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Digital divide among B40 students in Malaysian higher education institutions

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Abstract

While technological advances have led to digital transformation in many higher education institutions (HEIs), digital divide, especially among students in developing nations, is becoming a growing concern. This study aims to investigate the use of digital technology among B40 students (students from the lower socioeconomic backgrounds) in Malaysian HEIs. Specifically, this study intends to investigate how perceived ease of use, perceived usefulness, subjective norms, perceived behavioural control, as well as gratification constructs significantly affect digital usage among B40 students in Malaysian HEIs. This study used the quantitative research method with an online questionnaire which received 511 responses. SPSS was employed for demographic analysis, while Smart PLS software was used for structural model measurements. This study was based on two theories: planned behaviour theory and uses and gratification theory. The results showed that perceived usefulness and subjective norms significantly influenced the digital usage of the B40 students. In addition, all three gratification constructs indicated a positive effect on the students' digital usage.

Keywords Digital usage · Lower socio-economic background · Students · Higher education

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1 Introduction

Recent rapid technological advances have led to digital transformation in many higher education institutions (HEIs). The United Nations Educational, Scientific and Cultural Organization (UNESCO) highlighted that quality education links with almost all sustainable development goals (SDGs) which further emphasised the efforts in increasing people's access to quality education, regardless of the socioeconomic differences (UNESCO, 2016). Despite the pressing need to provide quality education for students of all levels, digital divide has become a growing concern in the higher education sector. Digital divide is a common issue in many countries, especially in developing nations (James, 2019). This is due to its significant impacts on societal development, particularly on individuals with limited or no access to technology who may be left behind in terms of socioeconomic opportunities (Sanders & Scanlon, 2021). Thus, narrowing the digital divide in society is crucial for sustainable quality education.

The emergence of the Coronavirus (COVID-19) disease in 2019 has led to various major disruptions globally, including the education sector, which was severely affected due to the pandemic. The HEIs, locally and globally, faced unprecedented challenges due to the disrupted teaching and learning process. Academicians had to adopt alternative teaching methods to replace the full face-to-face mode during the pandemic. Subsequently, online learning, or e-learning, emerged as an alternative 'emergency remote teaching' method for academicians to deliver education to their students. Even though digital teaching and learning has been adopted in education systems over the past few years, the pandemic has caused a dramatic increase in technology usage among students around the globe. As stressed by Radha et al. (2020), the teaching and learning process has dived into the digital world where academicians and learners are virtually connected.

The ubiquity of digital technologies has increased the demand for digital access, skills, and usage among higher education students. However, the disparity in their technological access, skills, and usage has been widely observed in the literature. As noted by Lai and Hong (2014), students' use of digital technologies is rather limited even though they have spent a considerable amount of time using digital tools. Wang et al. (2022) highlighted that the digital divide is closely related to poverty whereby people who are struggling with educational poverty would face considerable challenges in accessing effective Internet resources. Moreover, students from lower socioeconomic backgrounds generally have limited access to and use of the Internet which in turn creates obstacles to transforming education into a powerful tool to reduce inequalities among students (Nikolaos et al., 2019).

Similarly in Malaysian higher education context, digital teaching and learning evolved rapidly over the years. According to Azman et al. (2014), tertiary students in Malaysia are labelled as digitally matured. However, digital divide still exists among higher education students in this country, and it became more evident during the COVID-19 pandemic. The pandemic has led to more students losing out on opportunities to pursue higher education (Looi et al., 2023). Thus,

various initiatives were carried out by the Malaysian government to narrow the digital divide, especially focusing on B40 group with lower socio-economic backgrounds.

Digital learning has also been found to be related to stress due to academic, financial, and social issues. The deprivation that students experienced during the Covid-19 crisis, according to research, was significantly influenced by the stability of household income, which was affected by Malaysia's high levels of economic and social stress (Sharin, 2021). Sayed Umar, (2021) argued that the Covid-19 pandemic has uncovered the digital divide in Malaysia especially among students. They further added that despite Malaysia's digital progress, digital divide persists in many aspects including education. It was discovered that under the emergency online learning technique, students who were digitally excluded were less satisfied with their educational experiences (Tan et al., 2022). Government-linked companies (GLCs) took initiatives in providing RM150 million for students from lower-income families with laptops, tablets, and data connectivity (The Malaysian Reserve, 2021). The initiatives were to support home-based learning for students due to the Covid pandemic. Yet, as Zakri (2019) argued, efforts are still needed to ensure that these initiatives could bring real impacts and move beyond merely providing technological access to individuals. Although it is evident that Malaysia managed to narrow the digital divide, such impact does not occur at all levels (Zakri, 2019). For instance, while the pandemic has led to rapid transformation in higher education system, digital disparity has become more evident among students with lower socio-economic backgrounds. Furthermore, there is a scarcity of research on multi-level perspectives that focus on the digital divide in the Malaysian higher education context. Hence, this study seeks to examine the digital divide among higher education students with lower socioeconomic backgrounds. The study is guided by the following research questions:

1) Do perceived ease of use, perceived usefulness, subjective norms, and perceived behavioural control significantly affect the digital usage among B40 students in Malaysian HEIs?
2) Do the gratification constructs significantly affect the digital usage among B40 students in Malaysian HEIs?

