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Divided Digital Divide: The Third Level of the Digital Divide Depending on Devices and Purposes

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Abstract: ***The digital divide remains a significant social issue despite technological advancements. While previous research primarily focused on access disparities, this study aimed to address the multifaceted nature of the digital divide by investigating the correlation between technology purpose and device accessibility. We bring to light significant insights into the three levels of the digital divide and examine the relationships between different devices, digital skills, emotional costs, and self-efficacy. Based on data collected from our questionnaires, the results indicate that individuals with greater digital skills experience reduced emotional costs when using ICT devices. Notably, smartphone usage is versatile, challenging common perceptions that it is only used for entertainment. However, laptop and tablet usage for work-related tasks displays a stronger correlation with the level of emotional cost compared to entertainment-related usage. Our findings imply that certain types of devices, their specific usage, and the digital skills needed to use them should be considered by policymakers and educators in digital inclusion strategies to profoundly understand and systemically resolve the digital divide. Although limited by a relatively small sample size, this study emphasizes the need for more extensive, diverse datasets to bolster generalizability.***

Keywords: technology, digital, devices

1.Introduction

Digital technologies have witnessed an extensive transformation over the years, revolutionizing various sectors and enhancing human capabilities (Cruz-Jesus et al.2016). The widespread adoption of computers and internet usage has had lasting impacts on educational improvements, economic growth, and access to health care and health-related information (Singh et al, 2022). The ubiquity of information and communication technologies (ICTs) has been acknowledged as a catalyst for socioeconomic development (Hanafizadeh, et al.2013; Youssef et al.2013), offering immense potential for progress and innovation. Indeed, ICTs have proven to be vital tools for the development of nations worldwide (Wardhani et al.2018), resulting in an era of unprecedented progress and innovation. However, this rapid technological transformation has also brought to light an evolving and critical issue known as the digital divide.

Despite the seemingly limitless access to information facilitated by technological advancements, uneven access to ICTs has exposed the challenge of ensuring equitable access to digital technologies (Soomro et al., 2020). As society became increasingly dependent on digital technologies, the significance of the digital divide in shaping contemporary inequalities became apparent (Van Dijk, 2005; Pearce et al., 2013). Initially coined during the 1990s, the term “digital divide” refers to the uneven distribution of access to technology between individuals or groups with adequate access to ICT and those with limited or no access (Lythreatis et al.2021). This disparity is not limited merely to internet connectivity but is a compound multifaceted problem that encompasses variations in internet usage, digital skills, and overall benefits derived from technology usage (Scheerder et al.2017). For instance, in the realm of education, Soomro et al. (2020) highlights the significance of adequate access to digital technologies, especially in light of their potential impact on societal and economic development. This notion is echoed by the observations of Cruz-Jesus et al. (2016), who emphasize the transformative potential of emerging digital technologies.

Demographic factors such as age, education level, geographic location, language, race, and socioeconomic status play a significant role in shaping digital inequalities (Pun, 2020). Consequently, the digital divide has the potential to exacerbate existing social disparities, raising concerns about its broader impact on society and its development (Scheerder et al.2017). Having become more dependent on digital devices over the past years, the fundamental ideals of the topic “digital divide” have developed into multidimensional issues. To better understand the different issues encompassed by this topic, researchers have distinguished and classified various levels of the digital divide. Upon the initial introduction of this topic, they took a relatively simple approach, focusing on the uneven physical access towards the ICTs; this is now referred to as the first-level digital divide. However, throughout the development of the ICTs, the topic has expanded to embrace different layers underneath the distinction of binary access. The disparity between the skills necessary for using ICTs and the use purpose of the technology has been acknowledged as the second-level digital divide. Finally, the third-level digital divide refers to the benefits a type of technology can offer to an individual and the outcomes it provides (Scheerder, 2017).

