ProSafeNet

International Journal of Disaster Risk Management • Vol. 7, No. 2 • https://doi.org/10.18485/ijdrm.2025.7.2.13

Publisher: Scientific-Professional Society for Disaster Risk Management

International Journal of Disaster Risk Management

Article

Digital Literacy and Educational Empowerment Among Rural Women in Bangladesh: Bridging the Technology Access Gap

Ritesh Karmaker[1], Vladimir M. Cvetković[2,3,4*]

[1] Nizam Uddin Ahmed Model College, Mymensingh, Sherpur-2100, Bangladesh; karmakerritesh@gmail.com.

[2] Department of Disaster Management and Environmental Security, Faculty of Security Studies, University of Belgrade, Gospodara Vučića 50, 11040 Belgrade, Serbia; vmc@fb.bg.ac.rs.

[3] Scientific-Professional Society for Disaster Risk Management, Dimitrija Tucovića 121, 11040 Belgrade, Serbia.

[4] Safety and Disaster Studies, Department of Environmental and Energy Process Engineering, Technical University of Leoben, Franz Josef-Straße 18, 8700 Leoben, Austria.

[*] Correspondence: karmakerritesh@gmail.com.

Received: 9 July 2025; Revised: 10 September 2025; Accepted: 27 October 2025; Published: 30 December 2025.

ABSTRACT

This study explores how digital literacy influences the education and empowerment of rural women in Bangladesh from 2015 to 2024. Using data from surveys, semi-structured interviews, and focus groups, it examines how rural women access digital technologies, the challenges they face, and the social and educational benefits of increased digital engagement. Despite growth in digital literacy and ICT access over the past decade, rural women still face significant hurdles, including socioeconomic barriers, cultural and gender norms, limited digital infrastructure, high device costs, and unequal training opportunities. These structural issues, along with regional differences and low digital awareness, continue to widen the gender digital divide. The findings show that digital literacy significantly enhances educational participation, access to online learning, communication, and opportunities for income generation and entrepreneurship. The COVID-19 pandemic has further highlighted the importance of digital skills for maintaining educational continuity and for remote service access. However, participation remains uneven, especially among the most marginalized rural groups. The study emphasizes the need for targeted, gender-sensitive digital literacy programs that address affordability, connectivity, and cultural barriers. It also recommends policies to improve rural ICT infrastructure, expand community-based training, and foster inclusive digital ecosystems. Overall, this research provides new empirical evidence, showing that digital literacy—when combined with accessible infrastructure and culturally appropriate programs—can be a powerful tool for closing educational gaps, enabling socioeconomic mobility, and advancing gender equality in rural Bangladesh.

KEYWORDS

Digital literacy, technology access, rural education, gender inequality, digital divide.

Karmaker, R., & Cvetković, V. M. (2025). Digital Literacy and Educational Empowerment Among Rural Women in Bangladesh: Bridging the Technology Access Gap. International Journal of Disaster Risk Management, 7(2), 239–262. Retrieved from https://internationaljournalofdisasterriskmanagement.com/index.php/Vol1/article/view/239

1. Introduction

Digital literacy has become an increasingly fundamental catalyst for socioeconomic development, particularly in rural areas, where access to educational resources and economic opportunities can be limited. In rural Bangladesh, women, especially in marginalized communities, face substantial barriers to accessing Information and Communication Technology (ICT) and digital literacy resources Alam et al., 2023; Rahman & Parvin, 2024. These barriers, ranging from inadequate infrastructure and limited internet connectivity to sociocultural stigmas, hinder women's ability to fully utilize digital technologies for educational, economic, and personal empowerment (Cvetković & Svrdlin, 2020; Kutub et al., 2017; Popović & Cvetković, 2012; Akter et al., 2023; Jevtić et al., 2025;Emon & Nipa, 2024). Despite these significant challenges, rural women have demonstrated remarkable resilience and innovation in overcoming obstacles to acquiring digital skills, leading to substantial improvements in their socioeconomic conditions (Haque et al., 2023).

The role of ICT in empowering women has been extensively documented in the academic literature, emphasizing its potential to enhance educational outcomes, promote entrepreneurship, and improve health and financial literacy (Cvetković & Katarina, 2019; Domingo Dela Cruz & Ormilla, 2022; Cvetković et al., 2017; Ivanov & Cvetković, 2014; Jakovljević et al., 2015; Khan et al., 2024). Research by Sultana et al. (2018) and Haque et al. (2023) demonstrates that ICT has enabled rural women to participate in educational programs and engage in entrepreneurial activities, thereby improving their overall quality of life (Tasnima et al., 2024). However, access to technology alone does not ensure equitable digital inclusion. Socioeconomic status plays a pivotal role in determining how much individuals can benefit from digital resources. Factors such as household income, education level, and cultural norms heavily influence women's ability to access and use digital tools Karmaker and Rahman, 2024. As Siddiquee and Islam (2024 assert, socioeconomic inequalities exacerbate the digital divide, particularly for rural women, who are further disadvantaged by regional disparities in infrastructure and connectivity.

Government initiatives such as Digital Bangladesh and the establishment of Union Digital Centers (UDCs) have made progress in expanding access to ICT in rural areas, as highlighted by Noor and Hoque (2021 and Akter and Husain (2021. Yet, these initiatives face challenges due to infrastructural limitations, lack of digital awareness, and cultural barriers. Studies by Ullah (2017 and Amin (2024 critique the insufficient reach and impact of government programs, particularly those targeting disadvantaged women. Additionally, limited financial literacy and connectivity issues continue to restrict the adoption and effective use of mobile financial services and e-learning platforms, as discussed by Aziz and Naima (2021) and Rahman et al. (2023).

This study aims to examine how rural women in Bangladesh are overcoming these barriers and leveraging digital tools to bridge the gap in technology access and education (Sultana et al., 2018; Karmaker & Lemon, 2024). By exploring the socioeconomic, cultural, and policy-related factors that affect digital literacy, this research aims to provide a comprehensive understanding of how digital inclusion can be fostered among rural women (Al-Amin et al., 2024). Furthermore, the paper will examine the roles of government policies, NGOs, and community initiatives in enhancing digital literacy and expanding access to ICT (Islam, 2017; Amin, 2024). The ultimate goal of this study is to provide valuable insights into practical strategies to promote digital literacy (Gajović et al., 2025; Cvetković & Šišović, 2024; Goswami & Ahmad, 2025; Milenković et al., 2024; Sudar et al., 2024), empower rural women, and foster socioeconomic mobility and educational advancement in Bangladesh.

Despite the rapid digital transformation in Bangladesh, rural females continue to face significant barriers to accessing and utilizing technology for education and empowerment. Factors such as socioeconomic inequality, inadequate infrastructure, cultural restrictions, and limited awareness have deepened the gender digital divide. While government and NGO initiatives have expanded digital access, their reach and impact remain uneven across rural communities. This study seeks to address the critical problem of how digital literacy can bridge the gap in technology access and educational opportunities for rural females, thereby promoting gender equity and inclusive development.

Based on that, this paper has the following research questions: How does digital literacy influence educational participation and achievement among rural females in Bangladesh?; What socioeconomic and cultural factors affect rural females' access to digital tools and internet connectivity?; How effective are government and NGO initiatives in promoting digital literacy among rural females?; How has digital literacy contributed to reducing the educational gap between rural and urban females in Bangladesh?

1.1. Literature Review

Digital literacy has become an essential driver of socioeconomic transformation, enabling individuals to achieve personal, professional, and educational goals (Cvetković, 2016; Cvetković, 2023; Perić & Cvetković, 2019; Beli et al., 2025; Renner & Mayr-Veselinovic, 2025). Khan et al. (2024) identified the importance of digital literacy in fostering these advancements, especially in rural and underserved regions. Despite its potential, disparities in internet use and online skills persist, as highlighted by Siddiquee and Islam (2024). These disparities are often influenced by socioeconomic factors, leading to unequal access to digital tools and opportunities, as Emon & Nipa (2024) explore.

The impact of technology on women's empowerment has been extensively studied, with Sultana et al. (2018) and Haque et al. (2023) demonstrating how ICT can improve rural women's lives despite numerous obstacles. Similarly, Ullah (2020) and Khatun et al. (2017) examined the intersections of social, economic, and political power in shaping access to digital resources, underscoring the importance of targeted interventions. Aziz and Naima 2021 further noted that while digital services have eased access to financial systems, these remain underutilized due to limited awareness, financial literacy, and connectivity. In rural Bangladesh, Sarker (2020) examined ICT's dual role in empowering and marginalizing women, a challenge also echoed by Tasnima et al. (2024), who highlighted media literacy's influence on women's empowerment.

Access to technology alone is insufficient without infrastructure and policy support (Dada et al., 2025; Vračević, 2025; Milenković, 2025; Mančić, 2025; Onimisi, 2025). Noor and Hoque (2021) found that mobile phones significantly enhanced rural women's economic capabilities, while Akter and Husain (2021) lauded Union Digital Centers for connecting rural communities to global networks; however, Ullah (2017) opposed Union Information and Service Centers (UISCs) established at the Union Council level, arguing that they were insufficient for developing many factors. However, Amin (2024) critiqued the policy gaps that hinder digital inclusivity, particularly for disadvantaged groups. Islam and Inan 2021 attributed digital disparities in Bangladesh to systemic socioeconomic inequalities, underscoring the need for robust interventions. Alam et al. (2023) and Rahman & Parvin (2024) provided insights into barriers to e-learning, which, despite its potential, remains underutilized due to infrastructural and policy limitations, and both the public and private sectors operate for different reasons.

The transformative power of digital tools in governance and entrepreneurship is evident in studies such as Rana & Rahman (2022), which highlighted e-government's role in improving transparency and efficiency despite poor e-services. For women, ICT has been instrumental in enhancing entrepreneurship, as seen in Rahman et al. 2023, who detailed the empowerment effects of mobile phone use among rural entrepreneurs. Similarly, Roy et al. 2024 emphasized the significance of mobile financial services in transforming women's socioeconomic roles. These findings align with Islam and Islam 2023, who noted e-learning's role in bridging educational gaps, despite persistent systemic challenges. Emerging technologies have also been scrutinized for their potential to bridge inequalities. Awaghade (2022) discussed the impact of digital inequality on marginalized groups, while Farley and Burbules (2022) argued that technology could either exacerbate or reduce inequities depending on its implementation. Specific barriers, such as stigma and superstition, further restrict ICT adoption, as highlighted by Sultana et al. (2021).

