and learning. Nevertheless, it is evident from the findings on the digital divide indicators and online learning outcomes that the academic shifts are challenging and the method is not as fruitful.

The existence of digital divide at all three levels with exception for motivational access is a clear indication that there are barriers that both educators and management of higher education institution need to account for future endurance of virtual learning. The statistical outcomes signified that motivational access should also include element of support from tertiary institutions to drive students' digital skills. Then, result showed that mere access to digital tools are inadequate to induce effective online learning, a clear technological integration framework or planning is crucial to strategize the use of technologies in classrooms. Thus, both educators and management of higher education institution have vital roles to formulate, design and execute strategic inclusion of technologies in online pedagogy (Bhattacharjee, 2021)

Emotional and psychological support from educators is also crucial to manoeuvre through online learning for students, they have to empathize and provide encouragements to students to undertake the journey through online learning with its multiple challenges and adversities, particularly, during the situations like the Covid-19 pandemic (OECD, 2020).

Investments by higher education institutions to digitalise education should include training and up-skill programmes for educators. With the ever-evolving digital age, the future of education is at the hands of these educators, thus, investment to up-skill academic workforce to current digitalizing climate is extremely crucial. Educators' development to accommodate digitalizing environment would ease education in online environment. Higher education institutions, should design strong policy to uphold the professional development standards of educators. Increased incentives, recognition, resources and training opportunities should be provided in regular and up to date basis in addition to their salaries, to upheld educators' motivations and to honour their perseverance to digitalise and educate future generations (Li, 2020; Peterson et al., 2020).

There are also instances where management of higher educational institutions provided students with financial assistance and loaned devices. This is a great effort to bridge digital gap, these initiatives expanding beyond from the campus location would be beneficial for much larger number of students from respective institutions.

Higher education institutions' decisions, plans and agendas is also an important source of support that students seek to advance their acquirement of digital skills. Institution support motives, vision, attitude and stance towards ICTs is also a motivational determining factor for students to develop their digital competencies. Higher education institutions should continually be supportive to students by providing workshops, training and incorporate curriculums, which accommodate and adapt to digitalizing state of the world.

7.2.3 Government, Political Institutions and Policy Makers

The role of government, institutional bodies and policy makers in this unparalleled time of Covid-19 pandemic is tremendously essential. Their guidance and support is exponentially vital for general population to manoeuvre through the pandemic, the lockdowns around it, the collapse of public health, the economic meltdown and multiple other festering wounds of global inequalities, including digital divide. In the case of Malaysia, the added stress of political turmoil in the midst of Covid-19 pandemic has rendered disadvantageous to its people who were seeking assistance through the burning maze of pandemic. Critics highlighted that tactless and inadequate assistance provided was ineffective to overcome the destruction of the pandemic, which is inclusive of the issue of digital divide. Thus, a much more extensive and effective policy assistance should be brought forward to resolve the harrowing gap of digital divide and to ease the function and effectiveness of online learning and education in general.

The Malaysian Ministry of Higher Education in collaboration with respective educational organizations and technological mega players did came out with several initiatives. Free data plans assistance, free laptops for students in B40 category and special discounts for devices from companies such as Acer and Samsung were introduced to facilitate a conducive online learning tertiary environment for students (Astro Awani, 2021; Bernama; 2021; The Star; 2020). These initiatives does assist students to overcome divide in material access, especially since the finding did indicate that mobile data plan, laptop/notebook and smartphone did achieve a saturated technology diffusion rate in the study. Nevertheless, it also crucial to jot down that, divide in other types of material accesses persist, that brings a very important praxis where, should the assistances provided by ministerial bodies to students also include other types of digital tools? The bare minimum of laptop and data plans is solutions that would not heal the gap of digital divide in material accesses among tertiary students in the long run. Thus, to improve the welfare of underprivileged students the technology care package should include access to other fundamental devices and peripherals for students to function in the age of digitalisation. Community Internet centres does resolve the issues pertaining to material accesses but situations as Covid-19 pandemic has rendered it to be impractical, therefore, policy makers should allocate a sum of investment into the welfare of students by indulge into the demand of digitalisation, by allocating a set of diverse material technology equipment to its students.

Government and institutional bodies should also create and increase public awareness; they should eradicate misconception in regards to digitalisation (Joshinav, 2019). There should be an increase in organisation of campaigns and talks that encourage students or people in general to actively participate in digitalisation. This would be an important step in overcoming peoples' cynicism, scepticism and hesitancy towards digital adoption.

In addition, spotlights must be given from institutional bodies on developing and nurturing digital skills, initiatives to diversify students' digital usage among tertiary students and on improving online learning through pedagogical and policy reforms. Training and workshops to accommodate and tailor students' skill level in accordance with digitalisation is a fundamental step. Programmes to develop these skills from a younger age would also be beneficial. The Malaysian Ministry of Education (MOE) did included Rekabentuk and Teknologi Maklumat (RBT) classes into the curriculum of secondary school students, but simple conversations with the students and teachers revealed that these classes are only exclusionary to students with excellent academics performances. These discriminatory practices would only further widens digital divide. It is vital to reject the notion that digital inclusion is equivalent to meritocracy, the issue should be thwarted through hiring of sufficient suitable teachers and by increasing the access to infrastructure surrounding students. On this front, the government and policy makers should note that for an equal digitalisation, every students should be given equal opportunity to undertake digital curriculum.

Solutions launched by Malaysian Ministry of Higher Education (MOHE) through packaged data plan and devices for tertiary students are short-term solutions for long-term problems, with ever evolving state of the pandemic and rising digitalisation, comprehensive longer term ailments which is inclusive of skills development and digital engagement support and awareness should be induced. MOHE with other telecommunications and technological ministries like Malaysian Communications and Multimedia Commission (MCMC) and Ministry of Science, Technology and Innovation (MOSTI) should collaborate to eradicate the issue of digital divide among tertiary students and to improve the state of online learning in the nation. A collective action from these different ministerial departments would provide more resources like digital inclusion experts and financial incentives to have an effective execution to mend the issue.

