


Digital Equity: A Quantitative Study on Indigenous College Students' Attitudes in Sabah, Malaysia

Fung Lan Yong^{1*}, Florence Chuah², Steward G. Stephen³
Sawanah Mumin⁴, Loreta Ling Ling Uie⁵, Lesley Pien Chong⁶

¹Postgraduate Studies, Jesselton University College, 88300 Kota Kinabalu, Sabah, Malaysia
Email: fungyong@jesselton.edu.my

²Inclusive GEMS Consultancy, 46200 Petaling Jaya, Selangor, Malaysia
Email: florencecsy@gmail.com

³Department of Social Science and Management, Universiti Putra Malaysia, Sarawak, Malaysia
Email: stewardgiman@upm.edu.my

⁴Department of Social Science and Management, Universiti Putra Malaysia, Sarawak, Malaysia
Email: sawanahmumin@upm.edu.my

⁵Business Studies, Jesselton University College, 88300 Kota Kinabalu, Sabah, Malaysia
Email: loretaling8383@gmail.com

⁶Postgraduate Studies, Beijing Normal University, Haidian District, Beijing, P. R. China
Email: lesleypien96@gmail.com

CORRESPONDING AUTHOR (*):

Fung Lan Yong
(fungyong@jesselton.edu.my)

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ABSTRACT

The purpose of this study was to examine indigenous college students' attitudes toward digital equity in Sabah, Malaysia. Respondents were required to full out a digital equity questionnaire on Google Forms and their responses were subsequently analyzed by using SPSS 29.0. Findings revealed that very low to low-average proportions of college students tend to exhibit positive attitudes toward digital equity. Moreover, nonparametric tests showed nonsignificant differences in perceived digital equity by way of gender, age, and ethnicity. Besides, Wilcoxon signed rank test revealed that all digital equity items were significant at $p < .001$, with medians significantly different from the hypothesized value of 3.5, thus indicating strong disagreement. In view of the findings, some recommendations were made on strategies and ways to increase digital equity in Sabah.

Contribution/Originality: This research offers a valuable contribution by examining indigenous college students' attitudes toward digital equity in Sabah, Malaysia. Besides narrowing the gap that exists in the digital technology literature, it is the first quantitative study that examines indigenous college students' attitudes toward digital equity in the Bornean state, thus adding to the limited evidence base on the extent to which indigenous individuals have fair and equal access to, and the capability to benefit from, digital technologies.

1. Introduction

Digital equity reflects the situation in which every individual possesses the fundamental information technology resources to adequately participate in democracy, economy, and the community; it covers not only access to primary digital tools and the Internet to meet daily needs, but also the capability to capitalize on them. Digital equity is paramount for active engagement in terms of education and lifelong learning, professional development, and access to basic goods and services, and cultural and civic activities. Digital equity enables that everyone has equal access to education and training, employment opportunities, healthcare, and community engagement, besides fostering inclusivity, socioeconomic justice, moral-ethical consciousness, and patriotism in a knowledge-driven society. In brief, it strives to raise the status and welfare among marginalized communities, promote equality regardless of gender, age, or ethnicity, and drive socioeconomic development ([Internet Society Foundation, 2023](#)).

In terms of education, digital equity ensures that all students have equal access and chances to utilize and gain from digital technologies, regardless of their socioeconomic status and school location by bridging the digital divide through affordable Internet access, devices, and digital literacy skills to everyone. It promotes educational inclusivity and equal opportunities in the digital age by ensuring that every student has the necessary tools and skills to engage in online activities such as remote learning, research and presentations, internships, and job search. Besides, digital equity also eliminates the marginalization of students from vulnerable and disadvantaged communities by addressing existing inequalities through educational policies and infrastructure development. Overall, digital equity plays a significant role in education by providing equal access to modern technological tools and resources, online learning platforms, and learning opportunities by enabling students from different backgrounds to participate in remote learning, access educational resources and materials, and develop the essential digital skills for academic achievement, generic skills development, and better employability ([Lenovo, n. d.](#)).

1.1. Importance of Digital Equity in Sabah

The digital divide in Sabah, the least developed state of Malaysia ([Ooi, 2024](#)), has created an immense gap between those who have access to digital technologies, such as computers and the Internet, and those who do not even have regular electricity supply and running water. The digital divide in the island state is further exacerbated by low socioeconomic development, hazardous terrain, thick jungles, and other geographical characteristics, which disproportionately affect marginalized communities, including low-income individuals and remote and rural communities. Besides, lack of purchasing power, digital infrastructure, and Internet connectivity further hinders Sabahans' capability to fully participate in the knowledge economy, which worsen the disparities in education, employment, healthcare, and civic engagement, perpetuate existing inequalities, and widen the gap between different socioeconomic groups. Moreover, the lack of digital equity also profoundly limits Sabahans' educational and employment opportunities because many lack access to online job listings, remote learning and work opportunities, and the digital skills required for various courses and professions ([Lenovo, n. d.](#)).

In a recent study, [Ismail \(2025\)](#) elaborated the state of digital equity at Malaysian schools. Despite various governmental efforts, digital integration into teaching and learning

remains lopsided and unequal, with an enormous gap between urban and rural areas. Besides, many teachers tend to demonstrate different levels of competence and efficacy in utilizing digital tools, with those in urban areas having greater access to digital development programs compared to their rural counterparts. On the other hand, rural students' digital readiness is often obstructed by structural inequalities, including lack of access to digital devices at school, unpredictable Internet connectivity, lack of access to digital devices, and limited exposure to digital technology, all of which deprive students from impoverished families and those with special needs from digital adoption and learning.