In the context of economic development, studies like Khatun et al. 2021 and Nikey 2024 shed light on the role of ICT in fostering entrepreneurship and economic empowerment. Ateş et al. 2025 highlighted how digital tools have transformed rural economies, particularly for women. Other re-

searchers, such as Waldman et al. (2018), have demonstrated ICT's role in improving access to health services, further supporting the argument for broader digital inclusion.

Government initiatives such as Digital Bangladesh have shown mixed results. Hoque et al. (2022) praised its short-term successes, while Hossain et al. (2023) and Hussain et al. (2018) argued for greater investment to address infrastructural gaps. Ahmed et al. (2022) further noted gender disparities in the workforce and emphasized the role of ICT in reducing these inequalities.

Finally, NGOs and local initiatives have played a pivotal role in fostering digital literacy and reducing barriers. In 2017, Islam lauded NGOs' contributions to enhancing access and minimizing sociocultural constraints. Hoque and Kabir (2024) highlighted the role of Union Digital Centres in delivering affordable services, while Bhuiyan and Mollik (2023) advocated the use of technology to improve educational outcomes. Complementing these findings, Islam and Khan (2024) and Islam and Mostafiz (2024) explored how digital literacy and training could enhance women's financial independence and business performance. The literature underscores the complex interplay of socioeconomic, cultural, and policy factors in shaping digital inclusion in Bangladesh. While progress has been made, as seen in studies such as Karmaker and Rahman 2024 and Al-Amin et al. 2024, addressing barriers to infrastructure, awareness, and cultural norms remains critical to ensuring equitable access and empowering all segments of society.

2. Methods

A convergent mixed-methods design integrated qualitative and quantitative data to provide a comprehensive understanding of how empowering rural women in Bangladesh by enhancing their access to information and communication technology (ICT) and improving educational opportunities. Purposive sampling ensured key informants and focus group members with relevant expertise were included.

2.1. Sample

A total of 253 respondents participated in this study, all of whom were students from secondary and higher secondary institutions and collegiate universities across Sherpur, Bangladesh. The author and the Research Approval Committee (RAC) formed the group of respondents with the assistance of local authorities or institutions. Participants were recruited through random, convenience, and snowball sampling to ensure representation from diverse marginalized communities. All participants provided informed consent and were assured of confidentiality. Personal identifiers were anonymized, and the study received ethical approval from the Research Approval Committee (RAC) of NUAMC, Sherpur town-2100, Bangladesh. Students were recruited from seven institutions: urban—1 collegiate university and five schools; rural—1 college and one school in Sherpur, Bangladesh.

Questionnaire and Focus Group Discussion (FGD) Members (n = 26): Consisted of teachers, policymakers, local education administrators, a software engineer, and a research scholar for both structured questionnaires and FGDs. Participation was voluntary, and no compensation or transportation arrangements were provided. Participants traveled independently to the study locations. Surveys were administered both online and in-person to accommodate participants with limited internet access. Interviews and FGDs were conducted in local schools, government offices, and community centers to ensure a comfortable environment for discussion.

2.2. Study Area

The study was conducted in Sherpur Sadar Upazila, Sherpur, Bangladesh (25°00′ 0.00″ N, 90°01′ 0.12″ E), demonstrating how digital literacy empowers rural women by enhancing their access to information and communication technology (ICT) and improving educational opportunities.

2.3. Questionnaire

The survey instrument was developed following a comprehensive review of literature on access to information and communication technologies (ICT), the enhancement of educational opportunities, and the effects of government policy. It included 29 structured questions, of which 13 were Likert-scale items, organized into four thematic areas:

- Digital access: Internet connectivity, device availability, and affordability of data packages.
- Educational opportunities: Participation in online classes, access to e-learning platforms, engagement in skill-development programs, and perceptions of wage disparities.
- Technology usage: Frequency of digital tool use, smartphone ownership, use of mobile banking services, and familiarity with educational applications.
- Pilot testing: The instrument was pretested with 10 respondents to ensure clarity and reliability (Cronbach's $\alpha = 0.79$).

2.4. Interview

The semi-structured interviews and focus group discussions (FGDs) were designed to capture in-depth qualitative insights. Data collection relied on semi-structured guides centered on two primary areas:

- Cultural norms: Gendered expectations, household responsibilities, and community attitudes shaping access to education and digital technologies.
- Policy effectiveness: Perceptions of digital literacy initiatives and related government programs.

All interviews and FGDs were conducted in Bangla and later translated and transcribed into English by bilingual researchers to ensure linguistic accuracy.

Study sites included:

- An urban computer training centre (Sherpur Sadar).
- A rural college digital learning centre.
- An urban secondary school computer laboratory.

A total of 17 interviews and 26 FGDs were carried out in the participants' native language. Sessions were audio-recorded with informed consent, then transcribed and translated into English for thematic analysis.

2.5. Ethical Approval

NAMC/01-02-24.00.04.00031 and the Sherpur Sadar Upazila Committee carried out data collection at three locations in Sherpur District: an urban computer training center, an urban secondary school, and a rural college. All participants gave written informed consent after receiving explanations both verbally and in writing in Bangla. The RAC confirmed that: no institutional or individual identifiers would be revealed; data would be stored on encrypted servers with limited access for the research team; and participation was entirely voluntary, with no compensation to prevent coercion. The approval included specific permissions for: audio recording of interviews and FGDs; use of anonymized survey responses; accessibility provisions for participants with disabilities.

2.6. Data Collection Procedures

All data collection was conducted at three strategically selected sites within Sherpur District: an urban computer training center in Sherpur Sadar Upazila, an urban secondary school's computer

laboratory, and the leading digital learning center at a rural college. Surveys were administered in person across multiple scheduled sessions, resulting in a total of 253 completed questionnaires. Semi-structured interviews (n = 17) and FGDs (n = 26) were conducted in private rooms at these same locations, using identical workstation configurations (Intel i3 processors, 8 GB RAM, Windows 10) to maintain technical consistency. Data collection spanned from 22 March 2025 to 29 September 2025, providing adequate time for the systematic gathering of both quantitative and qualitative evidence. All collected materials were stored in encrypted files, with access strictly limited to the research team to ensure confidentiality and protect participants' personal information.

2.7. Analysis

Survey data, including 13 Likert-scale items, were analyzed using SPSS. The analytical strategy incorporated the following procedures:

- Descriptive statistics: Frequencies, percentages, means, and standard deviations were used to summarize demographic characteristics and examine initial patterns across key variables, such as access to education and employment outcomes.
- Regression analysis: Linear and logistic regression models assessed the influence of predictors (e.g., digital literacy, access to education) on women's advancement in digital skills and educational attainment. Assumptions of normality, linearity, and multicollinearity were examined prior to model estimation.

Anonymized datasets were stored on encrypted servers, and all personal identifiers were removed prior to analysis. Accessibility accommodations were provided to ensure the participation of individuals with disabilities.

Limitations

1. Selection bias: Voluntary participation may have led to overrepresentation of respondents who are more digitally literate.
2. Generalizability: Focusing on a single district limits broader applicability, although triangulation through mixed methods enhances contextual validity.
3. Self-reporting bias: Potential social desirability effects were reduced through anonymous data collection.
4. Logistical constraints: The absence of transportation support may have affected the participation of women from remote rural areas.

Complementing the survey analysis, 17 semi-structured interviews with students, professionals, and policymakers, and 26 FGDs with teachers and administrators were conducted in Bangla. These qualitative components provided more profound insights into women's digital literacy experiences, perceived barriers, and local understandings of empowerment.

2.8. Equations

The equation ($Y_1 = \beta_0 + \beta\iota X1+\beta2X2+ \beta3X3 + €$) represents a linear regression model in which Y1 is the dependent variable, predicted as a linear combination of the independent variables x1, x_2, and x_3. β_0 is the intercept term, and βι, β2, and β3 are the coefficients quantifying the relationship between the dependent variable and each independent variable. The error term € accounts for variability not explained by the model. It captures the influence of unmeasured or unknown factors. On the other side, equation (Y=3.5+2.1X1+1.8X2) represents a multiple linear regression model in which y is the dependent variable, predicted as a function of the independent variables x1 and x2. Here, 3.5 is the intercept, indicating the expected value of y when both x1 and x2 are zero. The coefficient 2.1 represents the expected change in y for a one-unit increase in x1, holding x2 constant, while 1.8 represents the expected change in y for a one-unit increase in x2, holding x1 constant.

3. Results

The demographic profile shows that most respondents reside in rural areas, giving the study a predominantly rural perspective. At the same time, female participants also form the majority, which may shape views on sociocultural and gender-related issues. A large share of respondents reported intermediate levels of education, suggesting that many are well-positioned to comment on educational reform and pathways toward job-oriented skills. The sample is composed mainly of young adults, consistent with the study's focus on ICT training and employment readiness. Additionally, unmarried participants outnumber married participants, which may influence perceptions of mobility, decision-making, and access to digital technologies. Overall, the distribution indicates that the findings reflect a rural-centric, youthful, and moderately educated population whose experiences and expectations frame the study's broader insights into women's access to technology, education, and employment-oriented digital skills (Figure 1).