2 Problem statement

According to Henderson et al. (2015), learning infused with digital technologies is crucial for students' learning process as it provides significant changes in terms of their learning experience. However, Panyajamorn et al. (2018) stressed that there are persistent concerns about the quality of online learning compared to face-to-face learning environment. The implementation of digital technologies in the higher education environment is among critical issues debated from both the scientific and practical perspectives (Kuemmel et al., 2019). Selwyn (2016) and Pinto and Leite (2020) urged researchers to look beyond the questions of

'what is being used' and 'what matters' when addressing the use of digital technologies for teaching and learning in higher education. In this sense, digital learning can be a challenging learning experience for vulnerable students. While past studies examined students' learning experience with digital learning (Alty et al., 2006; Clark et al., 2011; Persada et al., 2019), little is known about digital learning divide among students from vulnerable groups. Thus, this study aims to investigate the use of digital technology among vulnerable students (B40) in Malaysian HEIs. The anchoring question that guided this study is how the students' behavioural aspects can affect their digital usage in learning at their university. In addition, this study seeks to explore whether the varying levels of digital divide among the B40 students can affect their behaviour in using digital technology.

3 Theoretical perspectives

3.1 Digital divide in higher education

The advances of information and communication technologies (ICT) have made today's world more dynamic than ever before. However, in reality, not everyone has access to and proficiency with the most recent technologies, hence the digital divide has emerged as a new kind of socioeconomic inequality (Saha & Zaman, 2017). The term 'digital divide' refers to the gap between those with and without access to ICT, as well as between those who have and do not have such tools (Boje et al., 2003). Past studies demonstrated that digital divide has contributed to the widening of the wealth gap between rural and urban areas in emerging countries, where digital tools are seen as a key driver for socioeconomic development (Nair et al., 2010). In a similar vein, digital divide is also observed in the higher education sector as evidenced by the struggles faced by HEIs in meeting the varying demands of students with different levels of technological readiness, and with limited technological skills, which may hinder the students' performance (Naidoo & Raju, 2012).

Digital learning progresses rapidly in the Malaysian higher education sector. According to Azman et al. (2014), digital technologies are well adapted by learners in Malaysian HEIs, and most of them are considerably digitally mature. In addition, many educators in the HEIs utilise the digital teaching and learning approach to facilitate students' acquisition of new knowledge and skills, in line with the Industrial Revolution 4.0 (4IR) which enables them to implement online learning and provide the best learning outcomes for learners with necessary digital skills and knowledge for embarking their professional lives (Rahim et al., 2020). However, without sufficient action, the "information-rich and information-poor" gap in Malaysian higher education will continue to deepen and become an unbridgeable gulf if the country's progress towards knowledge economy is not reaped by those without proper access to and use of ICT.

3.2 Students from lower socioeconomic backgrounds

Students from lower socioeconomic backgrounds, or the underprivileged, may use technology less frequently than privileged students (Robinson et al., 2015). As pointed out by the authors:

> As the internet matures, forms of digital exclusion proliferate. First-level digital disparities in access are joined by digital engagement gaps, chasms between content consumers and producers, and disparate forms of participation in the high-tech economy.

Past scholars argued that the disparity in digital learning exists among students from lower socioeconomic backgrounds (Azubuike et al., 2021; Antonio & Tuffley, 2014; Blank & Groselj, 2014). The disadvantaged individuals typically have limited access to technology and the Internet as well as fewer opportunities and a lack of digital skills (Zillien & Hargittai, 2009).

Generally, Malaysians can be divided into three main groups according to their income level, which are Bottom 40% (B40), Middle 40% (M40), and Top 20% (T20). According to the Department of Statistics, Malaysia (DOSM, 2017), the B40 household income in Malaysia is generally not more than RM4,850 per month. B40 students are the most vulnerable group of learners who benefit the least from digital learning. The government plays an active role in providing the necessary educational platforms for B40 students to strive towards improving their life to the next level, as aspired by the Eleventh Malaysia Plan (11MP) (Sani et al., 2018). At the national level, numerous initiatives have been made to increase B40 students' access to digital learning.

3.3 Conceptual framework

Many frameworks have been used in the literature to explain the usage of digital technologies. Some of the popular theories forming the frameworks include the theory of reasoned action, the theory of planned behaviour (TPB), the technology acceptance model, and the theory of diffusion of innovations. To explore the factors that influence the digital divide among the B40 students in higher education, a research model that integrates the uses and gratification theory, TPB, and three digital divide levels is proposed in this study.

3.3.1 Theory of Planned Behaviour (TPB)

The TPB has been extensively and successfully utilised in various studies to understand and predict human behaviours (Ajzen, 2014). The TPB constructs consist of attitude, perceived ease of use (PEOU), perceived usefulness (PU), subjective norms, and perceived behavioural controls. According to Davis, (1989), PEOU refers to the extent to which a person believes that it is easy to use a technology, while PU refers to the degree to which a technology user believes that

the technological usage will increase his or her efficiency in performing certain task/job (Davis, 1989; Sledgianowski & Kulviwat, 2009). Subjective norms relate to how far an individual believes that others think he or she should perform certain behaviour (De Groot & Steg, 2007). Perceived behavioural control, on the other hand, refers to the ability of an individual to perform the task or job within his/her control (Ajzen, 1991). Perceived ease of use, perceived usefulness, perceived behavioural control, and subjective norms are variables adopted in the research framework of this study.

3.3.2 Uses and Gratification Theory (UGT)

Stafford et al. (2004) identified three key dimensions of gratification which relate to an individual's satisfaction in using the Internet, namely affective gratifications (e.g., a kind of emotional fulfilment), content gratifications (e.g., information, education, knowledge, learning, research), and social gratifications (e.g., live chatting, interaction, and social interaction with people in general). In this research, these three UGT constructs were integrated to study the B40 students' satisfaction in their digital learning usage. Thus, variables such as contents uses gratification, affective uses gratification, and social integrative uses gratification were adopted in the research framework of this study.

