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Understanding the First and Second Digital Divides in Rural Bangladesh: Internet Access, Online Skills, and Usage

Muhammad Shahadat Hossain Siddiquee
and Md. Saiful Islam

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Contents

1. Introduction

Differences in individuals' access to internet infrastructure refer to the first-level digital divide, whereas differences in individual's online skills and internet usage refer to the second-level digital divide (Newhagen & Bucy, 2005; Dimaggio et al., 2004; Katz & Rice, 2002; Nicole & Eszter, 2009). Access to the internet is a necessary precondition to digital inclusion. But in recent years, the debate over the digital divide focuses on the acquisition of online skills (i.e. second-level digital divide), which is essential to use the internet efficiently and effectively. Therefore, digital divide encompasses both inequality in internet access and online skills, which depend on the idea that both access and skills have positive consequences and their absence have negative consequences.

Bangladesh is a country with a clear-cut digital divide between rural and urban areas, which is primarily caused by income and wealth inequalities. But the uneven distribution of information and communications technologies (ICTs) between rural and urban areas contributes to the inequality in economic and social development (Brixiova, 2009). Therefore, the Government of Bangladesh (GoB) is taking initiatives to address the rural-urban divide in socio-economic development through the elimination of rural-urban disparities in the first- and second-level digital divides; this has become a key issue, as well as a major challenge for policymakers, practitioners, and academicians (Billon et al., 2009).

The present research study uses the theory of digital divide stemming from a comparative phenomenon of different forms of inequalities and aims to generate meaningful insights about the spectrum of individual internet access and online skills (i.e. the first- and second-level digital divides) in the setting of rural Bangladesh, where there is a dearth of data as well as a research gap. The survey "Digital Literacy and Access to Public Services 2019 (DLAP 2019 henceforth)," conducted by the BRAC Institute of Government and Development (BIGD) at BRAC University, collected relevant information from rural Bangladesh on internet access, online skills, and internet usage, intending to explore the extent of inequalities in individual internet access and online skills, as well as identify the factors associated with such inequalities for informing policy.

Though internet use became available in Bangladesh in the early 1990s, it grew slowly; only 0.4% of the population used the internet in some way until 2008. Despite the inception of mobile internet in 2005, Bangladesh did not see any noticeable presence or improvement of internet access and usage during this time. However, between 2009 and 2011, 3.5% of the population entered into the internet territory. This was caused by the significant decline in costs of internet-enabled handsets and internet service usage.

Bangladesh Telecommunication Regulatory Commission (BTRC) finds a clear-cut upward trend of internet subscriptions and access since 2011. For example, the number of internet subscribers, which is defined as at least one access in the last 90 days, has reached a new milestone of around 103.25 million in March 2020. However, broadband internet users are largely concentrated in Dhaka, Chattogram, and Sylhet cities and is just recently expanding to district and upazila (sub-district) levels. Since 2011, the number of internet users has been steadily growing in rural areas as well. Rural Bangladesh has now reached a milestone in internet penetration with the advent of 3G in 2013 and 4G in 2018—driving forces of digitization.

The government has taken advantage of this growth and took pro-rural government policies such as the implementation of Union Digital Centres (formerly known as Community Information Centres), digitization of local government institutes (LGIs) and public services, and introduction of ICT in education and healthcare services. Through such policies, the government has already established 5,275 digital centres, including 4,550 Union Digital Centres (UDCs) for the benefit of the people living in rural Bangladesh (Islam, 2018; Islam and Tsuji, 2010). However, despite steady growth in internet access in less than a decade and commendable government initiatives, rural people are not seeing the growth of online skills and internet usage. Therefore, this internet study explores the first and second digital divides persisting within rural Bangladesh for a better understanding of all woman.

Ensuring equitable internet access and usage to the rural population has become a growing concern and a big challenge for Bangladesh. It is imperative for the Bangladesh government to realize the variations in different factors associated with the first and second digital divides in rural Bangladesh. We aim to identify these factors in this study to better inform policymakers in making policies to reduce the digital divide and ensuring digital inclusion. More specifically, many covariates, such as

age, household size, household income, education, occupation, literacy, marital status, gender, and geographical location of the respondents have been used to check their influence on people's internet access (i.e. the first-level digital divide) and online skills (i.e. the second-level digital divide), respectively using the Probit regression approach. In addition, ordinary least squares (OLS) has been applied to identify the determinants of internet usage in rural Bangladesh. Cross-sectional survey data of 6,500 sample rural households from 325 primary sampling units (PSUs) were used.

