

Investigating the Interplay of Motivational Access, Physical Access and Digital Skills Access to ICT on Internet Usage Diversity

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Abstract: The rapid advancement of information and communication technologies (ICTs) during this decade has increased its importance for individuals, businesses and societies. However, despite efforts to improve digital infrastructure, access, and ownership, the digital divide remains a persistent issue and a barrier to many sectors. Digital divide is not limited to physical access, but it comprises a wide range of factors. The study explores the demographic information and the access to ICT aspects (motivational access, physical access, operational skill access, formal skill access, informational skill access, and strategic skill access) that shape university students' internet usage diversity. The study conducted an online survey on 351 students who were pursuing their studies in different disciplines at West Malaysian University. The role of demographic variables and ownership of 5 G-enabled devices in digital divide issues was investigated. Results showed that all demographic variables except gender have significantly impacted the dimensions of access to ICT to some extent. Furthermore, the study found that operational skills access, informational skills access, and physical access have predicted students' internet usage diversity. This implies the digital divide persists among university students in terms of operational skills, informational skills, and physical access to internet usage diversity. The findings also indicate that the digital divide persists across two levels of digital divide among university students in Malaysia. The results have strengthened the findings that the original digital divide of physical access has evolved into a divide that includes differences in skills to diversify internet usage.

Keywords: *Digital divide, motivational access, physical access, skills access, internet usage diversity*

1. Introduction

In this digital era, information and communication technologies (ICTs) have played significant roles in individuals' daily lives. ICTs have become an integral part of the present environment for which their uses vary across generations and among individuals (Youssef et al., 2022). The advancement of ICTs is growing very fast, and it is undeniable that these advancements have given huge advantages to the people, business activities, economic activities, and, without exception to educational activities. Many higher educational institutions have transformed digitally at a rapid pace due to ICT advancements after the post-COVID-19 pandemic. The rapid advancements of ICTs have given rise to a concerning phenomenon known as the digital divide among people. Digital divide is a phenomenon that refers to disparities in ICT access, skills, usage, and outcomes (Lythreathis et al., 2022), whereby it was initially conceptualized to explain the inequality of access to ICT opportunities (Ojo et al., 2022). However, despite the advancement and increasing access to digital technology, there still exist gaps in terms of actual usage among individuals, organizations, and countries (Pagán et al., 2018). Van Deursen and Van Dijk (2015) concluded that motivational and physical access are still relevant even though the digital divide policies' focus has moved to skills and usage access, since these accesses are necessary throughout the process of narrowing the digital gap. There was much research that had extended ICT access to other types of access, including motivational, skills, and usage, for which these access gaps were interdependently related. Therefore, materials, skills, and usage access should be addressed simultaneously (Van Deursen & Van Dijk, 2015). However, not many studies were noticeable concerning the theoretical aspects of the interplay among these gaps (Ghobadi & Ghobadi, 2015; Ojo et al., 2022).

The first objective of this study is to examine students' access level to ICT following the model of digital divide access level (Van Dijk, 2005) that encompasses motivational access, physical access, skills access, and usage access. Motivational access consists of endogenous motivation and exogenous motivation. An endogenously motivated individual performs an activity because he or she finds the activity interesting and enjoyable and

this motivation comes from his or her self-desire to discover new things and new challenges, to assess his or her potential, and to observe and gain knowledge from the activity (Ojo et al., 2022). However, exogenous motivational access denotes a person's desire for ICT adoption that comes from outside sources, including social influence, time, and material resources (Soomro et al., 2020). Physical access includes devices, software, and services to access ICT. For this study, 13 physical access devices were considered, including internet, laptop computer, smartphone, desktop computer, tablet, USB flash drive, webcam, printer, Microsoft Office software, photo editing software, video editing software, statistical software, and learning management system.

Skills access consists of operational skill, formal skill, informational skill, and strategic skill. Operational skills and formal skills are classified as medium-related skills, while informational skills and strategic skills are classified as content-related skills. Operational skills are the ability to operate a computer, network hardware, and software, while formal skills are competencies related to navigating the internet's hyperlinked structure. Informational skills are the ability to find, select, process, and evaluate information in specific sources of computers and networks according to specific questions and needs, while strategic skills are the capacities to use these sources as the means for specific goals and for the general goal of improving one's position in society (Van Deursen & Van Dijk, 2015). Regarding the usage access, the study adopted the terminology called internet usage diversity (Van Deursen & Van Dijk, 2015). There were also other terminologies used by earlier researchers, such as variation of internet use (Y. Li & Ranieri, 2013), internet usage (Ojo & Raman, 2017) and internet engagement (Ojo et al., 2022). Internet usage diversity is mostly defined in terms of frequency, the length of time the internet is used, or the type of online activities performed (Van Deursen & Van Dijk, 2015). In this study, internet usage diversity refers to the frequency of usage, either never, rarely, sometimes, often, or very often.

The second objective of the study is to examine the relationship between each of the types of access to ICT with demographic variables that include gender, study level, internet experience, and ownership of a 5 G-enabled device. The influence of ownership of 5 G-enabled devices is introduced in this study to investigate any digital divide in terms of the accessibility of ICT between students owning and not owning 5 G-enabled devices. Therefore, the significance of 5G technology can be brought as one of the determinants of the present digital divide, as reported by Lau et al (2023), which can be explored and elaborated for future research. Another study conducted by Ojo and Raman (2017) revealed a relationship between the opportunity and internet usage; an individual's internet usage diversity can be considered from a positive view of availability (Bigné et al., 2015). Therefore, in this study, the ownership of 5 G-enabled devices can be considered as an opportunity from a positive view of availability.

For the third objective of the study, the simultaneous relationship between each of motivational access, physical access, and skills access with internet usage diversity is investigated. All types of access to ICT are simultaneously tested to understand how access influences the digital divide among university students. In this relationship, internet usage diversity is the dependent variable, while the types of access to ICT are the independent variables.

There are diverse determinants of the digital divide that have been assumed in previous studies. However, limited empirical research on digital divide among university students has been conducted on the effects of demographic variables (gender, study level, internet experience, and ownership of 5G enabled device) on types of access to ICT and the simultaneous relationship between motivational access, physical access, and skills access with internet usage diversity. Therefore, this current study investigates the types of access to ICT, focusing on internet usage diversity among university students in Malaysia. While many studies have investigated the digital divide in terms of individual factors such as physical access or digital skills, this study is the first to look at the interaction of motivational access, physical access and digital skills access on internet usage diversity among Malaysian university students. Furthermore, the addition of 5 G-enabled device ownership and internet experience as significant demographic factors adds a new perspective to evaluating current access gaps in the context of upcoming technologies.