Numerous studies have shed light on the consequences of digital disparities in various aspects of offline engagements and life domains. However, previous findings mainly depended on a macro perspective on big data with general terms and a more specific and direct investigation of the relationships between digital divide levels is necessary. Thus, the current study conducted an exhaustive and methodical examination that outlines these disparities in offline results with a micro viewpoint. Specifically, it

investigates the digital divide based on specific digital devices, their usage, and digital skill.

2.Literature Survey

The trajectory of the digital divide can be traced back to its early recognition in the mid-1990s. One of the initial mentions of the topic was during a 1996 conference when President William J. Clinton's remark on the possibility of digital gaps intensifying inequalities in society underscored the spark in the sector of digital divide (website link). This notion contrasted with a previously prevalent one on the potential of technologies to equalize information availability through reduced costs (DiMaggio et al., 2001). The shift in focus led to an acknowledgment of the "digital divide, " a concept highlighting the disparities in technology access and usage, with implications for social inequality. Over time, the digital divide has evolved in response to changing technologies, socioeconomic factors, and policy interventions, shaping the ongoing discourse on equitable digital inclusion.

The concept of the first-level digital divide originally emerged as a framework to understand early digital inequalities primarily related to access. Scheerder et al. (2017) acknowledged this divide, defining it as the initial stage of digital inequality marked by disparities in access to technology. Bonfadelli et al. (2002) highlighted the binary distinction between individuals with and without Internet access, emphasizing the potential societal divide the technology could create. While the first-level digital divide focused on access, concerns grew regarding the perpetuation of societal inequalities. Ragnedda et al. (2017) observed that access to knowledge quickly became a prerequisite for power in various domains, emphasizing the socioeconomic implications of unequal access. Soomro et al. (2020) underscores that ICT could drive socioeconomic development, further intensifying the importance of addressing access disparities. Over time, digital divide research evolved to encompass more than just access. Pearce et al. (2013) pointed out this shift, highlighting that access disparities were only one facet of the broader digital divide. As access disparities decreased, new dimensions emerged, including skill development and digital outcomes. Pearce (2013) introduced the second and third levels of the digital divide, emphasizing that demographic differences, skills, interests, and infrastructure also contribute to ongoing inequalities.

The concept of emotional cost (Huang et al., 2017) pertains to the psychological barriers, such as stress and anxiety, experienced by digitally disadvantaged youth when engaging with computers and the Internet. This emotional toll can significantly impact their motivation and engagement. There are various factors that contribute to emotional discomfort in technology use (Huang et al., 2017). Age-related challenges, particularly among older individuals, can lead to fear and anxiety associated with technology. Additionally, youths without quality home computer access may continue to face emotional barriers even when gaining access to computers at school. Research methodologies employed to study emotional cost have typically focused on decision-making under emotional states (Huang et al., 2017). In investigating the connection between home computer access, computer use patterns, and the role of emotional costs and self-efficacy, studies have underscored the mediating role of emotional costs as subtle yet significant barriers for economically and digitally disadvantaged students.

Low computer self-efficacy and emotional costs can exacerbate differential patterns of Internet usage between disadvantaged and advantaged youth. Self-efficacy, as discussed by Huang et al. (2017), is an individual's belief in their ability to achieve specific goals, including technology-related tasks. Empirical studies have emphasized the pivotal role of self-efficacy on learning outcomes as well as technology adoption and engagement, empowering individuals to navigate digital environments effectively. Bandura (1977) defined self-efficacy as the judgment of one's capability to attain a goal. Researchers suggested a strong relationship between self-efficacy and technology engagement. Digitally disadvantaged students with low computer self-efficacy, as noted by Wei et al. (2011), may face challenges in adopting and effectively utilizing technology.

Existing digital divide research has exhibited certain limitations that our investigation aims to address comprehensively. Previous research often lacked a specific focus on the purpose of devices and the specific types of technology in relation to digital disparities, instead opting for a broader perspective. This has resulted in a gap in the literature concerning the direct relationships between technology usage and its impact on individuals or groups. Moreover, some studies have not kept pace with the rapid evolution of technology, potentially rendering their findings less relevant in the contemporary digital landscape. Furthermore, demographic variations have been acknowledged as influential factors in digital inequalities, but their intersections with the specific purposes of devices and technology usage remain insufficiently explored. To fill in these gaps, our research specifically examined the intricate relationships between the purpose of specific ICTs and their outcomes, such as emotional cost and self-efficacy levels, and assessed this relationship between the second and third levels of the digital divide. We took into account the evolving nature of technology and explored how demographic variations intersect with digital disparities, thereby contributing novel insights to this crucial area of inquiry.