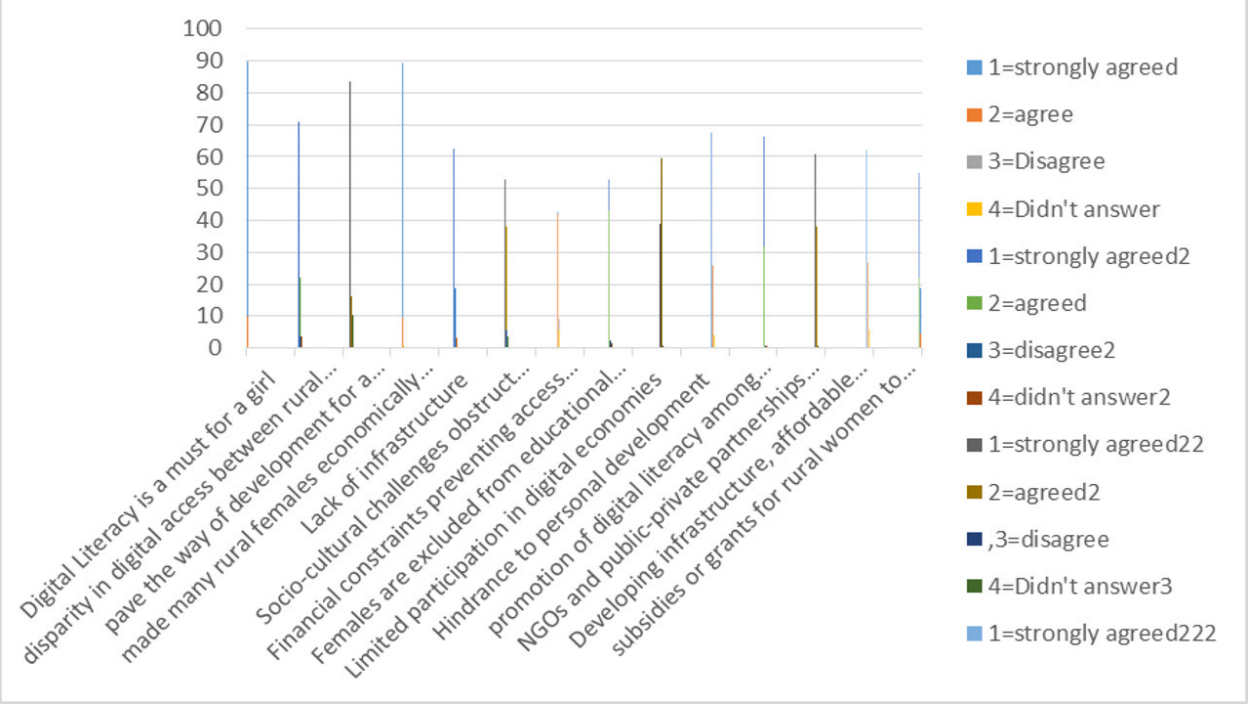

Figure 1. Respondents' views on field data gathered surveying facts regarding digital literacy among rural women. Source. Field Survey, 2024. Background information of the respondents.

The bar chart presents findings from a field survey examining how digital literacy can help narrow the gap in technology access and educational opportunities for rural females. Overall, respondents emphasized that digital literacy is a critical requirement for reducing existing disparities, with a large proportion strongly agreeing or agreeing that it plays a central role in empowering rural women. The results also underline persistent inequalities between rural and urban areas, largely driven by economic constraints and weak infrastructure. Participants frequently pointed to sociocultural barriers, such as restrictive gender norms, as well as financial constraints and inadequate digital infrastructure, all of which significantly limit women's ability to engage with technology. Despite these challenges, respondents recognized several avenues for improvement. Many expressed support for strengthening partnerships involving NGOs and private-sector actors, while others highlighted the importance of grants and affordable subsidies to increase accessibility for women in low-income rural households. The distribution of responses across categories such as "strongly agree," "agree," and "disagree" shows strong support for targeted interventions to improve digital literacy and expand educational and employment pathways for rural women. Figure 2 further illustrates participants' views on which measures are likely to be most effective in enhancing digital skills and supporting women's participation in the digital economy.

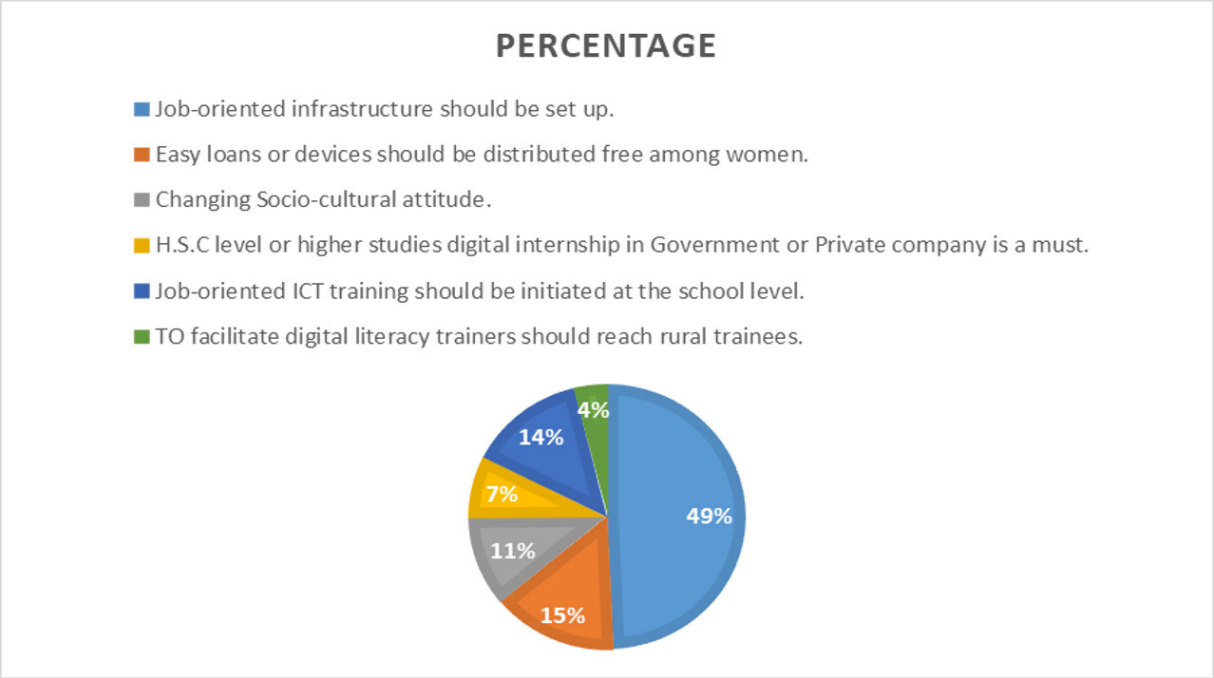

Figure 2. Percentage Distribution of Respondents Across Proposed Measures for Enhancing Women's Digital Literacy.

The responses indicate strong demand for systemic measures to enhance women's digital empowerment, with nearly half of the participants emphasizing job-oriented infrastructure as the most critical intervention. This focus reflects widespread expectations for sustainable employment pathways supported by a robust digital ecosystem. Financial access also emerged as an important factor, as 15 percent of respondents stressed the value of affordable loans or devices to help women acquire essential digital tools. Alongside economic considerations, 11 percent pointed to the need for shifting sociocultural attitudes that continue to limit women's participation in technology and education. Additional suggestions included the introduction of structured digital internships, which 7 percent viewed as moderately influential, and stronger school-level ICT training, supported by 14 percent of respondents who saw early exposure as key to reducing future skill gaps. A smaller yet meaningful share (4 percent) emphasized bringing training directly to rural areas to ensure that remote learners are not left behind. Overall, the data underscore the importance of infrastructure development, complemented by financial support, cultural change, and early digital education as essential components for advancing women's digital inclusion.

Table 1 reflects the shifting landscape of digital literacy among rural females in Bangladesh over the past decade, highlighting the steady rise in mobile and computing device ownership. These technologies have become central to improving educational access, strengthening economic participation, and advancing digital inclusion. Mobile phones, in particular, now function as the primary gateway to the digital world, offering affordable access to communication, online learning, and essential public services. Although the adoption of computers and tablets has expanded more gradually, their growing presence signals increasing engagement in higher-level digital activities such as formal education, entrepreneurial ventures, and e-governance platforms.

Between 2015 and 2018, growth remained modest but steady, mirroring early-stage government and NGO efforts that focused on raising awareness and providing basic digital training. In the 2019–2021 period, device ownership increased sharply, driven by initiatives such as BRAC's technology empowerment programs and the ICT Division's "Digital Bangladesh 2021" agenda, which expanded rural connectivity and subsidized digital tools. The 2022–2024 projections indicate a continued acceleration in ownership, supported by improvements in mobile network coverage, declining device costs, and targeted digital literacy campaigns explicitly aimed at rural women.

Rising digital literacy has opened new educational opportunities by enabling rural women to access online learning platforms and blended instructional materials. Economically, increased access to devices correlates with greater participation in digital marketplaces, micro-entrepreneurship, and remote work opportunities. On a social level, access to technology enhances empowerment by connecting women to broader networks, information resources, and community support systems.

The data underscores the importance of sustained investment in rural digital infrastructure, especially to ensure affordable device access and reliable internet connectivity. While mobile ownership has expanded quickly, computer and tablet access remains limited, suggesting the need for programs that broaden exposure to diverse digital tools and skill sets. The focus on rural females also provides a valuable model for addressing gender disparities in technology access and literacy across developing contexts.

This dataset offers a strong foundation for further research. Future studies could explore how digital literacy influences educational attainment and employment outcomes for rural women, assess the effectiveness of specific interventions in narrowing the digital divide, and examine the long-term socioeconomic benefits of increased digital access in rural communities.

Table 1 not only tracks the quantitative increase in digital device ownership but also reflects broader socioeconomic shifts driven by digital empowerment initiatives. These trends highlight the pivotal role of technology in fostering inclusive development for marginalized groups in rural Bangladesh.

Table 1. Digital Device Ownership among Rural Females (2015–2024).

Year	% of rural females owning a mobile device	% owning a computer/tablet	Source
2015	20%	5%	(UNESCO 2015)
2016	25%	6%	(WORLD BANK 2016)
2017	30%	8%	(BD GOVT. 2017)
2018	35%	10%	(UNDP 2018)
2019	40%	12%	(BRAC 2019)
2020	50%	15%	(ADB 2020)
2021	55%	18%	(ICT DIVISION 2021)
2022	60%	20%	(BRAC 2022)
2023	65%	25%	(WORLD BANK 2023)
2024	70% (estimated)	30% (estimated)	(ICT DIVISION 2024)

The objective of Table 2 is to demonstrate the steady rise in internet access among rural females in Bangladesh between 2015 and 2024 and to illustrate how the primary uses of the internet have evolved during this period. As digital connectivity expanded, rural women increasingly gained opportunities for education, economic participation, and access to healthcare, showing the internet's growing role in their empowerment. Initially, the internet was mainly used for social media. However, over time, it became central to e-learning, mobile banking, telemedicine, and online entrepreneurship, thereby helping reduce the rural-urban divide and supporting the socioeconomic development of rural communities.