3.3.3 Research Hypotheses and Framework

The TPB was employed as the underlying theoretical framework in this study. However, this theory was criticised in the past studies for neglecting non-cognitive aspects (Rapaport & Orbell, 2000; Wolff et al., 2011). In addition, Ajzen (2014) suggested that non-cognitive aspects could influence the individual's behaviour in a more direct manner, which is not sufficiently accounted in the TPB. Given this concern, the theoretical framework in this study was further extended by incorporating the UGT constructs to examine the digital usage among B40 students in Malaysian HEIs. This integrated theoretical framework will further enhance the proposed research framework. Table 1 below draws important key points from related literature which provide further inputs to form the hypotheses in this study.

PEOU is known as one the critical factors of technology usage. According to Lee (2009), PEOU is related to the user's effort in using technology for learning and perceived usability of technology. Past literature showed that there is a positive relationship between PEOU and digital usage (Davis 1989; Chauhan et al., 2019; Andre et al., 2021). It can be implied that perceived ease of use influences digital usage among students. Thus, we assume:

H1: Perceived ease of use positively impacts digital usage among students.

Perceived usefulness (PU) is the degree of confidence that using technology can improve one's ability to perform one's job. A recent study (Sayaf et al., 2022) has demonstrated a positive relationship between perceived ease of use and digital usage. The digital device can be used to teach students collaboration, communication, and

Table 1 Research hypotheses

Hypothesis	Motivation	Supporting Studies
H1 Perceived Ease of Use → Digital usage	Individual's PEOU as an important determinant of his/her acceptance of digital technology	Davis (1989)
H2 Perceived Usefulness → Digital usage	Perceived usefulness aspects that influence the individual's digital technology usage	Davis (1989)
H3 Subjective norm → Digital usage	Very close people/surroundings that influence the individual's technology usage activities	De Groot & Steg (2007)
H4 Perceived behavioural control → Digital usage	Perceived behavioural aspects that influence the individual's technology usage activities	Ajzen (1991)
H5 Content uses gratification → Digital usage	How the individual's information and knowledge influence his/her digital technology usage	Luo et al. (2010)
H6 Affective uses gratification → Digital usage	How the individual searches for emotional fulfilment, pleasant feelings, and aesthetic experience in digital learning	Mondi et al. (2008)
H7 Social integrative gratification → Digital usage	How the individual interacts with others when using digital technology medium	Stafford et al. (2004)

participation beyond the classrooms, such as flipped classroom which can promote the channels of study for the students (Limniou, 2021). Similarly, Youssef et al. (2022) emphasised that ICTs enhance the education experience and the perceived usefulness of digital devices. Therefore, we propose that:

H2: Perceived usefulness positively impacts digital usage among students.

Subjective Norm (SN) pertains to a person's belief that most of his/her references strive to promote the use of ICT in the learning system, or to inspire non-fulfilment and observance of the views and aspirations of the audience. It is regarded to be one of the elements impacting technology uptake and acceptance (Saengchai et al., 2019). The relationship between subjective norms and digital usage has been widely examined (Saengchai et al., 2019). It is believed that subjective norms play a significant role in forming attitudes towards technology usage (Ursavaş et al., 2019). In Tran et al., (2023) study, subjective norm is regarded as an important variable. The results of their study confirmed the positive impact of digital usage on subjective norm, which can be also observed in other past studies, which have demonstrated strong positive interaction between subjective norm and digital usage (Binyamin et al., 2018; Zhuang et al., 2021). These findings demonstrate that the social context in which the technology is deployed plays a crucial role in an individual's decision to finally use the technological innovation (Kowalczyk, 2008). Therefore, we propose that:

H3: Subjective norm positively impacts digital usage among students.

According to Cheon et al. (2012), perceived behavioural control positively influences the digital usage among students, which means that digital learning adoption is more common among students who are comfortable with using mobile devices. Universities must therefore offer students training opportunities in the fundamental uses and applications of mobile learning (m-learning) technology. Empirical results of past studies support the hypothesis that there is a positive effect of perceived behavioural control on the usage of mobile network for study (Altawallbeh et al., 2015; Hansen et al., 2018; Yeap et al., 2016). Therefore, we assume that:

H4: Perceived behavioural control positively impacts students' digital usage.

It pertains to the gratification or benefits that draw audiences to different forms of media and keep them engaged, as well as the kinds of material that meet their social and psychological needs (Abbasi et al., 2021). The influence of perceived behavioural control on digital usage of students may be positive or negative (Abbasi et al., 2021) and is determined by the content of digital learning. Digital games, for instance, can have a negative impact on digital usage and make students addictive to it. Gao & Feng (2016) claimed that gratification has a significant impact on how people use and interact with the media. Understanding these motivations is essential for creating relevant content and encouraging users to interact with brands on social

media. Improving perceived content quality can enhance customer satisfaction, and prolong usage time (Ray et al. (2019)) believe gratification and actual use of technologies positively impact intention to use. Based on above, our hypothesis is:

H5: Content uses gratification positively impact digital usage among students.

Affective gratification refers to emotional demands that information professionals seek gratification for through digital learning. It can satisfy the affective needs of the persons and are related to the individuals' satisfaction of emotional, pleasant or aesthetic experiences (Hussain et al., 2018). Kim & Kim (2020) claimed that affective gratification shows great impact on digital usage. However, Muyingo (2017) reported a negative finding since some students squandered a lot of time talking on the phone or using other distractions that have nothing to do with academic study. Nonetheless, we still propose it has a significant influence on digital usage of students, hence, the assumption is as follows:

H6: Affective uses gratification positively impacts digital usage among students.