Ismail (2025) highlighted a mismatch between national digital literacy goals and local implementation capacities, leaving many rural and remote schools without fundamental enablers, including technical staff, computer labs, and digital support. Besides, the scarcity of digitally-driven learning methods is also exacerbated by parents' limited ability to afford basic digital tools, such as smartphones, laptops, tablets, and data plans. Additionally, national digital education policies are deficient in addressing the specific needs of remote and rural communities. While 5G technology is being deployed across larger towns, many remote and rural schools still face monumental limitations in accessing fundamental digital resources, particularly areas characterized by thick jungles, muddy paths, and hilly terrains, where feeble and unreliable bandwidth constantly obstructs the effective transmission of online content. A Sabahan student, Veveonah Mosibin, has made headlines for climbing up a tree to complete her assessments online, thus highlighting the profound digital divide in underdeveloped and resource-scarce areas in Sabah (Zi, 2020).

1.2. Statement of the Problem

A review of literature showed that quantitative research on indigenous college students' attitudes toward digital equity is lacking in Malaysia, especially in the island state of Sabah. Therefore, the main purpose of this study was to investigate the attitudes toward digital equity of different ethnic groups, which helps fill the research gap and establish a theoretical framework for the study. Further, the authors this study decided to use a sample of Sabahan college students to test the robustness and reliability of the instrument used to measure the construct. Lastly, findings of this study could generate novel knowledge on the prevalence of digital equity in the local educational landscape, besides offering recommendations on how to enhance digital inclusion in Sabah, Malaysia.

1.3. Research Questions

To narrow the research gap and provide a contextual framework for the study, three research questions were formulated to guide the research. Serving as a compass, they keep the authors on target, thus allowing them to concentrate on the relevant areas of investigation. Besides providing a benchmark for the entire research process, they also help in defining the scope of the study, thus ensuring that the research remains focused and viable. The three research questions are as follows:

- i. What were the descriptive statistics of indigenous college students' attitudes toward digital equity and implications?
- ii. Were there any significant differences in students' attitudes by way of gender, age, and ethnicity?
- iii. Were any of the digital equity items significantly different from the hypothesized value of 3.5?

1.4. Significance of the Study

Findings from this study are particularly relevant to the context of Sabah, which has historically been underrepresented in digital literacy and infrastructure readiness as one of the poorest Malaysian states, where significant disparities exist between urban and rural areas in terms of Internet access, adequately trained teachers, and inclusive pedagogical innovations. Therefore, this study underscores the importance of addressing these intra-state problems by suggesting tailored digital strategies that can overcome the unique challenges faced by Sabah's remote and rural communities. For example, remote and underdeveloped districts, such as Kudat, Tongkod, and Semporna (Ooi, 2024), have perpetually disadvantaged by poor telecommunications infrastructure with towers that provide low coverage. Poor Internet connectivity in these areas not only hinders teachers' access to digital tools and pedagogies, but they also curtail students' exposure to digital learning.

Quantitative research on digital equity helps promote awareness and understanding with regard to the opportunities and challenges in providing basic digital education in rural and remote areas in Sabah. The primary objective of this study was to examine indigenous college students' perceptions of digital equity in Sabah, Malaysia. It aims to identify the factors influencing perceived digital equity to gain deeper insight into the multifaceted construct, and to provide recommendations for policymakers and other stakeholders to increase digital equity in the island state's rural and remote areas. Lastly, this research contributes to the broader goal of minimizing socioeconomic disparities, while improving the quality of education and digital use for all children in line with SDG 4 Quality Education.

2. Review of Literature

A literature review was conducted to establish a foundation for the study by providing a comprehensive overview of existing research, theories, and methodologies relevant to digital equity. Besides, by analyzing the existing literature, the authors are able to pinpoint areas where further investigation is needed, thus justifying the study. Further, the review process also helps clarify and refine the research questions, thus ensuring that they are relevant, focused, and contribute meaningfully to the concept of digital equity in the Malaysian context. Lastly, it helps the authors identify relevant theoretical frameworks that can guide their study and provide a lens for interpreting their findings. Lastly, the literature review indicated that empirical research on digital equity in the context of higher education is still lacking in Malaysia, especially the Bornean state of Sabah.

2.1. Digital Equity: Students' Attitudes

In an earlier study, Natrah (2022) examined Malaysian university students' attitudes toward, and motivation in, digital entrepreneurship. Findings revealed students tend to exhibit positive attitudes toward, and high motivation in digital entrepreneurship, with females obtaining higher scores in both constructs. On the other hand, Pua'at and Yunus (2023) explored the relationship between university students' attitudes toward digital citizenship in Malaysia. Findings revealed a substantial relationship between students' awareness, exposure, and attitudes toward digital citizenship. In other words, students tend to be well informed and exposed with regard to digital technology, while demonstrating favorable propensity for digital citizenship. Findings imply that university

students should be provided with proper training and guidelines on digital adoption, especially in the dimension of digital security.

In their empirical study on Malaysian university students' perceptions of the digital divide, [Subramaniam et al. \(2024\)](#) found a digital divide in the second and third levels in terms of perceived learning outcomes, digital skills, and digital adoption. Moreover, a majority of students were found to own basic online learning tools, such as laptops, smartphones, and mobile data plans. Nevertheless, the digital diffusion rate was found to be less than 90 percent, indicating a significant disparity among students in accessing various Internet tools, services, and peripherals. Overall, a digital divide tends to exist across all three levels, implying that effective measures should be implemented to drive digital transformation amongst university students.