Yearly trends reflect this progression: between 2015 and 2016, internet access rose from 5 to 7 percent, with usage limited primarily to communication. By 2017 and 2018, access had reached 10 and 12 percent, respectively, with increasing educational use and early engagement in e-governance. The period from 2019 to 2020 saw significant growth, with access rising from 15 to 20 percent and broader use of mobile banking and educational apps, marking a shift toward digital financial inclu-

sion and expanded learning opportunities. In 2021 and 2022, internet access rose further to 25 and 28 percent, accompanied by greater reliance on e-learning, telemedicine, and small business activities, particularly in areas with limited healthcare and employment infrastructure. By 2023 and 2024, access grew to 30 percent and an estimated 35 percent, respectively, reflecting a deepening integration of digital tools into daily life as rural females increasingly used the internet for education, health services, and income-generating activities. These developments have had a transformative impact: women gained access to online educational resources that helped narrow the rural-urban educational gap, participated more fully in economic activities through mobile banking and small-scale digital entrepreneurship, and benefited from improved healthcare via telemedicine in underserved regions. These trends underscore several key implications. Policymakers must continue to expand rural digital infrastructure, ensure affordability, and strengthen digital literacy initiatives tailored to women's needs.

The rise in internet access also represents meaningful progress toward gender equality by enabling rural females to participate more actively in education, the economy, and healthcare services. From an economic perspective, growing digital engagement offers substantial potential to stimulate rural development through e-commerce, financial inclusion, and entrepreneurship. Overall, Table 2 demonstrates that the past decade has seen consistent progress in digital access for rural women in Bangladesh, opening pathways to education and economic independence. Yet challenges remain, particularly in infrastructure, affordability, and skill development. With continued commitment to expanding connectivity and digital literacy, rural women will be increasingly equipped to participate in and benefit from a rapidly digitizing society.

Table 2. Internet Access and Usage among Rural Females (2015-2024).

Year	% rural females with internet access	Primary use	Source
2015	5%	Social media communication	a. (UNDP, 2015)
2016	7%	Social media, education	b. (World Bank, 2016)
2017	10%	Social media, education	c. (BRAC, 2017)
2018	12%	Education, e-governance	d. (ICT Division, 2018)
2019	15%	Education, mobile banking	e. (ADB, 2019)
2020	20%	E-learning, mobile banking	f. (BRAC, 2020)
2021	25%	E-learning, telemedicine, business	g. (UNICEF, 2021)
2022	28%	E-learning, business, health	h. (ICT Division, 2022)
2023	30%	E-learning, telemedicine, business	i. (World Bank, 2023)
2024	35%	E-learning, business, telemedicine (estimated)	j. (ICT Division, 2024)

Table 3 examines the progression of digital literacy training programs for rural women in Bangladesh from 2015 to 2024, illustrating how these initiatives have expanded to reduce the digital divide and enable women to access information, education, and economic opportunities. Over the years, the number of trained women has steadily increased, driven by major NGOs such as BRAC, government-led ICT initiatives, and a growing number of private-sector partnerships. Access to digital literacy training improved significantly during this period. In the early years, from 2015 to 2017, training remained relatively limited and was primarily delivered by organizations such as BRAC, Grameen Foundation, and the Government ICT Division. By 2020, however, the combined influence of COVID-19 response measures and intensified digital literacy campaigns substantially expanded training access, reaching a much larger proportion of rural females and demonstrating the critical importance of digital inclusion during crises. From 2021 onward, partnerships with private

companies and e-learning platforms further strengthened outreach, enabling training programs to penetrate deeper into rural communities and enhance women's opportunities for skill development.

The long-term outlook for these training initiatives remains highly promising. With continued engagement from government bodies, NGOs, and private actors, the number of rural females receiving training is expected to rise steadily. Digital literacy programs are increasingly designed not only to provide basic skills but also to prepare women for employment and higher education, aligning with national priorities for digital transformation. By 2024, the number of women trained is projected to reach 150,000, signaling a sustained commitment to digital inclusion and human capital development. These programs play a pivotal role in empowering women by equipping them with the competencies needed to navigate the digital world and elevate their socioeconomic status. They support the government's broader "Digital Bangladesh" vision and strengthen rural women's participation in the labor market and higher education.

A year-by-year view of the training highlights this evolution. Between 2015 and 2017, training began with smaller groups, expanding from 10,000 participants in 2015 to 20,000 in 2017, laying the foundation for future development. The period from 2018 to 2020 saw rapid growth, with 50,000 women trained by 2020 as BRAC and government-led initiatives intensified their outreach in response to the pandemic, emphasizing the importance of digital skills for remote learning, work, and essential services. From 2021 to 2024, the scope of training expanded even further through collaborations between government agencies, NGOs, and private-sector partners. By 2021, training had reached 70,000 females, supported by eLearning platforms and corporate initiatives, and by 2024, this number is expected to rise to 150,000. During these years, training shifted from basic literacy toward more advanced skill development relevant to employment and education.

The objective of Table 3 is to showcase this upward trajectory in digital literacy training initiatives and to highlight the transition from small-scale programs to considerable, coordinated efforts involving multiple stakeholders. The table underscores the growing emphasis on preparing rural females for meaningful participation in the digital economy and equipping them with skills that support both personal development and professional advancement. The role of these training programs is multidimensional: they empower women by expanding access to information, communication, and digital tools; enhance economic participation through digital entrepreneurship, mobile banking, and remote work; improve educational access by enabling engagement in e-learning; and strengthen healthcare access through telemedicine and online health information. These developments carry significant implications. The training programs contribute to gender equality by helping rural women compete more effectively in the digital economy and support broader national economic growth by cultivating a digitally skilled rural workforce. Policymakers must continue investing in infrastructure, affordability, and literacy initiatives to ensure that all rural females, including those in remote areas, have access to these opportunities. While training access has improved, persistent inequalities in connectivity, digital infrastructure, and affordability highlight the continued need for targeted interventions to eliminate the remaining digital divide.

In conclusion, Table 3 demonstrates significant progress in digital literacy training for rural women in Bangladesh between 2015 and 2024. The expansion of these initiatives, supported by government agencies, NGOs, and private partners, has played a vital role in empowering rural women, enhancing their socioeconomic position, and narrowing the digital divide. Looking ahead, the future of these programs appears encouraging, particularly with the growing focus on skills for employment and education. Continued efforts to ensure equitable access to digital training and resources will be essential for maximizing their impact on women's empowerment and economic participation across rural Bangladesh.

Table 3. Digital Literary Training Programs for Rural Females (2015-2024).

Year	# of females trained	Key organization involved	Source
2015	10,000	BRAC, Grameen Foundation	a. (UNDP, 2015)
2016	15,000	BRAC, Grameen Bank	b. (World Bank, 2016)
2017	20,000	Govt. ICT division, NGOs	c. (BRAC, 2017)
2018	25,000	Digital Bangladesh initiatives	d. (ICT Division, 2018)
2019	35,000	BRAC, Govt. initiatives	e. (ADB, 2019)
2020	50,000	COVID-19 response, digital literary campaigns	f. (BRAC, 2020)
2021	70,000	E-learning platform, private sector partnership	g. (UNICEF, 2021)
2022	90,000	NGO led rural digital inclusion initiatives	h. (ICT Division, 2022)
2023	12,0000	Focus on skills for work and education	i. (World Bank, 2023)
2024	15,0000 (estimated)	Government and NGO programs.	j. (ICT Division, 2024)

Table 4 provides a detailed overview of the barriers that rural females in Bangladesh faced in accessing digital literacy training between 2015 and 2024, highlighting the persistent challenges that continue to limit digital inclusion. The table outlines a range of obstacles, from poor internet access and the high cost of devices to inadequate infrastructure and entrenched sociocultural norms. By presenting the percentage of females affected by each barrier each year, the table offers a dynamic view of how these challenges have evolved and underscores the need for targeted interventions. In the early period from 2015 to 2017, infrastructural and financial obstacles were the most dominant, with a lack of internet access affecting 80 percent of rural females and high device costs affecting 75 percent. The absence of digital literacy programs, affecting roughly 70 percent of participants, further contributed to early exclusion. Between 2018 and 2020, as the digital ecosystem expanded, new barriers emerged: cultural and gender norms affected 68 percent of women, the gendered division of labor affected 50 percent, and the COVID-19 pandemic introduced additional constraints, with 65 percent of respondents identifying it as a significant barrier. In the years from 2021 to 2024, some barriers began to diminish in severity as awareness increased and training programs expanded. However, issues such as device affordability, affecting 45 percent, and uneven internet coverage, estimated at 40 percent, remained substantial, particularly in remote rural areas.

Looking ahead, the most pressing barriers are expected to revolve around the continued gap in internet coverage and the affordability of digital devices. Although infrastructure has improved in several regions, remote areas still lack reliable connectivity, and the cost of devices remains prohibitive for many households. To sustain progress in digital inclusion, it will be crucial to expand rural internet infrastructure and improve the affordability and availability of digital devices. Digital literacy itself plays a crucial role in addressing many of the inequalities rural females face by enhancing their access to education, healthcare, and economic opportunities. Overcoming the barriers identified in the table is key to ensuring that rural women can participate in online learning, engage in e-commerce, access telemedicine services, and contribute more fully to the digital economy. The transformative potential of digital literacy extends far beyond basic skills, contributing to broader socioeconomic development and promoting gender equality in rural Bangladesh.

The year-by-year analysis in Table 4 further illustrates this progression. From 2015 to 2017, infrastructural issues dominated, with over 70 percent of rural females affected by limited internet access and high device costs. During 2018–2020, sociocultural norms emerged more strongly as barriers, interacting with the effects of the COVID-19 pandemic and counterbalancing the gains made in expanding internet access and training availability. From 2021 to 2024, although awareness and partic-

ipation in digital literacy programs increased, barriers related to affordability and internet coverage continued to restrict full access. The gradual decline in the percentage of females affected by certain barriers indicates progress, but the continuing presence of others highlights the uneven nature of digital inclusion.