To improve the effectiveness of online learning, issues with technology integration, students' disengagement and digital distraction must be curbed. A strategic, transformative, comprehensive and long-term policy intervention from educational bodies and ministry is needed to overcome this detrimental threat of digital divide and issues with effectiveness of online learning. Cooperation from different ministerial departments would provide innovative solutions and intervention, which would improvise current practice of online learning in Malaysia. Higher education institutions should be provided with clear and practical guidance on the conduct of online learning. Ministries with panel of higher education representatives should carry out extensive researches and draft detailed protocols to effectively overcome the issue of unsuccessful technology integration in online learnings. To enhance students' emotional wellbeing to stay engaged in their online education, free and subsidized access to seek mental health assistance in public healthcare. Additionally, awareness should be raised surrounding issues of psychological state and wellbeing to survive mentally taxing digitalisation of education.

Governmental institutions also need to leverage public-private partnerships government like the Jalinan Digital Negara (Jendela) telecommunication infrastructural development and effectively execute it (The Star, 2021). The project is promising to bridge the gap of digital divide in both poor urban and rural areas, through promotion of 4G networks in moving towards 5G adoptions. Digi Telecommunication has highlighted that the government's Jendela plan would provide Malaysia's digital citizen with better Internet experience and connectivity (Digi, 2021). Thus, it extremely crucial that government continue to invest in these initiatives to upgrade and improve its people's connection to digital networks and communication.

The Government of Malaysia presented The Malaysian Digital Economy Blueprint at beginning of 2021, which encompasses initiatives and aspiration for Malaysia to become a digitalized high-income nation. In this report, MyDigital has been highlighted as a plan to escalate Malaysia as "technologically-enhanced" nation. To realise the dreams of MyDigital the government has addressed the necessity to address digital divide, it shows that there is an awareness among governmental bodies that an incomprehensive step into digitalisation would lead into risks of digital divide. The report emphasized the importance of a digital inclusive society for everyone to prosper from digital economy. The blueprint has also provided a discourse on education, as it addressed education as a driver to provide digital talents. "My Device" programme, Internet connectivity and integration of digital skills in early educations has been discussed as well as accessibility to online learning as steps to ensure students' digital inclusion. Other than stressing about accessibility to online learning, the report also underlined the importance to promote enhanced and effective learning in online environment. The report is an important vote of confidence from the government and policy makers to its people on its role to tackle digital divide. Mere words in report would not achieve a desired result, it is important that the items addressed in the report translate into actions.

7.2.4 Corporations

Corporation in ICT sectors, are one of the crucial stakeholders to overcome digital divide in Malaysia. Telecommunication companies like Telekom Malaysia, Maxis, Digi, Celcom, YTL Communications etc. made socially conscious effort to provide free and discounted price of Internet, data subsidies, fundraisers to donate used functional devices to B40; lower income families and new devices to underprivileged students during the Covid-19 pandemic. The same goes for technological devices mega players like Samsung, Acer, Lenovo, Hewlett-Packard etc.; discounted prices and gift vouchers were offered to students to relieve their burden to acquire devices. Whilst these corporations social works do bridge the gap digital divide, at that time, these solutions are too little and short-term to an extensive and long-term problem. There were occurrence at where, devices disseminated through these initiatives underwent faulty amidst usage and the data subsidies and connection speed being insufficient.

To tackle the wound of digital divide, a long-term solution should be proposed in collaboration with public policymakers like the RM 21 Billion Jalinan Digital Negara (Jendela) initiative. With a constant reminder of its benefit to underprivileged people; broadband infrastructural development must be inclusive of both rural and urban areas, with the cost-benefit analysis that comprehends people' welfare and subsequent socioeconomic impact, instead of immediate financial fulfilments. These efforts would definitely have a sustainable repercussion on corporate agendas and for the national educational and economic growth. Thus, corporations should initiate efforts to make telecommunication and technological facilities affordable and accessible for their customers and communities around them (Shenglin et al., 2020).

Private corporations do also have the social obligation to mend digital illiteracy in Malaysia. Maxis's eKelas programme for primary and secondary students is a prime example (Maxis eKelas, 2020). These programmes by corporations should also be organized for tertiary students and it should become frequent occurrences, with increased reach to enhance Malaysian students and individual citizens' digital skills and eventual usages.

Briefly, corporations especially those in telecommunication services and technological products industries have sufficient powers and resources to navigate the path of digital inclusion among students and civil society. It is rudimental for them to fulfil their social and moral obligations in bridging the gap of digital divide for the wellbeing and developments of communities surrounding them and beyond.

7.2.5 Non-Governmental Organizations (NGOs) and Grassroots Organizations

From grassroots organizations to non-governmental organization, all these different non-profit bodies has a crucial role to embark on to eradicate the issue of digital divide, building a digital society and to facilitate digitalisation of education. These organizations in Malaysian has played important roles to ease the burden of people during Covid-19. Organizations like Teach for Malaysia, Stand-Up Malaysia, has fundraised and donated laptop and necessary educational devices to needy and underprivileged students at various educational levels. These efforts does greatly help students, who are at disadvantaged position and those who are excluded in governmental or institutional assistances.

These social organizations could also fundraise and provide workshops and trainings on development of digital literacy, especially to those who are from lower income households. These initiatives could be of hybrid nature, both of physical and virtual medium, to accommodate students' lack of material accesses. NGOs and grassroots organization is also great medium to bridge the gap between general population and governmental institutions, in a way these social organizations could facilitate the transaction of welfare from governmental systems to people in need. The non-profit nature of these organizations often render them incapacitated to provide assistance in a vast scope. However, it is important to remember a little does go a long; NGOs and grassroots initiatives would provide a bottom-up push to encourage communities that they engage to bridge the digital divide and sparks progressive political and critical conversations to overcome the issue and its detrimental impact.