Social integrative gratification is an individual's sense of how other people will react to their actions. It places emphasis on social purpose (Li et al., 2019). It is hypothesised that when users use social media for study, they express their feelings, thoughts and ideas about their study experience (Gamage et al., 2022). Some people utilise the Internet just for social interactions, giving them significant social gratifications and positive impact on their continued intentions to post user-generated content (UGC) about their study experiences on social media (Chavez et al., 2021). Some people are encouraged to utilise the Internet just for social purposes, giving them significant social gratifications. (Stafford & Stafford, 2004). Can et al. (2019) demonstrated that faculty members use digital apps to gratify social integrative needs related to teaching and learning processes, strengthening their relationships with their students and/or colleagues in the process (Fig. 1). Hence, we assume as follows:

H7: Social integrative gratification positively impacts digital usage among students.

4 Methodology

Whether we are aware of it or not, researchers consistently hold certain views and philosophical presuppositions when conducting their work. These can include profoundly held ideas about the kinds of issues that should be researched, the appropriate research questions to ask, or the methods we should use to obtain assumptions for our studies (Cresswell & Poth, 2018). The distinctions between philosophical assumptions and theoretical viewpoints can be seen through a philosophy assumption or paradigm. The social constructivism orientation and epistemology assumption served as the foundation for this investigation and guided the creation of the study's research topics and methods.

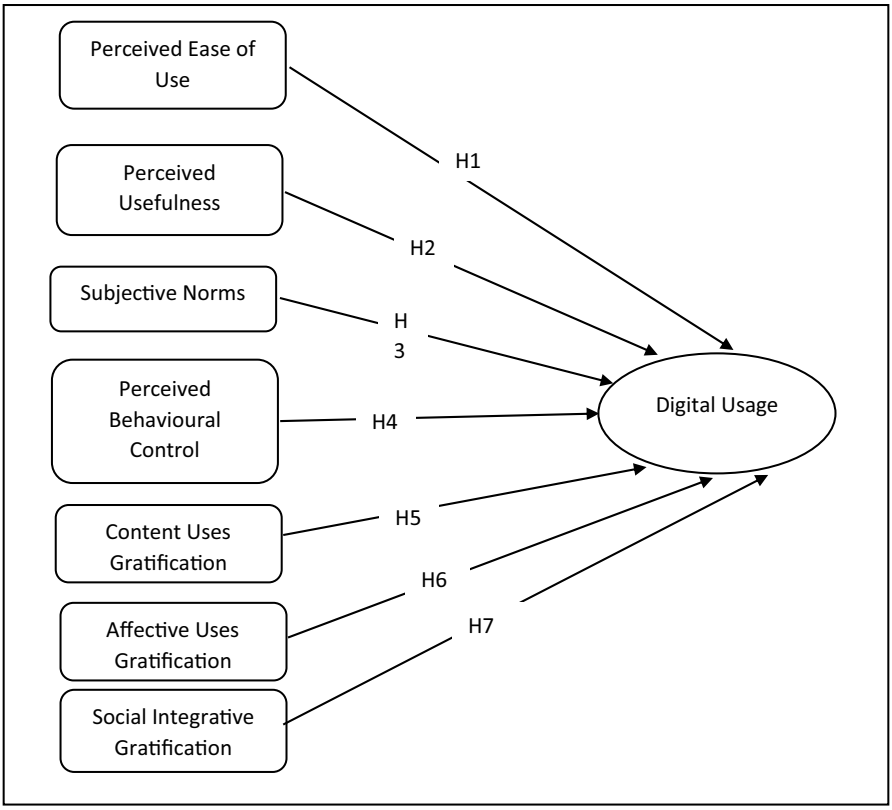

Fig. 1 Research framework

The study comprised two discrete components: 1) comprehensive desk reviews undertaken prior to commencement of primary data collection; and 2) primary data collection using the quantitative approach. The desk reviews were carried out by including literature that explored the state of digital divide among the B40 group in Malaysia in general and focused on the digital usage trends among students in HEIs in particular. These include past literature studies and data from governments' websites and international/regional bodies and institutions. The desk reviews were supplemented by additional documentation obtained during the field work. As for the quantitative method, a cross-sectional survey approach was employed to gain insights into the digital divide among students with lower socioeconomic backgrounds. Data were collected via an online survey administered through email and social media pages of HEIs. The collected data was analysed using partial least squares structural equation modelling (PLS-SEM) method. It is a variance-based analysis method to estimate composite-based path models. There were two stages of the data analysis, which are measurement model validation and structural model hypotheses testing.

4.1 Sampling and participants

To examine the hypotheses, a quantitative method was employed by utilising the survey-based research approach. A seven-point rating scale was used to obtain students' responses whereby the scale '1' represents 'extremely disagree' and '7' 'extremely agree'. In line with the study objectives, the survey was designed to consider only the responses of digital users among B40 students in HEIs. In this context, purposive sampling was employed to draw samples from the population that is close to hand, readily available, obtainable, or suitable for the researcher to conduct (Bhattacherjee 2000). The online survey was distributed via several channels available on the Internet, including social media platforms as well as email to potential students and students' association bodies of HEIs. This resulted in well distributed samples in terms of demographic information.

This study utilised a descriptive analysis approach to capture the respondents' demographic backgrounds. The descriptive data include percentage, frequency, mean, and standard deviation of the variables. The descriptive results describe the raw data in the form that is easy to understand. The collected data was analysed using structural equation modelling (SEM). Prior to the actual data collection, a pre-test was conducted on the survey involving two field experts and three students. The aim was to evaluate the level of content validity as well as to ensure that the instructions, questions, and scale items are clear to represent the variables. Based on the pre-test results, the research instrument was then refined to increase its validity. Some questions were also altered to eliminate any possible misunderstanding due to wording errors as indicated in the feedbacks obtained from the pre-test.

