



Determinants of Digital Safety in Thailand: An Empirical Analysis of the 3S Digital Citizenship Model

Montree Montreemanee^{1*} and Kasemsarn Chotchakornpant²

Article History

Receive: July 17, 2026

Revised: August 20, 2026

Accepted: August 26, 2026

ABSTRACT

This study examined the direct effects, mediating effects, and serial mediation pathway of digital savvy and digital safety in Thailand through the 3S Digital Citizenship Model, thereby extending the empirical evidence on the mechanisms through which socio-economic factors and digital engagement are associated with digital safety. This quantitative study used nationally representative secondary data from the 2025 Media and Information Literacy and Digital Literacy Survey with an analytical sample of 47,550 respondents. Data were analyzed using descriptive statistics, HC3 robust ordinary least squares regression, and bootstrap mediation analysis with 10,000 resamples at a 95% confidence level. The results showed that 1) education, online use, and online spending were positively associated with digital savvy, digital social, and digital safety, whereas income was positively associated with digital savvy but negatively associated with digital social and digital safety. 2) Digital savvy partially mediated the relationships between these predictors and digital safety. 3) Digital social partially mediated the relationships between these predictors and digital safety. 4) The serial mediation analysis revealed an ordered pathway in which digital savvy influenced digital social, which subsequently contributed to digital safety. 5) The policy implications suggest that digital safety policies should be implemented sequentially by strengthening digital savvy, promoting responsible online behavior, and developing self-protection practices to enhance citizens' digital safety. The findings contribute empirical evidence for policy, academic research, and practice by supporting targeted digital safety and digital literacy programs in Thailand.

Keywords : 3S Digital Citizenship Model; Digital Citizenship; Digital safety; Digital Inequality; Digital Governance

¹ Doctoral Student Governance and Development (International Program), Graduate School of Public Administration, National Institute of Development Administration

² Associate Professor, Graduate School of Public Administration, National Institute of Development Administration

*Corresponding author, E-mail: montree.montr@stu.nida.ac.th



Introduction

Digital transformation has increasingly changed how citizens communicate, learn, work, access public services, and participate in social and economic life. In Thailand, digital public policy has emphasized digital inclusion, digital government, citizen-centered public services, and public confidence in the use of digital public services. This policy direction is reflected in the Digital Government Development Plan of Thailand 2023-2027, which aims to develop public services that are convenient, transparent, modern, responsive to citizens' needs, and supportive of reducing inequality in access to government services (Digital Government Development Agency, 2023). However, access to digital technologies alone does not guarantee safe and meaningful digital participation. Citizens may use digital devices and online services regularly, but they may still lack the knowledge, judgment, and protective practices needed to avoid online risks.

This policy context is increasingly challenged by online harms that have become concrete digital governance concerns rather than general cybersecurity issues. Official complaint data from the 1212ETDA Online Fraud and Complaint Center showed that online problem complaints increased to 39,112 cases in 2025, rising by 10.62 percent from 35,358 cases in 2024. The largest complaint categories were online buying and selling problems and illegal websites. These figures indicate that everyday digital safety risks are closely connected to citizens' online transactions, platform use, information evaluation, and self-protection practices (Electronic Transactions Development Agency, 2026).

These complaint patterns indicate that digital safety has become an important issue for public administration and digital governance. Online risks such as scams, misinformation, privacy violations, unsafe digital transactions, harmful content, and cyberbullying affect citizens' ability to participate safely in digital society. These risks also create challenges for public agencies because legal enforcement, cybersecurity systems, and platform regulation cannot fully protect citizens from everyday digital decisions. As digital inequality involves not only access but also differences in skills, use, and outcomes, safe digital participation depends on citizens' ability to evaluate information, behave responsibly, and protect themselves in digital environments (van Dijk, 2020).

Digital citizenship provides a useful framework for understanding this issue. Ribble (2015) explains that responsible digital participation requires citizens not only to use digital tools, but also to understand how to behave appropriately, ethically, and safely online. This study adopts the 3S Digital Citizenship Model, consisting of digital savvy, digital social, and digital safety. Digital savvy refers to digital competence, digital social refers to responsible and norm-guided online behavior, and digital safety refers to protective practices that reduce vulnerability to online risks. The model explains digital citizenship as a developmental process in which citizens first build competence, then apply responsible online conduct, and finally achieve safer digital outcomes.

Although digital inequality and digital citizenship have been widely studied, fewer studies explain how socio-economic resources and digital engagement lead to safer digital outcomes. In the Thai context, empirical evidence remains limited on whether digital savvy and digital social function as mediating mechanisms between structural resources, digital engagement, and digital safety. Therefore, this study addresses this gap by testing both parallel and serial mediation pathways within the 3S Digital Citizenship Model. The findings are expected to provide evidence for strengthening digital citizenship, digital inclusion, and digital safety policy in Thailand.

Objectives

1. To examine the direct effects of socio-economic factors and digital engagement factors on digital savvy, digital social, and digital safety.
2. To examine the mediating role of digital savvy in the relationships between socio-economic and digital engagement factors and digital safety.
3. To examine the mediating role of digital social in the relationships between socio-economic and digital engagement factors and digital safety.
4. To examine the serial mediation pathway from digital savvy to digital social and then to digital safety.
5. To provide policy suggestions for strengthening digital citizenship and digital safety in Thailand.