3.Methods

3.1 Participants

Primarily, a total of 124 participants were involved in the online questionnaire. After data collection, a thorough data cleaning process was conducted. Two participants did not complete the questionnaire and were excluded. Additionally, participants with missing or incorrect data were excluded from the analysis, reducing the sample from 124 to 80 participants. There were no significant differences in the results after excluding the participants with missing data.

The final sample of 80 participants included 43 males (54%) and 37 females (46%). The age distribution of the participants showed a standard deviation of 6.5 with the mean average of 25 years old. The participants in the study represented a diverse range of racial and ethnic backgrounds: 21 Asian (26%); 9 Black or African American (11%); 12 Hispanic or Latino (15%); 1 Middle Eastern or North African (1%); 1 Native American or Alaska Native (1%); 1 Native Hawaiian or other Pacific Islander (1%); and 35 White (44%).

3.2 Measurement

The first section of the survey asked about the basic demographic information of the respondents. Information on respondents' age, gender, race and ethnicity, education level, majors, and GPAs was collected following previous studies (Huang et al.2017; Pearce et al.213; Soomro et al., 2020). The questions were "What is your age?", "What is your gender?", What is your race or ethnicity?", and "Are you currently enrolled as a student?". Questions relevant to age, GPAs, and major had user-generated responses, while those about gender, race and ethnicity, and education level were multiple-choice with the option to self-describe.

3.2.1 Digital access

The first level of the digital divide focuses on the binary distinction between access to ICTs and the Internet. It was examined by analyzing digital access. Digital access was divided into Internet access, personal technological devices, rented technological devices, and public technological devices. We consideredfour technological devices: desktop computers, laptop computers, tablets/iPads, and smartphones. The questions included in the survey were: "What type of Internet connection do you have in your residence?" and "What types of personal technological devices do you currently own? (excluding rented devices) ?".

3.2.2 Skill access

Participants' skill access—a factor of the second level of the digital divide—was measured by focusing on three different types of skill: Operational skills access, Informational skills access, and Strategic skills access. Questions from Kamal Ahmed Soomro (2020) were adapted to rate skills access. A 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5= strongly agree) was used to rate statements such as "ICTs (Information and Communication Technologies) are hard to use" and "ICT (Information and Communication Technologies) make me uncomfortable. "Each statement was labeled as either a positive or negative question based on whether it represented a strong or weak confidence in one's ability.

3.2.3 Emotional cost

Emotional cost is defined as the lack of digital competency and as one's experience of stress or anxiety when using ICTs (Huang et al.2017). Emotional cost towards computer use was assessed in order to evaluate the second level of the digital divide. Based on Huang et al. (2017), a 5-point Likert scale (1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, and 5 = strongly agree) was used to rate statements assessing emotional cost, such as "ICTs (Information and Communication Technologies) are hard to use, " "ICTs (Information and Communication Technologies) make me uncomfortable, " and "I don't think I could do advanced technological work. "

3.3 Procedure

On July 28, 2023 an online questionnaire was administered to US citizens between the ages of 18 and 29 who were recruited through random sampling. The questionnaire was hosted on a web-based platform accessible to the target population. Prior to accomplishing the questionnaire, participants had to read the consent form indicating that this study ensured voluntary participation and may request for their personal information. The consent form also indicated that the participants' responses would be used solely for research purposes. All participants received a small monetary incentive upon completion of the questionnaire. The average estimated time to complete the questionnaire was 16 minutes.