The objective of Table 4 is to illustrate how these barriers have shifted over time and to highlight both areas of progress and those requiring sustained attention. By tracking changes in these obstacles, the table offers valuable guidance for policymakers, NGOs, and stakeholders working to promote digital inclusion. It stresses the importance of addressing sociocultural norms, improving infrastructure, and reducing device costs to ensure that rural females can fully benefit from digital literacy initiatives. The barriers identified play a significant role in shaping the outcomes of digital literacy programs. Infrastructure and access barriers limit women's ability to use digital tools; sociocultural norms restrict their freedom to participate; economic constraints hinder their ability to afford devices; and a lack of awareness reduces their motivation to engage with available programs. These barriers collectively influence the effectiveness and reach of digital literacy initiatives.

The implications of these findings are far-reaching. The persistence of these barriers underscores the ongoing gender digital divide and the need for targeted interventions to ensure that rural women can fully participate in the digital economy. Policy support from government, NGOs, and the private sector is essential to improving internet coverage, providing affordable devices, and raising awareness about digital literacy. Community-based efforts are needed to challenge sociocultural norms and encourage acceptance of women's engagement with technology. Ensuring long-term sustainability will require continued investment in training programs, infrastructure, and outreach, supported by both local and international partnerships.

In conclusion, Table 4 provides valuable insights into the barriers that have shaped rural women's digital literacy journey over the past decade. It shows that while progress has been made in some areas, significant challenges persist, particularly in terms of affordability and the digital divide. Addressing these challenges will be essential for empowering rural women and enabling their full participation in the digital economy. With improvements in infrastructure, greater affordability of devices, and targeted efforts to overcome sociocultural barriers, rural females in Bangladesh will be better positioned to benefit from digital literacy and contribute meaningfully to the country's digital transformation.

Table 4. Barrier to Digital Literacy among Rural Females (2015-2024)

Year	Barrier	% Affected	Source
2015	Lack of internet access	80%	a. (UNDP, 2015)
2016	High cost of the device	75%	b. (World Bank, 2016)
2017	Lack of digital literary programs	70%	c. (BRAC, 2017)
2018	Cultural and Gender Norms	68%	d. (ICT Division, 2018)
2019	Poor infrastructure	60%	e. (ADB, 2019)
2020	Impact of COVID-19	65%	f. (BRAC, 2020)
2021	Lack of awareness	55%	g. (UNICEF, 2021)
2022	Gender division of labor	50%	h. (ICT Division, 2022)
2023	Affordability of the device	45%	i. (World Bank, 2023)
2024	Gap in internet coverage	40%(estimated)	j. (ICT Division, 2024)

Table 5 presents an analysis of the impact of digital literacy on the education of rural females in Bangladesh from 2015 to 2024, detailing the percentage of women using digital tools for learning, the outcomes associated with their use, and the organizations supporting these initiatives. The table highlights the growing integration of digital technologies into rural education, particularly through e-learning platforms, mobile applications, and digital governance programs. The increased

importance of digital tools became especially evident during the COVID-19 pandemic, when online learning emerged as a critical mechanism for maintaining educational continuity. Over the decade, a gradual but substantial rise in the use of digital tools for education is observed. Between 2015 and 2017, digital engagement was limited, with only 2 percent of rural females using e-learning tools in 2015 and 6 percent by 2017 as educational campaigns and early e-governance programs began to expand. The most notable shift occurred between 2018 and 2020, when the percentage increased from 12 percent to 18 percent due to the pandemic-driven push toward online learning. From 2021 to 2024, usage continued to climb, reaching 22 percent in 2021 and projected to reach 40 percent by 2024 as e-learning platforms expanded, mobile learning apps became more accessible, and ICT integration in rural schools deepened. These developments significantly enhanced educational access and quality, enabling rural females to learn beyond traditional classroom environments and access materials previously unavailable in their communities.

Despite these advances, several barriers continue to restrict the full potential of digital education in rural areas. Limited access to devices such as smartphones, tablets, and computers, along with unreliable internet connectivity, remain major challenges. While digital literacy levels have improved, many rural women still lack the foundational skills needed to utilize digital tools fully. Sociocultural norms also continue to shape women's engagement with digital learning; early marriage, domestic responsibilities, and traditional expectations often constrain their ability to participate. Looking forward, the future of digital literacy in rural education appears promising, though it will require targeted efforts to expand infrastructure, improve affordability, and address persistent cultural barriers. With continued investments in digital connectivity, device availability, and training programs, the percentage of rural females using digital tools for education is expected to reach 40 percent by 2024. The long-term success of digital education initiatives in rural Bangladesh ultimately depends on expanding internet access, reducing costs, and ensuring that families and communities support female engagement with digital learning platforms.

The role of digital literacy in rural education is increasingly significant. It enables rural females to access diverse learning materials, participate in online classes, and benefit from educational opportunities beyond their geographical limitations. The rise of mobile learning apps and e-learning platforms has allowed many women to overcome traditional barriers to education, offering new avenues for skills development and greater agency in shaping their educational and professional paths. Year-to-year trends reflect steady progress: slow foundational growth from 2015 to 2017, accelerated adoption during the pandemic years of 2018 to 2020, and continued expansion from 2021 to 2024, driven by broader ICT integration. The objective of Table 5 is to demonstrate this progression, highlight how digital tools have contributed to improved educational outcomes for rural females, and identify areas where support is still required. Digital tools serve not only as alternative learning mechanisms in areas with weak educational infrastructure but also as instruments of empowerment by narrowing the educational gap between rural and urban learners and expanding future possibilities for women.

The implications of the data are far-reaching. Continued development of digital infrastructure is essential to sustain the growth of digital education, particularly in ensuring reliable internet access and affordable devices. Expanding digital literacy initiatives is equally important to help rural women make the most of available digital learning opportunities. Educational policies must be inclusive and responsive to sociocultural barriers that restrict female participation in digital programs. Long-term sustainability will require ongoing investments in teacher training, curriculum development, and digital education planning. In conclusion, Table 5 highlights the increasing influence of digital literacy on rural female education in Bangladesh, demonstrating substantial progress in digital adoption while revealing persistent challenges that must be addressed. With coordinated efforts to expand infrastructure, improve affordability, and enhance digital skills training, digital literacy can continue to empower rural women and contribute significantly to gender equality and broader educational and social development goals.

Table 5. Impact of Digital Literacy on Education among Rural Females (2015-2024).

Year	% using digital tools for education	Key outcomes	Source
2015	2%	Minimum E-Learning, Limited tools	a. (UNDP, 2015)
2016	4%	Initiatives of Educational campaigns	b. (World Bank, 2016)
2017	6%	Introduction of the E-Governance program	c. (BRAC, 2017)
2018	8%	Gradual shift to digital platforms	d. (ICT Division, 2018)
2019	12%	Plot E-Learning projects	e. (ADB, 2019)
2020	18%	COVID-19 led to digital learning	f. (BRAC, 2020)
2021	22%	Expansion of E-Learning platforms	g. (UNICEF, 2021)
2022	28%	Use of mobile learning Apps	h. (ICT Division, 2022)
2023	35%	Integration of ICT into rural schools	i. (World Bank, 2023)
2024	40% (estimated)	Increased access to E Learning programs	j. (ICT Division, 2024)

3.1. Key Findings

The findings of this study reveal a significant yet uneven progression in digital literacy, educational participation, and technology-driven empowerment among rural females in Bangladesh between 2015 and 2024. Across all datasets, a clear upward trend emerges: more rural females are using digital tools for learning, gaining access to mobile technologies, and participating in digital literacy programs. However, these improvements remain constrained by structural, economic, and sociocultural barriers that continue to limit full educational equity.

A central challenge throughout the decade has been access to technology. High device costs and inadequate internet coverage remain persistent barriers, with an estimated 40 percent of rural females still experiencing connectivity issues in 2024. Sociocultural norms further restrict digital engagement as many women continue to face gendered expectations and domestic responsibilities that limit both access to and use of digital tools. The COVID-19 pandemic exposed the fragility of rural digital infrastructure, resulting in interrupted or insufficient digital learning for many girls due to poor connectivity and limited device availability. Despite these constraints, initiatives led by BRAC, UNICEF, and government partners contributed to gradual increases in digital literacy, particularly during the pandemic when demand for online learning accelerated.

The use of digital tools for education has grown consistently over the decade. From only 2 percent of rural females using digital tools in 2015, digital engagement rose to 18 percent by 2020 and is projected to reach 40 percent by 2024. E-learning platforms, mobile learning applications, and ICT integration into rural schools have played a transformative role, enabling rural females to access educational materials beyond the limitations of local classroom environments. Nevertheless, many women still lack foundational digital skills, and the most marginalized communities continue to face the widest gaps in digital engagement.

Digital literacy has also emerged as a powerful avenue for educational empowerment. It enables rural females to access online courses, self-directed learning opportunities, and high-impact resources that strengthen both academic and vocational skills. During the pandemic, digital literacy became essential for maintaining educational continuity and reducing the risk of learning loss. Beyond formal education, digital skills have opened new pathways in entrepreneurship, online marketing, and remote work, contributing meaningfully to socioeconomic mobility and gender equality.

Looking ahead, projected trends indicate continued growth in digital tool use among rural females. However, full digital inclusion will require long-term investments in infrastructure, affordable device programs, and gender-responsive policy interventions. To bridge the digital divide, strategies must address persistent social norms, improve rural internet connectivity, reduce device costs, and expand digital training programs. Strengthening school-level ICT integration, improving teach-

er training, and ensuring supportive learning environments will be essential for sustaining growth in rural digital education.

Overall, the study underscores that digital literacy has become a critical driver of educational opportunity and empowerment for rural females in Bangladesh. Substantial progress has been made, but targeted, sustained interventions remain necessary to ensure that all rural females can benefit from the digital transformation shaping the country's educational and economic landscape.

4. Discussion

The findings of this study provide valuable insights into the evolution of digital literacy among rural females in Bangladesh from 2015 to 2024, emphasizing both progress and persistent barriers. The upward trend in digital tool usage is consistent with Islam and Islam (2023), who documented a nationwide shift toward e-learning during the COVID-19 pandemic. The transformative impact of mobile learning apps observed in this study aligns with Sultana et al. (2018) and Haque et al. (2023), who found that digital resources significantly improved rural women's access to educational materials. However, the challenges related to foundational digital skills echo Aziz and Naima (2021), who noted that low digital and financial literacy limit the effectiveness of digital services in rural Bangladesh.