7.3 Limitations

Even though this study has played a part in contributing several notable and significant findings to digital divide studies and educational bodies, it is undeniable that in the world of research, none is without its own sets of limitations.

First, non-probability sampling methods was implemented in this study to collect samples. Quota sampling was used to select ten private and public higher education institutions in Malaysia and to select equal amount of student respondents from each institutions. The selection was done on the basis of representations of each private and public institution from most geographical regions in Malaysian, namely; northern, central and southern regions of peninsula Malaysian and both the Bornean region of Sabah and Sarawak. This method prompts a very limited geographical coverage of sample collected for data collection and especially since there was a lack of coverage on eastern region of peninsula Malaysia, as there were absence of private higher education institution with the same capacity and characteristic as the listed and selected institutions. Thus, there is an issue with generalization as the sample collected is not representative of every single educational institutions in Malaysia. Snowball sampling was implemented to disseminate questionnaire to respondents, yet this prompts issue with generalization, as the rolled ball would be of same characteristics and sample would not be of exact replication of the population.

Next, the employment of cross-sectional research design, have restricted the time frame to collect samples into one single period of time, particularly during the Covid-19, thus the issue of digital divide among Malaysian tertiary students and its impact on online learning has only been captured in the context of Covid-19 pandemic only.

Moreover, this research wholly adapted a quantitative research method, questionnaire survey was disseminated to collect data from student respondents. Qualitative method element would have been inclusive of critical responses from students. The hindrance of that approach may produce a biased feedback, as "close-ended" questions in quantitative survey method restricts genuine responses. Adopting mixed triangulation method would allow the ability to capture more robust and intrinsic sets of data.

Furthermore, the data collected for digital skills for example was based on self-reported and self-reflective scales, thus the threat of bias following respondents inclination toward providing consistent answer is real. This could cause serious correlation issues among exogenous and endogenous construct, Harmann's single factor test indicated that common method bias is not a critical concern for this study. Nevertheless, it is irrefutable, the responses from respondents may have underwent its fair share of tendency to appease socially preferable feedback. Another limitations is that, since digital skills in this study was measured based on self-reported survey responses from students, this practice may have exaggerated or understated the level of digital skills possessed by students.

Other than that, more than 90 percent of present study's student respondents are from urban areas, thus in general this study explains the scenario of digital divide among students and online learning outcomes among students from urban area, this study has a lack of representation of students from rural areas.

In addition, the findings has suggested and rebutted several theoretical claims, the relationship among digital divide indicators and its impact on online learning outcomes or effectiveness is not as straightforward, studies have suggested intervention of institutional motivation, technology integration, digital disengagement, emotional engagement and digital distraction play an important part in navigating those relationships.

Finally, there is also a lack of addressment on how the relationships studied were moderated or mediated. Effect of mediation or moderation from other constructs would explain a complete occurrence of the process, for findings that suggested that there are insignificant relationships between constructs and even among those that indicated significant relationships. For example, the insignificant relationship between material access and online learning outcomes could have been looked in depth with the inclusion of technology integration as a mediator.

7.4 Recommendations for Future Studies

The limitation highlighted in the previous section propels recommendations to be elaborated for future studies. The primary limitation stated was data collection using non-probability sampling method, which accentuates issue of coverage in data collection. This study only covers one private and public higher education institution form five main geographical region in Malaysia. Future studies could consider to cover institutions beyond the lens of geographical region, perhaps in accordance with states. Studies may also contemplate to employ probability-sampling method to provide a more levelled ground for generalization. Increasing coverage of geographical location will also provide a diverse data samples, thus further improving the robustness of the study.

Subsequently, future studies could also contemplate a longitudinal research design; this would enable understanding of a phenomenon beyond a certain event of time. This design of data collection would enable studies to investigate development of digital skills of samples over time. Longitudinal data collection method would also facilitate studies to observe the gap of digital divide among samples over a period.

Next, studies could adapt mixed-method research design, triangulation approach. Qualitative method such as in-depth interview would provide a very honest, critical and insightful data. The triangulation approach would provide robust and unassailable findings that are necessary for digital divide studies.

Additionally, future studies could use task-based assessment to evaluate students digital skills, the performance result would lack the element of bias and it would also report development of digital skills based on practical grounds. These practices would highlight a realistic picture of the level of digital skills among students or any form of target respondents.

Other than that, future studies could stress more on capturing digital divide and online learning outcomes among students from rural areas, since the majority of respondents of this present study are from urban areas. It is undeniable that the situation would be different for rural students, thus a research on digital divide among rural students and the effectiveness of their online learning would provide new insights to address and thwart the issue.

Future studies could take into consideration the role of institutional or systemic intervention, technology integration, student engagement and behaviour and digital distraction in influencing online learning effectiveness. The inclusion of these elements into conceptualization and studying their role in facilitating these relationships would further enhance the view on the impact of digital divide on online learning.

Finally, future studies should also address and study the involvement of moderator and mediator constructs in their intervention between digital divide indicators and online learning outcomes. These would provide a rigorous and extensive explanation for the occurrence of digital divide and its subsequently detrimental impacts on education.