To decide the sample size of the respondents, G* Power 3.1.9.2 software was utilised to calculate the minimum sample size required in this study. This tool is commonly used for statistical tests in diverse fields of study (Faul et al., 2009). A previous study on learners' adoption of online learning research (Yeap et al., 2016) employed the power of 0.95 in which a small effect size of 0.02 was obtained. In this study, the model has a maximum of nine predictors. Based on the 0.05 significance level (α) (Faul et al., 2009), the power of 0.80 and small effect size of 0.02 (Cohen, 1988a), a minimum sample size of 411 respondents was required for this research.

4.2 Instrument

The research instrument used in this study is a closed ended survey comprising measurement scales adapted from past literature. To test the research instrument, the survey was initially distributed to two experts and three students. Based on their feedbacks, some modifications were made in the measurement scales to further ensure content validity and reliability. The scales for PEOU, PU, subjective norm, perceived behavioural control, affective uses gratification, content uses gratification, social integrative gratification were examined by employing the five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The scale for digital usage was measured by employing the seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The specifics for each construct and the corresponding measurement items utilised in the survey instrument used in this study are shown in Table 2.

Table 2 Constructs and the respective measurement items

Construct	Operational Definition	Sources of Measurement	Measurement items
PEOU	Students' belief that using digital technology for their learning purposes would be free of effort	Alyoussef (2021)	1. I find digital technology easy to use 2. My interaction with digital technology is clear and understandable 3. It would be easy for me to find the required information by using digital technology
PU	Students' belief that using digital technology will help them to perform a task or job better	Alyoussef (2021)	1. Using digital technology improves my study performance 2. Using digital technology improves my productivity in the study course 3. I find digital technology useful for my studies
Subjective Norm	Students' perception that pressure from their peers/lecturers has influenced them to use digital technology for learning	Wu & Zhang (2014)	1. My peers' beliefs (trust) about digital technology have encouraged me to use the technology 2. My lecturers' thoughts (opinion) about digital technology have influenced the degree to which I use the technology 3. My close friends' belief (trust) about digital technology has conditioned me to use the technology
Perceived Behavioural Control	Students' judgement or self-confidence of their own capability in using digital technology	Mona et al. (2021)	1. Using digital technology is entirely within my control 2. I have the resources, knowledge, and ability to use digital technology 3. I will be able to use digital technology well for learning process

Table 2 (continued)

Construct	Operational Definition	Sources of Measurement	Measurement items
Content Uses Gratification	Students' use of Internet/digital technology for the content. delivered through the medium (e.g., information, learning, education, knowledge)	Luo et al. (2011); Mondi et al. (2008)	1. I use digital technology to get information for free 2. I use digital technology because it's a new way to learn 3. I use digital technology because it's easier to get information 4. I use digital technology to get up-to-date knowledge/information related to my studies 5. I use digital technology to explore topics of interest that are beyond my assignments
Affective Uses Gratification	Students' perception of their belief that using digital technology would enhance their emotional and pleasant feelings	Chang et al. (2021)	1. I like to talk to others about digital technology 2. I like showing my peers how to use digital technology in different ways 3. Computer-based courseware layout, animation, and illustrations are good to look at 4. I enjoy working with digital technology

Table 2 (continued)

Construct	Operational Definition	Sources of Measurement	Measurement items
Social integrative gratification	Students' use of Internet/digital technology for social purposes (e.g., chatting, live interaction, and interaction with people in general)	Mondi et al. (2008)	1. Using digital technology (e.g., e-mail) gives me the feedback I need from others 2. I use digital technology (e.g., e-mail) to interact with my friends 3. Using digital technology (via the Internet) prepares me to join the extended learning community in the world 4. Using digital technology (via the Internet and computers) improves my ability to communicate with other students 5. Using digital technology (via computers) keeps me from feeling lonely
Digital usage	Students' self-reported usage of digital technology to show the acceptance of a technology	Lu et al. (2005); Hsieh et al. (2018)	1. I use digital technology a lot for my study 2. I use digital technology whenever possible for my study 3. I use digital technology frequently for my study 4. I use digital technology whenever appropriate for my study

5 Results

5.1 Descriptive analysis

The demographic analysis shows the distributions of respondents in this study. As observed from the frequency result of each variable, the demographic distributions met the sampling requirement. Out of a total of 511 respondents, most were female (70.8%). The majority of respondents (53.8%) were between the ages of 22 and 24. They were followed by respondents between the ages of 19 and 21 (38.2%), and respondents aged 25 and older (8%). The respondents comprised different ethnicities, i.e., Malay (49.1%), Chinese (30.7%), Indian (13.7%), and others (6.5%). The majority of them (52.4%) came from families with monthly incomes of between RM 1,000 and RM 3,000. Approximately 23.9% came from households earning between RM3,001 and RM3,860 per month, while the remaining 23.7% came from those earning less than RM1,000 per month. In terms of location, majority of the respondents were from urban areas (60.5%), while 39.5% were from rural areas. Regarding digital learning tools, the majority of respondents (80%) said they used laptops, while others said they utilised smartphones (14.2%), desktop computers (2.9%), and tablets (2.9%).

5.2 Measurement model evaluation

For primary data analysis, the partial least square-structural equation modelling (PLS-SEM) method was used. PLS-Sem is a non-parametric statistical method and does not require the data to be normally distributed. It is a second-generation multivariate statistical tool. PLS-SEM has been employed in many studies as it allows estimating research models with multiple constructs, indicator variables, and structural paths without imposing distributional assumptions on the data (Hair et al., 2018). In addition, it is known as the predictive causal approach to structural equation modelling that emphasises prediction in estimating statistical models (Sarstedt et al., 2017). The analysis began with the assessment of the measurement model. The results are displayed in Tables 3 and 4.

