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Bridging the Third-Level Digital Divide: Socio-Demographic Determinants of the Digital Outcomes in Thailand

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The rapid evolution of digital technologies has transformed modern society, yet significant disparities in digital engagement persist. This study explores the third-level digital divide in Thailand, focusing on how sociodemographic factors shape digital engagement across economic, social, educational, and institutional domains. Using logistic regression analyses on a nationwide 2022 survey with 43,465 respondents, this research offers novel insights by identifying how gender, age, region, income, education, employment status, urban residency, and Internet confidence specifically affect different types of digital engagement. Key findings reveal that men are less likely to engage in online activities compared to women, while younger adults demonstrate higher digital participation. Notably, older adults rely more on institutional digital services, revealing an age-specific pattern. The study also highlights regional disparities, with the northeastern region showing higher engagement and the southern region lower across all domains. A novel finding is the contrasting role of income, which boosts economic engagement but reduces participation in institutional activities. Furthermore, this study underscores the strong role of education and Internet confidence in driving digital engagement across all areas. These findings offer crucial evidence for designing targeted interventions to bridge the digital divide, such as gender-equality-focused digital literacy programs, initiatives for older adults, regional infrastructure enhancements, financial subsidies, integrating digital literacy into education, and building digital confidence through practical, hands-on national campaigns.

Keywords: digital engagement, digital outcomes divide, Internet benefits, Thailand, Third-level digital divide

The emergence of digital technologies has profoundly transformed numerous dimensions of human life, including economic activities, social connections, educational prospects, and accessibility to government services. However, the persistent digital divide—a disparity between individuals who can access digital technologies and those who cannot—continues to pose a significant global challenge (OECD, 2001). This concept, as outlined by van Dijk (2020), comprises three distinct levels: the divide in Internet access (first level), the divide in digital skills (second level), and the divide in digital outcomes (third level).

The digital divide concept originated in the 1990s, initially emphasizing disparities in Internet access. The primary focus during this period was on the unequal availability of physical access to computers and the Internet. Policymakers and researchers recognized that access to technology was becoming a crucial determinant of social and economic opportunities (Servon, 2002). As technologies became more widespread in the early 2000s, the focus shifted the digital outcomes divide underscores inequalities in converting access to and use of information and communication technologies (ICTs) into significant economic, social, educational, personal, and institutional benefits. This aspect of the

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digital divide is especially pertinent as it focuses on the concrete advantages individuals can achieve through proficient use of digital technologies. Economic opportunities, social inclusion, educational attainment, and improved access to government services are some of the critical outcomes influenced by digital engagement (Bravo & Libaque-Saenz, 2019). However, the third-level digital divide has been relatively underexplored compared with the first and second levels (Scheerder et al., 2017), especially in the context of developing countries (Setthasuravich & Kato, 2020, 2022).

Thailand presents a unique context for studying the digital outcomes divide. The country faces a pronounced digital divide, both nationally and internationally. Fixed infrastructure underdevelopment has led to a low Internet penetration rate, especially at the household level; however, mobile penetration rates are higher due to widespread mobile network coverage and subscriptions (Setthasuravich et al., 2024). This disparity highlights the challenges in achieving digital inclusion across different regions of the country. Moreover, the aged society in Thailand faces unique challenges in digital inclusion (Robru et al., 2024). Many older individuals, particularly in rural areas, lack Internet access and smartphones, placing them at risk of being left behind in the digital transformation. According to 2022 data from the International Telecommunication Union (ITU), 88% of individuals in Thailand used the Internet, which is higher than the world average of 67.4% in 2023. However, less than 27.7% of people aged 75 years or older have access to the Internet. A significant urban–rural divide is also reported, with Internet usage in urban areas at 91.7% compared with 84.9% in rural areas (ITU, 2023). Urbanc–rural disparities further exacerbate the digital divide in Thailand. Investments in smart cities and digital parks are concentrated in urban areas, and rural regions often lag in digital infrastructure and access. This urban–rural divide is evident in the education sector, with schools in rural areas frequently lacking access to electricity, computers, and the Internet, which impedes students' ability to engage in e-learning (ITU, 2022).

In response to these challenges, the Thai government launched the Thailand Digital Economy and Society Development Plan for 2018–2037, presenting a comprehensive strategy to leverage digital technology for the nation’s development. It aims to enhance the global competitiveness of Thailand, create equal opportunities, reform public sector operations, and develop human capital for the digital age. The plan is structured into four phases, focusing on building a digital foundation, inclusion, full transformation, and global digital leadership. The plan proposes six key strategies: enhancing high-efficiency digital infrastructure, leveraging digital technology to drive economic growth, fostering an inclusive and equitable society, transitioning to a digital government, strengthening the workforce, and establishing trust in digital technology. Additionally, it emphasizes the need for urgent action, institutional restructuring, integrated resource allocation, and policy follow-up mechanisms to prepare Thailand for the digital age. Key projects include expanding broadband access, promoting e-commerce, and fostering a digital workforce. The ultimate goal is to eliminate the digital divide, ensuring that all citizens can fully benefit from digital advancements (Ministry of Digital Economy and Society, 2016).

Digital technologies bring a wide range of positive outcomes, including enhanced economic opportunities, social inclusion, educational advancement, and improved access to government services (van Dijk, 2020). Economically, digital engagement allows individuals to participate in online commerce, conduct financial transactions, and access job opportunities. Socially, it fosters improved communication, social networking, and community engagement. Educationally, digital technologies provide access to online learning resources, virtual classrooms, and digital tools that enhance learning outcomes. Institutionally, digital engagement facilitates access to e-government services, public information, and civic participation. However, digital engagement also presents challenges, such as digital addiction, privacy concerns, cyberbullying, and the risk of exacerbating socioeconomic disparities (Boerkamp et al., 2024; Scheerder et al., 2019). Digital addiction can negatively impact productivity and mental health, while privacy concerns arise from the extensive personal data shared online (Hidayatullah et al., 2023). Cyberbullying remains a significant issue, particularly among younger users. Moreover, without careful management, digital technologies can widen the gap between those with access and those without, intensifying existing socioeconomic disparities. Despite these challenges, this study focuses on the positive impacts of digital engagement. The primary goal is to understand how digital technologies can enhance socioeconomic opportunities and improve quality of life in Thailand. By concentrating on the beneficial effects, this research aims to identify how digital technologies can be leveraged to foster inclusive growth and development. This approach allows for a comprehensive analysis of how digital engagement can drive economic growth, promote social inclusion, advance education, and improve access to government services, providing valuable insights for policymakers and stakeholders aiming to promote digital inclusivity in Thailand.

Furthermore, the third-level digital divide—disparities in translating digital access into meaningful outcomes—has been underexplored, particularly in developing countries (Scheerder et al., 2017; Setthasuravich & Kato, 2020). While previous studies have examined this divide in developed countries, there is limited empirical evidence from Southeast Asia, especially Thailand, where regional, socioeconomic, and infrastructural challenges are unique (Setthasuravich et al., 2024). This study addresses this gap by offering a comprehensive analysis of Thailand's third-level digital divide, using data from a 2022 nationwide survey. Unlike earlier research focused primarily on the first and second levels of the digital divide (van Dijk, 2020; Wei et al., 2011), this study seeks to answer the key question: ***How do sociodemographic factors influence digital engagement across economic, social, educational, and institutional domains in Thailand?***

To address this question, the study sets the following objectives:

1. Examine the impact of sociodemographic factors on digital engagement in Thailand.
2. Identify the key predictors of positive digital outcomes across various domains.
3. Provide insights for policymakers and stakeholders to develop targeted interventions that promote digital inclusion in Thailand.