Background of Study: Self-efficacy and self-regulated learning are important for online learning settings, particularly during post- post-COVID-19 phase. Numerous universities have urged instructors to adopt online or blended learning approaches, and it has become increasingly crucial.

Research questions

The following research questions are designed to investigate the digital divide among students with four types of access to ICT:

- What are the levels of the four types of students' access to ICT?
- How does students' access to ICT relate to demographic characteristics (gender, study level, internet experience, and ownership of 5 G-enabled devices)?
- To what extent do motivational access, physical access, and skills access influence the internet usage diversity?

2. Literature review

Types of access to ICT

A study by Chang et al (2016) describes the digital divide as the divide, gap, or disparity between the sub-classes of the population that have adequate access to ICT, and the others that have poor or no access to computers, internet, and other digital devices. Soomro et al. (2020) denoted digital divide as the inequality of ICT access that generates a multifaceted problem, such as less or no effective participation of the people in the development of numerous features of society, due to their uneven access to ICT. The main consequence of the digital divide is that people have different access to information, knowledge, and other resources that could contribute to more general social inequalities and power differences (Bonfadelli, 2002). A multifaceted model by Van Dijk (2005) originally presented the digital divide at four successive levels: motivation, physical, skills, and access. Later, Van Dijk (2017) has conceptualized the digital divide issue into several distinct components such as motivational access, material access, digital skills, digital usage, and the resultant outcomes of digital usage. Subsequently, these components have been classified into three distinct levels of digital divide: motivational access and material access are in the first level, skills access and usage access are in the second level, and the resultant outcome of digital usage is in the third level. However, this present study only considers the first and second levels of the digital divide.

Motivation plays a significant role in forming an individual's attitude towards a particular task or situation. Motivational access encompasses individuals' motivation, attitudes toward technology, and their intention to adopt the technology (Subramaniam et al., 2024). This present study focuses on two different kinds of motivation – endogenous and exogenous motivation. Endogenous motivation results from an individual's self-desire to face new challenges and gain knowledge from a task or activity and feel the internal satisfaction from performing the task or activity (Subramaniam et al., 2024). Fischer et al. (2019) confirmed the positive effects of endogenous motivation on creative and innovative performance in any activity. This kind of motivation encourages satisfying and attractive behaviour, resulting in enjoyment and internal fulfilment for an individual who performs the activity. Exogenous motivation entails the performance of an individual through an activity to achieve a desirable outcome that is associated with instrument attributes, for example, rewards (X. Li et al., 2013). Meanwhile, endogenous motivation is expressed as perceived enjoyment, while exogenous motivation is also known as perceived usefulness. A study by Soomro et al. (2020) indicated that Pakistani faculty members were motivated to adopt digital technologies because of their internal satisfaction and attitudes that were internally constructed rather than the external sources such as availability of material resources, time, and social or cultural influence. The findings by Fischer et al. (2019) showed that the higher the perceived probability of receiving relational rewards in the form of praise, recognition, and performance feedback, the higher the endogenous motivation resulting in a greater positive effect on creative and innovative outcomes. This implies higher endogenous motivation and exogenous motivation would result in positive outcomes.

Physical or material access includes internet access, whether at home or elsewhere, and the expenses for hardware, software, and services (Van Dijk, 2005). This applies not only the core hardware of a computer, smartphone or internet connection but also peripheral equipment and materials such as paper and ink, software and also subscription charges that comprise a growing part of the total expenses for today's digital media and evidently, the sufficient income remains an important determinant (Van Dijk, 2012). Some additional cost is needed to have good-quality physical access. Therefore, sufficient income is required. Not all people can afford to have good quality physical access. Consequently, they are at a disadvantage in accessing quality ICT. For example, a report by Bernama (2024) stated that many phone users in Malaysia intended to upgrade their cellular service to 5G, however, they were deterred by the additional fee required to connect to

the next generation of high-speed wireless internet. In Malaysia, 58.9% of internet users used fixed broadband at home in 2022, which showed an increase of 37% from 2020 [22]. This implies that home internet access in Malaysia is improving in 2022 compared to 2020. This statistic has supported the earlier study by Ahmad et al. (2019), who showed no divide exists in digital device ownership, especially smartphones and home internet access.

People may be motivated to use computers and have sufficient physical access. However, they may lack digital skills. Learning how to manage the hardware and software is the next level to acquire after having acquired the motivation to use computers and some kind of physical access (Van Dijk, 2005; Van Dijk, 2012). There are two categories of digital skills: medium-related skills and content-related skills. The former comprises operational skills and formal skills and the latter comprises informational skills and strategic skills. Operational skills are basic skills in using digital technology, while formal skills are skills related to the hypermedia structure of the internet, which require the skills of navigation and orientation. Informational skills are competencies to seek information, and strategic skills are the capacity to use the internet as a means of reaching goals most optimally and efficiently. According to Van Deursen and Van Dijk (2011), education is found to be an important contributor to all these digital skills. Moreover, the acquisition of digital skills increases students' academic performance (Youssef et al., 2022). Gen and Gong (2021) reported that improving digital access and digital skills has a greater impact on Malaysian job seekers who are less active in the job market, and this implies that digital skills are crucial in job-seeking, particularly among university graduates. They further stated that degree-holding job seekers in Malaysia may have more opportunities than non-degree-holding job seekers to tap into the global market for digital tasks. Furthermore, they also believed that digital platform job seekers in Malaysia are young and highly educated women. Therefore, the universities must equip their graduates with sufficient digital skills during their studies so that they are digitally competent when entering the job market.

Having sufficient motivation, physical access, and digital skills is necessary to use ICT, but it is not a sufficient condition for actual usage. In this present study, usage access refers to internet usage diversity. A study by Kalmus et al. (2011) revealed two underlying motives for internet use: 1) social media and entertainment and 2) work and information. The study showed social media and entertainment motive was the most significantly predicted by the younger age with the frequency of internet use at public place, at friend's place and home, their openness to experience, who have lower education level, and ethnic minority status while work and information was best predicted by those with the frequency of internet use at work or school, active participation, who have higher education level, and ethnic majority status.