A survey by [Bukhori, Zainal, and Mustaza \(2025\)](#) probed Malaysian university students' digital communication abilities in online learning environments. Findings revealed no significant preference for online learning, with face-to-face delivery as the most preferred mode for discussions and lectures. Moreover, students were also found to demonstrate a moderate level of involvement during online classes, suggesting that many students tend to be disengaged or indifferent. With regards to online delivery, students tend to be adequate in basic communication tasks by (1) following instructions and making queries, (2) displaying interpersonal awareness by being attentive to others, and (3) showing empathy toward others by being willing to step into others' shoes. Lastly, a majority of students were found to display self-assertiveness in terms of leading discussions and resolving conflicts through digital communication.

2.2. Digital Equity: Teachers' Attitudes

In their investigation on Malaysian teachers' attitudes toward digital learning in the context of Malay Language instruction, [Marimothu et al. \(2024\)](#) revealed that teachers tend to exhibit positive cognitive and affective attitudes toward digital learning. Findings imply that policymakers and educational institutions should implement effective strategies to widen the practice of digital pedagogies. Additionally, they should also provide professional development programs to ensure greater integration of digital technologies into the teaching and learning process.

An investigation by [Ahmad and Rathakrishnan \(2025\)](#) indicated that 90.4 percent of teachers tend to have a satisfactory level of digital integration. Significant gender differences were found in digital integration, with 39.8 percent of female teachers being more likely to integrate technology compared to their male counterparts. This finding could be attributed to female teachers being more engaged with digital professional development programs and willing to adapt to educational technology trends. Besides, teachers' subject area was also found to significantly influence digital technology integration, with teachers in Islamic Education, Social Sciences, and TVET being more likely to integrate technology than those in Science, Mathematics, and Special Education. Higher integration among teachers might be due to the content of the subjects, which often involve multimedia applications, online discussions, and vocational digital tools.

Lastly, [Ahmad and Rathakrishnan \(2025\)](#) found that special education teachers were found to be 41.2 percent less likely to achieve satisfactory digital adoption compared to other teachers, highlighting the unique challenges that they tend to face, such as, the lack of adaptive digital tools, inadequate training in assistive technologies, and difficulties in

customizing digital content for students with diverse learning needs. Findings imply the necessity for digital literacy training, context-specific interventions, and data-based policies to enhance digital integration into education, especially in terms of promoting inclusive education for students from vulnerable and disadvantaged communities and those with special needs.

2.3. Digital Equity: Public Attitudes

Mohamed, Ghazali, and Nasir (2024) explored Malaysian parents' attitudes toward children's use of digital media. Findings showed that parents tend to demonstrate nuanced positive attitudes, perceiving that digital media tends to boost education, improve communication, and expose children to diverse cultures. Nevertheless, they also tend to show concern with regard to screen time, inappropriate content, and inactivity. Besides, parents' attitudes tend to be influenced by their education level, income, and children's age. Findings imply that policymakers, teachers, and parents themselves should determine how to leverage on digital media to create a healthier and more balanced digital world for children.

In their study, Tanusha, Leelavathi, and Muhammad (2023) found that about one-third of parents tend to perceive that digital devices can cause damage to eyesight and Internet addiction, besides exposure to radiation. Moreover, another one-third of parents tend to perceive digital devices as useful, especially in terms of socialization, digital awareness, portability, and entertainment, besides creative and interactive learning.

On the other hand, Kaur and Ab Karim (2024) investigated the factors influencing digital inclusion within the B40 community in Malaysia. Findings showed that affordability tends to affect the B40 community's adoption of digital technologies and all things Internet. Their digital accessibility is limited as their fairly low income prevents them from having mobile devices (e.g., tablets, laptops) and Internet connectivity. Findings imply that the government, civil society, academia, and industry stakeholders need to advocate a collaborative and holistic approach to creating an inclusive digital ecosystem characterized by easy accessibility, affordability, and digital capability.

In a survey examining the digitalization among high-level Malaysian executives from various industries, OpenMinds (2024) found that respondents tend to regard that data storage and backups are most crucial for data security, besides using passwords and reinforcing data security matters. Moreover, ease of adoption tends to be the most important factor for purchasing new digital tools for commercial purposes. However, while a majority of American companies are now using artificial intelligence (AI), only 28.9 percent of Malaysians employ AI tools. Lastly, findings imply that Malaysians urgently require appropriate digital training to become more innovative and change-capable in the face of rapid digital transformation in the corporate sector.

Finally, Zulkifli and Abidin (2025) investigated Malaysians' attitudes toward new technologies and online identity online. Age, gender, ethnicity, and occupational status were found to be significantly related to early adoption of emerging technologies and appreciation of novel technologies. Residential area, work sector, educational level, household income, and state were also found to be significant variables. Lastly, findings imply that practitioners, policymakers, and other stakeholders should upgrade the measures for protecting Malaysians' online identity and privacy.

3. Methodology

3.1. Research Design and Approach

A quantitative research design was adopted to allow the authors to systematically investigate attitudes toward digital equity through the use of numerical data and statistical analysis to quantify students' perceptions of the construct, with the primary objective of drawing meaningful conclusions and generalizing results to a broader college student population in Sabah. Further, statistical methods were used to calculate percentages of agreement and significant differences by way of age, gender, and ethnicity. The key elements of the current quantitative research design included (1) three succinctly stated research questions, (2) a convenient sample of college students as a representative subset, (3) a list of digital equity items to be measured, (4) an appropriate data collection method, (5) specific statistical methods to analyze data, and (5) ethical considerations (i.e., informed consent and privacy protection).