Over the years, a marked increase in digital literacy training programs can be observed, with key organizations such as BRAC, the ICT Division, and other NGOs playing a pivotal role in this shift. From 2015 to 2024, the number of women participating in digital literacy initiatives grew substantially, suggesting a positive trend towards closing the gender digital divide. Government and non-governmental efforts were critical in reaching larger rural populations, especially in the years following the COVID-19 pandemic, which accelerated the transition to digital education. The persistence of infrastructural and socioeconomic barriers in this study aligns with findings by Alam et al. (2023) and Rahman and Parvin (2024), who similarly observed that limited connectivity, device scarcity, and gendered constraints continue to hinder rural women's digital participation. These results also reaffirm Siddiquee and Islam's (2024) argument that structural inequalities remain the strongest predictors of digital exclusion in rural Bangladesh.

Despite these advances, the study highlights the ongoing challenges in achieving universal digital literacy in rural areas. The study's data reveal that, while the percentage of rural women with access to digital tools has risen, barriers such as internet access, device affordability, and cultural norms continue to affect women's full participation in these initiatives. The empowerment outcomes reported by participants support the findings of Rahman et al. (2023), who showed that mobile phone use enhances women's entrepreneurial capabilities and financial decision-making. This study also aligns with Roy et al. (2024), who noted that mobile financial services can shift women's socioeconomic roles by expanding income opportunities. Additionally, the emergence of self-directed learning aligns with Tasnima et al. (2024), who highlighted digital literacy's role in strengthening women's agency and personal development.The affordability of devices and limited internet coverage remain the most pressing issues, with affordability decreasing in importance over time but still present in 2024. The persistence of cultural and gender norms further complicates access to digital education, as traditional roles often limit women's engagement with technology, especially in rural areas. Access-related constraints identified in this study mirror the findings of Emon and Nipa (2024), who emphasized that low income and limited education reduce women's engagement with ICT. The cultural restrictions reported by participants also align with Haque et al. (2023), who noted that gender norms and household responsibilities often prevent rural women from attending digital training. Similarly, Ullah (2017) and Amin (2024) highlighted that government initiatives frequently fail to reach marginalized rural women because infrastructural weaknesses and low awareness remain unaddressed.

The methodological approach of combining quantitative data with reports from international organizations and primary data enabled a comprehensive understanding of the issue. This study effectively tracked changes over time, providing a nuanced view of the interplay among digital tool

availability, training efforts, and the socioeconomic and cultural barriers rural women face. Digital literacy is not just a tool for education but a means of empowering women in various aspects of life, including healthcare, financial independence, and broader societal participation. However, while the training programs have made a significant impact, their full potential is still hindered by the lack of reliable infrastructure and the high costs associated with accessing digital resources.

Furthermore, the study underscores the critical role that digital literacy plays in improving educational outcomes for rural women. As the findings show, digital literacy facilitates greater engagement with educational tools, especially during the COVID-19 pandemic, when many educational institutions moved to online platforms. This shift led to increased use of digital tools in education, with rural females benefiting from the introduction of e-learning programs, mobile apps, and ICT integration in schools. However, the growth of digital education is uneven, with rural areas still lagging behind urban centers in access and infrastructure.

The uneven performance of Digital Bangladesh observed in this study parallels the mixed evaluations by Hoque et al. (2022) and Hossain et al. (2023), who argued that while national ICT expansion has made progress, rural infrastructure remains insufficient. The greater effectiveness of NGO-led training, as evidenced in our data, supports Islam's (2017) observation that NGOs often provide more accessible and culturally appropriate digital literacy support than government centers. Similar to Amin (2024), our findings underscore the need for stronger policy coordination and targeted intervention for the most disadvantaged women.

The implications of these findings are significant for policy and intervention strategies moving forward. While digital literacy programs have proven effective, sustained efforts are needed to address the remaining barriers. In particular, the affordability of digital devices and internet access must be prioritized, along with tackling cultural barriers that inhibit women's engagement with technology. Policies focused on improving infrastructure and subsidizing devices could be instrumental in bridging the digital divide. Moreover, continued support for training programs, particularly those that integrate gender-sensitive approaches, will be essential for ensuring that rural females can fully participate in the digital economy and education.

The link between these findings and the broader discussion on gender equality in education is clear. The ability of rural women to access and utilize digital tools directly impacts their educational attainment, employability, and overall empowerment. The study highlights the importance of digital literacy not only as an educational tool but as a broader mechanism for social change. By reducing barriers to access, particularly in the most underserved rural areas, digital literacy can play a transformative role in enhancing the socioeconomic position of rural women and advancing gender equality.

Ultimately, while substantial progress has been made, further efforts are needed to ensure that rural females can fully leverage the benefits of digital literacy. The convergence of improved access to digital tools, enhanced training programs, and supportive policies will be key to achieving this goal. The findings of this study suggest that a multifaceted approach that addresses both infrastructure and sociocultural challenges is essential for fostering an inclusive digital future for rural women in Bangladesh.

The study has several limitations that should be acknowledged. Its geographical focus on Sherpur Sadar Upazila limits the generalizability of the findings to other rural regions of Bangladesh, and although the sample includes participants from varied backgrounds, it may not fully reflect the broader experiences of rural women across different districts and socioeconomic groups. The reliance on self-reported survey and interview data also introduces the possibility of response bias, while the study's timeframe, covering 2015 to 2024, limits the assessment of the long-term impacts of digital literacy initiatives.

Overall, the findings reinforce broader arguments in the literature that digital inclusion is shaped by intersecting structural, cultural, and socioeconomic factors (Khan et al., 2024; Karmaker & Rahman, 2024). This study extends the work of Al-Amin et al. (2024) by showing that digital literacy programs are most effective when paired with infrastructure support and gender-sensitive training models. Taken together, the results demonstrate that meaningful empowerment requires not only

access to technology but also supportive social environments, sustained institutional investment, and inclusive policy design.

Furthermore, the unavailability or outdated nature of some official datasets on rural digital infrastructure constrained the scope of comparative analyses. Nevertheless, individual comments gathered during the research offer valuable insights into emerging trends. Participants consistently emphasized that rural women are increasingly using smartphones and digital platforms to access educational resources despite infrastructural constraints, and noted that community-based training programs have enabled them to acquire digital skills previously beyond reach. Others highlighted how online learning tools have opened vocational and academic opportunities outside their immediate environment, and how rural females demonstrate resilience and adaptability even when facing financial or cultural barriers. Several respondents also underscored the importance of collaborative efforts between local authorities and educational institutions, which are helping rural women narrow the digital divide and improve educational outcomes.

5. Conclusion

In conclusion, this study's findings indicate a substantial increase in digital literacy among rural females in Bangladesh, with key improvements in internet access, digital training, and the educational applications of digital tools. Despite these advancements, barriers such as limited internet coverage, device affordability, and cultural norms remain significant obstacles that hinder the full utilization of digital technologies. The steady growth in digital literacy programs, spearheaded by both government and non-governmental initiatives, has enabled rural females to engage more in e-learning and business. However, challenges persist in achieving universal access.

This study also highlights the growing role of digital technologies in education, with rural females increasingly integrating mobile learning apps and e-learning platforms into their daily lives. However, the results suggest that to realize the potential of these technologies fully, further efforts are needed to overcome infrastructural barriers, particularly in affordable internet access and digital tools.

As we look to the future, it is clear that policy interventions and infrastructure development are crucial to ensure sustained progress. The implications of these findings are far-reaching, with the potential for digital literacy programs to contribute to gender equality, socioeconomic empowerment, and broader national development goals. Future research should focus on refining these interventions, exploring the impact of digital literacy on employment, and assessing the long-term sustainability of these initiatives in rural areas. In sum, while there has been significant progress, continued focus on overcoming the digital divide is necessary to ensure that rural females in Bangladesh can fully benefit from the opportunities digital technologies offer, ultimately contributing to their empowerment and advancing educational and economic equality.

This study underscores the transformative potential of digital literacy to enhance the education and empowerment of rural women in Bangladesh. While significant progress has been made in increasing digital tool usage, challenges related to access, affordability, and sociocultural barriers remain. As digital literacy continues to expand, targeted interventions must address these barriers to ensure that all rural females can fully benefit from digital education. By addressing these challenges, digital literacy can serve as a powerful tool to bridge the gender gap in education and foster long-term social and economic development in rural Bangladesh.

Author contributions: The authors confirm that they meet all authorship criteria. Specifically, the author made substantial contributions to the conception, design, data acquisition, analysis, and interpretation of the work. Additionally, the author drafted the manuscript, critically revised it for intellectual content, approved the final version for publication, and is accountable for ensuring the accuracy and integrity of the entire work.

Data Availability Statement: The datasets generated for this study can be found in the Figshare, https://doi.org/10.6084/m9.figshare.28045046

Funding Statement: This research received no specific grant from funding agencies in the public, commercial, or not-for-profit sectors. However, it was supported by the ProSafeNet (https://prosafenet.com/) through access to resources, expert guidance, and institutional collaboration.

Competing Interest Statement: The authors declare that there are no competing interests related to this work.