This study offers several important contributions. Empirically, it provides detailed insights into the third-level digital divide in Thailand, highlighting how sociodemographic factors influence digital engagement. This comprehensive examination identifies specific barriers and facilitators of digital engagement in the Thai context. From a policy perspective, the study provides valuable information for developing targeted interventions to promote digital inclusion and equitable access to digital opportunities across the country.

The paper is structured as follows: Section 2 provides a comprehensive literature review on the digital divide, including its theoretical foundations and empirical evidence. Section 3 details the methodology employed in this study. Section 4 presents the estimation results, highlighting key findings. Section 5 offers an in-depth discussion of the results and their implications. The conclusion is presented in the final section.

Literature Review

Theorizing the Digital Divide

The term "digital divide" refers to the gap between individuals, households, businesses, and geographic regions at different socioeconomic levels in terms of their access to ICTs and ability to utilize the Internet. This concept is multifaceted, encompassing three primary dimensions: the access divide, the usage divide, and the benefit divide. Recognizing these dimensions is essential for crafting effective strategies to address the digital divide and promote equitable access to technology. The concept gained prominence in the 1990s, initially centered on the access divide, with a focus on the unequal availability of physical access to computers and the Internet. During this period, policymakers and researchers identified technology access as a critical factor influencing social and economic opportunities (Servon, 2002).

As technologies became more widespread in the early 2000s, the focus shifted toward the usage divide. It became clear that simply providing access to technology was insufficient; individuals needed the skills and knowledge to use these technologies effectively. Digital literacy programs and initiatives aimed at increasing digital skills became a priority (van Dijk & Hacker, 2003). In recent years, the emphasis has further shifted to the benefit divide. Policymakers and researchers now recognize that the ultimate goal is not access and usage but ensuring that individuals can derive meaningful benefits from digital technologies. This includes economic advancement, improved health and education outcomes, and enhanced civic and social participation (Wei et al., 2011). The digital divide is a complex phenomenon consisting of three distinct levels: the Internet access divide (first level), the digital skills divide (second level), and the digital outcomes divide (third level).

The first-level digital divide, often termed the "Internet access divide," highlights the inequality between individuals with consistent access to digital technologies and those with limited or no access. This level emphasizes the physical availability of computers, Internet connectivity, and other ICT infrastructure. Several factors contribute to this divide. Economic inequalities enable wealthier individuals and families to afford devices like computers, smartphones, and high-speed Internet, whereas lower-income households often face challenges in acquiring these technologies, creating substantial access gaps (van Deursen & van Dijk, 2019). Additionally, geographic location significantly influences access: urban areas generally benefit from superior ICT infrastructure and faster, more reliable Internet

connectivity compared to rural regions. Rural and remote regions often face challenges such as limited or no Internet connectivity due to the high cost of infrastructure development in less populated areas (Gonzales et al., 2020). Education is another critical factor: individuals with higher levels of education are generally more likely to have access to digital technologies. Educational institutions often provide access to computers and the Internet, which can help bridge the gap for students from less privileged backgrounds (Friemel, 2016). Moreover, age can influence access: younger generations, who have grown up with digital technologies, are more likely to have access to and use these technologies. Older adults may face barriers due to a lack of familiarity or comfort with new technologies (Nain & Chaudhary, 2022; Yu et al., 2018). Finally, people with disabilities may encounter additional barriers to accessing digital technologies, including the need for assistive technologies and accessible design to ensure that they can effectively use ICTs (Helsper & Eynon, 2013; Phochai et al., 2024).

The second level of the digital divide is called the "digital skills divide." Despite having access to digital technologies, the ways in which individuals use and interact with these technologies can differ significantly. The usage divide considers variations in individual digital skills. Digital skills encompass the capacity to utilize digital technologies efficiently. These include fundamental abilities like navigating the Internet and operating standard software applications, alongside more advanced competencies such as coding, data analysis, and knowledge of cybersecurity practices (Scheerder et al., 2017). Those with higher digital literacy are more likely to use technology effectively. In addition, socioeconomic status plays a role; individuals from higher socioeconomic backgrounds exhibit more advanced usage patterns and online engagement. They are more likely to use the Internet for activities such as online banking, e-commerce, and accessing information and services that enhance their quality of life (Robinson et al., 2015). Next, age differences contribute to the usage divide: younger individuals tend to be more proficient in using digital technologies and participating in diverse online activities. In contrast, older adults often use the Internet less frequently and for more restricted purposes, which can limit their ability to fully utilize digital resources (van Deursen & Helsper, 2015). Higher levels of education correlate with more sophisticated use of digital technologies. Educated individuals are more likely to seek information, engage in online learning, and use digital tools for professional development (Tsetsi & Rains, 2017).

The third level of the digital divide, known as the benefit divide or "digital outcomes divide," emphasizes the disparity in the ability to transform access to and usage of ICTs into meaningful economic, social, educational, personal, and institutional benefits. This level focuses on leveraging digital technologies to enhance various aspects of life. Numerous factors contributing to the digital outcomes divide have been studied. For instance, economic opportunities play a crucial role; individuals equipped with the skills and resources to utilize digital technologies can secure better job prospects, engage in e-commerce, and participate in the digital economy, whereas those lacking these capabilities may miss out on significant economic advantages (Ritzhaupt et al., 2013). Educational attainment is another key factor, as access to online learning resources and e-learning platforms can improve educational outcomes and open doors to academic and professional advancement. However, those without the necessary access and skills may be unable to take advantage of these resources (Warschauer & Matuchniak, 2010). Moreover, health outcomes can be improved through digital technologies that provide access to telemedicine, health information, and online support communities. Those without access to these technologies may face barriers to obtaining timely and accurate health information and care (Mitchell et al., 2014). Civic engagement is another area where the benefit divide is evident; the Internet provides a platform for civic engagement, allowing individuals to participate in political discussions, access government services, and advocate for social causes. The digital outcomes divide means that those without digital access and skills are less likely to engage in these activities, which can impact their ability to influence decisions that affect their lives (van Deursen & van Dijk, 2014). Finally, the ability to leverage digital technologies for personal development, social connections, and accessing information can significantly enhance overall well-being (Zillien & Hargittai, 2009).

In sum, the digital divide is a multifaceted and complex issue encompassing disparities in access, usage, and digital outcomes. Each dimension presents unique challenges that must be addressed to promote equitable access to digital technologies. The access divide centers on the physical availability of ICTs, shaped by factors such as income, geographic location, education, age, and disability. The usage divide focuses on differences in digital literacy, skills, and patterns of Internet use, influenced by socioeconomic status, education, and age. Lastly, the digital outcomes divide highlights the ability to convert digital access and usage into significant economic, social, and personal benefits, including improved job opportunities, educational achievements, health outcomes, civic participation, and overall quality of life.

Empirical Evidence of the Third-Level Digital Divide

The third-level digital divide refers to the unequal social benefits individuals can derive from effectively using digital technologies in both professional and personal contexts. Unlike the first and second levels, this divide focuses on the tangible results of Internet use, such as economic growth, social inclusion, educational progress, and enhanced access to government services (Bravo & Libaque-Saenz, 2019). This dimension is particularly significant because it highlights inequalities in the benefits associated with digital technology use, emphasizing the need for not just access and skills but also the meaningful application of these technologies to achieve impactful outcomes. Furthermore, the third-level digital divide has notable implications for education, as disparities in digital skills and usage can influence knowledge acquisition and academic advancement (Çağlayan-Akay & Oskonbaeva, 2022). Despite its importance, this aspect of the digital divide has received less attention in research compared to the first and second levels (Scheerder et al., 2017).