3.2. Research Location

This study was conducted in Kota Kinabalu, Sabah, the capital city of the island state where quantitative research on educational equity and digital equity is scarce. Kota Kinabalu was chosen for its distinctive educational landscape, which can provide a sufficiently representative sample of the college student population in Sabah, thus allowing for a relatively fair assessment of students' perceptions of educational equity and digital technologies.

3.3. Sample and Justification

The sample of this study comprised 63 college students ($n = 63$) recruited from a private university college in Kota Kinabalu, Sabah, who have average and above-average English proficiency, and are studying a full-time at the institution. Initially, the registrar was contacted via email and phone, and he agreed to collect data for the study. Subsequently, he shared the survey link with students and urged them to respond. Voluntary participation and convenient access were the main considerations of this selection procedure, which could yield a realistic and contextually relevant sample.

Students come from culturally, linguistically, and ethnically diverse communities in Sabah. The sample size was based on theoretical and statistical considerations. According to the central limit theorem, a minimum of 30 participants is generally sufficient to ensure statistical power and generalizability for basic survey research ([Memon et al., 2020](#); [Roscoe, 1975](#); [RUBIKTOP, 2023](#)). Additionally, the sample was deemed representative of college students from the local colleges in Kota Kinabalu; hence, selection bias was minimized.

Additionally, the students were chosen because of their physical proximity to the first author, who serves as program leader of the university college's Master of Education in Leadership. In general, the study was delimited by proximity, accessibility, and registrar's willingness to participate in the research study. Students responded to the questionnaire on Google Forms; completion of the questionnaire was interpreted as informed permission, with all participants assured of anonymity and confidentiality.

While the sample size seemed small, it met the minimum requirement for quantitative research in the social sciences, particularly in educational leadership and educational psychology. For example, [Roscoe \(1975\)](#) recommended a sample size of 30 to 500 for most statistical research. This rule of thumb is supported by the central limit theorem, which stipulates that sampling distributions will approach normality when there are 30 or more respondents, allowing for acceptable statistical inference. Furthermore, the current sample size ensured a reasonable margin of error and enough power to identify modest effects in nonparametric analyses, such as the Kruskal-Wallis, Mann-Whitney U, and Wilcoxon signed rank tests, which were used to interpret data in the current study.

The sample consisted of 34.9 percent males and 65.1 percent females. Age-wise, 47.6 percent are 18 to 20 years old, 22.2 percent are 21 to 23 years old, 15.9 percent are 24 to 26 years old, and 14.3 percent are above 26 years old. Ethnicity-wise, 63.5 percent are Kadazandusuns, 3.2 percent are Malays, 6.3 percent are Rungus, 9.5 percent are Muruts, 4.8 percent are Bajaus, and 12.7 percent are of other ethnicities (see [Table 1](#)).

Table 1: Demographic Information of Respondents ($n = 63$)

Variable	Description	Frequency	Percentage
Gender	Male	22	34.9
	Female	41	65.1
Ethnicity	Kadazandusun	40	63.5
	Malay	2	3.2
	Rungus	4	6.3
	Murut	6	9.5
	Bajau	3	4.8
	Others	8	12.7
Age	18-20	30	47.6
	21-23	14	22.2
	24-26	10	15.9
	Above 26	9	14.3

3.4. Instrument

The Massachusetts Statewide Digital Equity Survey developed by [The Massachusetts Broadband Institute \(n. d.\)](#) was adapted to measure attitudes toward digital equity. It consists of 46 Likert-scale items, ranging from strongly disagree = 1 to strongly agree = 5.

To determine the reliability of the questionnaire, a pilot study was conducted on 20 college students and data were analyzed by using SPSS 29.0. Cronbach analysis was used to assess its reliability. Results indicated that the Cronbach's alpha of the Massachusetts Statewide Digital Equity Survey is 0.970. The high alpha value indicates that the items within the questionnaire are internally consistent, thus measuring the same underlying construct. The high coefficient also means that the items in the questionnaire are closely correlated, and are therefore, measuring the same concept.

3.6. Data Collection and Analysis

College students were required to complete the questionnaires on Google Forms and were informed that completion of the survey was their indication of consent to voluntarily participate in the study. Ethical issues were prioritized throughout the data collection procedure. All participants were given informed consent in relation to the purpose of the

study, its voluntary nature, and the possibility to withdraw at any time without any repercussions. To ensure confidentiality, all responses were anonymized and the data were securely stored in a strong room. Only the first writer has access to the data, thus guaranteeing that they would be used solely for scholarly purposes.

Data were automatically transferred onto a spreadsheet and subsequently analyzed using SPSS 29.0. First, the percentages of agreement on perceived digital equity were calculated. Second, Kruskal-Wallis H test was conducted to determine if there were any significant differences in students' perceptions in relation to age and ethnicity. Third, Mann-Whitney U test was run to determine if there were any significant differences in terms of gender. Fourth, Wilcoxon signed rank test was used to determine if any of the digital equity items were significant at a hypothesized value of 3.5.

4. Findings

4.1. Percentages of Agreement

Percentages of strongly agree and agree were collapsed to gain an overview of students' attitudes toward digital equity. First, an extremely low proportion (28.5 to 39.7 percent) of college students strongly agreed/agreed that they (1) used a desktop computer most of the time to access the Internet, (2) found it easy to participate in their local community via the Internet, (3) went to an Internet café to use the Internet, (4) went to the college library to use the Internet, (5) were concerned about online privacy or safety, (6) used discounted Internet services, (7) found it easy to pay their Internet bills, (8) had home Internet service bundled with other services such as telephone or TV, (9) had satellite Internet, (10) had dial-up Internet, and (11) had home wireline connection (see [Table 2](#)).