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APPENDICES

APPENDIX 1: PILOT STUDY OUTPUTS

Reliability Statistics of Motivational Access (Motivation and Attitude)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.357	.504	4

Reliability Statistics of Digital Usage (Personal Development)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.605	.673	4

Reliability Statistics of Digital Usage (Leisure)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.727	.750	3

Reliability Statistics of Digital Usage (Commercial Transaction)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.893	.894	3

Reliability Statistics of Digital Usage (Social Interaction)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.798	.803	3

Reliability Statistics of Digital Usage (Information)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.805	.838	2

Reliability Statistics of Digital Usage (News)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.757	.761	2

Reliability Statistics of Digital Skills (Operational Skills)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.936	.951	10

Reliability Statistics of Digital Skills (Information Navigation)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.944	.945	8

Reliability Statistics of Digital Skills (Social)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.942	.936	6

Reliability Statistics of Digital Skills (Creative)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.937	.937	8

Reliability Statistics of Digital Skills (Mobile)

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.676	.780	3

Reliability Statistics of Students' Satisfaction

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.959	.960	7

Reliability Statistics of Students' Perceived Learning

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.955	.955	6

APPENDIX 2: CONSTRUCTS AND INDICATORS

Original Items	Adopted and Adapted Items
Motivational Access: Motivation and Attitude Scale	
Technologies such as the Internet and mobile phones make life easier	Adopted from Helsper, Smirnova and Robinson (2017)
Knowing how to use technologies is beneficial when trying to get a job	
I feel that people pressure me to be constantly connected	Adapted from Helsper, Smirnova and Robinson (2017): *My friends/people around me encourage me to use technologies such as the Internet to be connected*
There are a lot of things on the Internet that are good for people like me	Adopted from Helsper, Smirnova and Robinson (2017)
Material Access Adopted and adapted from van Deursen and van Dijk (2017)	
Internet	
-	Fixed Broadband (e.g. UNIFI, Streamyx, etc)
	Mobile Data Plans
	Wireless Broadband
Devices	
Desktop	Personal Computer/Desktop
Laptop	Laptop/Notebook
Table	Tablet
Smartphone	Smartphone
Smart TV	Smart TV/ Television
Game Console	Game Console
Peripherals	
Printer	Printer
Scanner	Scanner
Additional Screen	Webcam

Additional Hardware	Docking Station
Docking Station	Computer Microphones
Digital Skills	
Operational Skills	
I know how to open downloaded files	Adopted from van Deursen, Helsper and Eynon (2014)
I know how to download/save a photo I found online	
I know how to use shortcut keys (e.g. CTRL-C for copy, CTRL-S for save)	
I know how to open a new tab in my browser	
I know how to bookmark a website	
I know where to click to go to a different webpage	
I know how to complete online forms	
I know how to upload files	
I know how to adjust privacy settings	
I know how to connect to a WIFI network	
Information Navigation	
I find it hard to decide what the best keywords are to use for online searches	Adopted from van Deursen, Helsper and Eynon (2014)
I find it hard to find a website I visited before	
I get tired when looking for information online	
Sometimes I end up on websites without knowing how I got there	
I find the way in which many websites are designed confusing	
All the different website layouts make working with the internet difficult for me	

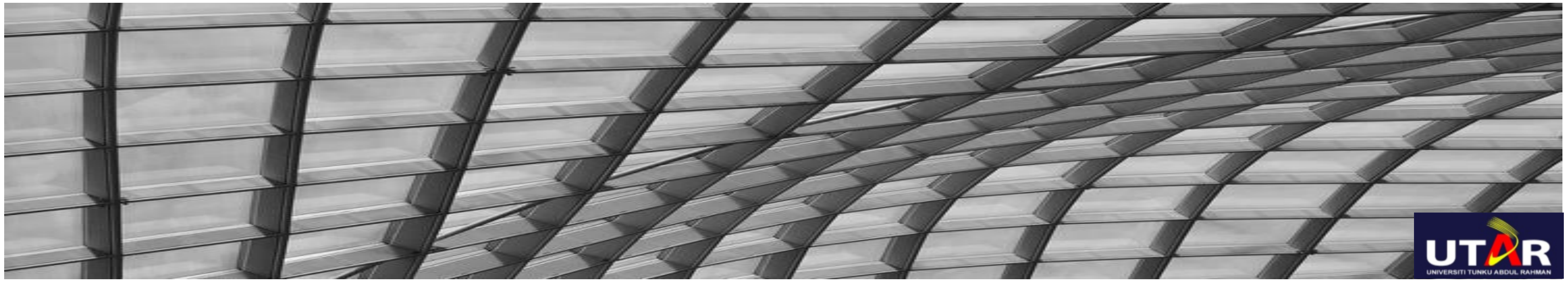
I should take a course on finding information online	
Sometimes I find it hard to verify information I have retrieved	
Social	
I know which information I should and shouldn't share online	Adopted from van Deursen, Helsper and Eynon (2014)
I know when I should and shouldn't share information online	
I am careful to make my comments and behaviours appropriate to the situation I find myself in online	
I know how to change who I share content with (e.g. friends, friends of friends or public)	
I know how to remove friends from my contact lists	
I feel comfortable deciding who to follow online (e.g. on services like Twitter or Tumblr)	
Creative	
I know how to create something new from existing online images, music or video	Adopted from van Deursen, Helsper and Eynon (2014)
I know how to make basic changes to the content that others have produced	
I know how to design a website	
I know which different types of licences apply to online content	
I would feel confident putting video content I have created online	
I know which apps/software are safe to download	
I am confident about writing a comment on a blog, website or forum	
I would feel confident writing and commenting online	

Mobile	
I know how to install apps on a mobile device	Adopted from van Deursen, Helsper and Eynon (2014)
I know how to download apps to my mobile device	
I know how to keep track of the costs of mobile app use	Adapted from van Deursen, Helsper and Eynon (2014): *I know how to keep track of the costs of mobile app use (e.g. in-app purchases for mobile games, mobile Spotify/Netflix/iflix/Viu subscriptions, etc)*
Digital Usage	
Personal Development	
Finding online courses and training	Adopted from van Deursen and van Dijk (2013)
Following online courses	
Independent learning	
Find vacancies/applying for jobs	Adapted from van Deursen and van Dijk (2013): *Finding study material through online resources*
Leisure	
Downloading music/video	Adopted from van Deursen and van Dijk (2013)
Hobby	
Free surfing	
Commercial Transaction	
Using sites such as ebay	Adapted from van Deursen and van Dijk (2013): *Using sites such as Lazada, Shopee etc.*
Acquiring product information	Adopted from van Deursen and van Dijk (2013)
Shopping or ordering products	
Social Transaction	
Using social network sites	Adopted from van Deursen and van Dijk (2013)
Chatting	
Sharing photos/videos	
Information	
Using search systems	Adopted from van Deursen and van Dijk (2013)
Searching information	