The actual utilization of digital technologies or media by an individual can be measured through diverse metrics such as the duration or frequency of usage, the specific purpose for which it is employed, and the extent of engagement in online activities (Subramaniam et al., 2024). For this present study, the frequency of usage, either never, rarely, sometimes, often, or very often, is employed to measure the internet usage diversity. The recent study by Nur Amalina Che Zainal et al. (2024) highlights the significant relationship between internet usage and new media literacy, indicating the importance of providing young people with the digital skills to navigate the online environment proficiently. They also further emphasized that internet engagement without these skills may limit the potential benefits and expose individuals to various online risks. According to Youssef et al. (2022), students' academic performance improves with the innovative and collaborative use of ICTs. An earlier study by Wei (2012) explored the multimodality of internet use as a critical indicator of digital inequalities and found that the more modes of internet activities people are engaged in, the more advanced uses they will add to their online behaviours. Regarding students' engagement and disengagement in technology-enhanced learning, Bergdahl et al. (2020) found that students who possessed high levels of digital skills related to engagement in technology-enhanced learning and digital skills, were not related to disengagement. This suggests that students with both high and low levels of digital skills tend to disengage to some extent when learning with technologies.

Demographic factors influencing access to ICT

Many studies have shown demographic factors such as gender, age, location, education level, household income, digital devices ownership, and internet access are the main contributors to the digital divide. According to Van Deursen and Van Dijk (2015), several socio-demographic variables, including gender, age,

and education level, appeared consistently in digital divide studies. Lythreath et al. (2022) identified nine main factors which are socio-demographic, socio-economic, personal elements, social support, type of technology, digital training, rights, infrastructure, and large-scale events that have affected the digital divide in recent years between 2017 and 2021 and digital divide has been mostly affected in education sector. A study by Afzal et al. (2023) revealed there are variations in internet access across different age groups, with younger individuals having higher levels of access compared to older age groups. The disparities in household internet access were observed between rural and urban areas, where rural areas are experiencing lower connectivity. Meanwhile, gender-based differences in personal device ownership were also evident which highlighting the potential gender-related digital divide, where students from low-income households faced lower levels of internet access, indicating a socio-economic divide in technology access.

Gender about digital skills was the least consistent indicator, while the most consistent indicator of digital skills was the educational level (Van Deursen & Van Dijk, 2011). A study by Ahmad et al. (2019) showed there was a gender divide in operational skills, social skills, creative skills, and mobile skills, except for informational skills, among secondary school students in Malaysia. However, Soomro et al. (2020) found there were no gender differences in digital skills among faculty members in Pakistan. The findings of the study showed significant gender differences among faculty's motivational and usage access in Pakistan, whereby male faculty were found to be more inclined to adopt digital technologies and had higher usage access than their female counterparts. Van Deursen and Van Dijk (2011) found that the level of educational attainment affected all four types of internet skills, but no gender differences for any of the four internet skills. Ojo et al. (2022) showed that demographic variables, including gender, education level, income, and internet experience, have influenced the internet engagement among urban people in Malaysia. However, an earlier study by Y. Li and Ranieri (2013) found there were no significant gender differences in internet inequality indicators, including technical apparatus, autonomy of use, availability of social support, and variation of use. An earlier study by Wei (2012) found that older, poorer, and less educated females only use the internet for limited basic applications.

Factors affecting internet usage diversity

Early research on digital divide issues revolved around the provision of internet access as the underlying factor of the digital divide. According to Van Deursen and Van Dijk (2015), digital divide issues should address motivational, physical, skills, and usage access simultaneously as each type of access interacts together to shape the digital inequalities. Improving motivation to adopt ICT would increase the tendency of an individual to increase his or her physical access, skills access, and usage access (Van Deursen & Van Dijk, 2015). Studies by Ojo and Raman (2017) and Ojo et al. (2022) suggested a usage behaviour as a variation in internet engagement by integrating the concept of access gaps with the ability-motivation-opportunity (AMO) framework. These studies viewed opportunity either from a positive view of availability or from a negative perspective of obstacles due to a lack of or not having physical access, as viewed by the earlier study. Meanwhile, the ability is defined as an individual's perception of the degree of his or her digital skills and competency to use the internet (Ojo & Raman, 2017).

With regard to digital skills, internet users must have technical competence, referring to the basic skills required to make use of the internet. Users must have internet skills to select the search system, define search queries, select information, and perform the evaluation. They also must have strategic internet skills which include the capacity to use the internet as a means of attaining particular goals and subsequently determining the goal of the internet session, engaging in the right actions, making decisions about how to reach the original goal by selectively retrieving information, and finally, gaining positive outcomes of internet use by making optimal decisions (Deursen et al., 2014). According to Hargittai (2002) and Hargittai (2005), to develop better online skills, people have to spend more time online to acquire more knowledge about the internet and gain more experience. Hargittai (2002) found that years of experience and intensity of use of the internet are known as strong predictors of internet skills. However, Van Deursen and Van Dijk (2011) showed that only operational internet skills grew with years of internet experience, but not with formal, information, and strategic internet skills.

3. Research Methodology

Research design: The study employed a cross-sectional survey design with a quantitative approach to gather information about the digital divide among higher education students in terms of motivational access, physical access, skills access, and usage access to ICT.

Sampling procedure and data collection: The sampling procedure was conducted in two stages. The first stage was the identification of lecturers to help out in the process of collecting data. The lecturers were selected from three fields of study of eight different faculties in a public university. Firstly, these lecturers were briefed about the objective of the study. Secondly, a convenience sampling approach was employed in the selection of the students by ensuring that the selected students represented all eight faculties in the university. The identified lecturers then helped to distribute the online survey to their students via their classes' WhatsApp groups. All participating students were informed that the survey was anonymous. Data were collected between 18th December 2023 to 11th January 2024.

Measures: Measurement items of motivational access and skills access in the questionnaire were measured by a 5-point Likert scale (1 – strongly disagree, 2 – disagree, 3 – neutral, 4 – agree, 5 – strongly agree). The measurements of motivational access and skills access were adapted from Soomro et al. (2018) and Soomro et al. (2020) to ensure the reliability and validity of the constructs. The measurement of physical access of 13 devices/software, which were either accessed at the university, colleges, rented house, or home using a dichotomous scale (0 – No, 1 – Yes) was also adapted from Soomro et al. (2018) and Soomro et al. (2020). Therefore, three separate indices were computed to reflect students' scores for their physical access: access at home, colleges or rented houses, and the university. Each device/software was assigned one point; the possible values for a score of physical access at home, at the place of stay, and university separately ranged from 0 to 13. A score of 0 means a student does not have the device. Each student's score was then converted to a scale of 5 points for uniformity with other variables. For this study, the average number of devices at three places was calculated for each student. As for usage access, the present study has used the term internet usage diversity adapted from Van Deursen and Van Dijk (2015) using 22 internet activities from Malaysia IUS 2022 (Malaysian Communications and Multimedia Commission, 2022) measured by 5-point ordinal scale (1 – never, 2 – rarely, 3 – sometimes, 4 – often, 5 – very often). Students were asked what frequency they engaged in 22 activities using a 5-point ordinal scale that ranged from never to very often in the analysis. These activities covered a broad range of academic and non-academic activities.