The empirical evidence on the third-level digital divide provides a comprehensive understanding of the barriers and outcomes associated with digital engagement across different socioeconomic contexts. Foundational works by Hargittai (2002) and Wei et al., (2011) provide critical insights into the evolution and impact of the digital divide. Hargittai (2002) critiqued the binary classification of technology use and highlighted the differences in online skills, suggesting that age negatively correlates with Internet skills, whereas experience impacts them positively. Wei et al., (2011) conceptualized the digital divide into three levels: access, capability, and outcomes, demonstrating how these layers interrelate and affect student learning outcomes.

The third-level digital divide has been explicitly recognized by the work of Van Deursen and Helsper (2015), which offered a nuanced understanding of digital inclusion, moving from skills and usage to tangible outcomes. Their study showed that individuals with higher social status benefit more from digital engagement, not in the extent of use but in the achieved outcomes, which exacerbates existing offline inequalities. Scheerder et al., (2019, 2020) further elucidated how sociocultural contexts influence beneficial Internet use and negative outcomes. Their qualitative research indicates that higher educational levels correlate with more positive outcomes, and the way different educational groups cope with negative outcomes varies significantly. In addition, the work by Ogbo et al., (2021) extended this understanding to sub-Saharan Africa, emphasizing that the welfare effect of technology hinges not only on adoption but also on the type of use, highlighting distinct classifications and predictors of Internet activities and outcomes. Furthermore, a recent study also highlighted the myriad benefits of Internet provision, particularly for socioeconomically disadvantaged groups. Boerkamp et al., (2024) conducted a systematic literature review that identified improved employability, enhanced economic standards, better school achievements, and strengthened social capital as significant positive outcomes of Internet use.

The effect of socioeconomic status on the third-level digital divide is well-documented. The third-level digital divide is a crucial aspect of digital inequality that focuses on the tangible benefits of using digital technologies and is influenced by economic, social, technological, and policy-related factors. Economic disparities are a significant contributor to the digital divide. The development index of a country affects all three levels of the digital divide (Chang et al., 2015). Financial disparities between regions and socioeconomic groups further exacerbate this issue. Higher income levels typically correlate with better access to digital resources and the ability to derive greater benefits from digital engagement (Nielsen, 2018). Additionally, social determinants, such as age, gender, education level, and employment status, significantly impact digital engagement. Younger individuals and those with higher education levels tend to benefit more from digital technologies, whereas older adults and less educated individuals often lack the digital literacy needed to leverage these resources effectively (Scheerder et al., 2017). These disparities highlight the critical need to address sociodemographic factors to close the digital divide. Furthermore, the availability and quality of Internet connectivity and access to digital devices are essential for narrowing this gap. Regions with robust digital infrastructure facilitate more effective digital engagement, contributing to improved economic, educational, and social outcomes. In contrast, areas with inadequate Internet connectivity and limited access to digital devices encounter significant challenges in utilizing digital technologies for personal and professional advancement. Government policies and interventions also play a pivotal role in mitigating the digital divide. Policies aimed at improving digital infrastructure, enhancing digital literacy, and promoting inclusive digital practices can significantly reduce the third-level digital divide. Effective e-government initiatives, for instance, can enhance access to government services and improve civic engagement among all demographic groups.

The COVID-19 pandemic has brought significant disparities in online learning outcomes into sharper focus. Research by Wang et al., (2024) and Guo and Wan (2022) underscores the critical role of socioeconomic factors and the quality of digital infrastructure in influencing educational achievements. Students from wealthier backgrounds, with greater access to digital devices and supportive learning environments, are better positioned to excel in online education. In contrast, students from lower-income households encounter challenges such as insufficient access to essential technology and unreliable Internet connectivity, which impede their academic progress. Badiuzzaman et al., (2021) and Yu (2018) emphasized that despite physical access to ICT, many students, particularly from disadvantaged backgrounds, struggle with online learning due to high data costs, poor network infrastructure, and a lack of digital literacy, resulting in a significant utility gap.

Moreover, the third-level digital divide manifests uniquely among different demographic groups. Calderon Gomez (2021) explored how economic, cultural, and social capital convert into digital capital and vice versa among young people in Madrid, highlighting that economic capital imposes material barriers while cultural and social forms of capital facilitate effective digital engagement. This underscores the importance of integrating sociocultural contexts into digital inclusion strategies. Similarly, studies by Park and Chun (2024) and Tőkés (2022) examined the digital divide among older adults in Korea and Romania, respectively, revealing that older adults often possess lower digital capital, which is influenced by regional disparities and socioeconomic factors. Tailored digital literacy programs and supportive environments are essential for enhancing digital engagement among older populations. Additionally, Cho and Kim (2021) explored the disparity in Internet use outcomes between individuals with disabilities and those without disabilities in South Korea. The study found significant gaps in Internet access, skills, motivation, and outcomes, emphasizing the need for government programs to promote digital skills and accessibility for persons with disabilities, ensuring equitable digital engagement.

Furthermore, Nam and Sayogo (2011) and Van Deursen (2020) emphasized the influence of sociodemographic factors on e-government adoption. Younger individuals and those with socioeconomic advantages are more likely to utilize e-government services. Perceived usefulness and trust in government were identified as key determinants of e-government engagement, highlighting the importance of improving the accessibility and value of these services to address the digital divide. Meanwhile, Van Deursen (2020) examined digital inequality during the COVID-19 pandemic, revealing that socioeconomic status, health conditions, and digital literacy significantly impacted the benefits people derived from online resources. The study underscores the need for tailored interventions to support vulnerable populations, ensuring equitable access to digital health information and services.

Despite the growing body of research on the third-level digital divide, several gaps remain. Most studies have been conducted in specific geographical and socioeconomic contexts in developed countries. Further research in diverse settings, particularly in developing countries like Thailand, is required to understand the unique challenges and opportunities in these regions. Specifically, studies often fail to investigate the mechanisms through which socioeconomic status and educational backgrounds affect different digital outcomes in Thailand. To address these gaps, this study provides an in-depth analysis of the factors shaping the third-level digital divide in Thailand. By examining economic, social, educational, and institutional outcomes, it seeks to enrich the existing literature on the digital divide and offer detailed insights into the unique barriers and enablers of digital engagement within the Thai context. The findings aim to guide policymakers and stakeholders in implementing effective measures to foster digital inclusion and ensure equitable digital outcomes across all segments of the Thai population.

Method

Categorizing the Outcomes and Hypotheses

In examining the third-level digital divide, it is essential to categorize the digital outcomes divide into distinct domains that encapsulate the varied benefits and challenges individuals experience from digital engagement. Building on the fivefold categorization of activity domains suggested by van Dijk (2005) and Van Deursen and Helsper (2015)—economic, social, political, institutional, and educational fields—this study focuses on four critical areas: economic (commerce and labor), social, educational, and institutional outcomes. The political domain is not included due to the lack of available data. Each of these domains represents a unique facet of how digital technologies influence and shape the lives of Internet users in Thailand.