News	
News services	Adopted from van Deursen and van Dijk (2013)
Newspapers and online magazines	
Gaming	
Playing online games	Adopted from van Deursen and van Dijk (2013)
Students' Satisfaction Adapted from Strong, Irby, Wynn and McClure (2012)	
I am satisfied with this program	I am satisfied with online classes/learning
Distance education is worth my time	Online classes are worth my time
I enjoy studying by distance	I enjoy studying by distance/online learning
Distance education is stimulating	Online classes are stimulating
Distance education is exciting	Online classes are exciting
I look forward to learning by distance	I look forward to learning through online classes
I prefer distance education	I prefer online classes to traditional face-to-face classes
Students' Perceived Learning Adapted from Sher (2009)	
I learned to interrelate the important issues in the course material	I learned to interrelate the important issues in the course materials through online classes
I gained a good understanding of the basic concepts of the material	I gained a good understanding of the basic concepts of the materials through online classes
I learned to identify the central issues of the course	I learned to identify the central issues of the courses through online classes
I developed the ability to communicate clearly about the subject	I developed the ability to communicate clearly about the subjects through online classes
I improved my ability to integrate facts and develop generalizations from the course material	I improved my ability to integrate facts and develop generalizations from the course material from online classes

I learned concepts and principles in this course	I learned concepts and principles of the courses through online classes

APPENDIX 3: QUESTIONNAIRE SURVEY



Digital Divide among Malaysian Tertiary Students and Its Impact on Online Learning During the Covid-19 Pandemic

Dear Mr./Ms.,

Good Day,

I am Latha Subramaniam, a Master of Philosophy student from Universiti Tunku Abdul Rahman (UTAR), Sg.Long Campus. The purpose of this survey is to study digital divide among Malaysian higher education students and its impact on online learning during the Covid-19 pandemic. Your responses to all the questions/statements in the questionnaire have to derive from your own experience.

I would appreciate it very much if you could spend approximately seven minutes to complete this questionnaire. There is no right or wrong answers and honest feedback is critical for the accomplishment of this study. All information will be treated in strict confidential and your responses will only be analysed in aggregate forms.

If you do have any enquiries, please feel free to contact me through my email latha.s2996@1utar.my

Thank you very much.

Sincerely,
Latha Subramaniam

Required*

Please make sure that you kindly fulfil the following conditions to proceed to the next section of the survey. Thank You. *

Are you a Malaysian?

Are you a full-time/part-time student enrolled in Malaysian higher education institutions?

Are you required to engage in online learning during the Covid-19 pandemic?
Mark only one circle

- ○ Yes
- ○ No *"Submit Form"*

Tertiary Educational Institution Enrolled in: *

Mark only one circle

○ University of Malaya (UM), KL Campus

○ Universiti Malaysia Sabah (UMS), Kota Kinabalu Campus

○ Universiti Malaysia Sarawak (UNIMAS), Kota Samarahan Campus

○ Universiti Sains Malaysia (USM), Penang Campus

○ Universiti Tun Hussein Onn Malaysia (UTHM), Pagoh Campus

○ AIMST University, Kedah Campus

○ Curtin University, Miri Campus

○ INTI International University, Nilai Campus

○ Multimedia University, Melaka Campus

○ Universiti Tunku Abdul Rahman (UTAR), Sg.Long Campus

○ None of the Above *"Submit Form"*

Section A: Motivational Access

Motivation and Attitude *

Mark only one circle per row

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
Technologies such as the Internet and mobile phones make life easier	○	○	○	○	○
Knowing how to use technologies is beneficial for online classes/learning	○	○	○	○	○
My friends/people around me encourage me to use technologies such as the Internet to be connected	○	○	○	○	○
There are a lot of things on the Internet that are good for people like me	○	○	○	○	○

Section B: Material Access

I have the following Internet plan(s): *

Mark only one circle per row

	Yes	No
Fixed Broadband (e.g. UNIFI, Streamyx, etc)	○	○
Mobile Data Plans	○	○
Wireless Broadband	○	○

I own the following device(s): *

Mark only one circle per row

	Yes	No
Personal Computer/Desktop	○	○
Laptop/Notebook	○	○
Tablet	○	○
Smartphone	○	○
Smart TV/ Television	○	○
Game Consoles	○	○

I own the following peripheral(s): *

Mark only one circle per row

	Yes	No
Printer	○	○
Scanner	○	○
Webcam	○	○
Docking Station	○	○
Computer Microphones	○	○

Section C: Digital Usage

Hours of Internet Use Daily: *

Mark only one circle

○ Less than 1 hour

○ 1-4 hours

○ 5-8 hours

○ 9-13 hours

○ 14-18 hours

○ More than 18 hours

2.) How often do you use the Internet for Personal Development? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Finding online courses and training	○	○	○	○	○
Following online courses	○	○	○	○	○
Independent learning	○	○	○	○	○
Finding study material through online resources	○	○	○	○	○

3.) How often do you use the Internet for Leisure? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Downloading music/video	○	○	○	○	○
Hobby	○	○	○	○	○
Free surfing	○	○	○	○	○

4.) How often do you use the Internet for Commercial Transaction? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Using sites such Lazada, Shopee etc.	○	○	○	○	○
Acquiring product information	○	○	○	○	○
Shopping or ordering products	○	○	○	○	○

5.) How often do you use the Internet for Social Interaction? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Using social network sites	○	○	○	○	○

	Never	Rarely	Sometimes	Often	Always
Chatting	○	○	○	○	○
Sharing photos/videos	○	○	○	○	○

6.) How often do you use the Internet for Information? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Using search systems	○	○	○	○	○
Searching information	○	○	○	○	○