Literature Review

Digital Citizenship and the 3S Digital Citizenship Model

Digital citizenship explains how citizens participate ethically, responsibly, and safely in digital society. As digital technologies are increasingly used in communication, education, employment, public services, commerce, and civic life, digital citizenship cannot be understood only as access to technology. It also involves the knowledge, skills, values, responsibilities, and protective practices needed for meaningful participation in digital environments. Ribble (2015) conceptualizes digital citizenship as appropriate and responsible technology use, including digital literacy, etiquette, communication, rights and responsibilities, and security. Tadlaoui-Brahmi et al. (2022) further show that digital citizenship is operationalized through multiple dimensions of learning and practice, such as digital skills, responsible participation, ethical awareness, and safety-related behavior. Webster (2025) defines digital citizenship as the knowledge, skills, attitudes, and actions required for effective and responsible participation in digital society. Overall, the literature suggests that digital citizenship should not be treated only as a set of individual digital skills, but as a broader developmental process that links competence, responsible conduct, and protective behavior.

Given that broad digital citizenship frameworks often contain overlapping dimensions, this study applies the 3S Digital Citizenship Model to organize the concept into three core domains: digital savvy, digital social, and digital safety. Digital savvy refers to citizens' digital competence, including the ability to access, understand, evaluate, and use digital information. Digital social refers to respectful, ethical, and norm-guided online behavior. Digital safety refers to protective practices that reduce vulnerability to online risks. The 3S model is therefore used as a focused analytical framework that translates broad digital citizenship concepts into a sequential structure for empirical testing.

The 3S model follows the policy logic of Educate, Respect, and Protect. Digital savvy represents the competence dimension, digital social represents the behavioral dimension, and digital safety represents the protective outcome. The model views digital citizenship as a developmental process in which competence supports responsible online conduct and responsible conduct leads to safer digital participation. This sequence is important because digital competence alone may not be sufficient to produce safety unless it is applied through responsible online behavior. This logic is consistent with the view that digital inequality involves not only access but also differences in skills, use, and outcomes (van Dijk, 2020).



Digital Inequality and Socio-Economic Resources

Digital inequality theory explains why socio-economic resources remain important in digital citizenship development. Earlier views of the digital divide emphasized unequal access to computers and the internet, but contemporary research shows that access alone does not ensure equal digital outcomes. Differences in education, income, skills, patterns of use, and social context can shape how citizens benefit from digital participation and manage online risks. van Dijk (2020) therefore conceptualizes digital inequality as a multidimensional process involving access, skills, usage, and outcomes. This perspective suggests that socio-economic resources should be examined not only as determinants of access, but also as conditions that shape citizens' ability to develop competence, behave responsibly, and protect themselves online.

Education is a key socio-economic resource because it strengthens citizens' capacity to evaluate information, solve problems, learn new technologies, and understand social rules and responsibilities. Recent digital divide research shows that inequalities in digital participation are shaped not only by access, but also by differences in use, skills, and outcomes (Lythreath et al., 2022). Citizens with higher education may therefore be better prepared to develop digital savvy through stronger learning and information-evaluation skills. Education may also support digital social by increasing awareness of rights, responsibilities, norms, and ethical conduct, and may contribute to digital safety by improving citizens' ability to recognize risks and apply protective practices. This interpretation is consistent with digital citizenship education literature, which emphasizes that safe, ethical, and responsible digital behavior requires intentional education and support (Li et al., 2025).

Income may also influence digital citizenship outcomes, although its effects may vary. Citizens with higher income may have better access to devices, internet quality, paid services, and learning opportunities, which may support digital savvy. However, economic resources alone do not automatically produce responsible or safe digital behavior because digital inequality also involves skills, patterns of use, and outcomes (Lythreath et al., 2022). Higher-income citizens may also engage more frequently in online transactions, increasing exposure to scams, privacy risks, and unsafe digital commerce. In the Thai context, where online buying and selling problems and illegal websites are major sources of online complaints, income-related digital engagement may increase both opportunities for digital participation and exposure to online risks (Electronic Transactions Development Agency, 2026). Therefore, income is expected to affect digital savvy, digital social, and digital safety differently.

Digital Engagement and Digital Citizenship Outcomes

In addition to socio-economic resources, digital engagement is important for explaining digital citizenship outcomes. Digital use intensity reflects the frequency and diversity of citizens' participation in digital environments. Frequent and varied use of digital technologies can create practical learning opportunities through repeated exposure to online platforms, digital services, communication tools, and information sources. This is consistent with recent digital divide research, which shows that digital inequality involves not only access, but also differences in digital use, skills, and outcomes (Lythreath et al., 2022). Therefore, digital engagement should be understood as both an opportunity for learning and a condition that may increase exposure to online risks.

Digital use intensity may strengthen digital savvy by increasing familiarity with digital tools and online information. This interpretation is consistent with Lythreath et al. (2022), who explain that digital inequality involves not only access but also differences in use, skills, and outcomes. Digital use intensity may also support digital social because citizens who interact more frequently online may become more familiar with digital norms, responsibilities, and appropriate conduct. Ribble (2015) emphasizes that

responsible digital citizenship includes digital etiquette, rights and responsibilities, and digital security. At the same time, greater digital use may increase exposure to risks such as misinformation, unsafe transactions, privacy concerns, harmful content, and inappropriate online interaction. Therefore, digital use intensity may contribute to digital safety by creating both learning opportunities and a stronger need for responsible and protective practices. This is consistent with the digital competence framework for citizens, which emphasizes confident, critical, responsible, and safe engagement with digital technologies (Vuorikari et al., 2022).

Online services spending is another indicator of digital engagement. It reflects expenditure on internet access, digital subscriptions, and other online services. Regular spending may indicate continuous access, deeper platform participation, and greater involvement in digital transactions. Such engagement can support digital savvy through repeated use, strengthen digital social through online communication and service experience, and increase the need for protective practices, which are central to responsible digital citizenship (Ribble, 2015). In the Thai context, the growth of digital transactions and online service use makes online services spending important for understanding both participation opportunities and citizens' exposure to online safety risks.