Economic outcomes refer to the tangible benefits that individuals derive from engaging in online commercial and labor activities. Economic commerce encompasses activities such as purchasing goods and services online, booking accommodations or hotels, and conducting online banking transactions. These activities highlight the role of digital technologies in facilitating commercial transactions and enhancing financial management. Economic labor includes searching for job information, applying for jobs online, and selling goods and services. The ability to buy and sell goods and services online can significantly enhance economic opportunities, particularly for small business owners and entrepreneurs (Lawrence, 2011; Pestek & Hadzijamakovic, 2024). Furthermore, digital engagement in the labor market can affect an individual's ability to access job opportunities, enhance their employability, and achieve career advancement (Dihan, 2024; Khurshid & Baig, 2024). In the context of Thailand, understanding how different socioeconomic groups engage with and benefit from these economic activities is crucial for identifying potential disparities and promoting inclusive economic growth. Accordingly, **Hypothesis 1** posits that sociodemographic factors, including gender, age, region of residence, income, education level, occupation status, urban residency, and confidence in using the Internet, significantly influence the likelihood of individual engagement in economic activities online. This hypothesis aims to explore the primary determinants that shape digital economic engagement and identify areas where targeted interventions can help bridge the digital divide and promote equitable economic opportunities.

Social outcomes pertain to the ways in which digital technologies influence social interactions, relationships, and community engagement (Erhardt & Freitag, 2021). This includes the use of social media (e.g., Facebook, Instagram, and Twitter), communicating via applications like LINE and Facebook Messenger, and engaging in online dating. Social outcomes of digital engagement can significantly impact an individual's social capital, sense of belonging, and overall well-being (Karabchuk & Shomotova, 2021). In Thailand, where social media use is highly prevalent, examining the social outcomes of digital engagement is essential for understanding how digital technologies affect social cohesion and identifying any existing social disparities. Thus, **Hypothesis 2** posits that sociodemographic factors, including gender, age, region of residence, income, education level, occupation status, urban residency, and confidence in using the Internet, significantly affect the likelihood of individual engagement in social activities online. This hypothesis aims to investigate the primary determinants that shape digital social engagement and identify areas where interventions can promote more inclusive social participation through digital means.

Educational outcomes refer to the influence of digital technologies on learning, knowledge acquisition, and academic achievement. This includes access to online learning materials, participation in virtual classrooms, and the use of digital tools for educational purposes (Bala, 2024). The digital divide in educational outcomes can significantly affect academic performance and future opportunities (Cochrane, 2020). Digital technologies offer unparalleled access to educational resources, fostering lifelong learning and skill development. Engaging in online educational activities is essential for personal and professional advancement, especially in today's fast-paced digital economy. In the Thai context, it is vital to examine how digital engagement shapes educational outcomes across various socioeconomic groups and regions. Accordingly, **Hypothesis 3** posits that sociodemographic factor—such as gender, age, region, income, education level, employment status, urban or rural residency, and Internet confidence—play a critical role in determining individual participation in online educational activities. Understanding these dynamics is essential for designing targeted policies and interventions that ensure equitable access to digital educational resources and opportunities. Such measures support lifelong learning and skill development across diverse socioeconomic groups in Thailand.

Institutional outcomes pertain to the engagement in and benefits derived from digital government services and other institutional digital platforms. This includes access to e-government services, online public information, and digital participation in civic activities. Effective digital interaction with institutional services can enhance citizens' access to government resources, increase transparency, and promote civic participation (Zhao et al., 2024). Successful engagement with digital government services ensures that individuals are well-informed and adequately supported by public resources. In the context of Thailand, analyzing institutional outcomes can provide valuable insights into how effectively digital government initiatives are reaching and benefiting various population segments. This analysis can also identify areas for improvement in public digital services. Accordingly, **Hypothesis 4** posits that sociodemographic factors, including gender, age, region of residence, income, education level, occupation status, urban residency, and confidence in using the Internet, significantly influence the likelihood of individual use of the Internet for institutional outcomes. This hypothesis underscores the importance of understanding the diverse factors that affect digital

engagement with government services, aiming to enhance the accessibility and effectiveness of these services for all citizens.

The exclusion of the political domain is due to the lack of available data from Thailand. Although political outcomes are undoubtedly important, the absence of robust data limits the ability to conduct a thorough analysis in this study. Nevertheless, categorizing digital outcomes into economic, social, educational, and institutional domains provides a structured framework for examining the third-level digital divide. This categorization highlights the multifaceted nature of digital engagement and its impact on various aspects of individual lives. By focusing on these four domains, this study aims to contribute to a deeper understanding of digital inequalities and inform the development of effective policies and interventions to promote digital inclusion in Thailand.

Data Source and Sample Selection

This study utilized data from the "Thailand Internet User Behavior Survey 2022," conducted by the Electronic Transactions Development Agency. This extensive survey captures a diverse representation of Internet users across Thailand, encompassing a wide range of socioeconomic backgrounds, age groups, and regions. The sampling process was carefully controlled and weighted to account for the uneven distribution of Internet users nationwide, as highlighted in the "Household Information and Communication Technology Use Survey 2021" by the National Statistical Office. Data collection took place between April and July 2022, involving 46,348 voluntary respondents. The survey was conducted online, with questionnaires distributed via email using the Electronic Transactions Development Agency's database and promoted through websites and social media platforms such as Facebook, LINE@, and Instagram. Sponsorship from various government and private organizations further enhanced access and participation. For this study, the final sample comprised 43,465 respondents aged 18 and above, ensuring the inclusion of adult Internet users who are more likely to engage in diverse online activities and experience varied digital outcomes.

Independent Variables

Table 1 presents a comprehensive classification, and operational definitions of the independent variables employed in this study.

Table 1

Categories and Operational Definitions of Independent Variables

Independent Variables	Categories/Operational Definitions
Gender	0: Female
	1: Male
Age	1: 18–25 years (young adults)
	2: 26–44 years (adults)
	3: 59–59 years (middle-aged adults)
	4: 60+ years (older adults)
Region	1: Northern
	2: Northeastern
	3: Central
	4: Southern
	5: Western
	6: Eastern
Income	0: Less than 15,000 THB
	1: 15,000 THB and above
Education Level	0: Below primary school
	1: Lower primary school
	2: Upper primary school
	3: Junior high school
	4: High school/vocational certificate
	5: Associate degree, vocational certificate/diploma
	6: Bachelor's degree
	7: Master's degree
	8: PhD
Occupation	0: Unemployed
	1: Employed
Residence	0: Rural area
	1: Urban area
Degree of Confidence in Using the Internet	0: Not confident at all
	1: Slightly confident

Independent Variables	Categories/Operational Definitions
	2: Very confident
	3: Most confident

Dependent Variables

The dependent variables in this study were organized into several primary outcome domains, each represented by a series of binary (Yes/No) questions (Table 2). For each domain, a summary scale was created based on these dichotomous items. Following the approach recommended by Van Deursen and Helsper (2015), the summary scale was then converted into a binary format: if at least one of the questions within a domain was answered "Yes," the factor was assigned a value of 1; if all responses were "No," the factor was assigned a value of 0.

The dependent variables and their corresponding questions are outlined in Table 2. The table also includes the percentage of respondents who answered "Yes" to each question, along with the actual number of affirmative responses in parentheses. The economic outcomes were divided into two categories: economic commerce and economic labor. Economic commerce included activities such as purchasing goods and services online (24.82%, n = 10,787), booking accommodations or hotels online (4.65%, n = 2,020), and conducting online banking transactions (32.13%, n = 13,966). Economic labor encompassed searching for job information or applying for jobs online (8.11%, n = 3,525) and selling goods and services online (4.48%, n = 1,947).