The remainder of this paper is organized as follows: Empirical evidence is discussed in Section 2. Section 3 describes the conceptual framework adopted for the study. Data and methodology is described in Section 4, while Section 5 presents an analysis of the findings. And finally, the paper ends with concluding remarks provided in Section 6.

2. Empirical Literature

There exists a substantial body of work relevant to this paper. It is relatively well-established that inequalities in internet access exacerbate social inequality (van Deursen et al., 2019). Digital inequality has evolved rapidly over the past decades, and the scholars working in this field have used multiple dimensions to explain the inequalities (Blank & Groselj, 2014; Helsper, 2012; Ono & Zavodny, 2007; Van Deursen & Van Dijk, 2015; Zillien & Hargittai, 2009). With growing digital divide, "E-inclusion" has become a widely discussed issue.

Digital divide is termed as a complex and multidimensional issue and it is linked to a number of socio-demographic, economic, and locational characteristics, including income, education, race, gender, geographic location, age, skills, awareness, culture, and attitudes (Carr, 2007). Cross-country analysis shows that income and education are the most powerful determinants for the first- and second-level digital divides (Hilbert, 2010). Age also plays a role in measuring the digital divide. For example, individuals aged between 12 to 59 years are more likely to use the internet than the older generation (Fox & Madden, 2005).

Although there are no significant differences in internet access and online skills for the European Union (EU) countries, significant differences persist between rural and urban areas in terms of internet access and online skills (Várallyai et al., 2015). In regard to gender, experimental research design considering income, education, and employment as confounding factors shows that women with the same level of those confounding factors are more likely to have internet access and skills compared to men (Rubin, 2017). Based on the discussion above it is clear that one of the biggest challenges that policymakers face is to establish effective use of ICT through ensuring internet access and essential online skills inclusively.

As per BTRC, active internet connections in Bangladesh comprise 90.5 million, implying more than 50% internet penetration in 2018. However, "After Access" survey conducted by LIRNEasia in 2018, an Asia Pacific-based think-tank, finds that Bangladesh has the lowest internet use—only 13% of the population—among the countries surveyed in Asia and it is increased to 33% after considering the population aged 15-65 years. In contrast, Bangladesh fares better when it comes to ownership of/access

to mobile (i.e. 74% of the population aged 15-65 years), which is the highest percentage of mobile phone usage among the Asian countries surveyed. Therefore, a substantial difference between internet access and online skills persists in Bangladesh. In addition, Bangladesh also faces the worst gender gap in both internet and computer use, as it does in mobile access. For example, women in Bangladesh are 62% less likely to use the internet and 34% less likely to own a mobile phone than men. Mobile phone and internet use are also related to the marital status of an individual. Unmarried people have better access to mobile and internet than married people (Flamm and Chaudhuri, 2007; Rice and Katz, 2003). Moreover, a large rural-urban gap in internet use is evident in Bangladesh, with rural dwellers lagging behind as much as 38% compared to urban dwellers (LIRNEasia, 2018).

Therefore, the research question is whether and how internet access and online skills differ between the "haves" and "have-nots" groups in terms of access, skills, and usage, respectively. Unfortunately, even though the first- and second-level digital divides as a research topic has attracted attention from both academia and research, the literature is still underdeveloped for the Bangladesh context, especially the rural one.

More specifically, the practice of identifying the characteristics of the internet users in Bangladesh, including household size, household income, education, occupation, age, marital status, gender, and geographical location, is not very common. The current contribution of this study provides an empirical investigation of the determinants of first- and second-level digital divides in terms of internet access, online skills, and internet usage. Though Bangladesh has moderate internet accessibility, skills and usage are limited. This study explores the digital divide utilizing the perspectives from resource and appropriation theory (Van Dijk, 2005). Three phases of internet appropriation, i.e. internet access, online skills, and internet usage, have been studied to identify how important determinants are associated with the first- and second-level digital divides in rural Bangladesh.