Digital Savvy, Digital Social Behavior, and Digital Safety

Socio-economic resources and digital engagement may create opportunities for digital citizenship development, but they do not automatically produce responsible or safe online behavior. Citizens may have access to technology and use digital platforms frequently, yet still lack the judgment, self-regulation, and social awareness needed for responsible participation. Tadlaoui-Brahmi et al. (2022) emphasize that digital citizenship involves multiple dimensions of learning and practice, including digital skills, responsible participation, ethical awareness, and safety-related behavior. Webster (2025) similarly defines digital citizenship as involving the knowledge, skills, attitudes, and actions required for effective and responsible participation in digital society. Therefore, it is necessary to explain how digital competence is translated into responsible behavior and safer digital outcomes.

Social learning theory provides a useful explanation of this process. Bandura (1986) argues that behavior develops through cognitive processes, observation, reinforcement, and self-regulation. Applied to digital citizenship, this means that responsible online behavior is not produced by knowledge alone. Citizens learn by applying digital knowledge in real situations, observing social consequences, adjusting their conduct, and internalizing appropriate digital norms. This logic supports the 3S Digital Citizenship Model because digital savvy provides the cognitive foundation for responsible conduct, while digital social represents the behavioral application of that competence.

Digital savvy is therefore expected to support digital social behavior. Citizens with stronger digital savvy are better prepared to evaluate information, understand digital rules, recognize online risks, and make informed decisions. This interpretation is consistent with Vuorikari et al. (2022), who emphasize that digital competence requires knowledge, skills, and attitudes for confident, critical, and safe digital engagement. Digital social can therefore be understood as the behavioral expression of digital savvy.

Digital safety represents the protective outcome of this developmental process. Citizens with stronger digital savvy and digital social are more likely to assess information credibility, protect privacy, avoid suspicious online activity, and reduce risky interaction. This logic is consistent with Ribble (2015), who views responsible technology use as involving digital literacy, etiquette, rights and responsibilities, and digital security. In the Thai context, where citizens increasingly face online transaction risks, misinformation, and unsafe digital interactions, this developmental pathway is particularly important for explaining digital



safety. Accordingly, digital safety should be viewed as a developmental outcome in which digital competence is translated into responsible conduct and protective practices.

Conceptual Framework

Based on the reviewed literature, the conceptual framework positions Digital safety as the outcome of the 3S Digital Citizenship Model. Education and income represent socio-economic resources, while digital use intensity and online services spending represent digital engagement factors. These predictors are expected to influence Digital safety directly and indirectly through Digital savvy and Digital social. The model also tests a serial pathway in which digital savvy strengthens digital social behavior, which subsequently contributes to digital safety, as illustrated in Figure 1. The framework summarizes the hypothesized direct, parallel mediation, and serial mediation pathways among the study variables. Solid arrows represent hypothesized direct relationships, while dashed arrows indicate control variables. Gender, generation, disability status, and municipal residence were included as control variables to account for demographic and residential differences that may influence digital access, digital use, online risk exposure, and digital safety practices; however, they were not treated as main hypothesis-testing variables. Digital savvy and digital social are examined as parallel mediators, and the pathway from digital savvy to digital social to digital safety represents serial mediation.

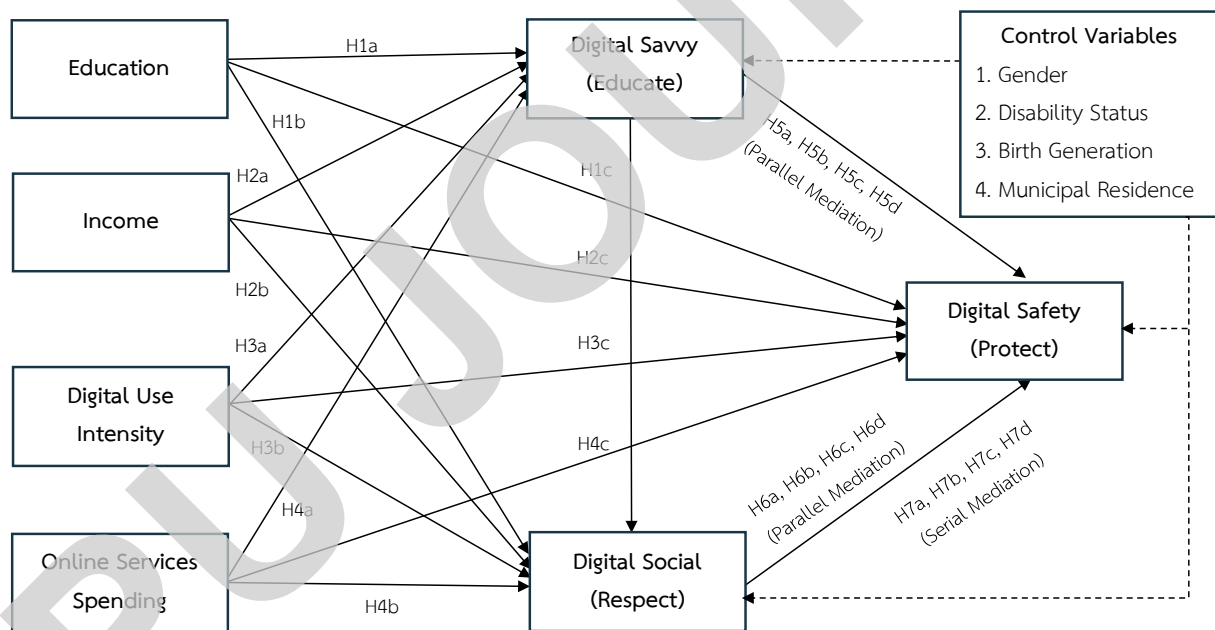


Figure 1 Conceptual Framework of the 3S Digital Citizenship Model

Hypotheses

Based on the literature review and the conceptual framework, this study proposes three groups of hypotheses. The first group concerns the direct effects of socio-economic and digital engagement factors on the three domains of the 3S Digital Citizenship Model: digital savvy, Digital social, and digital safety. The second group concerns the parallel mediating roles of digital savvy and digital social in the relationships between these predictors and digital safety. The third group concerns the serial mediation pathway in which digital savvy strengthens digital social, which subsequently contributes to digital safety. Each direct-effect hypothesis is tested across digital savvy, digital social, and digital safety, while the mediation hypotheses are tested separately for education, income, digital use intensity, and online services spending.