6. References

1. ADB (2019). Gender and digital literacy in rural schools.
2. ADB (2019). ICT and women's empowerment in Bangladesh.
3. ADB (2019). ICT for rural women: Barriers and opportunities.
4. ADB (2020). Asian development outlook 2020: Technology and the future of work. Asian Development Bank;
5. Ahmed, N., Sinha, A., Saha, A., Rony, R. J., Khan, S. S., Abeer, I. A., & Hasan, M. (2022, December). Structured training as an enabler for women in ICT: A case study from Bangladesh. *In 2022 IEEE International Conference on Teaching, Assessment and Learning for Engineering (TALE)* (pp. 120-124). IEEE. https://doi.org/10.1109/TALE54877.2022.00027
6. Akter, M., & Husain, T. (2021). The impact of the Union Digital Centre on women's empowerment: An assessment of the Union Digital Center on women's empowerment in rural areas of Bangladesh. *Dynamics of Public Administration*, 38(2), 188-197. https://doi.org/10.5958/0976-0733.2021.00014.6
7. Akter, R., Roy, T., & Aktar, R. (2023). The Challenges of Women in Post-disaster Health Management: A Study in Khulna District. International Journal of Disaster Risk Management, 5(1), 51–66. https://doi.org/10.18485/ijdrm.2023.5.1.5
8. Akter, S. (2024). Digitalization of education in rural schools: A study of access, utilization, and impact toward digitalization in Bangladesh. *American International Journal of Multidisciplinary Scientific Research*, 15(1), 1-9. https://doi.org/10.46281/aijmsr.v15i1.2205
9. Alam, M. J., Pervez, A. K. M., Kabir, M. S., Amin, M. R., & Bhuiya, R. A. (2023). The challenges and prospects of e-learning in higher education in Bangladesh: A review. *Asian Journal of Education and Social Studies*, 43(1), 10-19. https://doi.org/10.9734/ajess/2023/v43i1931
10. Al-Amin, S. Y. E. E. D. U. L., Rony, A. K., & Rahman, S. S. (2024). Impact of women entrepreneurship on digital entrepreneurship: A focus on women's participation in Bangladesh. *Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)*, 43(10), 137-150. https://doi.org/10.5281/zenodo.13969563
11. Amin, S., & UN.ESCAP. (2024). Critical analysis of ICT connectivity in rural Bangladesh: Importance, constraints, and the way forward. *United Nations Economic and Social Commission for Asia and the Pacific*. https://hdl.handle.net/20.500.12870/7510
12. Ateş, Ö., Bayram, G. E., & Bayram, A. T. (2025). The impact of digital tools on the economic empowerment of rural women. In Empowering Women Through Rural Sustainable Development and Entrepreneurship. *IGI Global Scientific Publishing.* (pp. 309-324).x. https://doi.org/10.4018/979-8-3693-6572-4.ch016
13. Awaghade, A. B. (2022). Online education: issues and challenges in digital equality. *International Journal of Human Rights and Constitutional Studies*, 9(4), 369-380. https://doi.org/10.1504/IJHRCS.2022.126183
14. Aziz, A., & Naima, U. (2021). Rethinking digital financial inclusion: Evidence from Bangladesh. *Technology in Society*, 64, 101509. https://doi.org/10.1016/j.techsoc.2020.101509
15. BD Govt. National ICT policy (2017). Government of Bangladesh; United Nations Development Programme.

16. Beli, A., Renner, R., Cvetković, V. M., Ivanov, A., & Gačić, J. (2025). A Cross-National Study of Disaster Risk Management: Strengths and Weaknesses in Bulgaria, Romania, and Albania with Reflections on Serbia. International Journal of Disaster Risk Management, 7(1), 431–460. https://doi.org/10.18485/ijdrm.2025.7.1.25
17. Bhuiyan, M. I. U., & Mollik, M. M. (2023). Leveraging technology to enhance quality education in primary schools: Opportunities and challenges in Bangladesh. In Global Perspectives on Value Education in Primary School (pp. 35-57). https://doi.org/10.4018/978-1-6684-9295-6.ch003
18. BRAC. (2017). Barriers to ICT access in rural Bangladesh.
19. BRAC. (2017). ICT in education: Empowering rural girls in Bangladesh.
20. BRAC. (2017). Women and technology: Bridging the digital divide in rural Bangladesh.
21. BRAC. (2019). Empowering rural women through technology. BRAC; Asian Development Bank
22. BRAC. (2020). COVID-19 and the rural digital divide.
23. BRAC. (2020). Digital inclusion for rural women in Bangladesh.
24. BRAC. (2020). Technology for learning: Empowering rural women in education.
25. BRAC. (2022). Digital literacy programs for women in rural Bangladesh. BRAC;
26. Cvetković, V. & Šišović, V. (2024). Capacity Building in Serbia for Disaster and Climate Risk Education. Disaster and Climate Risk Education Insights from Knowledge to Action, edited by Ayse Yildiz and Rajib Shaw, book series Disaster Risk Reduction, Springer Nature Singapore Pte Ltd., 152 Beach Road.
27. Cvetković, V. (2016). The relationship between educational level and citizen preparedness for responding to natural disasters. Journal of the Geographical Institute "Jovan Cvijić" SASA, 66(2), 237–253.
28. Cvetković, V. M. (2023). A Predictive Model of Community Disaster Resilience based on Social Identity Influences (MODERSI). International Journal of Disaster Risk Management, 5(2), 57–80. https://doi.org/10.18485/ijdrm.2023.5.2.5
29. Cvetković, V., & Katarina, A. (2019). Edukacija građana o smanjenju rizika od katastrofa korišćenjem multimedijalnih sadržaja – društvene igre, kompjuterske igrice i simulacije [Citizen education for disaster risk reduction using multimedia content – board games, computer games and simulations]. Vojno delo, 71(6), 122–151.
30. Cvetković, V., & Svrdlin, M. (2020). Vulnerability of women to the consequences of naturally caused disasters: the Svilajnac case study [Ugroženost žena od posledica prirodno izazvanih katastrofa]. Bezbednost, 62(3), 43–61.
31. Cvetković, V., Tarolli, P., Roder, G., Ivanov, A., Ronan, K., Öcal, A., & Kutub, R. (2017). Citizens education about floods: A Serbian case study. 7th International Scientific Conference "Archibald Reiss Days", Academy of Criminalistics and Police Studies, Belgrade.
32. Dada, K. S. J., Mohammed, H. A., Mallam, D., & Ajayi, E. O. (2025). Security of information resources in Federal College of Education libraries in Northwest Nigeria. International Journal of Contemporary Security Studies, 1(1), 85–98. https://doi.org/10.18485/fb_ijcss.2025.1.1.7
33. Domingo Dela Cruz, R. ., & Ormilla, R. C. G. (2022). Disaster Risk Reduction Management Implementation in the Public Elementary Schools of the Department of Education, Philippines. International Journal of Disaster Risk Management, 4(2), 1–15. https://doi.org/10.18485/ijdrm.2022.4.2.1
34. Emon, M. H., & Nipa, M. N. (2024). Exploring the gender dimension in entrepreneurship development: A systematic literature review in the context of Bangladesh. *Westcliff International Journal of Applied Research*, 8(1), 34-49. https://doi.org/10.47670/wuwijar202481mhemnn
35. Farley, I. A., & Burbules, N. C. (2022). Online education viewed through an equity lens: Promoting engagement and success for all learners. *Review of Education*, 10(3), e3367. https://doi.org/10.1002/rev3.3367

36. Gajović, A., Cvetković, V. M., Renner, R., & Milašinović, S. (2025). Digital Platform for Ecological Education of Students – Advancing the United Nations Sustainable Development Goals and the European Green Deal: The Case of ProSafeNet (Global Hub). International Journal of Contemporary Security Studies, 1 (2).
37. Goswami, T., & Ahmad, A. (2025). Integrating Disability into Disaster Management Education in India: A Critical Review. International Journal of Disaster Risk Management, 7(1), 163–176. https://doi.org/10.18485/ijdrm.2025.7.1.9
38. Haque, A., Haque, W., Ahmed, E., Islam, M. Z., & Islam, M. K. (2023). Empowering women through IT: The role of the IT sector in Bangladesh. *Saudi Journal of Economics and Finance*, 7(10), 459-465. https://doi.org/10.36348/sjef.2023.v07i10.005
39. Hoque, M. R., Sorwar, G., & Hossain, M. U. (2022). Sustainable rural development through union digital center: The citizen empowerment perspective. *55th Hawaii International Conference on System Sciences | 2022*, 2732-2741. http://hdl.handle.net/10125/79672
40. Hoque, S. M. S., & Kabir, M. A. A. (2024). Assessing ICT and e-government service through UDC in Bangladesh: Rural dwellers' economic benefits. *Electronic Government, an International Journal*, 20(2), 161-174. https://doi.org/10.1504/EG.2023.10046454
41. Hossain, B., Fatima, M. J., Muzykant, V. L., Hoesin, C. F. I. S., & Nahiduzzaman, M. (2023). An overview of digital media literacy in digital Bangladesh. *Jurnal Cita Hukum*, 11(2), 267-288. https://doi.org/10.15408/jch.v11i2.34755
42. Hussain, B. M., & Chen, D. (2018, August). Information & communication technology (ICT) can change the way of women entrepreneurs run their businesses: A case study in Bangladesh. *In 2018 Portland International Conference on Management of Engineering and Technology (PICMET)* (pp. 1-6). IEEE. https://doi.org/10.23919/PICMET.2018.8481852
43. ICT Division. (2018). Challenges in rural connectivity and women's ICT use.
44. ICT Division. (2018). Digital Bangladesh Vision 2021.
45. ICT Division. (2018). The role of technology in enhancing rural education.
46. ICT Division. (2021). Digital Bangladesh 2021 report. Ministry of Posts, Telecommunications, and Information Technology, Bangladesh;
47. ICT Division. (2022). Bringing digital education to rural Bangladesh.
48. ICT Division. (2022). Connecting the unconnected: Internet access in rural Bangladesh.
49. ICT Division. (2022). Overcoming connectivity gaps in rural areas.
50. ICT Division. (2024). Digital literacy and its impact on education in rural Bangladesh.
51. ICT Division. (2024). National connectivity and digital literacy survey 2024.
52. ICT Division. (2024). National ICT development strategy for 2024. Ministry of Posts, Telecommunications, and Information Technology, Bangladesh.
53. ICT Division. (2024). Overcoming barriers in rural digital literacy in Bangladesh.
54. Islam, K. A., & Khan, M. S. (2024). The role of financial literacy, digital literacy, and financial self-efficacy in fintech adoption. *Investment Management and Financial Innovations*, 21(2), 369-380. https://doi.org/10.21511/imfi.21(2).2024.30
55. Islam, M. M., & Islam, M. M. (2023). E-learning in Bangladesh: Challenges and overcoming strategies. *Journal of the National Academy for Planning and Development (NAPD)*, 32(1), 79-100.
56. Islam, M. N., & Inan, T. T. (2021). Exploring the fundamental factors of digital inequality in Bangladesh. *Sage Open*, 11(2), 21582440211021407. https://doi.org/10.1177/21582440211021407
57. Islam, M. R. (2017). Non-governmental organizations and community development in Bangladesh. *International Social Work*, 60(2), 479-493. https://doi.org/10.1177/0020872815574133
58. Islam, M. R., & Mostafiz, F. (2024). Impact of soft skills training on rural women's development in Bangladesh: A mixed-method approach. *BUFT Journal of Business & Economics (BJBE)*, 5, 223-245. https://doi.org/10.58481/BJBE/2415
59. Ivanov, A., & Cvetković, V. (2014). The Role of Education in Natural Disaster Risk Reduction. Horizons, International Scientific Journal, 16, 115–131.