Data Analysis: Both descriptive and inferential statistics using SPSS Version 27.0 were conducted for data analysis. Descriptive statistics using mean, range, and standard deviation were employed to address research question 1. Multiple regression analysis was performed to address research question 2. Meanwhile, research question 3 was addressed by employing hierarchical multiple regression analysis.

4. Results

Demographic information of participants: A total of 351 pre-diploma, diploma, and undergraduate students who enrolled in the field of management science, social sciences and humanities, and computer science in a public university participated in this study. There were 66.7% females and 33.3% males.

The majority of the participants (76.4%) were in the age group of 17 – 19 years and 23.6% were in the age group of 20 – 26 years. More than 50% of the participants were in a diploma, 28.2% in a pre-diploma and 18.5% were undergraduates. Almost all students (98.9%) have accessed the internet by using smartphones and/or laptops (98%). Some of the students (31.9%) also used tablets and only 17.1% used desktops to access the internet. Most of the students have accessed the internet by using two devices (46.7%), followed by three devices (31.3%), and four devices (14%). Only 4% of students have accessed the internet using one device and a number of them (4%) used five devices to access the internet. The majority of students (61.8%) had 7 years or more in terms of internet experience, 24.5% with 5 years or less than 7 years of internet experience, and only 13.7% of students with less than 5 years of internet experience. Among the students, 50.4% had ownership of 5 G-enabled devices. Table 1 shows detailed demographic information about the participants.

Table 1: Demographic information of participants

Demographic information	Categories	n	%
Gender	Male	117	33.3
	Female	234	66.7
Age group	17 – 19 years	268	76.4
	20 – 26 years	83	23.6
Study level	Pre-diploma	99	28.2
	Diploma	187	53.3
	Undergraduate	65	18.5
Device to access the internet	Smartphone	347	98.9
	Laptop	344	98.0
	Desktop	60	17.1
	Tablet	112	31.9
	Smart TV	84	23.9
Number of devices to access the internet	1	14	4.0
	2	164	46.7
	3	110	31.3
	4	49	14.0
	5	14	4.0
Internet experience	Less than 5 years	48	13.7
	5 years < 7 years	86	24.5
	7 years or more	217	61.8
Access to 5 G-enabled devices	No	174	49.6
	Yes	177	50.4

Levels of access to digital technologies (Research question 1): The present study examined the higher education students' ICT access, which included motivational, physical access, skills access, and usage access, adopting the model suggested by Ghobadi and Ghobadi (2015) and Van Deursen and Van Dijk (2011). To determine the level of access to ICT, the study used the cut-off point 1.00 – 2.33 as low access, 2.34 – 3.66 as moderate access, and 3.67 – 5.00 as high access.

Descriptive statistics, including mean and standard deviation (SD), were acquired and are presented in Table 2 below. Students reported that they had an average internet experience of 8.2 years (SD = 2.704). They tended to have high levels of endogenous motivational access (mean = 4.40, SD = 0.674) and exogenous motivational access (mean = 3.89, SD = 0.689) that both ranged from 1.00 to 5.00, reflecting students' high motivation to adopt digital technologies. On comparing the two types of motivation, it was revealed that endogenous motivation was significantly higher than exogenous motivation ($t = 13.589$, $p < 0.0005$), indicating the desire of a student to adopt digital technologies from himself or herself which was higher than the outside sources including parental, peer, or social influences. Average scores for physical access at university were 1.94 (SD = 1.199), at place of stay (mean = 2.74, SD = 0.923), and at home (mean = 2.65, SD = 1.087). Results revealed that physical access at the university was the lowest, indicating a limited physical access at the university, while physical access at the place of stay and home was at a moderate level. The overall mean score for physical access was 2.44 (SD = 0.750), indicating a moderate level of overall physical access. For further analysis on physical access, the study considers the overall mean score.

Results revealed that all skills access were at high levels and there were significant differences between operational skills (mean = 4.03, SD = 0.686) and formal skills (mean = 3.66, SD = 0.815) ($t = 10.928$, $p < 0.001$), operational skills and informational skills (mean = 3.90, SD = 0.745) ($t = 4.644$, $p < 0.001$), informational skills and formal skills (mean = 3.66, SD = 0.815) ($t = 7.089$, $p < 0.001$), strategic skills and formal skills ($t = 10.736$, $p < 0.001$), and strategic skills and informational skills ($t = 6.455$, $p < 0.001$). The mean score of the frequency usage for the overall 22 internet activities was 3.14 (SD = 0.609), indicating a moderate level of internet usage diversity. The total overall mean of all access to ICT was 3.68 (SD = 0.664), indicating an overall high access level.

The overall Cronbach's alpha for internal consistency of access to ICT dimensions was 0.963, ranging from 0.810 to 0.925, indicating good to excellent internal consistency of the variable scales. The correlation of factors indicated all the dimensions of students' access to ICT were positively and significantly (ranged from $r = 0.138$ to $r = 0.821$) correlated to one another. Gender was poorly correlated with six factors of access to ICT, except for physical access ($r = 0.118$, $p < 0.05$). Study level was significantly correlated with all variables except endogenous motivational access. Internet experience was poorly correlated with gender but significantly correlated with other variables (ranged from $r = 0.165$ to $r = 0.235$). Access to 5 G-enabled devices was poorly correlated with physical access and study level but significantly correlated with other variables (ranging from 0.109 to $r = 0.218$). Table 2 displays the results of correlational analyses of the variables.