- H₁ : Higher education level is positively associated with stronger digital citizenship outcomes.
- H_{1a} : Higher education level positively predicts digital savvy.
 - H_{1b} : Higher education level positively predicts digital social.
 - H_{1c} : Higher education level positively predicts digital safety.
- H₂ : Higher individual income is positively associated with stronger digital citizenship outcomes.
- H_{2a} : Higher individual income positively predicts digital savvy.
 - H_{2b} : Higher individual income positively predicts digital social.
 - H_{2c} : Higher individual income positively predicts digital safety.
- H₃ : Higher digital use intensity is positively associated with stronger digital citizenship outcomes.
- H_{3a} : Higher digital use intensity positively predicts digital savvy.
 - H_{3b} : Higher digital use intensity positively predicts digital social.
 - H_{3c} : Higher digital use intensity positively predicts digital safety.
- H₄ : Higher online services spending is positively associated with stronger digital citizenship outcomes.
- H_{4a} : Higher online services spending positively predicts digital savvy.
 - H_{4b} : Higher online services spending positively predicts digital social.
 - H_{4c} : Higher online services spending positively predicts digital safety.
- H₅ : Digital savvy mediates the relationship between socio-economic and digital engagement factors and digital safety.
- H_{5a} : Digital savvy mediates the relationship between education and digital safety.
 - H_{5b} : Digital savvy mediates the relationship between income and digital safety.
 - H_{5c} : Digital savvy mediates the relationship between digital use intensity and digital safety.
 - H_{5d} : Digital savvy mediates the relationship between online services spending and digital safety.
- H₆ : Digital social mediates the relationship between socio-economic and digital engagement factors and digital safety.
- H_{6a} : Digital social mediates the relationship between education and digital safety.
 - H_{6b} : Digital social mediates the relationship between income and digital safety.
 - H_{6c} : Digital social mediates the relationship between digital use intensity and digital safety.
 - H_{6d} : Digital social mediates the relationship between online services spending and digital safety.
- H₇ : Digital savvy and Digital social serially mediate the relationship between socio-economic and digital engagement factors and digital safety.
- H_{7a} : Digital savvy and Digital social serially mediate the relationship between education and digital safety.
 - H_{7b} : Digital savvy and Digital social serially mediate the relationship between income and digital safety.
 - H_{7c} : Digital savvy and Digital social serially mediate the relationship between digital use intensity and digital safety.
 - H_{7d} : Digital savvy and Digital social serially mediate the relationship between online services spending and digital safety.



Research Methodology

Population and Sample

The population of this study consisted of individuals aged 6 to 76 years living in Thailand who were included in the target population of the 2025 Media and Information Literacy and Digital Literacy Survey. As digital participation may vary across age groups, birth generation was included as a control variable. The survey was conducted under the Office of the National Digital Economy and Society Commission (ONDE), with field data collection carried out by the National Statistical Office of Thailand (NSO). The population covered the general population and persons with disabilities across key demographic and residential groups in Thailand. The survey was designed to provide national-level evidence on media and information literacy, digital literacy, and digital citizenship-related behaviors (Office of the National Digital Economy and Society Commission, 2025).

The sample used in this study consisted of 47,550 respondents from the 2025 Media and Information Literacy and Digital Literacy Survey. This included 46,800 respondents from the general population and 750 respondents with disabilities. The respondents were selected through the national household survey design implemented by the NSO to ensure broad coverage of major demographic and residential groups across Thailand. Therefore, the analytical sample was appropriate for population-level explanatory analysis of digital savvy, digital social, and digital safety within the 3S Digital Citizenship Model rather than small-group psychometric validation.

Research Instruments

The research instrument was based on survey items from the 2025 Media and Information Literacy and Digital Literacy Survey of the Office of the National Digital Economy and Society Commission. Since this study used secondary data, the researcher did not develop a new questionnaire. Instead, relevant survey items were selected and organized according to the 3S Digital Citizenship Model. Digital savvy was measured using items related to digital access, communication, information evaluation, and digital literacy competence. Digital social was measured using items related to digital rights and responsibilities, digital etiquette, and digital law-related responsible conduct. Digital safety was measured using items related to digital security, digital health and wellness, digital commerce, and risk-prevention practices (Office of the National Digital Economy and Society Commission, 2025).

The quality of the composite measures was assessed using ordinal alpha and ordinal omega. The reliability values were .52 and .60 for digital savvy, .62 and .69 for digital social, and .56 and .62 for digital safety. These values indicated modest but usable internal consistency for population-level explanatory analysis, as reliability should be interpreted in relation to the purpose of measurement, the breadth of the construct, and the intended use of the results (DeVellis, 2017). Because the study used secondary survey items rather than a researcher-developed psychometric instrument, the 3S domains were treated as observed composite indicators. Construct validity was therefore considered cautiously and acknowledged as a limitation of the study. The variables, measurement, and coding used in this study are presented in Table 1.