Social outcomes were measured by questions related to using social media platforms including Facebook, Instagram, and Twitter (35.99%, n = 15,645), chatting via applications such as LINE and Facebook Messenger (64.94%, n = 28,226), and engaging in online dating (0.81%, n = 352). Educational outcomes were assessed through questions on online learning (11.08%, n = 4,818), attending online training courses (7.46%, n = 3,242), searching for academic information (10.92%, n = 4,748), and applying to schools or universities online (1.90%, n = 824). Institutional outcomes involved following government news, such as COVID-19 reports (10.37%, n = 4,508), and registering for or checking the eligibility of government programs (17.03%, n = 7,403).

Table 2

Dependent Variables and Corresponding Questions

Outcomes	Questions	Yes %
Economic Commerce 1	Did you use the Internet to purchase goods and services online?	24.82 (10,787)
Economic Commerce 2	Did you use the Internet to book accommodations/hotels online?	4.65 (2,020)
Economic Commerce 3	Did you use the Internet to conduct online banking transactions (e.g., transfers, top-ups)?	32.13 (13,966)
Economic Labor 1	Did you use the Internet to search for job information/apply for jobs online?	8.11 (3,525)
Economic Labor 2	Did you use the Internet to sell goods and services online?	4.48 (1,947)
Social 1	Did you use social media such as Facebook, Instagram, Twitter?	35.99 (15,645)
Social 2	Did you use the Internet to chat via applications such as LINE, Facebook Messenger?	64.94 (28,226)
Social 3	Did you use the Internet for online dating?	0.81 (352)
Educational 1	Did you use the Internet for online learning?	11.08 (4,818)
Educational 2	Did you use the Internet to attend online training courses?	7.46 (3,242)
Educational 3	Did you use the Internet to search for academic information?	10.92 (4,748)
Educational 4	Did you use the Internet to apply for schools/universities?	1.90 (824)
Institutional 1	Did you use the Internet to follow government news (e.g., COVID-19 reports)?	10.37 (4,508)
Institutional 2	Did you use the Internet to register/receive/check eligibility for	17.03

government programs (e.g., We Win Scheme)?	(7,403)

Note: Numbers of samples are in parentheses.

Data Analyses

This study employed the procedure of data analysis proposed by Van Deursen and Helsper (2015). The principal axis factoring (PAF) method was initially used to assess the dependent variables, followed by varimax rotation to establish the factor structure of the 14 outcome items. It offers significant benefits in measuring dependent variables. PAF is particularly useful for identifying underlying factor structures when the assumption of multivariate normality is violated, as is the case with binary items. This method aids in identifying the latent constructs underlying the observed variables, providing a clear and accurate representation of the data (Costello & Osborne, 2005). This study used PAF to effectively group related activities, such as economic, social, educational, and institutional outcomes, enhancing the reliability and validity of the measurement model and ensuring robust, interpretable results.

To examine the relationship between the independent variables and the outcomes across four domains (economic, social, educational, and institutional government), logistic regression analysis was employed. Adjusted odds ratios (AOR) with robust standard errors were calculated to account for clustering effects within the data. The analysis, conducted using STATA, provides results with 95% confidence intervals (CIs) and significance levels (p-values). This analysis aimed to identify the sociodemographic factors influencing the likelihood of Internet users in Thailand engaging in and deriving benefits from digital activities within these domains. Significant predictors are highlighted, and the implications of these findings are discussed concerning digital inclusion and policy recommendations.

Results

Before examining the detailed logistic regression analysis results, we conducted a PAF test with varimax rotation was conducted to establish the factor structure of the 14 outcome items related to digital engagement. Since the Internet outcomes were measured using binary items, the multivariate normality assumption was not met, making PAF the most suitable method. The analysis identified a five-factor structure aligned with the theoretical concepts determined a priori, which provided the best fit for the data. Following the recommendation of Tabachnick and Fidell (2019), a factor loading threshold of 0.32 was used as the minimum acceptable loading for an item. All 14 items exceeded this threshold, contributing to a robust five-factor structure (see Table 3).

The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was calculated at 0.7001, categorized as "middling" (Kaiser, 1974). According to Netemeyer et al., (2003), a KMO value above 0.60–0.70 is deemed sufficient, further confirming that the sample size was appropriate for factor analysis. Additionally, Bartlett's test of sphericity produced a significant chi-square value of 15,480.579 ($p < 0.001$), indicating that the correlation matrix was not an identity matrix and confirming the suitability of the data for factor analysis (Bartlett, 1950). These findings affirm the appropriateness of using PAF and validate the five-factor structure for analyzing the digital outcomes in this study. The strong loadings of the items of each factor underscore the robustness of the identified structure in capturing the underlying theoretical constructs. This factor structure provided a clear delineation of digital outcomes, facilitating a nuanced analysis of how various sociodemographic factors influence each domain.

Table 3

Subscale loadings of the Digital Outcomes

Subscale	Factors				
	1 Economic Commerce	2 Economic Labor	3 Social	4 Educational	5 Institutional
Did you use the internet to purchase goods and services online?	0.843				
Did you use the internet to book accommodations/hotels online?	0.577				
Did you use the internet to conduct online banking transactions (e.g., transfers, top-ups)?	0.821				
Did you use the internet to search for job information/apply for jobs online?		0.778			
Did you use the internet to sell goods and services online?		0.778			

Subscale	Factors				
	1 Economic Commerce	2 Economic Labor	3 Social	4 Educational	5 Institutional
Did you use social media such as Facebook, Instagram, Twitter?			0.707		
Did you use the internet to chat via applications such as LINE, Facebook Messenger?			0.716		
Did you use the internet for online dating?			0.402		
Did you use the internet for online learning?				0.778	
Did you use the internet to attend online training courses?				0.749	
Did you use the internet to search for academic information?				0.806	
Did you use the internet to apply for schools/universities?				0.605	
Did you use the internet to follow government news (e.g., COVID-19 reports)?					0.881
Did you use the internet to register/receive/check eligibility for government programs (e.g., We Win)?					0.881

Table 4 shows the results from the logistic regression analyses. These results indicate significant associations between various sociodemographic factors and the likelihood of engaging in different online activities across economic, social, educational, and institutional domains.