3. Conceptual Framework

This study partially uses the following conceptual framework designed by Van Dijk (2005) for analyzing the first-level digital divide in Bangladesh. The causal model of the core argument identifies how the first-level digital divide, access to the internet, is created and perpetuated by existing inequalities, as depicted below in Figure 1.

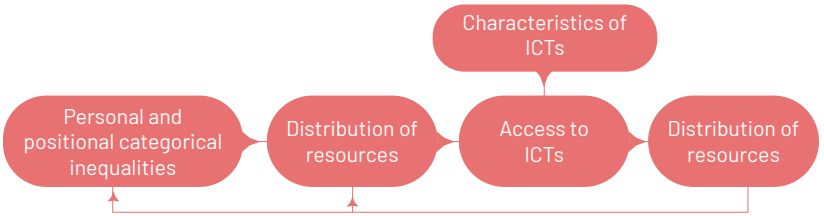

Figure 1. A causal model of the core argument

Source: Van Dijk (2005, p. 15)

Inequalities in personal characteristics such as age (young vs. old), gender (male vs. female), and race (white vs. black), and inequalities in positional characteristics such as education (high vs. low), employment (employed vs. unemployed), nation (developed vs. undeveloped), and region (rural vs. urban) determine digital divide in terms of access. These categorical inequalities in society create an unequal distribution of resources, which in turn creates unequal access. Since inequalities in access depend on the types of technologies, unequal technology adaptations induce unequal participation in society. Finally, unequal participation in society reproduces categorical inequalities and unequal distribution of resources.

Adopting this model, we analyze how individuals' heterogeneity in characteristics determines internet access and creates a first-level digital divide. It is plausible that younger people have more access to the internet than the older; similarly, highly educated people have more access to the internet than people with a low level of education. Regional

variations, gender, marital status, household income may also cause variation in access to the internet. Therefore, this study has included and analyzed those factors from the digital divide perspective.

Van Dijk (2005) also constructed the cumulative and recursive model of four successive stages of access to ICT: motivational, material, skills, and usage access (Figure 2). This helps us to identify the second-level digital divide.

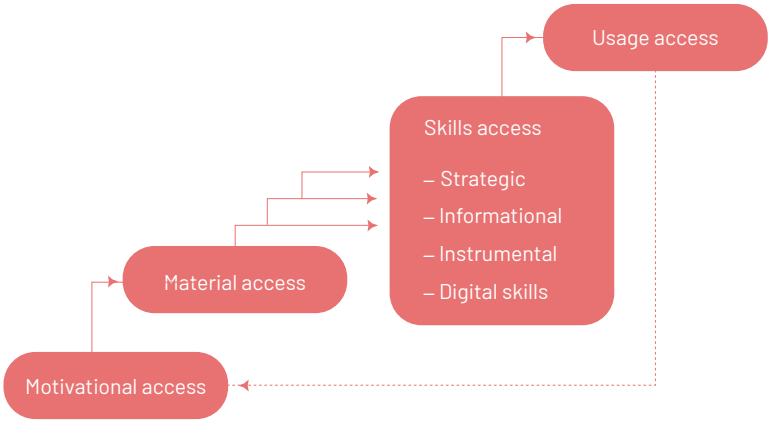

Figure 2. A cumulative and recursive model of successive kinds of access to digital technologies

Source: Van Dijk (2005, p. 22)

Multiple factors determine an individual's motivation in access to ICT (i.e. internet, computer), such as cost to acquire technology, time to use technology, knowledge about usefulness, etc. To analyze the dynamics of material access, a few factors such as gender, age, social status, education, household income, occupation, etc. matter for such access. After having material access, individuals' skills—operational, informational, and digital—to command and use ICT are important. Individual's education, occupation, and gender also matter for online skills. The final stage represents the user access to the technology (internet usage in our study). Amount of usage time, years of experience,

and types of online activities, etc. also matter for user access. Individuals' material access, practical and operational skills can be analyzed based on our survey findings. In our study, internet access is defined by having a broadband connection or mobile data connection or using from others' mobile or using the internet from a local computer shop. To identify online operational and practical skills, we asked respondents to find passport documents from Bangladesh's official passport website, then find information about the passport application fee, and finally asked them to find the passport office hotline number. So material access to the internet and online skills can be measured from our data and would help identify what factors predict differences in internet access and online skills. Finally, internet use has been modelled to identify the gap in internet usage based on the same covariates used as determinants of internet access and online skills, respectively. Overall, this study adopts the well-recognized framework to interpret the digital divide in rural Bangladesh and this framework is similar to the study of Hargittai (2001), who has identified the importance of skills and experience to identify the digital divide.