As can be seen from Table 4, the result for each construct is consistent with its related items whereby all the factor loadings are greater than 0.7. Additionally, both Alpha and Rho_A values for all constructs are between 0.7 to 0.95. Thus, all reliability values are considered acceptable. The convergent validity was measured by composite reliability (CR) and Average Variance Extracted (AVE). According to Elkaseh et al. (2016), the acceptable values of CR should be larger than 0.7 and smaller than 0.95, while AVE should be 0.5 and above. These values meet the threshold values as needed for the quality criteria with regards to the assessment of reflective measurement models in research (Ghasemy et al., 2020). Therefore, all the constructs measured in this study are considered valid and reliable (Table 4).

Fornell and Larcker (2016) stated that the discriminant validity (Heterotrait-Monotrait ratio) should be smaller than 0.85. The discriminant validity indicates the differences between a construct and its factors from other constructs and their factors

Table 3 Respondents' demographic profile

		Frequency(n)	Percentage (%)
Gender	Male	149	29.2
	Female	362	70.8
Age	19—21 years old	195	38.2
	22–24 years old	275	53.8
	25 and above	41	8
Ethnicity	Malay	251	49.1
	Chinese	157	30.7
	Indian	70	13.7
	Others	33	6.5
Monthly income (RM)	Less than 1,000	121	23.7
	1,000—3,000	268	52.4
	3,100— 3,860	122	23.7
Location	Urban	309	60.5
	Rural	202	39.5
Digital tools	Laptop	408	80
	Smartphone	73	14.2
	Desktop	15	2.9
	Tablet	15	2.9

and shows the degree to which a construct is significantly different from other constructs (Fornell & Larcker, 2016). Therefore, the discrimination validity obtained in this study has met this requirement (Table 5).

To measure the significance of the path model, path coefficients were evaluated by utilising a one-tailed percentile bootstrapping test with 10,000 sub-samples at 0.05 significance level. The greater the coefficient value (i.e., β value), the greater the substantial effect on the endogenous latent construct. However, the β value has to be verified for its significance level through the t-statistic test (Hussain et al., 2018). Based on this consideration, it can be concluded that three of the study's hypotheses, i.e., H7, H1 and H6, had the most substantial effects on the respondents' digital usage (β values are 0.284, 0.133, and 0.114 respectively) with their t-values being the greatest among all others (Table 6). On the contrary, H3, H2, and H4 indicated the smallest β values compared to the others. Yet, the t-statistic for H3 is 2.196, which is not the smallest value. To assess the model's in-sample fit, the R^2 values were then assessed. It was found that all the endogenous constructs obtained R^2 values around 0.365. This value is clearly lower than the value in Amaro and Duarte's (2015) study, which had a considerably more complex model with additional antecedent constructs. While this study model's in-sample model fit is rather small according to absolute standards (Hair et al., 2018), it is considered acceptable in this study in light of the model's complexity.

F-square, which is the effect size, refers to the degree of impact of each exogenous latent construct on the endogenous latent construct. Therefore, based on the specifications in Cohen (1988b) (where $>=0.02$ is small, $>=0.15$ is medium; $>=0.35$

Table 4 Loadings, convergent validity, and reliability estimates

Constructs	Items	Loadings	Alpha	Rho_A	CR	AVE
Affective Uses Gratification	AU 3	0.760	0.763	0.785	0.845	0.578
	AU 4	0.815				
	AU 1	0.730				
	AU 2	0.734				
Content Uses Gratification	CUG 1	0.788	0.868	0.878	0.904	0.655
	CUG 2	0.743				
	CUG 3	0.814				
	CUG 4	0.871				
	CUG 5	0.824				
Perceived Behavioural Control	PBC 1	0.783	0.8	0.807	0.883	0.716
	PBC 2	0.885				
	PBC 3	0.867				
PU	PU1	0.780	0.839	0.842	0.903	0.757
	PU2	0.869				
	PU 3	0.801				
PEOU	PEOU 1	0.903	0.752	0.762	0.858	0.668
	PEOU 2	0.862				
	PEOU 3	0.845				
Social Integrative Gratification	SIG 1	0.752	0.753	0.755	0.844	0.574
	SIG 2	0.741				
	SIG 3	0.778				
	SIG 4	0.760				
Subjective Norm	SN 1	0.854	0.819	0.821	0.892	0.734
	SN 2	0.833				
	SN 3	0.883				
Digital Usage	USE 1	0.841	0.874	0.878	0.914	0.727
	USE 2	0.870				
	USE 3	0.881				
	USE 4	0.816				

Table 5 Discrimination validity assessment based on $HTMT_{0.85}$ criterion (N = 511)

Constructs	AU	CUG	PUC	PEOU	PU	SIG	SN	USE
AU								
CUG	0.556							
PBC	0.646	0.719						
PU	0.516	0.702	0.725					
PEOU	0.551	0.643	0.707	0.752				
SIG	0.704	0.705	0.673	0.618	0.568			
SN	0.595	0.476	0.545	0.538	0.448	0.542		
USE	0.504	0.537	0.528	0.536	0.490	0.639	0.296	