Table 4

Estimation Results of Logistic Regression Analyses for the Digital Outcomes

Factors	Economic Commerce		Economic Labor		Social		Educational		Institutional	
	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI
Gender (ref. Female)										
Male	0.806*** (0.018)	0.771 - 0.842	0.863*** (0.028)	0.809 - 0.920	0.883*** (0.021)	0.844 - 0.925	0.829*** (0.024)	0.784 - 0.878	0.855*** (0.022)	0.813 - 0.899
Age (ref. 18-25 years (young adults))										
26-44 years (adults)	0.935* (0.028)	0.880 - 0.992	0.704*** (0.030)	0.648 - 0.765	0.981 (0.034)	0.916 - 1.050	0.189*** (0.007)	0.177 - 0.203	1.468*** (0.056)	1.361 - 1.583
45-59 years (middle-aged adults)	0.583*** (0.020)	0.545 - 0.624	0.367*** (0.020)	0.331 - 0.408	0.881** (0.033)	0.818 - 0.948	0.136*** (0.006)	0.125 - 0.148	1.686*** (0.070)	1.554 - 1.829
60+ years (older adults)	0.275*** (0.015)	0.247 - 0.306	0.191*** (0.021)	0.155 - 0.236	0.825*** (0.040)	0.751 - 0.906	0.072*** (0.006)	0.061 - 0.085	1.807*** (0.096)	1.628 - 2.005
Region (ref. Northern)										
Northeastern	0.901* (0.038)	0.830 - 0.978	1.604*** (0.102)	1.416 - 1.817	2.099*** (0.098)	1.916 - 2.300	1.564*** (0.088)	1.400 - 1.747	2.192*** (0.106)	1.994 - 2.409
Central	1.134** (0.045)	1.050 - 1.225	1.330*** (0.079)	1.184 - 1.493	1.043 (0.044)	0.960 - 1.134	1.589*** (0.084)	1.433 - 1.761	1.335*** (0.062)	1.218 - 1.462
Southern	0.328*** (0.016)	0.299 - 0.360	0.960 (0.068)	0.837 - 1.103	0.321*** (0.015)	0.294 - 0.351	0.654*** (0.043)	0.574 - 0.745	0.514*** (0.032)	0.456 - 0.581
Western	0.562*** (0.034)	0.499 - 0.634	1.275** (0.114)	1.070 - 1.518	0.649*** (0.038)	0.579 - 0.727	0.709*** (0.065)	0.593 - 0.849	0.615*** (0.051)	0.524 - 0.723
Eastern	0.990 (0.053)	0.892 - 1.099	0.844 (0.073)	0.712 - 1.001	0.984 (0.055)	0.882 - 1.098	1.554*** (0.108)	1.356 - 1.781	0.976 (0.064)	0.858 - 1.109
Income (ref. Below average)										
Above average	1.426*** (0.036)	1.357 - 1.499	1.889*** (0.076)	1.746 - 2.043	1.010 (0.028)	0.957 - 1.065	0.785*** (0.026)	0.735 - 0.838	0.900*** (0.027)	0.849 - 0.954
Education Level (ref.* Below primary school*)										
Lower primary school	1.895*** (0.239)	1.479 - 2.427	0.793 (0.154)	0.542 - 1.162	1.483*** (0.108)	1.287 - 1.710	0.912 (0.159)	0.649 - 1.283	1.609*** (0.175)	1.299 - 1.991
Upper primary school	1.486** (0.180)	1.172 - 1.885	0.713 (0.127)	0.503 - 1.011	1.706*** (0.116)	1.492 - 1.950	0.822 (0.132)	0.601 - 1.126	1.743*** (0.181)	1.423 - 2.137
Junior high school	2.870*** (0.335)	2.283 - 3.608	0.710* (0.123)	0.506 - 0.997	2.377*** (0.162)	2.080 - 2.716	1.147 (0.176)	0.849 - 1.549	2.270*** (0.232)	1.858 - 2.774
High school/vocational certificate	4.436*** (0.503)	3.551 - 5.540	1.346 (0.214)	0.986 - 1.838	2.856*** (0.187)	2.513 - 3.246	1.879*** (0.272)	1.415 - 2.494	2.153*** (0.214)	1.771 - 2.617
Associate degree, vocational certificate/diploma	4.323*** (0.498)	3.449 - 5.419	1.526** (0.247)	1.112 - 2.094	3.068*** (0.213)	2.678 - 3.515	1.501** (0.222)	1.123 - 2.006	1.628*** (0.169)	1.329 - 1.995
Bachelor's degree	6.626*** (0.754)	5.302 - 8.282	2.347*** (0.373)	1.719 - 3.204	3.705*** (0.249)	3.247 - 4.227	4.040*** (0.586)	3.040 - 5.369	2.752*** (0.276)	2.261 - 3.350
Master's degree	12.586*** (1.598)	9.813 - 16.141	3.403*** (0.573)	2.447 - 4.732	4.444*** (0.416)	3.699 - 5.339	12.902*** (1.990)	9.536 - 17.458	5.932*** (0.665)	4.762 - 7.389
Ph.D.	7.309*** (1.406)	5.014 - 10.655	2.922*** (0.775)	1.738 - 4.912	1.722** (0.286)	1.243 - 2.386	17.769*** (3.882)	11.579 - 27.266	6.629*** (1.258)	4.570 - 9.617

Factors	Economic Commerce		Economic Labor		Social		Educational		Institutional	
	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI	AOR (Robust SE)	95% CI
Occupation (ref. Unemployed)										
Employed	1.755*** (0.198)	1.406 - 2.190	0.656** (0.095)	0.494 - 0.871	0.825 (0.087)	0.670 - 1.015	2.725*** (0.428)	2.003 - 3.707	0.945 (0.106)	0.758 - 1.178
Residence (ref. Rural area)										
Urban area	1.696*** (0.040)	1.620 - 1.775	1.333*** (0.047)	1.244 - 1.428	1.505*** (0.038)	1.432 - 1.580	1.244*** (0.038)	1.171 - 1.321	1.293*** (0.035)	1.226 - 1.363
Degree of Confidence in Using the Internet (ref. Not confident at all)										
Slightly confident	3.448*** (0.257)	2.980 - 3.990	1.465*** (0.148)	1.201 - 1.786	1.891*** (0.108)	1.690 - 2.115	1.952*** (0.181)	1.626 - 2.342	2.633*** (0.226)	2.226 - 3.114
Very confident	4.992*** (0.362)	4.330 - 5.754	1.829*** (0.178)	1.511 - 2.214	2.472*** (0.137)	2.218 - 2.754	2.303*** (0.208)	1.929 - 2.749	3.093*** (0.259)	2.625 - 3.643
Most confident	2.629*** (0.191)	2.280 - 3.032	1.126 (0.111)	0.928 - 1.367	1.916*** (0.105)	1.722 - 2.133	1.133 (0.104)	0.947 - 1.355	1.797*** (0.151)	1.523 - 2.120
Wald (Chi - Square)	6913.62***		2667.89***		4190.71***		6016.25***		2479.11***	
Pseudo R2	0.169		0.106		0.097		0.206		0.064	

Note: *N*= 43,465, Robust standard errors in parentheses, *** p<0.001, ** p<0.01, * p<0.05

Economic Commerce Outcomes

The analysis revealed significant sociodemographic influences on economic commerce activities, including online purchasing, booking accommodations, and online banking. Men were less likely than women to engage in these activities (AOR = 0.806, 95% CI: 0.771–0.842). Age was also critical, with older adults showing a lower likelihood of participation compared to young adults (e.g., AOR = 0.275 for 60+ years, 95% CI: 0.247–0.306). Regional disparities were noted, with the southern region showing the lowest engagement (AOR = 0.328, 95% CI: 0.299–0.360), while the central region had the highest (AOR = 1.134, 95% CI: 1.050–1.225). Higher income (AOR = 1.426, 95% CI: 1.357–1.499) and education levels were strong predictors of increased online commerce, particularly for those with a master's degree (AOR = 12.586, 95% CI: 9.813–16.141). Employment status also played a role, with employed individuals more likely to engage in online commerce (AOR = 1.755, 95% CI: 1.406–2.190). Urban residents were significantly more engaged than rural residents (AOR = 1.696, 95% CI: 1.620–1.775). Internet confidence strongly influenced participation, with those "very confident" having a higher likelihood of engagement (AOR = 4.992, 95% CI: 4.330–5.754).