Table 2: Descriptive statistics, correlation, reliabilities and level of access to ICT

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1 Endogenous motivational access	1											
2 Exogenous motivational access	0.457****	1										
3 Physical access	0.102	0.138**	1									
4 Operational skill access	0.561****	0.647****	0.191****	1								
5 Formal skill access	0.331****	0.590****	0.109*	0.654****	1							
6 Informational skill access	0.528****	0.715****	0.173****	0.721****	0.681****	1						
7 Strategic skill access	0.531****	0.700****	0.098	0.699****	0.584****	0.821****	1					
8 Internet usage diversity	0.222****	0.238****	0.181***	0.352****	0.263****	0.303****	0.233****	1				
9 Gender (0 – male, 1 – female)	0.092	-0.026	0.118*	0.041	-0.094	-0.037	-0.005	0.069	1			
Study level												
10(0 – pre-diploma/diploma, 1 – undergraduate)	-0.057	0.337****	0.205****	0.158**	0.295****	0.227****	0.198****	0.216****	0.114*	1		
11Internet experience	0.210****	0.213****	0.211****	0.199****	0.172***	0.166**	0.165**	0.235****	0.050	0.222**	1	
12Ownership of 5G enabled devices (0 – no, 1 – yes)	0.150**	0.208****	0.006	0.189****	0.212****	0.207****	0.162**	0.139**	0.109*	0.077	0.142**	1
Mean	4.40	3.89	2.44	4.03	3.66	3.94	4.06	3.14	-	-	8.20	-
SD	0.674	0.689	0.750	0.686	0.815	0.708	0.690	0.609	-	-	2.704	-
Minimum	1.00	1.00	1.00	1.00	1.33	1.17	1.00	1.45	-	-	2	-
Maximum	5.00	5.00	5.00	5.00	5.00	5.00	5.00	4.77	-	-	11	-
Level of access to ICT	High	High	Moderate	High	Moderate	High	High	Moderate	-	-	-	-
Cronbach's alpha	0.858	0.810	SIM	0.833	0.771	0.920	0.925	0.888	-	-	SIM	-
Number of items	4	5	-	5	3	6	6	22	-	-	-	-

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$ **** $p < 0.0005$ SIM – Single item measure

About usage access, the five most favourite internet activities that students did were listening/watching online content like music, videos, TV, movies, and podcasts (80.9%), getting information (79.8%), video communication (76.7%), online banking (75.2%), and online learning (74.9%) while the least favourite was writing/replying e-mails (11.4%). The descriptive statistics of internet usage diversity are shown in Table 3. Considering the overall motivational access, physical access, skills access, and usage access, results showed that motivational access (mean = 4.15, SD = 0.582) was at the highest level, followed by skills access (mean = 3.97, SD = 0.633), internet usage diversity (mean = 3.14, SD = 0.609), and physical access (mean = 2.44, SD = 0.750).

Table 3: Descriptive statistics of internet usage diversity

Internet usage diversity	Frequency	%	Mean	SD	Minimum	Maximum
Listening/watching online content like music, videos, TV, movies, podcasts	284	80.9	4.23	1.000	1	5
Getting information	280	79.8	4.27	1.007	1	5
Video communication	269	76.7	4.14	1.001	1	5
Online banking	264	75.2	4.07	1.028	1	5
Online learning	263	74.9	3.96	0.913	1	5
Online shopping	189	53.8	3.53	1.079	1	5
Downloading content from the internet to a computer or smartphone	187	53.3	3.51	1.063	1	5
Work-related activities	173	49.3	3.33	1.244	1	5
Visiting a social network	146	41.6	2.98	1.292	1	5
Online games	142	40.5	3.20	1.235	1	5

Reading an online publication	141	40.1	3.27	1.008	1	5
Cloud storage	141	40.1	3.24	1.089	1	5
Uploading content to internet sites from a computer or smartphone	136	38.8	3.11	1.126	1	5
Online bill payment	127	36.2	2.99	1.298	1	5
Content creation	96	27.3	2.84	1.128	1	5
Online access to government	87	24.8	2.66	1.268	1	5
Online job searches	64	18.2	2.40	1.219	1	5
Online newspaper reading	59	16.8	2.52	1.041	1	5
Selling goods and services	50	14.3	2.17	1.200	1	5
Maintaining blogs	49	13.9	2.29	1.072	1	5
Online job application	45	12.8	2.12	1.133	1	5
Writing/replying to e-mails	40	11.4	2.35	0.994	1	5
Overall			3.14	0.609	1	5

Relationships of students' access to ICT with demographic information (Research question 2): To investigate how demographic variables were associated with students' access to ICT, seven separate multiple regressions were performed. The demographic variables included gender, study level, internet experience, and ownership of 5 G-enabled devices. For analysis, the study level was recoded as 0 – pre-diploma/diploma and 1 – undergraduate.

Gender, study level, internet experience, and ownership of 5G enabled devices significantly explained as 7.5%, 16.1%, 9%, 7.9%, 13.8%, 9.8%, 7.2%, and 9.8% of the variance in endogenous motivational access ($F(4, 346) = 6.968, p < 0.0005$), exogenous motivational access ($F(4, 346) = 16.658, p < 0.0005$), physical access ($F(4, 346) = 8.547, p < 0.0005$), operational skill access ($F(4, 346) = 7.374, p < 0.0005$), formal skills access ($F(4, 346) = 13.901, p < 0.0005$), informational skill access ($F(4, 346) = 9.428, p < 0.0005$), strategic skill access ($F(4, 346) = 6.744, p < 0.0005$), and internet usage diversity ($F(4, 346) = 9.399, p < 0.0005$), respectively. Study level, internet experience, and ownership of 5 G-enabled devices were significant predictors of endogenous motivational access, exogenous motivational access, operational skill access, and strategic skill access. Internet experience ($\text{Beta} = 0.214, t = 3.987, p < 0.0005$) was the most significant predictor of endogenous motivational access followed by ownership of 5G enabled devices ($\text{Beta} = 0.122, t = 2.322, p < 0.05$) and then study level ($\text{Beta} = -0.108, t = -2.008, p < 0.05$). The most significant predictor of exogenous motivational access was study level ($\text{Beta} = 0.294, t = 5.773, p < 0.0005$), followed by ownership of 5G enabled devices ($\text{Beta} = 0.169, t = 3.376, p < 0.001$), and then internet experience ($\text{Beta} = 0.125, t = 2.450, p < 0.05$).

For physical access, the most significant predictor was study level ($\text{Beta} = 0.187, t = 3.510, p < 0.001$), followed by internet experience ($\text{Beta} = 0.170, t = 3.198, p < 0.01$), and gender ($\text{Beta} = 0.136, t = 2.610, p < 0.01$). Ownership of 5G enabled device ($\text{Beta} = 0.155, t = 2.953, p < 0.01$) was the most significant predictor of operational skill access, followed by internet experience ($\text{Beta} = 0.149, t = 2.790, p < 0.01$), and then study level ($\text{Beta} = 0.117, t = 2.181, p < 0.05$) while study level ($\text{Beta} = 0.249, t = 4.810, p < 0.0005$) was the most significant predictor of formal skills access and then ownership of 5G enabled device ($\text{Beta} = 0.190, t = 3.736, p < 0.0005$). As for informational skill access, the most significant predictor was study level ($\text{Beta} = 0.187, t = 3.529, p < 0.0005$) and then ownership of 5G enabled devices ($\text{Beta} = 0.183, t = 3.514, p < 0.0005$). Study level ($\text{Beta} = 0.162, t = 3.028, p < 0.01$) was also the most significant predictor of strategic skill access, followed by ownership of 5G enabled devices ($\text{Beta} = 0.135, t = 2.563, p < 0.05$), and then internet experience ($\text{Beta} = 0.110, t = 2.054, p < 0.05$). The most significant predictor of internet usage diversity was internet experience ($\text{Beta} = 0.179, t = 3.384, p < 0.001$) and then study level ($\text{Beta} = 0.177, t = 3.347, p < 0.001$). It was found that gender was not a significant predictor for any of the types of access to ICT.