Second, only a low proportion (41.2 to 49.2 percent) of college students strongly agreed/agreed that they (1) found it easy to get healthcare or telehealth services via the Internet, (2) used a laptop computer, tablet, or a similar device most of the time to access the Internet, (3) had home Internet service that could meet their household needs, (4) could afford to pay for the Internet every month, (5) had Internet service in their area, (6) found Internet service affordable for them, (7) felt confident navigating the Internet or using online tools, (8) had Internet access for the entire household, (9) used a laptop computer, tablet, or a similar device most of the time to access the Internet, (10) found it easy to search and apply for a job via the Internet, (11) found it easy to get transportation information from the Internet, (12) found it easy to search and/or apply for benefits/resources via the Internet, (13) most likely used the Internet to get healthcare or telehealth services, (14) most likely used the Internet to participate in their local community, (15) were interested in online classes to get digital skills support, and (16) found online government services (e.g., benefits portals, income tax services, or payments for permits or tickets) very accessible to Malaysians (see [Table 2](#)).

Third, a low-average proportion (52.4 to 61.9 percent) of college students strongly agreed/agreed that they (1) had a computer, smartphone, tablet, or other Internet enabled devices for the entire household, (2) were interested in in-person support from a friend/instructor to get digital skills support, (3) could afford or access a device to use the Internet, (4) were concerned about Internet safety, (5) were interested in a DIY training module to get digital skills support, (6) were aware of tools or resources that they could use to stay safe online, (7) would most likely use the Internet to search and/or apply for benefits or resources, (8) found general Internet searching easy for them, (9) would

most likely use the Internet to search and apply for a job, (10) would most likely use the Internet to get transportation information, (11) had Internet service at home, (12) had a data plan for a smartphone or tablet (13) were most concerned that a loved one or they could get scammed or tricked via the Internet, (14) were most concerned that they could be tracked or surveilled via the Internet, (15) were most concerned that a loved one or they could be harassed or abused online, (16) were most concerned that their data could get stolen or used without their consent, and (17) were most concerned that a loved one or they could get scammed or tricked via the Internet (see Table 2).

Lastly, an average proportion of college students strongly agreed/agreed that they (1) used a smartphone most of the time to access the Internet and (2) would most likely use the Internet to search for information (see Table 2).

Table 2: Percentages of Agreement on Perceived Digital Equity

Item	1	2	3	4	5	4+5 (Collapsed)
I have Internet service at home	4.8	17.5	22.2	19	36.5	55.5
I have a data plan for a smartphone or tablet	3.2	6.3	28.6	19	42.9	61.9
I have home wireline connection	17.5	17.5	25.4	15.9	23.8	39.7
I have dial-up Internet	22.2	12.7	31.7	12.7	20.6	33.3
I have satellite Internet	27	17.5	27	9.5	19	28.5
My home Internet service can meet my household needs	9.5	9.5	38.1	17.5	25.4	42.9
My home Internet service is bundled with other services such as telephone or TV	14.3	19	28.6	15.9	22.2	38.1
I can afford to pay for the Internet every month	9.5	7.9	33.3	22.2	27	49.2
It is easy for me to pay my Internet bill	11.1	23.8	25.4	19	19	38
I use discounted Internet service	15.9	9.5	38.1	12.7	23.8	31.9
There is Internet service in my area	7.9	11.1	36.5	20.6	23.8	44.4
Internet service is affordable for me	6.3	11.1	34.9	22.2	25.4	47.6
I am concerned about online privacy or safety	12.7	12.7	34.9	15.9	23.8	39.7
I feel confident navigating the Internet or using online tools	1.6	12.7	38.1	14.3	33.3	47.6
I can afford or access a device to use the Internet	4.8	7.9	34.9	20.6	31.7	52.3
I go to the college library to use the Internet	14.3	11.1	42.9	11.1	20.6	31.7
I go to an Internet café to use the Internet	17.5	11.1	38.1	17.5	15.9	33.4
Everyone in my household has access to the Internet	9.5	9.5	31.7	20.6	28.6	49.2
Everyone in my household has a computer/smartphone/tablet, or other Internet enabled devices	4.8	11.1	31.7	20.6	31.7	52.3
I use a smartphone most of the time to access the Internet	1.6	6.3	20.6	17.5	54	71.5

I use a desktop computer most of the time to access the Internet	14.3	15.9	41.3	9.5	19	28.5
I use a laptop computer/tablet or a similar device most of the time to access the Internet	9.5	12.7	36.5	19	22.2	41.2
I am able to regularly use the Internet for online activities	1.6	4.8	39.7	22.2	31.7	53.9
It is easy to search and apply for a job via the Internet	0	11.1	44.4	14.3	30.2	44.5
It is easy to get healthcare or telehealth services via the Internet	0	7.9	50.8	20.6	20.6	41.2
It is easy to participate in my local community via the Internet	3.2	12.7	46	17.5	20.6	38.1
General Internet searching is easy for me	1.6	9.5	33.3	20.6	34.9	55.5
Getting transportation information from the Internet is easy for me	3.2	6.3	41.3	20.6	28.6	49.2
Searching and/or applying for benefits/resources is easy via the Internet for me	1.6	3.2	46	23.8	25.4	49.2
I most likely use the Internet to search and apply for a job	0	6.3	38.1	22.2	33.3	55.5
I most likely use the Internet to get healthcare or telehealth services	0	19	38.1	20.6	22.2	42.8
I most likely use the Internet to participate in my local community	3.2	9.5	42.9	23.8	20.6	44.4
I most likely use the Internet to search for information	1.6	3.2	19	23.8	52.4	76.2
I most likely use the Internet to get transportation information	0	1.6	31.7	31.7	34.9	66.6
I most likely use the Internet to search and/or apply for benefits or resources	0	3.2	39.7	23.8	33.3	57.1
I am interested in in-person classes to get digital skills support	1.6	4.8	34.9	30.2	28.6	58.8
I am interested in online classes to get digital skills support	3.2	6.3	41.3	20.6	28.6	49.2
I am interested in in-person support from a friend/instructor to get digital skills support	4.8	4.8	38.1	25.4	27	52.4
I am interested in a DIY training module to get digital skills support	1.6	7.9	33.3	25.4	31.7	57.1
I am concerned about Internet safety	1.6	9.5	31.7	22.2	34.9	57.1
I am most concerned that my data could get stolen or used without my consent	6.3	4.8	27	17.5	44.4	61.9
I am most concerned that a loved one or I could get scammed or tricked via the Internet	1.6	7.9	22.2	22.2	46	68.2