The questionnaire was composed of three sections divided into the three levels of the digital divide. The first section requested information on the participants' demographic data and included questions pertaining to the first level of the digital divide. The second and third sections focused on the second and third levels of the digital divide, respectively. The sections were left ambiguous for the participants to exclude external factors.

4.Results

Table 1 presents the descriptive analysis results for total skills access (cumulative total score of the participant's skill access), total emotional cost, total usage time of all four devices (desktop computers, laptop computers, tablet/iPads, and smartphones) for entertainment purposes, and total usage time of all four devices for work purposes. The maximum score was 90. A higher score represents greater digital competency. A higher emotional cost indicates more stress and anxiety incurred by the user for their use of the ICT devices.

Table 1: Descriptive analysis of total skill access (TotalSkillAcc), total emotional cost (EmoCost_Sum), total usage time of all four devices for entertainment purposes (SumPurpEnter_AllDevices), and total usage time of all four devices for work purposes (SumPurpEnter_AllDevices)

	TotalSkillAcc	EmoCost_Sum	SumPurpEnter_AllDevices	SumPurpWork_AllDevices	
Valid	80	80	80	80	
Missing	0	0	0	0	
Mean	70.487	19.175	8.088	6.075	
Std. Deviation	12,275	5.668	4.584	2.809	
Minimum	45,000	7.000	0.000	1.000	
Maximum	90.000	33.000	20.000	12.000	

The impact of the type of technology participants used on the relationship between the factors of the second and third levels of the digital divide was evaluated based on the correlation of the total usage time for the four devices for entertainment and work with the level of emotional cost and skill access of the users. The significance of the data differed by the type of technology used. For desktop computers, the data showed no specific significant correlation between total usage time and level of emotional cost and between total usage time and total skill access. While there was a significant negative correlation between total usage time for work purposes and level of emotional cost for both laptop computers (r (78) =-.282*, p =.011) and tablet PCs (r (78) =-.274*, p =.014), no significant correlations were found with their total usage time for entertainment purposes. This suggests that more time spent on work-related tasks using a laptop or tablet PC is associated with lower emotional costs.

Although the correlations varied between devices, both devices consistently demonstrated that total skill accessibility and technologies' emotional toll on users ran parallel, such that when one showed significance, the data of the other were also significant. While this pattern was also observed for smartphones, the correlations between smartphone usage for entertainment and work, total skill access, and emotional cost exhibited statistical significance. Specifically, total usage time of smartphones for both entertainment and work purposes showed a negative correlation with the level of emotional cost with values of r (78) =-.385***, p < 0.001 and r (78) =-.477***, p < 0.001, respectively. While laptops and tablet PCs only showed significance with usage intended for work, smartphones showed a strong correlation for both entertainment and work purposes.

Table 2: Correlation analysis of variables

Correlation

Person's Correlation

Variable		EmoCost_Sum	TotalSkillAcc	SumPurpEnter_AlDevices	SumPurpWork_AllDevices
1. EmoCost_Sum	Pearson's r	-			
	p-value	-			
2 TotalSkillAcc	Pearson's	-0.555***	-		
	p-value	<.001	-		
3. SumPurpEnter_AlDevices	Pearson's	-0.235	0.322**	-	
	p-value	0.035	0.004	-	
4 SumPurpWork_AllDevices	Pearson's	-0.431***	0.524***	0.607***	-
	p-value	<.001	<001	<.001	-
5. SumPurp_DeskT_Ente	Pearson's	-0.079	-0.096	0.525***	0.249
	p-value	0.488	0.395	<.001	0.026
6. SumPurp_DeskT_Work	Pearson's	-0.217	0.185	0.359**	0.650***
	p-value	0.054	0.100	0.001	<.001
7. SumPurp_LapT_Ente	Pearson's	-0.106	0.202	0.839**	0.421***
	p-value	0.350	0.073	<.001	<.001
8 SumPurp_LapT_Work	Pearson's	-0.282	0.413***	0.503***	0.803**
	p-value	0.011	<.001	<.001	<.001
9 SumPurpSmP_Ente	Pearson's ,	-0.385***	0.564***	0.631***	0.679***
	p-value	<.001	<001	<.001	<.001
10 SumPurpSmP_Work	Pearson's	-0.477***	0.582***	0.526***	0.842***
	p-value	<.001	<.001	<.001	<.001
11. SumPurpTabP_Ente	Pearson's ,	0.009	0.085	0.642***	0.176
	p-value	0.939	0.455	<001	0.119
12 SumPurpTabP_Work	Pearson's	-0.274"	0.235*	0.239	0.230*
	p-value	0.014	0.036	0.033	0.040
13 Freq_DeskT	Pearson's	0.074	-0.051	0.149	-0.026
	p-value	0.515	0.656	0.186	0.818
14 Freq_LapT	Pearson's r	0.046	-0.004	0.199	0.154
	p-value	0.685	0.972	0.077	0.172
15. Freq_SmP	Pearson's	-0.063	0.313**	0.300**	0.298**
	p-value	0.579	0.005	0.007	0.007
16. Freq_TabP	Pearson's r	0.035	0.025	0.320**	0.025
	p-value	0.760	0.828	0.004	0.829