7.) How often do you use the Internet for News? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
News services	○	○	○	○	○
Newspapers and online magazines	○	○	○	○	○

8.) How often do you use the Internet for Gaming? *

Mark only one circle per row

	Never	Rarely	Sometimes	Often	Always
Playing online games	○	○	○	○	○

Section D: Digital Skills

Operational Skills *

Mark only one circle per row

	Not at all true of me	Not very true of me	Neither true nor untrue of me	Mostly true of me	Very true of me	I do not understand what this means
I know how to open downloaded files	○	○	○	○	○	○
I know how to download/save a photo I found online	○	○	○	○	○	○
I know how to use shortcut keys (e.g. CTRL-C for copy, CTRL-S for save)	○	○	○	○	○	○
I know how to open a new tab in my browser	○	○	○	○	○	○
I know how to bookmark a website	○	○	○	○	○	○
I know where to click to go to a different webpage	○	○	○	○	○	○
I know how to complete online forms	○	○	○	○	○	○
I know how to upload files	○	○	○	○	○	○
I know how to adjust privacy settings	○	○	○	○	○	○
I know how to connect to a WIFI network	○	○	○	○	○	○

Information Navigation *

Mark only one circle per row

	Not at all true of me	Not very true of me	Neither true nor untrue of me	Mostly true of me	Very true of me	I do not understand what this means
I find it hard to decide what the best keywords are to use for online searches	○	○	○	○	○	○
I find it hard to find a website I visited before	○	○	○	○	○	○
I get tired when looking for information online	○	○	○	○	○	○
Sometimes I end up on websites without knowing how I got there	○	○	○	○	○	○
I find the way in which many websites are designed confusing	○	○	○	○	○	○
All the different website layouts make working with the internet difficult for me	○	○	○	○	○	○
I should take a course on finding information online	○	○	○	○	○	○
Sometimes I find it hard to verify information I have retrieved	○	○	○	○	○	○

Social *

Mark only one circle per row

	Not at all true of me	Not very true of me	Neither true nor untrue of me	Mostly true of me	Very true of me	I do not understand what this means
I know which information I should and shouldn't share online	○	○	○	○	○	○
I know when I should and shouldn't share information online	○	○	○	○	○	○
I am careful to make my comments and behaviours appropriate to the situation I find myself in online	○	○	○	○	○	○
I know how to change who I share content with (e.g. friends, friends of friends or public)	○	○	○	○	○	○
I know how to remove friends from my contact lists	○	○	○	○	○	○
I feel comfortable deciding who to follow online (e.g. on services like Twitter or Instagram)	○	○	○	○	○	○

Creative *

Mark only one circle per row

	Not at all true of me	Not very true of me	Neither true nor untrue of me	Mostly true of me	Very true of me	I do not understand what this means
I know how to create something new from existing online images, music or video	○	○	○	○	○	○
I know how to make basic changes to the content that others have produced	○	○	○	○	○	○
I know how to design a website	○	○	○	○	○	○
I know which different types of licences apply to online content	○	○	○	○	○	○
I would feel confident putting video content I have created online	○	○	○	○	○	○
I know which apps/software are safe to download	○	○	○	○	○	○
I am confident about writing a comment on a blog, website or forum	○	○	○	○	○	○
I would feel confident writing and commenting online	○	○	○	○	○	○

Mobile *

Mark only only one circle per row

	Not at all true of me	Not very true of me	Neither true nor untrue of me	Mostly true of me	Very true of me	I do not understand what this means
I know how to install apps on a mobile device	○	○	○	○	○	○
I know how to download apps to my mobile device	○	○	○	○	○	○
I know how to keep track of the costs of mobile app use (e.g. in-app purchases for mobile games, mobile Spotify/Netflix/iflix/Viu subscriptions, etc)	○	○	○	○	○	○

Section E: Online Learning Outcome

Students' Satisfaction (During the Coivd-19 pandemic………) *

Mark only one circle per row

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
I am satisfied with online classes/learning	○	○	○	○	○
Online classes are worth my time	○	○	○	○	○
I enjoy studying by distance/online learning	○	○	○	○	○
Online classes are stimulating	○	○	○	○	○
Online classes are exciting	○	○	○	○	○
I look forward to learning through online classes	○	○	○	○	○
I prefer online classes to traditional face-to-face classes	○	○	○	○	○

Students' Perceived Learning (During the Covid-19 pandemic………) *
Mark only one circle per row

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
I learned to interrelate the important issues in the course materials through online classes	○	○	○	○	○
I gained a good understanding of the basic concepts of the materials through online classes	○	○	○	○	○
I learned to identify the central issues of the courses through online classes	○	○	○	○	○
I developed the ability to communicate clearly about the subjects through online classes	○	○	○	○	○
I improved my ability to integrate facts and develop generalizations from the course material from online classes	○	○	○	○	○
I learned concepts and principles of the courses through online classes	○	○	○	○	○

Section F: Demographic Information

Do you have any prior experience of undertaking online learning/classes before Covid-19 Pandemic? *
Mark only one circle

○ Yes

○ No

Gender: *
Mark only one circle

○ Female

○ Male

Ethnicity: *
Please Specify: ________________

Household Income per Month: *
Mark only one circle

○ Below RM1000

○ RM1000-RM2000

○ RM2001-RM3000

- ○ RM3001-RM4000
- ○ RM4001-RM5000
- ○ RM5001-RM6000
- ○ RM6001-RM7000
- ○ RM7001-RM8000
- ○ More than RM8000

Currently Enrolled in: *
Mark only one circle

- ○ Matriculation / Foundation Studies or equivalent
- ○ Diploma or equivalent
- ○ Undergraduate
- ○ Postgraduate

Field of Study: *
Mark only one circle

- ○ Accountancy/Business/Management
- ○ Arts and Humanities

- ○ Education
- ○ Engineering
- ○ Health Science
- ○ Science
- ○ Social Science
- ○ Other:

Place of Access to Online Learning during the Covid-19 Pandemic: *
Mark only one circle

- ○ Campus *"Submit Form"*
- ○ Home
- ○ Hostel
- ○ Internet Café
- ○ Friend's Home
- ○ Other:

Following question (7) in Section F, for the selection of option other than campus please select the State online learning was accessed during the Covid-19 Pandemic: *

Mark only one circle

- ○ Perlis
- ○ Kedah
- ○ Penang
- ○ Perak
- ○ Kelantan
- ○ Terengganu
- ○ Pahang
- ○ Selangor
- ○ Johor
- ○ Melaka
- ○ Negeri Sembilan
- ○ Sabah
- ○ Sarawak
- ○ Federal Territory of Kuala Lumpur

- ○ Federal Territory of Putrajaya
- ○ Federal Territory of Labuan

Following question (8) in Section F, please specify the name of the Village/Town/City where online learning takes place during the Covid-19 Pandemic. *

Please Specify: ________________

APPENDIX 4: DATA ANALYSIS OUTPUTS

Cross-Tabulation between Different types of Internet Access and Laptop/Notebook and Smartphone

Laptop/Notebook * Smartphone * Fixed Broadband * Mobile Data Plans * Wireless Broadband Cross-tabulation							
					Smartphone		
Wireless Broadband	Mobile Data Plans	Fixed Broadband			No	Yes	Total
No	No	No	Laptop/Notebook	Yes		3	3
			Total			3	3
		Yes	Laptop/Notebook	Yes		22	22
			Total			22	22
		Total	Laptop/Notebook	Yes		25	25
			Total			25	25
	Yes	No	Laptop/Notebook	No	0	1	1
				Yes	3	88	91
			Total		3	89	92
		Yes	Laptop/Notebook	No	1	5	6
				Yes	1	200	201
			Total		2	205	207
		Total	Laptop/Notebook	No	1	6	7

				Yes	4	288	292
			Total		5	294	299
	Total	No	Laptop/Notebook	No	0	1	1
				Yes	3	91	94
			Total		3	92	95
		Yes	Laptop/Notebook	No	1	5	6
				Yes	1	222	223
			Total		2	227	229
		Total	Laptop/Notebook	No	1	6	7
				Yes	4	313	317
			Total		5	319	324
Yes	No	No	Laptop/Notebook	Yes	2	4	6
			Total		2	4	6
		Yes	Laptop/Notebook	No		1	1
				Yes		5	5
			Total			6	6
		Total	Laptop/Notebook	No	0	1	1
				Yes	2	9	11
			Total		2	10	12
	Yes	No	Laptop/Notebook	No		1	1

				Yes		29	29
			Total			30	30
		Yes	Laptop/Notebook	No		1	1
				Yes		33	33
			Total			34	34
		Total	Laptop/Notebook	No		2	2
				Yes		62	62
			Total			64	64
	Total	No	Laptop/Notebook	No	0	1	1
				Yes	2	33	35
			Total		2	34	36
		Yes	Laptop/Notebook	No		2	2
				Yes		38	38
			Total			40	40
		Total	Laptop/Notebook	No	0	3	3
				Yes	2	71	73
			Total		2	74	76
Total	No	No	Laptop/Notebook	Yes	2	7	9
			Total		2	7	9
		Yes	Laptop/Notebook	No		1	1

				Yes		27	27
			Total			28	28
		Total	Laptop/Notebook	No	0	1	1
				Yes	2	34	36
			Total		2	35	37
	Yes	No	Laptop/Notebook	No	0	2	2
				Yes	3	117	120
			Total		3	119	122
		Yes	Laptop/Notebook	No	1	6	7
				Yes	1	233	234
			Total		2	239	241
		Total	Laptop/Notebook	No	1	8	9
				Yes	4	350	354
			Total		5	358	363
	Total	No	Laptop/Notebook	No	0	2	2
				Yes	5	124	129
			Total		5	126	131
		Yes	Laptop/Notebook	No	1	7	8
				Yes	1	260	261
			Total		2	267	269

		Total	Laptop/Notebook	No	1	9	10
				Yes	6	384	390
			Total		7	393	400

Cross-Tabulation between Different types of Internet Access

Mobile Data Plans * Fixed Broadband * Wireless Broadband Cross-tabulation			
Wireless Broadband	Mobile Data Plans	Fixed Broadband	
		No	Yes
No	No	3	22
	Yes	92	207
Yes	No	6	6
	Yes	30	34

Cross-Tabulation between Laptop/Notebook and Smartphone

Laptop/Notebook * Smartphone Cross-tabulation		
	Smartphone	
Laptop/Notebook	No	Yes
No	1	9
Yes	6	384

Descriptive Statistics of Indicators

Constructs	Indicators	Min	Max	Mean	Median	Standard Deviation	Excess Kurtosis	Skewness
Motivational Access	InternetAttitude1	1.00	5.00	4.12	4.00	1.01	2.08	-1.44
	InternetAttitude2	1.00	5.00	4.30	5.00	1.03	3.35	-1.89
	InternetAttitude3	1.00	5.00	4.04	4.00	1.05	1.79	-1.38
	IntenetAttitude4	1.00	5.00	4.10	4.00	1.01	2.33	-1.51
Digital Skills	OperationalSkills1	0.00	5.00	4.55	5.00	1.10	9.63	-3.15
	OperationalSkills2	0.00	5.00	4.58	5.00	1.07	10.36	-3.24
	OperationalSkills3	0.00	5.00	4.27	5.00	1.27	3.75	-2.07
	OperationalSkills4	0.00	5.00	4.57	5.00	1.13	9.77	-3.22
	OperationalSkills5	0.00	5.00	4.52	5.00	1.14	8.81	-3.02
	OperationalSkills6	0.00	5.00	4.55	5.00	1.13	9.25	-3.12
	OperationalSkills7	0.00	5.00	4.55	5.00	1.14	9.38	-3.15
	OperationalSkills8	0.00	5.00	4.55	5.00	1.14	9.18	-3.11
	OperationalSkills9	0.00	5.00	4.42	5.00	1.17	5.93	-2.49
	OperationalSkills10	0.00	5.00	4.59	5.00	1.07	11.47	-3.41
	InformationNavigation1_Reverse	0.00	5.00	3.30	3.00	1.29	-0.60	-0.44
	InformationNavigation2_Reverse	0.00	5.00	3.85	4.00	1.25	0.56	-1.12