I am most concerned that I could be tracked or surveilled via the Internet	1.6	7.9	30.2	22.2	38.1	60.3
I am most concerned that a loved one or I could be harassed or abused online	1.6	4.8	25.4	23.8	44.4	68.2
I am aware of tools or resources that I can use to stay safe online	1.6	9.5	31.7	25.4	31.7	57.1
Online government services (e.g., benefits portals, income tax services, payments for permits or tickets) are very accessible to Malaysians	1.6	4.8	46	17.5	30.2	47.7

Strongly disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly agree = 5

4.2. Nonparametric Test Results

Nonparametric tests showed that there were no significant differences in perceived digital equity by way of gender, age, and ethnicity (see [Table 3](#)).

Table 3: Mann-Whitney U and Kruskal-Wallis H Results

Public leadership	Nonparametric test	p-value
Gender	Mann-Whitney U test	0.319
Age	Kruskal-Wallis H test	0.845
Ethnicity	Kruskal-Wallis H test	0.238

4.3. Wilcoxon Signed Rank Test Results

Wilcoxon signed rank test revealed that all digital equity items were significant at $p < .001$, with medians significantly different from the hypothesized value of 3.5, indicating strong disagreement (see [Table 4](#)).

Table 4: Wilcoxon Signed Rank Test Results

Item	p-value	Conclusion
I have Internet service at home	<0.001**	Median significantly differed from the test value indicating strong disagreement
I have a data plan for a smartphone or tablet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I have home wireline connection	<0.001**	Median significantly differed from the test value indicating strong disagreement
I have dial-up Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I have satellite Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
My home Internet service work can meet my household needs	<0.001**	Median significantly differed from the test value indicating strong disagreement
My home Internet service is bundled with other services such as telephone or TV	<0.001**	Median significantly differed from the test value indicating strong disagreement
I can afford to pay for the Internet every month	<0.001**	Median significantly differed from the test value indicating strong disagreement

It is easy for me to pay my Internet bill	<0.001**	Median significantly differed from the test value indicating strong disagreement
I use discounted Internet service	<0.001**	Median significantly differed from the test value indicating strong disagreement
There is Internet service in in my area	<0.001**	Median significantly differed from the test value indicating strong disagreement
Internet service is affordable for me	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am NOT concerned about online privacy or safety	<0.001**	Median significantly differed from the test value indicating strong disagreement
I feel confident navigating the Internet or using online tools	<0.001**	Median significantly differed from the test value indicating strong disagreement
I can afford or access a device to use the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I go to the college library to use the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I go to an Internet café to use the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
Everyone in my household has access to the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
Everyone in my household has a computer, smartphone, tablet, or other Internet enabled devices	<0.001**	Median significantly differed from the test value indicating strong disagreement
I use a smartphone most of the time to access the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I use a desktop computer most of the time to access the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I use a laptop computer/tablet or a similar device most of the time to access the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am able to regularly use the Internet for online activities	<0.001**	Median significantly differed from the test value indicating strong disagreement
It is easy to search and apply for a job via the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
It is easy to get healthcare or telehealth services via the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
It is easy to participate in my local community via the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
General Internet searching is easy for me	<0.001**	Median significantly differed from the test value indicating strong disagreement
Getting transportation information from the Internet is easy for me	<0.001**	Median significantly differed from the test value indicating strong disagreement
Searching and/or applying for benefits/resources is easy via the Internet for me	<0.001**	Median significantly differed from the test value indicating strong disagreement
I most likely use the Internet to search and apply for a job	<0.001**	Median significantly differed from the test value indicating strong disagreement
I most likely use the Internet to get healthcare or telehealth services	<0.001**	Median significantly differed from the test value indicating strong disagreement
I most likely use the Internet to participate in my local community	<0.001**	Median significantly differed from the test value indicating strong disagreement
I most likely use the Internet to search for information	<0.001**	Median significantly differed from the test value indicating strong disagreement
I most likely use the Internet to get transportation information	<0.001**	Median significantly differed from the test value indicating strong disagreement

I most likely use the Internet to search and/or apply for benefits or resources	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am interested in in-person classes to get digital skills support	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am interested in online classes to get digital skills support	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am interested in in-person support from a friend/instructor to get digital skills support	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am interested in a DIY training module to get digital skills support	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am concerned about Internet safety	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am most concerned that my data could get stolen or used without my consent	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am most concerned that a loved one or I could get scammed or tricked via the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am most concerned that I could be tracked or surveilled via the Internet	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am most concerned that a loved one or I could be harassed or abused online	<0.001**	Median significantly differed from the test value indicating strong disagreement
I am aware of tools or resources that I can use to stay safe online	<0.001**	Median significantly differed from the test value indicating strong disagreement
Online government services like benefits portals, income tax services, or paying for permits or tickets are very accessible to Malaysians	<0.001**	Median significantly differed from the test value indicating strong disagreement