Table 1 Variables, Measurement, and Coding

Variable	Role	Operationalization	Coding/Scale
Digital Savvy	Mediator	Average of digital access, digital communication, information evaluation, and digital literacy competence	1-4 composite
Digital Social	Mediator	Average of digital rights, digital etiquette, and digital law-related responsible conduct	1-4 composite scale
Digital Safety	Dependent variable /outcome	Average of digital security, digital health, digital commerce, and risk-prevention practices	1-4 composite scale
Education	Independent variable	Highest educational attainment	1-7 ordered categories
Income	Independent variable	Monthly individual income bracket	1-7 ordered categories
Digital Use Intensity	Independent variable	Extent of digital engagement and use	1-7 ordered categories; composite scale
Online Services Spending	Independent variable	Monthly spending on online services	1-7 ordered categories
Gender, Birth Generation, Disability Status, Municipal Residence	Control variables	Demographic and contextual characteristics	categorical indicators

Note. Gender, birth generation, disability status, and municipal residence were included as control variables to account for demographic and residential differences, but they were not treated as main hypothesis-testing variables.

Data Collection

Data were collected through a national household survey conducted by the National Statistical Office of Thailand (NSO) under the 2025 Media and Information Literacy and Digital Literacy Survey project of the Office of the National Digital Economy and Society Commission (ONDE). The survey was implemented as part of a national data collection project covering the target population across Thailand, including both the general population and respondents with disabilities. Since the present study used secondary data from this survey, the researcher did not directly collect data from respondents.

Data Analysis

1. Descriptive statistics were used to summarize demographic characteristics and key study variables, while reliability analysis was conducted to assess the internal consistency of the digital savvy, digital social, and digital safety composite measures.
2. Robust ordinary least squares regression models with HC3 robust standard errors were estimated to examine the direct effects of education, income, digital use intensity, and online services spending on digital savvy, digital social, and digital safety. HC3 robust standard errors were applied to strengthen statistical inference in cross-sectional survey analysis, particularly when heteroskedasticity may affect the



estimation of standard errors (Hayes, 2022). The analysis was conducted using the available analytical sample from the secondary dataset. Sampling weights were not applied in the regression and mediation models because the objective was to examine relationships among variables within the analytical sample rather than to estimate weighted national prevalence rates.

3. Parallel mediation analysis was conducted to examine whether digital savvy and digital social independently mediated the relationships between the predictors and digital safety.

4. Serial mediation analysis was conducted to test the ordered pathway from digital savvy to digital social and then to digital safety.

Mediation analyses used 10,000 bootstrap resamples and 95 percent confidence intervals. Indirect effects were considered statistically significant when the bootstrap confidence interval did not include zero (Hayes, 2022). Standardized coefficients (β) were used to summarize the direct-effect models for compact comparison, whereas unstandardized coefficients (b) were reported for mediation effects because indirect effects were evaluated using bootstrap confidence intervals. All statistical analyses were conducted using R version 4.4.3 (2025-02-28). The study used de-identified secondary data and reported results only in aggregate form; therefore, no information that could identify individual respondents was disclosed.

Results and Discussion

This section presents the results of the study in accordance with the stated research objectives. It includes the demographic characteristics of respondents, descriptive statistics and reliability analysis, direct-effect models, mediation analysis, and a summary of hypothesis testing.

The demographic characteristics of respondents are shown in Table 2. Overall, the analytical sample provides broad population-level coverage across gender, birth generation, disability status, municipal residence, education, and income groups. The distribution shows that the sample was generally balanced by gender and municipal residence, including respondents from all major birth generations, and covered both the general population and respondents with disabilities. The education and income profiles also indicate sufficient socio-economic variation for examining differences in Digital savvy, Digital social, and Digital safety in Thailand.

Table 2 Demographic Characteristics of Respondents

Demographic Variable	Category	n	%
Gender	Male	23,355	49.12
	Female	24,195	50.88
Birth generation	Baby Boomer	9,254	19.45
	Generation X	12,706	26.72
	Generation Y	11,846	24.91
	Generation Z	8,483	17.87
	Generation Alpha	5,261	11.05
Disability status	No disability	46,800	98.42
	Disability	750	1.58
Municipal residence	Within municipal area	24,272	51.05
	Outside municipal area	23,278	48.95

Table 2 (Continued)

Demographic Variable	Category	n	%
Education	Postgraduate degree	3,815	8.02
	Bachelor's degree	15,547	32.70
	Higher vocational/associate degree	9,333	19.63
	High school or vocational certificate	9,667	20.33
	Junior high school	3,222	6.78
	Primary school or lower	5,653	11.89
	Never attended school	313	0.66
Income	Very high income	16	0.03
	High income	153	0.32
	Moderate to high income	1,680	3.53
	Moderate income	7,972	16.77
	Low to moderate income	11,415	24.01
	Low income	12,819	26.96
	Very low income	13,495	28.38

Note. Percentages are calculated based on the analytical sample used in this study. Some percentages may not total 100.00 due to rounding.

Prior to conducting the main hypothesis testing for direct effects and mediation effects, a preliminary analysis was performed to evaluate the descriptive statistics and psychometric reliability of digital savvy, digital social, and digital safety. These three domains were measured as observed composite indicators because the items were drawn from a national survey and covered broad areas of digital knowledge, online behavior, and safety practices. Reliability was assessed using ordinal alpha (α) and ordinal omega (ω), which are appropriate complementary estimates for ordered categorical item responses (Vizioli & Pagano, 2022). The descriptive statistics and reliability values of the three 3S Digital Citizenship domains are presented in Table 3.

Table 3 Descriptive Statistics and Ordinal Reliability of 3S Digital Citizenship Dimensions (N = 47,550)

Construct	Mean	S.D.	Median	Skewness	Kurtosis	Ordinal Alpha(α)	Ordinal Omega(ω)
Digital Savvy	3.18	0.43	3.25	-0.47	-0.39	.52	.60
Digital Social	3.03	0.45	3.00	-0.31	-0.27	.62	.69
Digital Safety	3.20	0.44	3.25	-0.83	0.55	.56	.62

Note. Scores are based on four-point digital citizenship item scales. Ordinal alpha (α) and ordinal omega (ω) are reported as complementary reliability estimates for the observed composite measures.