Table 4: Summary of multiple regression analyses for types of access to ICT

Demographic information	Types of access to ICT					
	Endogenous motivational access		Exogenous motivational access		Physical access	
	Beta	t	Beta	t	Beta	t
Gender (0 – Male, 1 – Female)	0.056	1.064	-0.017	-0.347	0.072	1.351
Study level (0 – Pre-diploma/Diploma, 1 – Undergraduate)	-0.108	-2.008*	0.294	5.773****	0.014	0.263
Internet experience	0.214	3.987****	0.125	2.450*	0.158	2.899**
Ownership of 5 G-enabled devices (0 – No, 1 – Yes)	0.122	2.322*	0.169	3.376***	0.048	0.903
R	0.273		0.402		0.195	
R square	0.075		0.161		0.038	
F(4, 346)	6.968****		16.658****		3.403**	

Table 4: Summary of multiple regression analyses for access to ICT (Continue)

Demographic information	Types of access to ICT									
	Operational skills access		Formal skills access		Informational skills access		Strategic skills access		Internet usage diversity	
	Beta	t	Beta	t	Beta	t	Beta	t	Beta	t
Gender (0 – Male, 1 – Female)	0.030	0.577	-	-1.795	-0.041	-0.782	-0.006	-0.123	0.070	1.355
Study level (0 – Pre-diploma/Diploma, 1 – Undergraduate)	0.117	2.181*	0.249	4.810****	0.187	3.529****	0.162	3.028**	0.177	3.347***
Internet experience	0.149	2.790**	0.095	1.833	0.100	1.894	0.110	2.054*	0.179	3.384***
Ownership of 5 G-enabled devices (0 – No, 1 – Yes)	0.155	2.953**	0.190	3.736****	0.183	3.514****	0.135	2.563*	0.093	1.781
R	0.280		0.372		0.313		0.269		0.313	
R square	0.079		0.138		0.098		0.072		0.098	
F(4, 346)	7.374****		13.901****		9.428****		6.744****		9.399****	

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$ **** $p < 0.0005$

Students of lower study level were more likely to have higher endogenous motivational access compared to their undergraduate counterparts. Meanwhile, students of higher study level were more inclined to have higher exogenous motivational access, operational skills access, informational skills access, strategic skills access, and internet usage diversity than their pre-diploma/diploma counterparts. Results showed that students who had more years of internet experience would have higher levels of endogenous motivational access, exogenous motivational access, physical access, operational skills access, strategic skills access, and internet usage diversity, but not formal skills access and informational skills access. Students who owned 5 G-enabled devices have higher levels of endogenous motivational access, exogenous motivational access, operational skills access, informational skills access, strategic skills access, but not internet usage diversity. Table 4 above shows the summary of seven multiple regression analyses predicting the types of access to ICT.

Influences of motivational access, physical access, and skills access on internet usage diversity (research question 3): To investigate the influences of each motivational access, physical access, and skills access on the internet usage diversity, all independent variables were divided into two models. They were individually analysed using hierarchical multiple regression analysis using internet usage diversity as the dependent variable. Model 1 included three independent variables: endogenous motivational access,

exogenous motivational access, and physical access. Model 2 included all the variables in Model 1: operational skills, informational skills, and strategic skills.

As shown in Table 5 below, the independent variables in Model 1 significantly explain 9.3% of the variance in internet usage diversity ($F = 11.930$, $p < 0.0005$). For this model, all the independent variables have reached significant levels. Exogenous motivational access is the most significant predictor of internet usage diversity ($Beta = 0.155$, $t = 2.688$, $p < 0.01$), followed by physical access ($Beta = 0.145$, $t = 2.814$, $p < 0.01$), and then endogenous motivational access ($Beta = 0.136$, $t = 2.370$, $p < 0.05$). After controlling for endogenous motivation, exogenous motivation, and physical access and introducing the three skills access in model 2, the results show a significant relationship ($F = 9.666$, $p < 0.0005$) with 14.4% of the variance in internet usage diversity which is explained by endogenous motivation, exogenous motivation, physical access, and the new included operational skills, informational skills, and strategic skills. The R-squared is increased by 14.4% with physical access and operational skill access reaching significant levels. The predictive power of operational skills is the highest ($Beta = 0.289$, $t = 3.393$, $p < 0.001$) and then the physical access ($Beta = 0.134$, $t = 2.638$, $p < 0.01$), indicating high levels of physical access and operational skills access are significantly associated with higher internet usage diversity. The findings have concluded that operational skills access is the most significant predictor of internet usage diversity, followed by physical access. Endogenous motivational access, exogenous motivational access, informational skills access, and strategic skills access do not influence internet usage diversity. Results have implied that a digital divide exists in internet usage diversity in terms of operational skills and physical access. Table 5 presents the results.

Table 5: Hierarchical multiple regression results predicting internet usage diversity

Variables	Model 1				Model 2			
	B	Std error	Beta	t	B	Std error	Beta	t
Endogenous motivational access	0.102	0.052	0.113	1.961*	0.023	0.057	0.026	0.410
Exogenous motivational access	0.156	0.050	0.177	3.096**	0.009	0.068	0.010	0.129
Physical access	0.145	0.042	0.179	3.472***	0.119	0.041	0.147	2.885**
Operational skills access					0.214	0.075	0.241	2.859**
Formal skills access					0.008	0.054	0.011	0.152
Informational skills access					0.179	0.077	0.219	2.331*
Strategic skills access					-0.131	0.082	-0.147	-1.609
R			0.322				0.401	
R square			0.104				0.161	
R-squared change			0.104				0.057	
F			13.418***				9.394***	

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$ Dependent variable – Internet usage diversity

Discussion

Levels of access to ICT: In this digital era, being tech-savvy is desirable for most people which including teachers and students. There is limited research conducted about university students' digital literacy. This study revealed that students needed motivational access, physical access, skills access, and usage access to enable them to access ICT. Results of the study showed that students tended to have high levels of endogenous motivational access, exogenous motivational access, operational skills access, informational skills access, strategic skills access, and moderate levels of physical access and internet usage diversity. This is consistent with the study by Soomro et al. (2020), who found that endogenous motivational access, exogenous motivational access, operational skills access, informational skills access, and strategic skills access were at high levels and physical access was at a moderate level among Pakistan faculty members.