* p < .05, ** p < .01, *** p < .001

5.Discussion

While numerous studies have illuminated the consequences of digital disparities in various aspects of offline engagements and life domains, a methodical examination outlining distinct correlations among the specific purposes of different technologies remains lacking. This research thus delves deeper into these disparities and their impacts to enrich the understanding of the specific purposes of different types of technology.

The results revealed that participants with greater digital competency experience less stress and anxiety when using ICTs. This finding is consistent with that of Huang et al. (2017), which showed that individuals with more experience with computers experience higher emotional costs. These results highlight the importance of digital

literacy programs in reducing emotional barriers to technology adoption.

The results also showed that more total time spent on laptop computers and tablet PCs for work-related tasks led to a decrease in emotional cost. This implies that individuals who use these devices for work experience lower emotional costs, potentially due to increased familiarity and comfort with performing work-related tasks on these devices.

Additionally, our results showed that smartphone usage exhibited unique characteristics compared to other devices. Specifically, it showed significant correlations with emotional cost for both work and entertainment purposes. This indicates that smartphones are a versatile device that is not restricted to a single type of usage. Our data challenge the notion that smartphones are mainly used for gaming and entertainment, and suggest that they serve a broader range of purposes. When narrowing our perspective is limited to specific purposes, the connection with entertainment becomes less pronounced than that with task-oriented activities. Notably, the smartphone emerged as the sole device displaying a robust and definitive correlation with the entertainment factor, rendering it the primary focus for assessing this aspect. Conversely, a distinct proclivity toward work-related usage became apparent in our examination of laptop computers and tablet PCs due to their. Thus, for research purposes primarily centered on work-related factors, it is sufficient to concentrate exclusively on laptop and tablet PC usage.

When addressing the digital divide, policymakers should focus not only on the binary distinction of the number of devices between individuals but also on the types of technologies they use and their skill levels. It is crucial to note the differences that the type of technology entails in both the second and third levels of the digital divide. Specifically, as this paper illustrates, smartphones are adaptable for both educational and work-related purposes, and could be assessed as a valuable tools for reducing emotional barriers to technology use.

6.Conclusion

This paper highlights the vital role of digital competency in mitigating emotional barriers to technology adoption. Individuals with greater skills in their usage of technologies experience lower levels of stress and anxiety when using ICTs. The study additionally underscores the versatility of smartphones, challenging the common perception that they are primarily used for entertainment. Instead, smartphones serve a broader range of purposes, including work-related tasks. Policymakers and educators should consider the importance of digital literacy programs in reducing emotional obstacles to technology use and acknowledge the diverse functionality of smartphones in shaping digital inclusion strategies. Although this study's findings are consistent with those of prior research, a more extensive and diverse dataset should be measured to strengthen the generalizability of the findings. The limitation from the relatively small sample size could have an impact on the broader population of interest.

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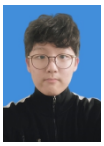
Author Profile



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