From Table 3, the results show that although values were modest, they were considered usable for population-level explanatory analysis because the measures were broad observed composite indicators derived from national survey items rather than narrow psychometric scales. This interpretation follows the view that reliability should be assessed in relation to the purpose of measurement, the breadth of the construct, and the intended use of the results (DeVellis, 2017). Digital social showed the strongest



reliability, followed by digital safety and digital savvy. These results support the use of the three 3S domains as composite indicators in the subsequent regression and mediation analyses.

1. To examine the direct effects of socio-economic factors and digital engagement factors on digital savvy, digital social, and digital safety, robust OLS regression analysis was conducted to test whether education, income, digital use intensity, and online services spending directly predicted the three 3S Digital Citizenship domains. The direct-effect results are presented in Table 4.

Table 4 Summary of Robust OLS Regression Results for Direct Effects

Predictor	Digital Savvy (β)	Digital Social (β)	Digital Safety (β)	Interpretation
Digital Savvy	-	-	.42 ^{***}	Strong competence predictor of safety
Digital Social	-	-	.47 ^{***}	Strongest behavioral predictor of safety
Education	.14 ^{***}	.10 ^{***}	.06 ^{***}	Supported for all 3S domains
Income	.02 [*]	-.06 ^{***}	-.03 ^{**}	Positive for Savvy; opposite direction for Social and Safety
Digital Use Intensity	.09 ^{***}	.12 ^{***}	.07 ^{***}	Supported for all 3S domains
Online Service Spending	.14 ^{***}	.08 ^{***}	.04 ^{***}	Supported for all 3S domains
Adjusted R ²	.08	.03	.31	Model explanatory power

Note. Controls were included in the models. * $p < .05$. ** $p < .01$. *** $p < .001$.

From Table 4, education, digital use intensity, and online services spending positively predicted digital savvy, digital social, and digital safety. These findings indicate that socio-economic resources and digital engagement can support digital citizenship development when they expand citizens' opportunities to learn, practice, and apply digital skills in everyday life. Therefore, H1a-H1c, H3a-H3c, and H4a-H4c were supported.

Income showed a more complex pattern. It positively predicted digital savvy but negatively predicted digital social and digital safety. Therefore, H2a was supported, while H2b and H2c were not supported. This result suggests that income may support digital competence through better access to devices, services, and learning opportunities, but income alone does not automatically lead to responsible online behavior or safer digital practices. This finding is consistent with digital inequality theory, which explains that digital outcomes depend not only on access or resources but also on differences in skills, use, and outcomes (van Dijk, 2020). In practical terms, higher income may increase digital access and online service use, but it may also increase exposure to online transactions, digital commerce, and platform-based risks. Therefore, income should not be interpreted as a simple protective factor. Instead, the negative associations with digital social and digital safety suggest that economic resources need to be accompanied by digital responsibility, risk awareness, and protective practices.

For digital safety, the strongest predictors were digital social and digital savvy. This finding supports the logic of the 3S Digital Citizenship Model, which views safer digital participation as an outcome of both responsible conduct and digital competence. Ribble (2015) similarly explains that digital citizenship involves responsible technology use through digital literacy, digital etiquette, rights and responsibilities,

and digital security. Tadlaoui-Brahmi et al. (2022) also support this interpretation by showing that digital citizenship is multidimensional and includes digital skills, responsible participation, ethical awareness, and safety-related practices. The role of digital savvy is further consistent with the digital competence framework for citizens, which emphasizes knowledge, skills, attitudes, critical judgment, and safe practices in digital environments (Vuorikari et al., 2022).

2. To examine the mediating role of digital savvy in the relationships between socio-economic and digital engagement factors and digital safety, mediation analysis was conducted to test whether digital savvy functioned as a mechanism through which education, income, digital use intensity, and online services spending were linked to digital safety. The mediation results are presented in Table 5.

Table 5 Summary of Parallel and Serial Mediation Results for Indirect Effects

Predictor	Parallel Indirect via Digital Savvy (b) [95% CI]	Parallel Indirect via Digital Social (b) [95% CI]	Serial indirect via Digital Savvy and Digital Social (b) [95% CI]	Mediation Conclusion
Education	.03, 95% [.03, .03]	.02, 95% [.02, .02]	.01, 95% [.01, .01]	Partial mediation; all pathways significant
Income	.03, 95% [.03, .03]	.01, 95% [.01, .01]	.01, 95% [.01, .01]	Partial mediation; all pathways significant
Digital Use Intensity	.02, 95% [.02, .02]	.02, 95% [.02, .02]	.01, 95% [.01, .01]	Partial mediation; all pathways significant
Online Services Spending	.03, 95% [.03, .03]	.02, 95% [.02, .02]	.01, 95% [.01, .01]	Partial mediation; all pathways significant

Note. Values are unstandardized indirect effects (b). Bootstrapped 95% confidence intervals are based on 10,000 resamples. Indirect effects are significant if the confidence interval does not include zero.

From Table 5, digital savvy significantly mediated the relationships between all four predictors and digital safety. Education, income, digital use intensity, and online services spending all had significant indirect effects on digital safety through digital savvy. Therefore, H5a-H5d were supported.

This finding indicates that socio-economic resources and digital engagement do not influence digital safety only through direct effects. Their effects also operate through the development of digital competence. In this study, digital savvy represents the cognitive foundation of digital citizenship because it reflects citizens' ability to access, understand, evaluate, and use digital information and technologies. This result is consistent with Vuorikari et al. (2022), who explain that digital competence includes the knowledge, skills, and attitudes required for confident, critical, and safe engagement with digital technologies.