60. Jakovljević, V., Cvetković, V., & Gačić, J. (2015). Prirodne katastrofe i obrazovanje [Natural Disasters and Education]. Beograd: Fakultet bezbednosti, Univerzitet u Beogradu.
61. Jevtić, M., Cvetković, V. M., Gačić, J., & Raonić, Z. (2025). Factors of Vulnerability and Resilience of Persons with Disabilities During Disasters: Challenges and Strategies for Inclusive Risk Reduction. International Journal of Disaster Risk Management, 7(1), 91–114. https://doi.org/10.18485/ijdrm.2025.7.1.6
62. Karmaker, R., & Lemon, M. H. A. (2024). Female students, dropping out of education. *Indonesian Journal of Multidiciplinary Research*, *4*(1), 77-88.
63. Karmaker, R., & Lemon, M. H. A. (2024). Female students, dropping out of education. Indonesian Journal of Multidisciplinary Research, 4(1), 77–88.
64. Karmaker, R., & Rahman, R. (2024). Female having education in the world of technology wading obstacle facing religious and social barrier. *ASEAN Journal of Religion, Education, and Society*, 3(1), 23-36. https://doi.org/10.13140/RG.2.2.35051.11046
65. Karmaker, R., & Rahman, R. (2024). Female having education in the world of technology wading obstacle facing religious and social barrier. ASEAN Journal of Religion, Education, and Society, 3(1), 23–36. https://doi.org/10.13140/RG.2.2.35051.11046
66. Khan, A. S. N., Mansur, M., Pamela, K. S., & Promy, N. K. (2024). Women business moving beyond development enigma. *Journal of Global Entrepreneurship Research*, 14(1), 5. https://doi.org/10.1007/s40497-023-00374-0
67. Khatun, F., Heywood, A. E., Hanifi, S. M. A., Rahman, M. S., Ray, P. K., Liaw, S. T., & Bhuiya, A. (2017). Gender differentials in readiness and use of mHealth services in a rural area of Bangladesh. *BMC Health Services Research*, 17, 1-11. https://doi.org/10.1186/s12913-017-2523-6
68. Khatun, F., Saadat, S. Y., & Islam, M. J. (2021). Digital platform economy in Bangladesh: Opportunities and challenges. *CPD Report 11, Centre for Policy Dialogue (CPD).*
69. Kutub, J. R., Cvetković, V. M., & Huq, S. (2017). Assessment of women's vulnerability and their coping mechanism living in flood prone areas: A case study of Belkuchi Upazila, Sirajganj. Serbian Science Today, 2(1), 35–43.
70. Mančić, T. (2025). Climate change as a security challenge, risk and threat of the 21st century and its consequences on critical infrastructure. International Journal of Contemporary Security Studies, 1(1), 191–204. https://doi.org/10.18485/fb_ijcss.2025.1.1.14
71. Milenković, D. (2025). Theoretical, institutional and organizational aspects of the integrated disaster risk reduction system: Towards a deeper understanding of disaster resilience in Serbia. International Journal of Contemporary Security Studies, 1(1), 175–190. https://doi.org/10.18485/fb_ijcss.2025.1.1.13
72. Milenković, D. ., Cvetković, V. M., & Renner, R. (2024). A Systematic Literary Review on Community Resilience Indicators: Adaptation and Application of the BRIC Method for Measuring Disasters Resilience . International Journal of Disaster Risk Management, 6(2), 79–104. https://doi.org/10.18485/ijdrm.2024.6.2.6
73. Nikey, R. (2024). Digital landscape and women entrepreneurship development in Bangladesh *(Doctoral dissertation, Brac University)*. http://hdl.handle.net/10361/24750
74. Noor, S., & Hoque, M. (2021). Access to mobile phones and women's socio-economic empowerment in rural areas of Bangladesh: Understanding gender relation transformation. *Indonesian Journal of Social Research (IJSR)*, 3(1), 1-16. https://doi.org/10.30997/ijsr.v2i3.105
75. Onimisi, T. (2025). Improved security and education: Pathways to national development. International Journal of Contemporary Security Studies, 1(1), 205–212. https://doi.org/10.18485/fb_ijcss.2025.1.1.15
76. Perić, J., & Cvetković, V. M. (2019). Demographic, socio-economic and phycological perspective of risk perception from disasters caused by floods: case study Belgrade. International Journal of Disaster Risk Management, 1(2), 31–45. https://doi.org/10.18485/ijdrm.2019.1.2.3

77. Popović, M., & Cvetković, V. (2012). Žene u mirovnim operacijama i odlučivanju u sektoru bezbednosti [Women in peacekeeping operations and decision-making in the security sector]. Kultura – Polis, 1(1), 201–214.
78. Rahman, M. A., & Parvin, R. A. (2024). Advancing Bangladesh's digital transition: From digital foundations to technological leadership. *Technological Innovation and Emerging Operational Applications in Digital Earth,* https://doi.org/10.20944/preprints202410.0441.v1
79. Rahman, M. S., Haque, M. E., Afrad, M. S. I., Hasan, S. S., & Rahman, M. A. (2023). Impact of mobile phone usage on empowerment of rural women entrepreneurs: Evidence from rural Bangladesh. *Heliyon*, 9(11). https://doi.org/10.1016/j.heliyon.2023.e21604
80. Rana, M., & Rahman, A. (2022). Attitude of citizens towards e-government services in digital Bangladesh. *Dhaka University Journal of Management*, 161-189. https://doi.org/10.57240/DUJM-JUNE11
81. Rashid, A. T. (2016). Digital inclusion and social inequality: Gender differences in ICT access and use in five developing countries. *Gender, Technology and Development*, 20(3), 306-332. https://doi.org/10.1177/0971852416660651
82. Renner, R., & Mayr-Veselinovic, C. (2025). Social License to Operate: Where Are You? The Role of Risk Communication in Raw Material Extraction. International Journal of Contemporary Security Studies, 1(1), 49–74. https://doi.org/10.18485/fb_ijcss.2025.1.1.5
83. Sarker, A. (2020). ICT for women's empowerment in rural Bangladesh *(Doctoral dissertation, Monash University).*
84. Siddiquee, M. S. H., & Islam, M. S. (2024). Factors determining the first and second level of digital divide in rural Bangladesh. *SN Social Sciences*, 4(10), 189. https://doi.org/10.1007/s43545-024-00988-5
85. Sudar, S., Cvetković, V. M., & Ivanov, A. (2024). Harmonization of Soft Power and Institutional Skills: Montenegro's Path to Accession to the European Union in the Environmental Sector . International Journal of Disaster Risk Management, 6(1), 41–74. https://doi.org/10.18485/ijdrm.2024.6.1.4
86. Sultana, S., Guimbretière, F., Sengers, P., & Dell, N. (2018, April). Design within a patriarchal society: Opportunities and challenges in designing for rural women in Bangladesh. *In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems* (pp. 1-13). https://doi.org/10.1145/3173574.3174110
87. Sultana, S., Mandel, I., Hasan, S., Alam, S. R., Mahmud, K. R., Sultana, Z., & Ahmed, S. I. (2021, June). Opaque obstacles: The role of stigma, rumor, and superstition in limiting women's access to computing in rural Bangladesh. *In Proceedings of the 4th ACM SIGCAS Conference on Computing and Sustainable Societies* (pp. 243-260). https://doi.org/10.1145/3460112.3471960
88. Tasnima, T., Abu Bakar Ah, S. H., Padzil, R., & Md Syed, M. A. (2024). It's a men's world: Influence of media literacy for women's empowerment through social media engagement in Bangladesh. *Information Development*. https://doi.org/10.1177/02666669241303723
89. Ullah, M. S. (2017). Empowerment of the rural poor through access to ICT: A case study of the union information and service center initiative in Bangladesh. *Journal of Creative Communications*, 12(2), 81-97. https://doi.org/10.1177/0973258617708366
90. Ullah, M. S. (2020). ICTs, power prejudice, and empowerment: Digital exclusion of the poor in rural Bangladesh. *In Digital Inequalities in the Global South* (pp. 103-133). https://doi.org/10.1007/978-3-030-32706-4_6
91. UNDP (2018). Human development report 2018: Digital transformation in Bangladesh. United Nations Development Programme.
92. UNDP. (2015). Gender, ICT, and development: Challenges for rural women.
93. UNDP. (2015). Impact of technology on education in rural Bangladesh.
94. UNDP. (2015). Internet for all: A global study of digital access.
95. UNESCO. (2015). Education for all 2015 national review Bangladesh. United Nations Educational, Scientific and Cultural Organization;

96. UNICEF. (2021). Barriers to internet access and digital skills for rural girls.
97. UNICEF. (2021). Digital learning for rural girls in Bangladesh.
98. UNICEF. (2021). Education and technology: A look at Bangladesh's rural women.
99. Vračević, N. (2025). Strategic roles of private military companies: The evolution and privatization of warfare in the context of contemporary global conflicts. International Journal of Contemporary Security Studies, 1(1), 163–174. https://doi.org/10.18485/fb_ijcss.2025.1.1.12
100. Waldman, L., Ahmed, T., Scott, N., Akter, S., Standing, H., & Rasheed, S. (2018). 'We have the internet in our hands': Bangladeshi college students' use of ICTs for health information. *Globalization and Health*, 14, 1-16. https://doi.org/10.1186/s12992-018-0349-6
101. World Bank. (2016). ICT for education: Rural women's experiences.
102. World Bank. (2016). The gender digital divide in Bangladesh.
103. World Bank. (2016). World Development Report 2016.
104. World Bank. (2016). World development report 2016: Digital dividends. World Bank Group; Bangladesh Government
105. World Bank. (2023). Bridging the gender digital divide in Bangladesh.
106. World Bank. (2023). Digital economy for Bangladesh: Trends and opportunities. World Bank Group;
107. World Bank. (2023). Digital skills for rural students in Bangladesh.
108. World Bank. (2023). Global information technology report.