4. Data and Methodology

4.1. Data Collection

This study relies on the data collected by BIGD from the rural areas of Bangladesh in November of 2019 with a view to a broader understanding of the first- and second-level digital divides, and the factors associated with those divides. The survey "DLAP 2019" is a statistically representative data at the following levels: 1) nationally representative of rural Bangladesh; and 2) representative of each of the eight administrative divisions of the country: Barishal, Chattogram, Dhaka, Mymensingh, Khulna, Rajshahi, Rangpur, and Sylhet. This survey includes 60 districts of Bangladesh out of 64. The hill tract districts were excluded due to language and other barriers. A sound and appropriate statistical methods were applied for selecting 6,500 sample households randomly from 325 PSUs or villages. One of the main objectives of this survey was to look at the individuals' status of internet access, online skills, and internet usage in rural Bangladesh. An individual, who is better informed about the mobile and internet, was selected from the household to answer the survey questionnaire.

4.2. Measures

4.2.1. Explanatory Variables

We selected the better-informed individual within a household and asked the survey participant about their age (open field), household size (open field), education (four categories), literacy (two categories), household income (four categories), occupation (four categories), marital status (three options), gender (two options), and geographical location (eight divisions). We recoded age into the following seven categories: below 15, 15-24, 25-34, 35-44, 45-54, 55-64, & 65 and above. Household size ranges from 1 to 16 and it, therefore, has been re-categorized into seven categories.

4.2.2. Dependent or Outcome Variables

This study uses three outcome variables for exploring the first- and second-level digital divides: internet access, online skills, and internet

usage. The following four have been asked to the respondents to obtain the measure of internet access: the presence of a broadband connection at home, presence of internet connection on their mobile phones, utilization of other's mobile phone for internet access, and usage of internet from the local computer shop. Using these four questions, we have created a dummy variable "internet access" with the presence (internet access=1) and absence (internet access=0) of any one attribute. We consider the most digitally able individual's internet accessibility at least one of the internet facilities mentioned above.

This study has used the survey measure of online skills (i.e. user know-how) using the practical test for exploring whether respondents were able to find out the relevant documents, fee, and hotline number through searching. The three specific questions—"Could you find out the information of required documents for passport application?", "Could you find out the information of passport fee?", and "Could you find out hotline number of the passport office?"—have been used to create a dummy variable "online skills" with the presence (online skills=1) and absence (online skills=0) of any one attribute. In case of measuring the presence of internet skills, we consider an individual's internet skills to find out at least one of the assigned tasks (i.e. document, fee, and hotline number) through internet searching within the stipulated time of five minutes.

For measuring the determinants of internet usage, we considered a list of nine functional activities: reading news, downloading/listening to songs, downloading/watching movies, online training, watching YouTube videos, playing games, paying bills, searching for information, and using social media. Using the binary response of these nine activities, we aggregated the number of activities performed by an individual using the internet (i.e. values of the dependent variable range from 0 to 9).

4.2.3. The Sample

Table 1 reports the sample background characteristics of the individual respondents who are better informed about the internet infrastructure. The average age of the respondents stands at around 34 years and the majority of respondents are in their mid-forties with just slightly over a fifth (around 21%) in their above the mid-forties. Household size with 4, which is also the natural average household size for Bangladesh, participated more in the survey (around 28%).

About a fifth of the sample respondents (18%) never attended any educational institution. Respondents with below Secondary School Certificate (SSC) education have the highest participation (around 44%), followed by SSC/Higher Secondary Certificate (HSC)/equivalent (32%). Only around 5% of the respondents have a graduation degree or above education. Over a quarter of respondents (26%) are illiterate. Around 39% of the respondents' reported monthly income is up to BDT 10,000, while 16% live on over BDT 20,000 per month, and the rest (45%) lies in between. Around half of the respondents (48%) comprise unemployed and students. More than two-thirds of the respondents are married. More males (63%) than females participated in the survey. Regarding locations in rural Bangladesh where people have access to and skills on the internet, about a fifth of respondents belongs to the Dhaka division (19%). An equal number of respondents participated from Chattogram and Rajshahi (15%).