3. To examine the mediating role of digital social in the relationships between socio-economic and digital engagement factors and digital safety, mediation analysis was conducted to test whether digital social functioned as a mechanism through which education, income, digital use intensity, and online



services spending were linked to digital safety. As shown in Table 5, digital social significantly mediated the relationships between all four predictors and digital safety. Therefore, H6a-H6d were supported.

This result shows that responsible online behavior is an important pathway to digital safety. Socio-economic resources and digital engagement may create opportunities for digital participation, but safer digital outcomes depend partly on whether citizens apply responsible conduct in online environments. Digital social reflects respectful communication, responsible sharing, ethical participation, and awareness of digital rules and responsibilities. This finding is consistent with Ribble (2015), who emphasizes appropriate and responsible technology use as a core element of digital citizenship. It also aligns with Webster (2025), who defines digital citizenship as involving the knowledge, skills, attitudes, and actions needed for responsible participation in digital society.

4. To examine the serial mediation pathway from digital savvy to digital social and then to digital safety, serial mediation analysis was conducted to test whether education, income, digital use intensity, and online services spending were linked to digital safety through the ordered pathway from digital savvy to digital social and then to digital safety. As presented in Table 5, the serial indirect effects were significant for all four predictors. Therefore, H7a-H7d were supported.

This finding confirms the developmental logic of the 3S Digital Citizenship Model. Digital safety is not only a technical outcome or a direct result of digital access. Rather, it develops through a sequential process in which citizens first build digital savvy, then apply that competence through digital social, and finally achieve stronger digital safety. This pattern is consistent with social learning theory, which explains that behavior develops through cognitive processes, observation, reinforcement, and self-regulation (Bandura, 1986). In this study, digital savvy provides the cognitive foundation, while digital social represents the behavioral application of that competence in digital environments.

Table 6 summarizes the hypothesis testing results. Overall, the findings provide strong support for the 3S Digital Citizenship Model. Education, digital use intensity, and online services spending were positively associated with all three digital citizenship outcomes. Income was partially supported because it showed a positive association with digital savvy but negative associations with digital social and digital safety. The mediation hypotheses were supported, confirming that digital savvy and digital social are important pathways through which socio-economic and digital engagement factors are linked to digital safety.

Table 6 Hypothesis Testing Summary

Hypothesis	Main Finding	Conclusion
H _{1a} - H _{1c}	Education significantly predicted Digital Savvy, Digital Social, and Digital Safety.	Supported
H _{2a} - H _{2c}	Income positively predicted Digital Savvy but negatively predicted Digital Social and Digital Safety.	Partially Supported
H _{3a} - H _{3c}	Digital Use Intensity positively predicted Digital Savvy, Digital Social, and Digital Safety.	Supported
H _{4a} - H _{4c}	Online services spending positively predicted Digital Savvy, Digital Social, and Digital Safety.	Supported

Table 6 (Continued)

Hypothesis	Main Finding	Conclusion
H _{5a} - H _{5d}	Digital Savvy significantly mediated the relationships between all predictors and Digital Safety.	Supported
H _{6a} - H _{6d}	Digital Social significantly mediated the relationships between all predictors and Digital Safety.	Supported
H _{7a} - H _{7d}	Digital Savvy and Digital Social serially mediated the relationships between all predictors and Digital Safety.	Supported

Note. Hypothesis conclusions are based on HC3 robust OLS regression and bootstrap mediation analysis. Direct-effect hypotheses were evaluated using standardized regression coefficients, while mediation hypotheses were evaluated using bootstrapped confidence intervals.

From Table 6, the results show that the 3S Digital Citizenship Model was largely supported. Education, digital use intensity, and online services spending were positively associated with digital savvy, digital social, and digital safety, while income showed partial support because its effects differed across the three domains. The mediation results further confirmed that digital savvy and digital social were important mechanisms linking socio-economic and digital engagement factors to digital safety.

5. To provide policy suggestions for strengthening digital citizenship and digital safety in Thailand, this study uses the empirical findings to suggest that digital safety policy should be designed as a sequential process. Policy should begin with strengthening citizens' digital savvy through digital literacy, information evaluation, and risk awareness, then promote digital social through responsible online communication, ethical participation, and respect for digital rights and responsibilities, and finally strengthen digital safety through practical protective measures such as privacy protection, fraud prevention, safe digital transactions, and appropriate responses to online risks.

This policy sequence is supported by both parallel and serial mediation results. The parallel mediation results show that digital savvy and digital social are important mechanisms linking socio-economic and digital engagement factors to digital safety. The serial mediation results further show that digital savvy contributes to digital social, which subsequently contributes to digital safety. Therefore, the findings may provide useful evidence for policy design by showing that digital safety should be strengthened through citizens' competence, responsible online behavior, and practical self-protection, rather than through infrastructure or technical cybersecurity measures alone.

Conclusion

1. The direct-effect analysis showed that education, digital use intensity, and online services spending were positively associated with digital savvy, digital social, and digital safety. Income showed a mixed pattern because it was positively associated with digital savvy but negatively associated with digital social and digital safety. This finding indicates that greater economic resources may improve access and competence, but they do not automatically produce responsible or safer digital behavior.

2. Digital savvy partially mediated the relationships between socio-economic and digital engagement factors and digital safety. This result shows that education, income, digital use intensity, and online service spending contribute to digital safety partly through the development of citizens' digital competence.



3. Digital social also partially mediated the relationships between socio-economic and digital engagement factors and digital safety. This finding indicates that responsible online behavior is an important mechanism through which socio-economic resources and digital engagement are translated into safer digital participation.

4. The serial mediation analysis confirmed an ordered pathway from digital savvy to digital social and then to digital safety. This means that citizens first need to develop digital competence, then apply that competence through responsible online conduct, and finally achieve stronger digital safety. Therefore, the main contribution of this study is to show that digital safety is produced through a sequential process of competence formation, responsible conduct, and protective practice.