Table 6 Structural model evaluation

Predictors	Paths	Coefficient	*t* value	*p* value	Confidence Intervals Bias Corrected (97.5%)	Supported	VIF	f^2
H6	AU- > USE	0.133	2.458	0.014	(0.028, 0.241)	Yes	1.726	0.016
H5	CUG- > USE	0.114	2.022	0.043	(-0.008, 0.228)	Yes	2.098	0.010
H4	PBC- > USE	0.073	1.335	0.176	(-0.037, 0.175)	No	2.116	0.004
H1	PEOU- > USE	0.160	1.242	0.214	(-0.036, 0.296)	No	2.146	0.019
H2	PU > USE	0.063	2.376	0.018	(-0.032, 0.296)	Yes	1.788	0.004
H7	SIG- > USE	0.284	5.148	0.000	(0.167, 0.383)	Yes	1.832	0.069
H3	SN- > USE	-0.103	2.196	0.028	(-0.192, -0.005)	Yes	1.453	0.011

is larger) all the hypotheses in this study were considered having small effect size. The obtained value of VIF is smaller than 3. This indicates that there was no potential issue of collinearity problem in this study (Kock, 2015). As indicated by the path model, all the proposed hypotheses were statistically supported, except for PU and perceived behavioural control, which did not have a significant effect on the digital usage ($p > 0.05$). The other tested hypotheses indicated a positive relationship between the predictors and the outcome variable.

Figure 2 illustrates the path coefficient and factors loading results. As can be seen, social integrative gratification- > usage, PEOU- > usage, affective uses gratification- > usage has a strong effect on the digital usage, with the coefficient values of 5.022, 2.377, 2.365 respectively. The smallest coefficients were indicated by PU and perceived behavioural control, with 1.253 and 1.335 respectively. In terms of factors loading, PEOU2, PU1, PU2, PUC2, PBC2, CUG4, AU4, USE2, and USE3 indicated the highest values whereby more than 40 for each of the items showed high effect in their constructs.

6 Discussions and implications

The findings of this study can be summarised as follows:

- PU and subjective norm were found to positively influence the digital usage among the B40 students in Malaysian HEIs.
- Content uses gratification was found to positively influence the digital usage among the B40 students in Malaysian HEIs.
- Affective uses gratification was found to positively influence the digital usage among the B40 students in Malaysian HEIs.
- Social integrative gratification was found to positively influence the digital usage among the B40 students in Malaysian HEIs.

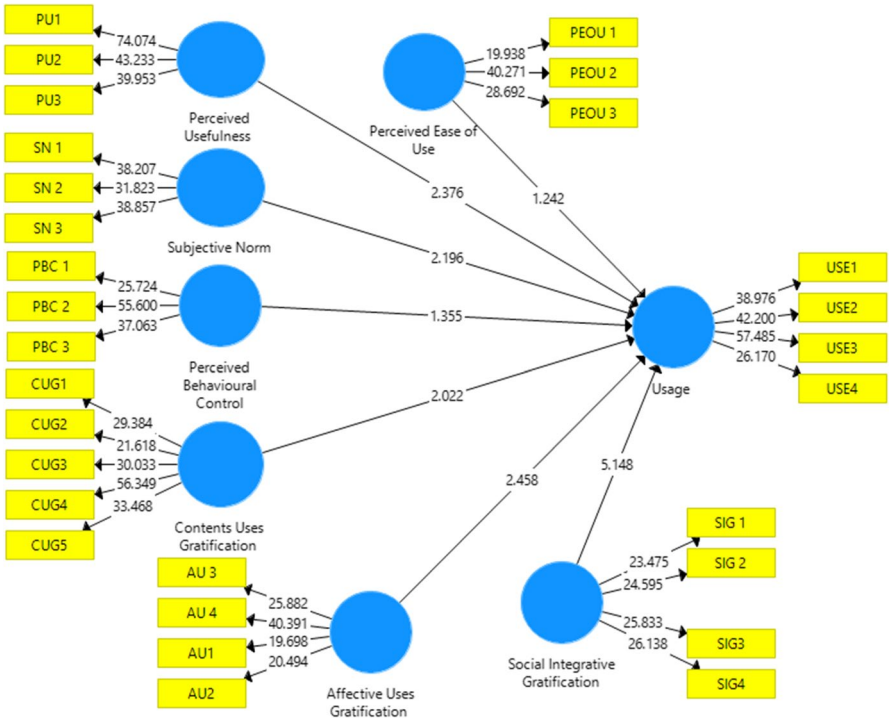

Fig. 2 Structural model

Social integrative gratification indicated the strongest positive impact on the B40 students' usage of digital technology for their learning. This result is consistent with past literature, including the study by Staford and Staford (2001, 2004). According to Mondi et al. (2007), once students are satisfied with their social integrative gratification, they would be encouraged to use digital technology for their learning. Similarly, when people believe that using technology will allow them to benefit from their social and relational links, they would express their social integrative gratification (Chang et al., 2021). This gratification aspect can strengthen people's ties with the relevant others and thus improve their sense of belonging or social identity (Nambisan & Baron, 2007). In contemporary times, students must adapt to the dynamic changes of online learning technologies due to competitive job prospects after graduation. Students today must possess the skills necessary to use digital technology professionally, particularly those related to ICTs, artificial intelligence (AI), and other 4IR-related skills necessary for them as twenty-first century learners, in addition to the fundamental technical skills required by HEIs and the society. Their ability to use digital technology is in keeping with UNESCO and SDG goals, which place an emphasis on providing students of all socioeconomic backgrounds with high-quality education.

Additionally, affective uses gratification indicated a significant positive impact on the digital usage among the B40 students in Malaysian HEIs. This result is in line

with the study by Mondi et al. (2008), who similarly reported that students enjoy using digital technologies and relating well to the technologies during their learning process. The positive result as observed in this study demonstrates that students generally prefer digital technologies that evoke their pleasure and emotional engagement in learning. Students from low-income families should therefore be inspired to use technology. Through technology, which is thought to be essential for sustainable quality education, the digital divide among vulnerable students will be further narrowed.