Students were found to have relatively high endogenous motivation compared to exogenous motivation, which was in line with Soomro et al. (2020), indicating that students and faculty members had a resemblance in motivational access to ICT. Students were motivated to adopt digital technologies from their desire to gain new knowledge, which was influenced by their interest that exists within themselves, rather than being based on

external sources such as the availability of material resources, time, and social or cultural influence. Findings of the present study also showed that overall physical access to ICT was at a moderate level, suggesting students had access to adequate ICT infrastructure. Even though physical access was at a moderate level, it ranked last among the dimensions of access to ICT and this was consistent with the studies by Van Deursen and Van Dijk (2015) and Soomro et al. (2020). The results showed that physical access at the university obtained the lowest score. This calls for attention by the university authorities to equip the university with adequate and latest digital technologies to serve students as well as lecturers in the teaching and learning process.

Results of the present study revealed that the sequence of skills access level was strategic skills, followed by informational skills, and then operational skills. However, the results differed from the study by Soomro et al. (2020) which found the sequence of the skill levels was operational skills, followed by informational skills, and then strategic skills among the faculty members. The difference was due to the population studied. As for the students, they access ICT for learning purposes, thus, they had strategies for achieving excellence in academics, seeking information, and basic operational skills. As for faculty members, they access ICT for teaching purposes, and hence, they have to initially know the basic operational skills, then they must have informational skills to seek information, and finally, they achieve the teaching goal. About internet usage diversity, the study found that the most frequent internet usage was listening/watching online content like music, videos, TV, and movies, getting information, video communication via the internet such as WhatsApp and Facebook, online banking, online learning, online shopping, and downloading content from the internet to a computer or smartphone while the least frequent was writing/replying e-mails. The overall internet usage diversity score was 3.14 at a moderate level, indicating students were not so addicted to internet activities, which means they were able to balance their non-academic from academic activities.

Demographic information and access to ICT: Students of lower study level were more likely to have higher endogenous motivational access compared to their undergraduate counterparts. On the other hand, students of higher study level were more inclined to have higher exogenous motivational access, operational skills access, informational skills access, strategic skills access, and internet usage diversity than their pre-diploma/diploma counterparts. There were motivational gaps between lower study levels and higher study levels. Endogenous motivational access was higher among students of lower study level, which was consistent with the study by Lepper et al. (2005), who showed that intrinsic motivation had a significant linear decrease from lower grade through higher grade children, while exogenous motivational access was higher among students of higher study level. The reason is that students of lower study level who had just entered the university have high endogenous motivation for their academic achievement and as they proceeded to higher study levels, they became exogenously motivated by something rewarding. Education level appeared to be an important contributor to all skill levels which was consistent with the earlier studies (Van Deursen & Van Dijk, 2011; Van Deursen & Van Dijk, 2015) while a recent study by Ojo et al. (2022) showed educational attainment is positively related to frequency engagement with the internet. The possible reason was that students of higher study levels had gone through courses and training throughout their studies in the university, which caused them to be operationally, informationally, and strategically skilled in using computers and the internet. Students from higher study levels also showed have higher frequency in internet usage diversity, which was consistent with the study (Ojo et al., 2022).

Results showed that students who had more years of internet experience would have a higher level of endogenous motivational access, exogenous motivational access, physical access, operational skills access, strategic skills access, and internet usage diversity, but not informational skills access. In contrast to the studies by Van Deursen and Van Dijk (2011) and Van Deursen and Van Dijk (2015), the present study contributes internet experience only to the levels of operational skills and strategic skills, but not informational skills. About internet usage diversity, the results of the study were consistent with the studies by Van Deursen and Van Dijk (2015) and Ojo et al. (2022), who showed a positive relationship between internet experience and internet usage diversity among the Dutch and the Malaysians, respectively.

Students who owned 5 G-enabled devices revealed to have higher levels of endogenous motivational access, exogenous motivational access, operational skills access, informational skills access, strategic skills access, but not internet usage diversity. A study by Lau et al. (2023) reported that the implementation of 5G technology in Malaysia has the potential to reduce the digital divide and promote inclusiveness, thereby contributing to the

growth of a sustainable and environmentally conscious economy. Further studies are needed to investigate the potential of 5G technology in narrowing the digital divide among people by relating it to levels of access to ICT.

The result of the study also found that gender was not a significant predictor for any dimensions of access to ICT which was consistent with Kalmus et al. (2011), Ragnedda et al. (2024) and Van Deursen and Van Dijk (2011) who showed that gender was not a significant predictor of internet usage diversity and digital skills, respectively. However, it was inconsistent with Ojo and Raman (2017), who showed that gender was a determinant of internet engagement, while Van Deursen and Van Dijk (2015) showed that gender was an important variable related to digital skills.

Effects of motivational access, physical access, and skills access on internet usage diversity: The results concluded that operational skills access was the most significant predictor of internet usage diversity, followed by physical access. Students with high levels of operational skills and physical access were inclined to have a higher frequency of internet usage diversity. Gómez (2018) found that medium-oriented skills (operational and formal skills) were more or less generalized among the young respondents, who generally expressed being familiar with the use of digital devices. Endogenous motivational access, exogenous motivational access, informational skills access, and strategic skills access did not influence internet usage diversity. The results showed that students' operational skills access and physical access were more important in explaining their internet usage diversity, but not endogenous motivational access, exogenous motivational access, informational skills access, and strategic skills access. The results have implied that a digital divide exists in internet usage diversity in terms of operational skills and physical access. Besides that, follow-up analyses using an independent samples t-test showed that computer science students had significantly higher operational skills level than their peers from other fields of study ($t = -3.211, p < 0.001$). Apart from that, the use of one-way ANOVA has revealed that the physical access for students from high monthly household income was significantly higher than their peers from lower monthly household income. This calls for attention from the university to support students by providing digital skills training opportunities. For example, students need to be supported and encouraged to attend digital skills training provided by the university. Through digital skills training opportunities, students can also enhance their digital literacy and digital competence. Results of the present study were also partially consistent with Ojo and Raman (2017), who found that extrinsic motivation and internet skills were significant predictors of internet engagement among Malaysians aged between 20 years to above 50 years old.

Theoretical and practical implications of internet usage diversity on digital divide: The existence of digital divides on six dimensions of access to ICT among public university students was investigated. There are several implications of internet usage diversity on the digital divide among public university students. The results of the study found that operational skills access and physical access were significant predictors of internet usage diversity.