5. The policy implication of this study is that digital safety policy in Thailand should be designed as a sequential process. Policy should begin by strengthening digital savvy through digital literacy training, information-evaluation skills, and risk awareness. It should then promote digital social through responsible communication, ethical online participation, respect for digital rights, and awareness of digital responsibilities. Finally, policy should strengthen digital safety through practical self-protection skills, privacy protection, fraud prevention, safe digital transactions, and appropriate responses to online risks.

Overall, the 3S Digital Citizenship Model provides a practical framework for designing digital safety policies that integrate competence development, responsible online behavior, and protective practices in Thailand's digital governance context.

Contribution

1. The study contributes to digital citizenship scholarship by empirically examining the 3S Digital Citizenship Model as a concise framework linking digital savvy, digital social, and digital safety. The model explains digital safety as a developmental outcome in which digital competence and responsible online conduct serve as key pathways toward safer digital participation. This strengthens the theoretical connection among digital citizenship, digital inequality, and social learning perspectives.

2. The study provides empirical evidence from a national analytical sample of 47,550 respondents in Thailand. By testing both direct and indirect effects through parallel and serial mediation, this study shows how education, income, digital use intensity, and online services spending are associated with digital citizenship outcomes. The use of HC3 robust regression and bootstrap mediation analysis further strengthens the robustness of the findings.

3. The study contributes to public policy and digital governance by showing that digital safety policy should go beyond infrastructure, access expansion, and technical cybersecurity. Effective policy should strengthen citizens' digital competence, responsible online behavior, and protective practices as connected stages of digital safety development, supporting a shift toward capability-oriented and safety-oriented digital governance.

Suggestion

1. National digital safety programs should integrate digital savvy, digital social, and digital safety rather than treating digital literacy, online responsibility, and cyber protection as separate policy areas. Policies should help citizens develop digital competence, practice responsible online conduct, and apply protective practices in daily digital activities.

2. Education-based interventions should be prioritized because education was consistently associated with all three domains of the 3S Digital Citizenship Model. Digital citizenship education should be included in formal education, lifelong learning, community training, and public awareness programs.

3. Policy support should prioritize groups with high digital exposure but limited capacity to manage online risks, including younger users, people with disabilities, older adults, low-income groups, and residents outside municipal areas.

4. Public agencies should develop practical curricula covering information verification, respectful communication, privacy protection, fraud prevention, and safe digital transactions through real-life digital risk scenarios.

5. Evaluation systems should move beyond access, infrastructure, and participation indicators by assessing citizens' ability to recognize online risks, protect personal information, behave responsibly, and respond appropriately to harmful digital situations.

Limitations

1. The cross-sectional design means that the findings should be interpreted as associations rather than causal relationships. Future studies should use longitudinal data to examine how digital savvy, digital social, and digital safety develop over time.

2. The study relied on secondary survey data, so the analysis was limited to variables available in the 2025 Media and Information Literacy and Digital Literacy Survey. Other relevant factors, such as prior digital literacy training, platform-specific behavior, family support, and community-level resources, could not be included.

3. The 3S domains were measured as observed composite indicators from secondary survey items rather than researcher-developed latent constructs with full validation. Future research should further test construct validity using confirmatory factor analysis and other validation approaches.

4. Future studies may conduct age-specific analysis or sensitivity analysis excluding very young respondents to examine whether the results remain stable across age groups.

References

- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall.
- DeVellis, R. F. (2017). *Scale development: Theory and applications* (4th ed.). SAGE Publications.
- Digital Government Development Agency. (2023). *Digital Government Development Plan of Thailand 2023-2027*. Digital Government Development Agency.
- Electronic Transactions Development Agency. (2026). *1212 ETDA statistics for 2025: Online problem complaints increased to 39,112 cases*. Ministry of Digital Economy and Society. https://www.etda.or.th/th/pr-news/1212_stat_68.aspx
- Hayes, A. F. (2022). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach* (3rd ed.). Guilford Press.
- Li, L., Valdez, J. P. M., & Du, Y. (2025). Digital citizenship education at the early childhood level: How is it implemented? A systematic review. *International Journal of Child Care and Education Policy*, 19, Article 13. <https://doi.org/10.1186/s40723-025-00153-2>
- Lythreathis, S., Singh, S. K., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change*, 175, Article 121359. <https://doi.org/10.1016/j.techfore.2021.121359>
- Office of the National Digital Economy and Society Commission. (2025). *Media and information literacy and digital literacy summary survey report Thailand 2025*. Ministry of Digital Economy and Society.
- Ribble, M. (2015). *Digital citizenship in schools: Nine elements all students should know* (3rd ed.). International Society for Technology in Education.



- Tadlaoui-Brahmi, A., Çuko, K., & Alvarez, L. (2022). Digital citizenship in primary education: A systematic literature review describing how it is implemented. *Social Sciences & Humanities Open*, 6(1), Article 100348. <https://doi.org/10.1016/j.ssaho.2022.100348>
- van Dijk, J. A. G. M. (2020). *The digital divide*. Polity Press.
- Vizioli, N., & Pagano, A. (2022). From alpha to omega: Estimation of ordinal reliability. A practical guide. *Revista Costarricense de Psicología*, 41(2), 119-136. <https://doi.org/10.22544/rcps.v41i02.02>
- Vuorikari, R., Kluzer, S., & Punie, Y. (2022). *DigComp 2.2: The Digital Competence Framework for Citizens*. Publications Office of the European Union. <https://doi.org/10.2760/115376>
- Webster, J. (2025). Defining digital citizenship and digital citizenship education: A Delphi study. *Journal of Research on Technology in Education*, 1-16. <https://doi.org/10.1080/15391523.2025.2536564>