Table 1. Sample background at a glance

Background characteristics	Percentage of Sample
Age (in years)	
Below 15	3.43
15-24	29.18
25-34	25.95
35-44	19.94
45-54	11.11
55-64	6.65
>=65	3.74
Household size	
1	1.58
2	10.78
3	20.63
4	27.66
5	19.22
6	10.63
>=7	9.49

[Table 1. contd...]

[...Table 1. contd]

Background characteristics	Percentage of Sample
Education	
Not passed any class	18.11
Below SSC/equivalent	44.20
SSC/HSC/equivalent	32.43
Graduate/equivalent or above	5.26
Literacy	
Illiterate	26.30
Literate	73.70
Monthly household income (BDT)	
<=10,000	38.57
10,001-20,000	44.94
20,001-30,000	11.06
>30,000	5.43
Occupation	
Agriculture	17.82
Student	18.03
Unemployed	30.42
Non-agriculture	33.74
Marital status	
Not married	25.77
Married	70.37
Widowed/Divorced/Separated	3.86
Gender	
Female	36.91
Male	63.09
Division	
Rangpur	14.15
Barishal	8.00
Chattogram	15.08
Dhaka	19.38
Khulna	13.23
Mymensingh	8.31
Rajshahi	15.08
Sylhet	6.77

4.2.4. Mode of Analysis

This study examines outcome variables such as internet access, online skills, and internet usage for exploring the first- and second-level digital divides. It shows how each outcome variable is related to individuals' background characteristics based on two methods: binary and regression analyses. The former shows the relationship of each outcome variable with age, household size, education, literacy, household income, occupation, marital status, and gender. The latter includes the Probit and OLS regression approaches, which show how explanatory variables (i.e. background characteristics) explain differences in internet access, online skills, and internet usage, respectively.

4.2.5. Correlation Matrix Internet Access and the Covariates

Correlation is used as an initial check to explore the issue of multicollinearity among the explanatory variables. Moreover, it is also possible to observe at a glance how the explanatory variables are associated with the outcome variable as well. Using the full sample, Table 2 represent the correlation matrix, which explains the bivariate linear relationship between variables. Though multicollinearity is multivariate, correlation is also used as a good indicator of multicollinearity and indicates the need for further examination. Therefore, the correlation matrix of predictors would help identify the presence of multicollinearity. The correlation coefficients show that no issue of multicollinearity persists in the dataset except for the correlation between education and literacy (i.e. close to the cut-off point of 0.70). This study has taken care of the issue while estimating regression approaches of Probit and OLS.

Table 2. Correlation matrix: Internet access and the covariates

	Internet access	Age	Household size	Education	Literacy	Household income	Gender
Internet access	1						
Age	-0.42***	1					
Household size	0.16***	-0.24***	1				
Education	0.41***	-0.36***	0.12***	1			
Literacy	0.34***	-0.43***	0.12***	0.68***	1		
Household income	0.32***	-0.13***	0.30***	0.26***	0.20***	1	
Gender	0.08***	0.16***	0.08***	-0.03**	-0.09***	0.00	1

*** and ** imply statistically significant at 1% and 5% level, respectively

Table 3. Correlation matrix: Online skills, internet usage, and the covariates

	Online skills	Internet usage	Age	Household size	Education	Literacy	Household income	Gender
Online skills	1							
Internet usage	0.39***	1						
Age	-0.12***	-0.21***	1					
Household size	0.00	0.05**	-0.01	1				
Education	0.25***	0.34***	-0.08***	0.02	1			
Literacy	0.14***	0.18***	-0.24***	0.02	0.45***	1		
Household income	0.02	0.11***	0.11***	0.27***	0.12***	0.08***	1	
Gender	0.08***	0.20***	0.02	0.07***	-0.00	-0.01	-0.07***	1

*** and ** imply statistically significant at 1% and 5% level, respectively

4.2.6. Correlation Matrix
Online Skills, Internet Usage, and the Covariates

For examining how online skills and internet usage are related to the covariates as well as the issue of multicollinearity among the explanatory variables, this study has addressed these issues using the correlation matrix reported in Table 3. Individuals with internet access have been considered as the sample for the analysis. Findings reveal no issue of multicollinearity present among the explanatory variables.