Economic Labor Outcomes

The analysis showed significant sociodemographic influences on economic labor activities, such as job searching and selling goods online. Men were less likely to engage in these activities compared to women (AOR = 0.863, 95% CI: 0.809–0.920), and older adults had progressively lower engagement than young adults (e.g., AOR = 0.191 for 60+ years, 95% CI: 0.155–0.236). Regionally, individuals in the northeastern region were more likely to participate in economic labor activities (AOR = 1.604, 95% CI: 1.416–1.817), while the southern and eastern regions showed no significant differences. Higher income (AOR = 1.889, 95% CI: 1.746–2.043) and education levels were associated with increased engagement, especially for those with a master's degree (AOR = 3.403, 95% CI: 2.447–4.732). Interestingly, employed individuals were less likely to engage in economic labor activities (AOR = 0.656, 95% CI: 0.494–0.871). Urban residents had a higher likelihood of participating (AOR = 1.333, 95% CI: 1.244–1.428). Confidence in using the Internet also played a key role, with those "very confident" more likely to engage (AOR = 1.829, 95% CI: 1.511–2.214).

Social Outcomes

The analysis revealed significant sociodemographic influences on social activities such as social media use, chatting, and online dating. Men were less likely to engage in online social activities than women (AOR = 0.883, 95% CI: 0.844–0.925). Older adults had lower engagement compared to young adults, with middle-aged adults (AOR = 0.881, 95% CI: 0.818–0.948) and older adults (AOR = 0.825, 95% CI: 0.751–0.906) showing decreased participation. Regional differences were notable, with the northeastern region having higher engagement (AOR = 2.099, 95% CI: 1.916–2.300), while the southern region showed the lowest (AOR = 0.321, 95% CI: 0.294–0.351). Income did not significantly impact online social engagement, but education played a crucial role. Higher educational attainment, such as a master's degree (AOR = 4.444, 95% CI: 3.699–5.339), led to increased social engagement. Urban residency significantly increased the likelihood of engaging in social activities (AOR = 1.505, 95% CI: 1.432–1.580). Confidence in using the Internet was also a key factor, with those "very confident" more likely to participate in online social activities (AOR = 2.472, 95% CI: 2.218–2.754).

Educational Outcomes

The analysis showed significant sociodemographic influences on educational activities such as online learning and searching for academic information. Men were less likely than women to engage in these activities (AOR = 0.829, 95% CI: 0.784–0.878). Engagement decreased with age, with adults aged 26–44 years (AOR = 0.189, 95% CI: 0.177–0.203) and older adults aged 60+ (AOR = 0.072, 95% CI: 0.061–0.085) showing the lowest participation. Regionally, the northeastern (AOR = 1.564, 95% CI: 1.400–1.747) and central regions had higher engagement, while the southern region had the lowest (AOR = 0.654, 95% CI: 0.574–0.745). Higher income reduced the likelihood of engagement (AOR = 0.785, 95% CI: 0.735–0.838), but education significantly increased it, especially for individuals with a PhD (AOR = 17.769, 95% CI: 11.579–27.266). Employment status positively influenced engagement (AOR = 2.725, 95% CI: 2.003–3.707), as did urban residency (AOR = 1.244, 95% CI: 1.171–1.321). Confidence in using the Internet strongly impacted participation, with "very confident" individuals having higher engagement (AOR = 2.303, 95% CI: 1.929–2.749).

Institutional Outcomes

The analysis showed that gender significantly influenced engagement in institutional government activities, with men being less likely than women to participate (AOR = 0.855, 95% CI: 0.813–0.899). Age had a notable effect, as older age groups were more likely to engage, particularly those aged 60+ (AOR = 1.807, 95% CI: 1.628–2.005). Regional differences were pronounced, with the northeastern region showing the highest engagement (AOR = 2.192, 95% CI: 1.994–2.409), while the southern region had the lowest (AOR = 0.514, 95% CI: 0.456–0.581). Higher income reduced participation (AOR = 0.900, 95% CI: 0.849–0.954), while higher education increased it, especially for those with a PhD (AOR = 6.629, 95% CI: 4.570–9.617). Employment status did not significantly affect engagement. Urban residency increased the likelihood of participating (AOR = 1.293, 95% CI: 1.226–1.363). Confidence in using the Internet was a key factor, with "very confident" individuals more likely to engage (AOR = 3.093, 95% CI: 2.625–3.643).

The comparative analysis revealed nuanced impacts across economic, social, educational, and institutional domains. Gender was consistently significant, with men less likely to engage in online activities than women, as shown by lower AORs across all domains. Age had a clear influence, with younger adults showing the highest engagement, while older adults, particularly those 60+, demonstrated higher participation in institutional activities. Regional disparities were evident, with the northeastern region leading in social and institutional engagement, while the southern region had the lowest across most domains. Income positively impacted economic commerce and labor but was associated with lower institutional engagement. Educational attainment strongly enhanced engagement in all domains, with those holding higher degrees showing the highest participation. Employment status positively influenced economic commerce and education but negatively affected economic labor. Urban residency was a strong predictor of higher engagement due to better digital access. Confidence in Internet skills significantly boosted engagement across all activities, with "very confident" individuals showing the highest likelihood of participation.

Discussion

Summary of the Main Findings

The results of this study elucidate the complex dynamics of the third-level digital divide in Thailand, encompassing economic, social, educational, and institutional domains. Each domain reveals distinct patterns influenced by various sociodemographic factors, highlighting the multifaceted nature of digital inequality and its implications for policy and intervention strategies.

Economic outcomes in this study are bifurcated into economic commerce and labor. The findings reveal significant gender disparities in digital economic engagement, with men less likely to participate in online commerce, such as purchasing and financial transactions. This aligns with research suggesting that consumer behaviors differ by gender, with women often engaging more actively in online shopping for household needs (Dai et al., 2019). However, these results diverge from Van Deursen and Helsper's (2018) study in the Netherlands, which showed men achieving greater economic outcomes online. This contrast underscores the importance of cultural and contextual differences in shaping digital engagement patterns, suggesting that gender dynamics in digital commerce are not universal and must be understood within local socio-cultural frameworks. The pronounced age-related decline in economic commerce participation among older adults highlights the persistent barriers they face in navigating digital platforms, reinforcing the need for targeted digital literacy programs tailored to their specific needs (van Deursen & van Dijk, 2019). Additionally, regional disparities are evident, with residents in the central region more likely to engage in economic commerce compared to those in other regions. This likely reflects the uneven distribution of digital infrastructure and economic development across Thailand (Gonzales et al., 2020; Setthasuravich et al., 2024), suggesting that addressing regional infrastructure gaps is crucial for promoting equitable digital participation. Socioeconomic status also plays a critical role, as individuals with higher income and educational attainment are more likely to engage in digital commerce. This emphasizes the intersection between socioeconomic advantage and digital engagement, wherein those with more resources are better positioned to benefit from digital platforms. Similarly, economic labor outcomes reflect these patterns, with men, older adults, and lower-income individuals less likely to participate in online job searches and selling activities. Education emerges as a pivotal factor in enhancing digital skills and facilitating access to vocational training and job platforms (Pestek & Hadzijamakovic, 2024). Moreover,

regional differences in labor outcomes further indicate the necessity of localized economic policies and digital infrastructure improvements to bridge the digital divide and foster inclusive economic participation.