The findings also revealed that PU had a significant impact on the students' digital usage. This is in line with the studies by Davis (1989) and Alyoussef (2021) which similarly suggested that students tend to use digital technologies for their learning process when they find the technologies useful. There was also a significant positive influence of subjective norm on the B40 students' digital usage, which is consistent with the finding by Abdullah et al. (2016). Thus, it can be said that the B40 students are influenced by their peers or lecturers in utilising digital technologies for their learning process. In this sense, subjective norms are potentially a pushing factor for students to learn in the digital environment.

Content uses gratification also seemed to have a significant positive influence on the digital usage among the B40 students, which is consistent with the finding by Lou et al. (2011). Thus, the students generally found that the digital learning content is useful in assisting them to gain knowledge and solve their academic-related questions, and continually motivate them towards achieving academic success. Through the digital learning content, students are able to enhance their knowledge, gather pertinent data to address their academic challenges, document successful accomplishments and experiences, as well as obtain useful feedbacks to correct errors.

On the other hand, PEOU was found to be not significant in determining the B40 students' digital usage. This result contradicts several previous studies in the literature (e.g., Letchumanan & Muniandy, 2013; Mohd et al., 2009; Sorkun et al., 2022). It might be possible that the students feel frustrated whenever they feel technically challenged during their digital learning tasks, such as in using certain software to compute or carry out difficult tasks. This holds true especially when the students need to learn using a new software, and such difficulty can cause psychological pressure among the students in digital learning environment. While students who can overcome this challenge may feel a sense of accomplishment, others may be unwilling or unable to complete difficult tasks using digital tools or might even find other ways to complete the tasks.

Similarly, no significant relationship was observed between perceived behavioural control and the digital usage among the B40 students in Malaysian HEIs. Students nowadays generally are frequent users of digital technologies, and thus their ability in using the tools and applications can be improved while overcoming the difficulties. Due to this reason, the students might be thinking that perceived behavioural control does not influence their digital usage. Despite this, there are still issues and challenges with perceived behavioural control. As argued by Mohd et al. (2009), the primary component influencing perceived behavioural control is perceived difficulty. Moreover, the absence of facilitating conditions can negatively influence users' intention to use digital technology (Hadadgar et al., 2016).

Overall, this research has revealed significant positive influences of all gratification aspects (i.e., social integrative, affective uses and content uses) as well as PU and subjective norm on the digital usage among the B40 students in Malaysian HEIs. Additionally, social integrative gratification was found to have the greatest influence on the students' digital usage. These findings may serve as a wake-up call, particularly for key stakeholders in higher education, that some areas require critical attention in providing a digital learning environment for all students enrolled in higher education, including those from lower-income homes. The findings could also assist future educators and digital learning developers in designing effective teaching and learning strategies which also consider the digital learning usage among the B40 group.

At the policy level, the results could be useful for the Malaysian government to develop and enhance policies related to the digital divide among the B40 students. The focus on B40 students in this study is deserving of further consideration in the context of supporting the government's efforts towards addressing technological inequality and providing quality education for the society at all levels. The results may provide useful inputs for various policy makers, business and education sectors, as well as community groups which aim to increase digital access and usage among students, particularly the B40 group.

7 Limitations and conclusion

This study mainly focused on B40 students in Malaysian HEIs. Its main limitation, therefore, is in terms of providing inputs pertaining to the differences in students' digital usage by various monthly income groups, such as between B40 students and those from middle and high income homes. The study also has sampling limitations; it is impossible to obtain samples that are representative of the entire population of Malaysian undergraduates who use digital learning. Furthermore, since the questionnaire was answered by the students themselves, the general method bias or same source bias may occur due to self-reported measures from the same samples while answering the survey (Tehseen et al., 2017). Common method variance can lead to systematic measurement errors that either inflate or deflate the observed relationships between constructs, thus producing errors. Additionally, it can produce a false internal consistency, which is an apparent correlation among variables generated by their common source (Chang et al., 2010).

Given the aforementioned constraints, this study offers several suggestions that future studies concentrating on the many facets of digital usage in higher education settings would find helpful. As this study only involved B40 undergraduates, it would be interesting for future research to further investigate the consistency of the findings by involving different student groups in HEIs, such as postgraduates and students from different geographical backgrounds. Future research may also replicate this study by exploring other constructs which could potentially be linked to students' digital usage and access as well as skills like creativity and ICT. Last but not least, it would be interesting if future studies could examine this area of research by employing a qualitative approach, such as interviews, as qualitative data would yield more detailed and in-depth responses in relation to the digital usage among the B40 students.

In conclusion, given the extensive use of digital technologies in HEIs for teaching and learning, it is critical to look at variables that could affect student usage of digital technologies, especially among students from lower socioeconomic backgrounds. This study examined seven constructs in relation to the B40 students' digital usage, namely PEOU, PU, subjective norm, perceived behavioural control, content uses gratification, affective uses gratification, and social integrative gratification. The SPSS was employed for implementing descriptive analyses, while Smart PLS was used for performing measurement model and structure model evaluations. The results showed that only perceived behavioural control and PEOU did not have any significant influence on digital usage. One plausible explanation is the students' proficiency with digital technologies; some may feel challenged and frustrated by complex tasks using the technology. Therefore, lecturers and educational providers should consider students' varying levels in performing learning tasks using technologies. In addition, PU, subjective norm, content gratification, affective gratification, and social integrative gratification should all be taken into account as key factors for a successful application of digital teaching and learning.

Authors contributions A. Devisakti- Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Project administration; Software; Validation; Visualization; Writing, Editing. Dr. Muftahu-Conceptualization, Reviewing, Editing. Hu Xiaoling – Data collection, Writing, and Editing.

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Declarations

Competing interests The authors report there are no competing interests to declare.

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