	InformationNavigation3_Reverse	0.00	5.00	3.13	3.00	1.37	-1.04	-0.18
	InformationNavigation4_Reverse	0.00	5.00	3.44	4.00	1.43	-0.73	-0.62
	InformationNavigation5_Reverse	0.00	5.00	3.35	4.00	1.38	-0.65	-0.53
	InformationNavigation6_Reverse	0.00	5.00	3.57	4.00	1.33	-0.21	-0.78
	InformationNavigation7_Reverse	0.00	5.00	3.63	4.00	1.40	-0.41	-0.76
	InformationNavigation8_Reverse	0.00	5.00	3.34	4.00	1.38	-0.71	-0.49
	Social1	0.00	5.00	4.37	5.00	1.00	6.29	-2.29
	Social2	0.00	5.00	4.38	5.00	0.97	7.29	-2.42
	Social3	0.00	5.00	4.49	5.00	0.91	9.56	-2.77
	Social4	0.00	5.00	4.51	5.00	0.92	9.22	-2.79
	Social5	0.00	5.00	4.48	5.00	1.00	9.20	-2.88
	Social6	0.00	5.00	4.44	5.00	1.01	7.91	-2.64
	Creative1	0.00	5.00	3.68	4.00	1.24	0.32	-0.88
	Creative2	0.00	5.00	3.70	4.00	1.21	0.33	-0.84
	Creative3	0.00	5.00	3.03	3.00	1.42	-1.16	-0.11
	Creative4	0.00	5.00	2.82	3.00	1.42	-1.04	0.07
	Creative5	0.00	5.00	3.13	3.00	1.38	-1.05	-0.20
	Creative6	0.00	5.00	3.56	4.00	1.28	-0.20	-0.70
	Creative7	0.00	5.00	3.23	3.00	1.33	-0.77	-0.32
	Creative8	0.00	5.00	3.26	3.00	1.32	-0.72	-0.33

	Mobile1	0.00	5.00	4.61	5.00	0.93	10.68	-3.15
	Mobile2	0.00	5.00	4.62	5.00	0.87	11.46	-3.15
	Mobile3	0.00	5.00	4.32	5.00	1.11	3.56	-1.93
Digital Usage	PersonalDevelopment1	1.00	5.00	3.62	4.00	1.07	-0.35	-0.44
	PersonalDevelopment2	1.00	5.00	3.91	4.00	1.10	-0.05	-0.83
	PersonalDevelopment3	1.00	5.00	3.98	4.00	0.91	-0.42	-0.53
	PerosnalDevelopement4	1.00	5.00	4.33	5.00	0.85	1.18	-1.23
	Leisure1	1.00	5.00	3.65	4.00	1.18	-0.75	-0.48
	Leisure2	1.00	5.00	3.85	4.00	1.07	-0.29	-0.68
	Leisure3	1.00	5.00	4.13	4.00	0.93	0.10	-0.86
	CommercialTransaction1	1.00	5.00	3.37	3.00	1.14	-0.84	-0.09
	CommercialTransaction2	1.00	5.00	3.55	4.00	1.12	-0.67	-0.34
	CommercialTransaction3	1.00	5.00	3.41	3.00	1.13	-0.85	-0.14
	SocialInteraction1	1.00	5.00	4.28	5.00	0.94	0.95	-1.25
	SocialInteraction2	2.00	5.00	4.37	5.00	0.83	0.31	-1.12
	SocialInteraction3	1.00	5.00	4.11	4.00	0.97	-0.29	-0.80
	Information1	1.00	5.00	4.32	4.00	0.83	1.85	-1.29
	Information2	2.00	5.00	4.47	5.00	0.72	0.82	-1.21
	News1	1.00	5.00	3.56	4.00	1.05	-0.63	-0.26
	News2	1.00	5.00	3.50	4.00	1.08	-0.86	-0.18

	Gaming	1.00	5.00	2.99	3.00	1.29	-1.06	0.15
Students' Satisfaction	StudentsSatisfaction1	1.00	5.00	2.99	3.00	1.10	-0.72	-0.09
	StudentsSatisfaction2	1.00	5.00	3.07	3.00	1.12	-0.62	-0.15
	StudentsSatisfaction3	1.00	5.00	2.95	3.00	1.16	-0.81	-0.07
	StudentsSatisfaction4	1.00	5.00	2.92	3.00	1.10	-0.67	-0.09
	StudentsSatisfaction5	1.00	5.00	2.75	3.00	1.16	-0.81	0.12
	StudentsSatisfaction6	1.00	5.00	2.75	3.00	1.18	-0.86	0.15
	StudentsSatisafction7	1.00	5.00	2.69	3.00	1.29	-1.01	0.26
Students' Perceived Learning	StudentsPerceivedLearning1	1.00	5.00	3.33	3.00	0.96	-0.02	-0.53
	StudentsPerceivedLearning2	1.00	5.00	3.26	3.00	1.00	-0.28	-0.47
	StudentsPerceivedLearning3	1.00	5.00	3.27	3.00	1.02	-0.19	-0.56
	StudentsPerceivedLearning4	1.00	5.00	3.22	3.00	1.06	-0.47	-0.42
	StudentsPerceivedLearning5	1.00	5.00	3.31	3.00	0.99	-0.07	-0.54
	StudentsPerceivedLearning6	1.00	5.00	3.36	4.00	1.01	-0.13	-0.58