4.2.7. Probit Model

This study uses the Probit model for two reasons: measuring the marginal effects of the explanatory variables Y_i used for modelling "internet access" and "online skills", respectively. More specifically, the binary response variable in the Probit model serves as the dependent variable with binary outcomes, 0 and 1. Here, $Y_i = 1$ indicates i-th individual with internet access or online skills and $Y_i = 0$ represents i-th individual without any internet access or online skills. The Probit model used for modelling "internet access" or "online skills" takes the following form:

$$\Pr(Y_i = 1 \mid X_i) = \Phi(\beta^{1} X_i) \ldots(1)$$

Where Pr, and denotes probability, the cumulative density function of standard normal distribution and maximum likelihood estimates respectively. (X_i) is a function with values on the interval [0, 1]. The explanatory variable X_i represents age, household size, household income, education, occupation, marital status, gender, and geographical location of the respondents. The standard normal distribution yields the Probit model:

$$\Phi(\beta' X_i) = \int_{-\alpha}^{\beta' X_i} \frac{1}{\sqrt{2\pi}} \exp\{-\frac{1}{2} t^2\} dt \ldots\ldots\ldots\ldots(2)$$

The Probit marginal effects are calculated as $\Phi(\beta' X_i) \frac{\partial \Phi(\beta' X_i)}{\partial X_{i,k}} = \Phi(\beta' X_i) * \beta_k$.

Therefore, the effects of the explanatory variables (X_i) used in the study on internet access or online skills, denoted by (Y_i), depend on $\Phi(\beta^{1} X_i) * \beta_k$. For example, the estimated marginal effects show whether marginal effects of internet access (i.e. haves) are more or less likely compared to those who belong to the "have-nots" group. Similarly, the coefficients of the online skills regression show whether the marginal

effects of the covariates are more or less likely to be skilled individuals compared to those who are not. In the Probit marginal function, positive and negative signs in coefficients imply more likely and less likely to occur, respectively.

4.2.8. Ordinary Least Squares (OLS) Regression

We run an OLS regression using the number of performed activities using the internet as the dependent variable and the covariates age, household size, household income, education, occupation, marital status, gender, skills, and geographical location of the respondents. The OLS regression results will show how internet usage differs by socio-economic, demographic, and regional characteristics of an individual. More specifically, OLS findings would help supplement binary analyses well, as it shows which covariates remain significant in explaining the difference, holding other covariates as constant. The following multivariate linear regression model of internet usage is used for our analytical purpose:

$$y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3} \ldots + \beta_k x_{ik} + \varepsilon_i,\ \varepsilon_i \sim N(0, \sigma^2)$$

Here β_s are the coefficients, Xs are explanatory variables, and error term ε_i follows all the assumption of the classical linear regression model. Here, the dependent variables, y_i = number of performed activities using the internet, and Xs are explanatory variables.

5. Findings

5.1. Internet Access

Opportunity and Means to Internet Access

Internet access measures an individual's access to at least one of the means to internet access: broadband, own mobile, other's mobile, and computer shop. Considering this, findings show that overall 37% of the respondents have access to the internet. However, significant variation in access to the internet persists over the different means of internet access. An estimated 33.6% of the respondents have internet access through their own mobile devices, which is incomparable with the others (Figure 3).

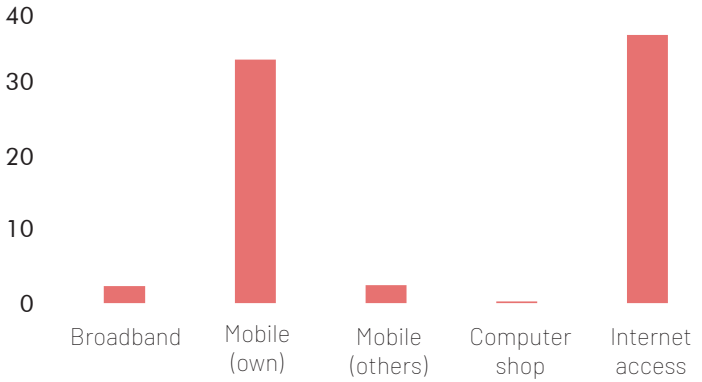

Figure 3. Internet access: Opportunity and means to internet access in rural Bangladesh