Orientation program to enhance students' digital skills and internet usage diversity: The present study investigated a model of access to ICT among the Malaysian students' population. The model includes four types of access: motivational, physical, skill, and usage. Although Malaysians exhibit very high internet penetration of 97.4% in January 2024 with 33.59 million internet users (Kemp, 2024), the study finds there are several access divides that are still present. From the findings, study level and internet experience have influenced the internet usage diversity, which agrees with the earlier studies (Kalmus et al., 2011; Van Deursen & Van Dijk, 2015; Ojo & Raman, 2017). Students at higher study levels who have more years of internet experience showed higher engagement in internet usage diversity. The positive relationships between study level and internet experience with internet usage diversity indicated that the students became more confident in using digital technologies for gaining more information and their learning as well. Thus, universities should provide students with opportunities to learn about internet usage diversity to build up their confidence in using ICTs for their learning purposes.

Similarly, study level was also positively associated with all skills access, indicating that higher study levels tended to develop higher digital skills levels. Thus, it is important to expose students at a lower study level with less internet experience to undergo an orientation program or digital skills training so that they are

familiar and confident in handling digital technologies for their academic tasks. According to Shen et al. (2013), an orientation program will help students develop self-efficacy to handle tools in a course management system. Teachers and lecturers also must undergo continuous training so that they will be competent in using ICT and be able to produce high-level ICT skills generation (Umar & Yusoff, 2014).

Promote the ownership of 5 G-enabled devices: The study findings demonstrate ownership of 5 G-enabled devices in all dimensions of access to ICT except for physical access and internet usage diversity. Students who owned 5 G-enabled devices had significantly higher endogenous motivational access, exogenous motivational access, operational skills access, informational skills access, and strategic skills access than students who did not own 5 G-enabled devices. Lau et al. (2023) in their study reported that the deployment of 5G technology offers a prospect to narrow the digital gap in Malaysia. The remote and underserved regions will benefit from the extension of 5G network infrastructure that can lead to enhanced connectivity, access to digital services, and increased opportunities for the region's economic participation. A report by Umar and Yusoff (2014), 5G availability in Malaysia has increased from 21.0% in Q1 to 27.0% in Q4 of 2023. However, Malaysia is still lagging behind its neighbouring countries, such as Singapore with 53.8% 5G availability and Thailand with 45.5% 5G availability, but it is slightly higher than the Philippines, at 26.2%. Umar and Yusoff (2014) also reported that in terms of 5G network performance, Malaysia is leading other Southeast Asian countries with Malaysia's 5G median download speed of 451.79 Mbps. Therefore, the implementation of 5G technology in Malaysia has the potential to reduce disparities and promote economic growth, preserve the environment, and social well-being (Lau et al., 2023).

5. Conclusion, Limitations and Future Study

Conclusion: This study concludes that the digital divide still poses daunting challenges for university students in Malaysia based on motivational access, physical access, skills access, and usage access to ICT, which is consistent with a study by Subramaniam et al. (2024). Nevertheless, one of the study's contributions was to include demographic variables such as gender, study level, internet experience, and ownership of 5 G-enabled devices in the multiple regression models for each dimension of ICT access. In response to research question 1, the results of the study provide statistical evidence that firstly, there is a development of digital divide and secondly, digital divide levels include differences in motivational access, physical access, digital skills access, and usage access to ICT. Despite students' lower physical access to ICT, the findings of the study suggest that the students' high motivational access is more likely to help them in developing better digital skills when using digital technologies, which is consistent with Soomro et al. (2020). Regarding the second research question, ownership of 5 G-enabled devices does not show significant effects on physical access and internet usage diversity, which implies that students are frequently engaged with the internet. The results indicate that the intervention of new digital technologies, such as 5G technology, has narrowed the digital divide in some way. However, there are operational, formal, informational, and strategic skills gaps between students who own 5 G-enabled devices and those who do not own them. There is also no gender gap noticeable in all dimensions of access to ICT and this implies that regardless of gender, all have access to ICT. Results also show there are digital inequalities in terms of study level, internet experience, and ownership of 5 G-enabled devices with regard to endogenous motivational access, exogenous motivational access, operational skills access, formal skills access, informational skills access, and strategic skills access.

In response to research question 3, findings of the study showed operational skills access, informational skills access, and physical access are significant factors when engaging in internet usage diversity. Meanwhile, endogenous motivation, exogenous motivation, formal skills, and strategic skills had no effects on internet usage diversity. This suggests that to engage in internet usage diversity, university students still have digital gaps in operational skills, informational skills, and physical access in which are disconcerting challenges for them. The results have confirmed the successive flow of the digital divide that started from motivational access to usage access except for the relationships between endogenous motivational access with physical access and physical access with strategic skills access. The reason for these contrary relationships is due to digital disturbance among students, as reported in a prior study by Bergdahl et al. (2020), who believe digital disengagement could also be the cause of digital disturbance. This study provides some valuable contributions to the reality of the digital divide among Malaysian university students.

Finally, bridging the digital divide among university students requires a concerted effort from both public and private corporations, particularly those in the technology and telecommunications industry, and public institutions, including government bodies, political organizations, and policymakers. Since the digital divide is closely intertwined with social and economic disparities, substantial support and intervention from both the public and private sectors are imperative. This study contributes to the literature on the digital divide by presenting an integrated access model that considers motivational, physical and digital skill access. It allows us to better understand how these factors influence internet usage diversity in a Malaysian university context. Future access indicators such as 5 G-enabled devices and their relationship to digital access and consumption give valuable information for policy and infrastructure development.

Limitations and future study: There are some limitations of the study. First, this study only limits to students who were studying in three study levels: pre-diploma, diploma, and undergraduate, excluding the post-graduate students. The post-graduate students should also be included in future studies to explore the comparisons on digital divide issues. Second, this study only depends on self-reported data of students' digital skills. Students with weak digital skills might have been reluctant to report their actual digital skills level. Digital skills tests can be given to students to assess their digital skills levels, which, of course, requires a lot of time, particularly if the sample size is large. Third, this study only measures internet usage diversity by its frequency of usage; never, rarely, sometimes, often, or very often. Future research should also include internet usage diversity by the number of internet activities used as an indicator of digital inequalities (Wei, 2012). Lastly, this study focuses only on the first and second digital divide, excluding the third level of digital divide outcomes. Therefore, the future study should also include the digital divide outcomes such as students' learning satisfaction, their life satisfaction, and academic performance. With regard to the findings of these research questions, the digital divide among university students does hurt higher educational outcomes, which needs to be explored for future research.

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