** $p < .001$

5. Implications and Recommendations

5.1. Low to Low-average Levels of Digital Equity

Findings imply that very low to low-average proportions of college students showed positive attitudes toward digital equity. Before joining the university college, many of them attended secondary schools that are farther away from the towns. Living in the agrarian areas, they tend to have limited exposure to digital technology and Internet connectivity. In a literature review, [Ismail \(2025\)](#) summarized that rural students in Malaysia often lack the ability for content creation and digital problem-solving, indicating that they only possess surface-level familiarity with digital technology. While demonstrating basic digital literacy skills (seek, retrieve, and process information from the Internet), they are unable to perform photo and video editing, do troubleshooting, and interpret digital ethics. This situation is further compounded by a resource-scare learning environment, sociocultural values, social exclusion, and other community-level determinants. In the context of Sabah, while e-learning tends to spark curiosity and engagement amongst rural students, implementation is seriously constrained by device ownership, weak Internet connectivity, and socioeconomic hurdles.

On the other hand, teachers in rural areas, besides carrying a heavy workload, often encounter time and resource constraints, resistance to change, a lack of advanced digital exposure, and other infrastructural barriers. Their confidence and efficacy are further affected by the lack of advanced digital skills, unequal access to technology and training, and obstacles in incorporating digital tools into their teaching. While they are familiar with basic digital devices, such as Google, WhatsApp, and Messenger, many still lack advanced search strategies and the appraisal skills to implement digital information literacy instruction (Ismail, 2025).

5.2. Digital Society Mindset

Gong (2023) asserted that digital equity should encompass not only focus only on its socioeconomic aspects, but also citizens' social lives and public services. Therefore, digital equity in Malaysia should be grounded on a digital society mindset, which not only underscores productivity and efficiency, but also inclusivity, human rights, and digital rights. A digital society mindset is characterized not only by technological expertise, but also by social tenets that uphold human and digital rights, including the right to receive and impart information, right to privacy, and right to quality education in line with SDG 4 Quality Education.

Digital rights can be promoted by implementing measures that emphasize digital inclusivity, which ensures that all individuals, including the marginalized and disadvantaged, have access to digital tools. Digital inclusion requires pragmatic strategies that can eliminate sociohistorical, institutional, and structural barriers to digital adoption, which requires innovative infrastructure, effective network performance, and safer and user-friendly devices and apps. It also requires community-based solutions to ameliorate social inequities, besides evaluating the digital impact on education, healthcare, and communal cohesion (Gong, 2023).

5.3. Ethical and Digital Literacy Issues

Ethical digital citizenship is a critical element of digital equity, which involves the principled and exemplary application of digital technologies (Abu, 2023). It encompasses individuals' rights and duties in the digital realm, besides the sociocultural impact of digitalization. Ethical digital citizenship requires individuals to acquire an array of attitudes and behaviors to demonstrate digital capabilities in a socially and culturally appropriate, manner including digital ethos, online safety and security, and scrupulous social media use. It also includes deep awareness of such issues as digital identity and privacy, cyberbullying, intellectual piracy, and digital fraud. In brief, ethical digital citizenship should be instilled to inspire Malaysians to utilize technology in a way that maximizes its benefits, while minimizing its abuse and risks.

The Malaysian government has launched several initiatives that aim to address ethical and digital literacy issues (Abu, 2023). First, the Ministry of Education has incorporated digital citizenship education into the school curriculum, which aims at promoting digital literacy, online safety, and digital ethos by highlighting the cruciality of appropriate attitudes and behaviors, critical thinking, innovative problem-solving, and civic-conscious interactions in the digital landscape. Second, the Malaysian Communications and Multimedia Commission has frequently launched digital civility campaigns, which aim to promote virtuous cyber behaviors and attitudes grounded on respect, authenticity, compassion, and empathy, while encouraging citizens to report identity theft, cyber fraud,

cyberbullying, hate speech, and other digital abuses. Third, Malaysia observes February 7th as Safer Internet Day, which is an educational and awareness campaign celebrated in over 100 nations. It underscores cybersecurity awareness and digital security through various events and activities held in the community. Lastly, Malaysia has enforced several rules and regulations to improve the country's digital applications, security, and privacy; for example, the Personal Data Protection Act 2010 regulates the collection, use, and disclosure of personal data.

5.4. Principles for Digital Inclusion

According to [Gong \(2023\)](#), principles for digital inclusion should include an inclusive design and assessment of the user experience. First, digital tools should be at the disposal of everyone, including the disenfranchised and those with special needs; for example, public websites should be available in multiple languages, including dialects spoken by indigenous communities. Besides, analog options should be provided to financially excluded and underserved individuals with limited digital access and digital literacy. Second, all digital initiatives should be translated into meaningful and productive user experiences; for example, while satellite technologies promise greater speeds and more reliable performance in rough weather, actual performance is measured by service providers in terms of signal coverage under favorable situations, but not by download speeds. While digital platforms often meet the legal obligations by subjecting users to various terms and condition regarding their use, unfortunately, many people still report cyberbullying, adult cyber threats, image-based abuse, and harassment on various digital platforms.

Lastly, principles for digital inclusion should also include good governance and public interest. First, good governance, especially in terms of data security and personal privacy, is fundamental in the protection of digital rights. It encompasses the installation of safe, integrated, and interoperable digital structures that can protect personal data in the cyberworld. Second, government policies should not benefit the private sector at the expense of the general public. While many state-of-the-art digital applications are privately owned, clarity and transparency with regard to digital applications should be upheld; for example, open access to procurement processes can greatly improve the culpability of both public and private sectors ([Gong, 2023](#)).