Social outcomes pertain to the ways digital technologies influence social interactions and relationships. The study reveals that men are less likely to engage in social activities online, such as using social media and chat applications. This gender disparity in social digital engagement may be linked to different social behaviors and communication preferences between genders (Theophilou et al., 2023). Age is another significant factor, with older adults less likely to participate in social activities online. This finding emphasizes the need for inclusive digital literacy programs that cater to older populations to enhance their social connectedness through digital means (Karabchuk & Shomotova, 2021; White, 2023). Regional disparities are stark in social outcomes, with the northeastern region showing higher engagement compared with the other regions. This could reflect regional cultural differences in social media usage and community engagement. Income did not significantly impact social digital engagement, which may suggest that social media and chat applications are relatively accessible across different income groups in Thailand; this aligns with the findings of Van Deursen and Helsper (2015, 2018). However, education levels were strongly associated with social digital engagement, indicating that higher education correlates with a greater use of social platforms. This aligns with the notion that education enhances digital literacy and the ability to leverage social technologies effectively (del Rocío Bonilla et al., 2020).

Educational outcomes are significantly influenced by digital technologies, providing unprecedented access to learning resources and opportunities for skill development. The results indicate that men, older adults, and individuals from lower-income households were less likely to engage in online educational activities. This trend highlights the persistent barriers faced by these groups in accessing and benefiting from digital educational resources (Cochrane, 2020). Regional differences were notable, with individuals in the northeastern and central regions more likely to engage in online educational activities compared with those in the southern and western regions. This finding suggests that regional disparities in educational infrastructure and Internet connectivity need to be addressed to promote equitable access to digital education (Friemel, 2016). Higher income levels and educational attainment were positively associated with online educational engagement, reinforcing the critical role of socioeconomic status in accessing and using digital educational resources. In addition, employment status significantly affected educational outcomes, with employed individuals more likely to participate in online learning. This underscores the importance of workplace digital literacy programs and support for continuous learning (Tsetsi & Rains, 2017).

Institutional outcomes were associated with engagement with digital government services and other institutional platforms. The study found that men and individuals from lower-income households are less likely to engage with digital government services. This gender and income disparity in institutional digital engagement highlights the need for inclusive e-government initiatives that cater to the needs of all demographic groups (Zhao et al., 2024). Age significantly influenced institutional outcomes, with older adults more likely to engage with digital government services. This may reflect the increased need for government-related information and services among older populations. Moreover, the regional disparities in institutional outcomes were pronounced, with the northeastern region showing higher engagement compared with the other regions. This finding suggests that regional efforts to improve digital literacy and access to e-government services are crucial for promoting civic participation and transparency (Nam & Sayogo, 2011). Education and confidence in using the Internet were strong predictors of institutional digital engagement. Higher educational attainment and greater confidence in using digital technologies were associated with an increased use of digital government services. This underscores the importance of digital literacy programs and initiatives that build confidence in using digital platforms, particularly for government-related activities (Van Deursen, 2020).

The results of this study align with key theories and concepts of the digital divide, particularly the third-level digital divide, which focuses on disparities in digital outcomes. According to Van Dijk's (2020) framework, the digital divide extends beyond access and usage, encompassing the ability to derive tangible benefits from digital technologies. This study reveals how sociodemographic factors influence economic, social, educational, and institutional outcomes, underscoring the multifaceted nature of digital inequality.

Implications for Policy and Practice

The findings of this study carry important implications for both policy and practice, particularly in tackling Thailand's third-level digital divide. Drawing on benchmarks from the Thailand Digital Economy and Society Development Plan (2018–2037) and international frameworks, the following detailed policy recommendations are proposed:

First, gender-sensitive digital literacy programs are essential. The persistent gender disparities in digital engagement across domains highlight the need for policies that support gender equality in technology use, in line with UN SDG 5 (gender equality). These programs must be tailored to address the specific barriers that women and men face when engaging with digital commerce, labor, social, educational, and institutional activities. Targeted interventions will ensure that both genders are equally empowered to participate fully in the digital economy and society.

Second, the gaps in digital engagement among older adults call for inclusive digital literacy programs. Policies should prioritize lifelong digital learning through senior-focused digital inclusion programs that provide user-friendly training and accessible devices. These programs could mitigate the digital exclusion of older populations and should be delivered through local community centers, leveraging existing infrastructures like public libraries, in line with Thailand's smart aging strategies.

Third, addressing regional digital infrastructure disparities is crucial. The study highlights the need for localized strategies that align with Thailand's Smart Cities initiative and ITU standards for digital inclusion. Investment in broadband infrastructure in underserved regions must be prioritized. Additionally, subsidies for digital devices and Internet services in rural areas, coupled with region-specific digital literacy programs, will help close the regional digital divide and ensure more equitable access to digital opportunities.

Fourth, financial and educational barriers to digital engagement must be reduced. Given the strong influence of income and education on digital participation, policies should focus on providing subsidies for low-income households to make digital technologies more affordable. Furthermore, the integration of digital literacy into the formal education system, along with vocational training aligned with labor market demands, will foster greater economic participation and enhance digital fluency. These efforts will contribute to achieving Thailand's digital workforce development goals.

Finally, building digital confidence is essential for greater engagement. National digital literacy campaigns, modeled on the "OECD Framework for Digital Talent and Skills in the Public Sector", should emphasize practical, hands-on training. Programs that include ongoing mentorship and peer learning opportunities can help individuals build confidence in their digital skills, ensuring that they are equipped to participate effectively in the digital economy and society.

Study Limitations, Strengths, and Directions for Future Research

While this study provides valuable insights into the third-level digital divide in Thailand, several limitations must be acknowledged. A key limitation is the reliance on an online survey, which excludes individuals without Internet access or those less comfortable with digital technologies. This likely skews the sample toward more digitally literate individuals, underrepresenting marginalized groups such as older adults, rural residents, and those from lower socioeconomic backgrounds. As a result, the study may not fully capture the experiences of these populations. Additionally, the study's cross-sectional design limits the ability to establish causal relationships between sociodemographic factors and digital engagement outcomes. Future research should adopt longitudinal designs to track changes over time and explore causal pathways.

Moreover, the study focuses primarily on positive outcomes, such as economic opportunities and educational advancements, without examining potential negative impacts like digital addiction, online harassment, or data privacy concerns. These issues, along with political participation, were not covered due to data limitations and should be addressed in future research. Unmeasured variables, such as individual motivations and local policies, were also excluded, which could further shape digital engagement.

Despite these limitations, this study has several strengths. Unlike surveys conducted by survey institutions, which often focus on descriptive statistics, this study provides a nuanced analysis by examining the interaction of multiple sociodemographic factors across economic, social, educational, and institutional domains. The study offers critical policy implications by highlighting the intersection of gender, age, region, and socioeconomic status in shaping digital engagement, contributing to a more comprehensive understanding of the third-level digital divide in Thailand.

Conclusion

This study significantly contributes to understanding the third-level digital divide in Thailand by providing nuanced insights into how sociodemographic factors influence digital engagement across economic, social, educational, and institutional domains. It highlights the disparities in digital engagement based on gender, age, region, income, education, employment status, urban residency, and Internet confidence. This study provides policymakers and stakeholders with valuable information by focusing on these specific domains and identifying key predictors of digital outcomes. With this information, they can develop targeted interventions aimed at promoting digital inclusion and equitable access to digital opportunities, ultimately fostering more inclusive socioeconomic growth in Thailand. Theoretically, this study broadens the comprehension of the third-level digital divide by integrating sociodemographic factors with digital engagement outcomes, particularly within the context of developing countries in which this level of digital divide has been less explored. It enhances the existing models and debates in the digital divide literature by identifying multiple factors influencing digital engagement in Thailand, thereby offering a comprehensive framework for future research on digital inequalities and their socioeconomic implications.

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