5.5. Fair and Inclusive Society

The [Internet Society Foundation \(2023\)](#) recommended five ways of creating an equitable and inclusive environment in the digital age. First, the government and other stakeholders should invest in digital infrastructure by expanding broadband facilities and improving connectivity in underserved areas. Second, innovative digital literacy programs should be implemented to provide education and training to enhance the digital skills amongst marginalized communities, older adults, and individuals with limited access and special needs. Besides, conventional education should incorporate ICT modalities to augment the teaching and learning process in all educational settings. Third, affordability measures should be enforced to make digital tools and services more accessible for individuals who are disadvantaged or marginalized. Moreover, researchers, technologists, and social workers should design digital prototypes that are more affordable for communities where basic technologies are still scarce or inaccessible. Fourth, accessibility initiatives should be implemented to ensure that digital platforms, devices, and content are within reach among individuals with special needs through inclusive design and adherence to

accessibility standards. Fifth, partnerships should be increased to encourage public-private collaboration in sharing expertise, resources, initiatives, and enterprises that promote digital equity.

5.6. Students with Special Needs

According to [Mastam, Mokhtar, and Zaharudin \(2024\)](#), although the integration of digital technology into education is increasingly prevalent in Malaysia, many students with special needs often face distinct challenges in accessing and utilizing basic digital tools and resources. To enhance their digital skills, Design for Learning (UDL) should be adopted to make digital classrooms more accessible to accommodate their physical and mental attributes, individual needs, and cognitive processing styles. First, personalized learning paths should be implemented to ensure that each student's digital skill development plans are individualized according to his or her interests, strengths, and career aspirations. Second, students with special needs should have easier access to digital tools and resources to augment their skills and knowledge; for example, assistive technology, including alternative input methods, captioning, and screen readers should be provided to ensure that students with special needs can effectively participate in the learning process. Third, collaborative learning should be practiced to encourage interpersonal communication, cooperation, and social inclusion. Fourth, students with special needs should be exposed to culturally relevant content in order to acquire different perspectives, sociocultural allusions, and real-life scenarios to gain a sense of inclusivity and belonging. Fifth, formative feedback and assessment should be practiced to evaluate students' progress rather than just depending on summative results based on formative evaluation.

5.7. Teacher Professional Development

[Mastam, Mokhtar, and Zaharudin \(2024\)](#) postulated that teacher professional development is crucial in enhancing digital learning amongst students with special needs. First, teachers can greatly benefit from participating in professional development initiatives to become more digitally competent in creating inclusive online classrooms. Second, to acquire a more diverse range of digital skills, teachers should engage in community partnerships to work with local groups, businesses, and other interested stakeholders who can provide internships, mentorship programs, and other experiential learning opportunities, which not only help them gain a sense of community and self-efficacy, but also allow them to apply their newly acquired digital competencies for promotion or potential employment elsewhere.

According to [Ismail \(2025\)](#), teacher training is fundamental in any digital transformation agenda; professional development should go beyond fundamental ICT competency by prioritizing innovative pedagogy, curricular integration, and equitable digital practices. For instance, teachers serving isolated or resource-poor schools should be scaffolded by peer mentoring models, continuous learning platforms, and other kinds of digital support. Additionally, digital use and adoption should be appropriately aligned with multicultural educational principles to ensure that all digital content is accessible to all, including students with special needs and those who are culturally and linguistically diverse. Finally, monitoring and evaluation measures must be implemented to appraise the actual impact of digital literacy policies on remote and rural schools, while feedback loops involving principals, staff, students, and parents help ensure that policy design is grounded on authentic teaching and learning experiences.

5.8. 5G Network Coverage

Finally, [Ismail \(2025\)](#) reiterated that, to achieve 80 percent of 5G network coverage in Malaysia, education departments, digital startups, local NGOs, and other stakeholders must strive to develop a more inclusive and locally responsive digital strategy across every state. Principal priorities should focus on (1) reinforcing teachers' digital competencies by providing relevant training programs, (2) establishing community-based digital learning hubs, and (3) increasing the appropriateness and accessibility of digital content to narrow the digital gap between urban and remote and rural communities. Further, a differentiated policy approach that considers regional disparities should be introduced to reduce the gaps in digital infrastructure and adoption. Therefore, a multitiered framework should be implemented so that schools in underserved communities can have better infrastructural support, Internet provision schemes, and other digital upgrades and subsidies.

5.9. Generalizability of Findings

To enhance the generalizability of findings and minimize bias, future research on digital equity should recruit more diverse, representative samples with a wider range of demographic characteristics. Further, a larger sample size should be employed to increase the likelihood that the findings can be generalized to the broader population of college students. Besides, future research should also be conducted in various states and locations to account for contextual variations and increase the applicability of findings. More valid and reliable instruments should be utilized to ensure accuracy and consistency of data collection. Lastly, mixed methods that incorporate both quantitative and qualitative data collection should be practiced to gain a more comprehensive understanding of digital equity in the context of Sabah.

Ethics Approval and Consent to Participate

This study has strictly adhered to all ethical procedures involving the use of human subjects. Informed consent was obtained from all respondents who were ascertained of their anonymity, with their responses kept strictly confidential. They were also informed that the study was of low risk and that they could stop participating any time without any repercussions.

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Conflict of Interest

The authors report no potential conflict of interest regarding this study in terms of the research, or publication of this article.

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