5.2. Online skills

Ability to Perform Test

The established measure of online skills (i.e. user know-how) using the practical test (described above) has been used to quantify the online skills of an individual. First of all, we measure the ability of an individual by applying the internet test to find the passport application form, fee for passport, and hotline number of the Bangladesh passport office

within five minutes through searching online. Skilled individuals refer to those who were able to complete at least one of the assigned tasks, such as finding document, fee, and hotline number through searching online. In the case of exploring online skills, only individuals with access to the internet have been analyzed.

Figure 4 shows a symmetric distribution of individuals with access to the internet over the three tests used for measuring their online skills. Findings show that around 35% of respondents have internet skills. Negligible variation exists over the three tests applied to individuals with internet access.

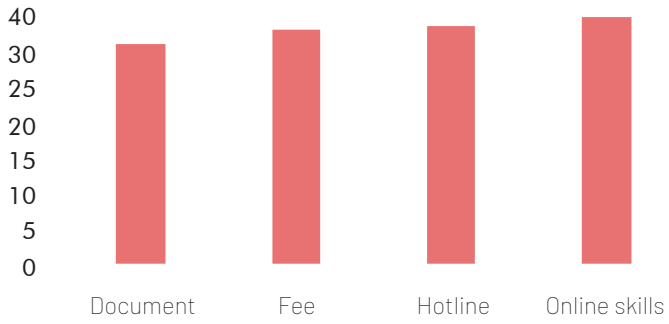

Figure 4. Online skills: Ability to perform tests

5.3. Internet Usage

Involvement in Internet Activities

Internet access is the precondition of online skills and internet usage. After having internet access, usage is important to benefit from using the internet. To measure the level of usage, we asked the respondents about their involvement in internet activities, including using the internet for reading news, downloading or listening to songs, downloading or streaming movies, online training, watching YouTube videos, playing games, paying bills, searching for information, and social media. In the case of exploring internet usage, only individuals with access to the internet have been considered as a sample for our analysis.

The result shows that 31% of the respondents with internet access could not perform any of the nine online activities using the internet. This implies that internet access is a necessary condition for internet usage, not a sufficient condition, as having access to the internet does not guarantee usage. Around 15% of them performed four activities out of nine. Except for the non-performers, the distribution takes approximately normal shape with the peak around at four.

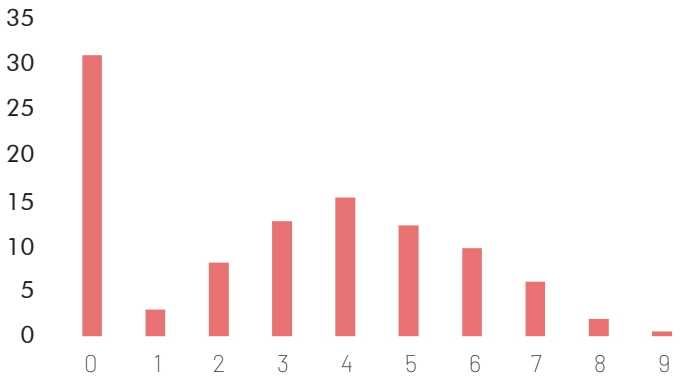

Figure 5. Internet usage pattern: Involvement in internet activities in rural Bangladesh

5.4. Binary Relationship

5.4.1. Binary Relationship: Internet Access vs. Covariates

Column 1 in Table 4 reports the binary relationship of respondent's background characteristics with internet access. There are clear differences in internet access among various groups considered in the study. Groups with younger ones, those with relatively larger household size than the national average, the more educated, literate, student, those with more income, unmarried, male, and those with located in Chattogram and Dhaka have better internet access.

For example, findings reported in Column 1 of Table 4 show that the age group 15 to 24 has 65% internet access on average, which is a statistically

significant difference compared to the combined average of all other age groups that have less extent of internet access. Henceforth, internet access declines with an increase in age. Moreover, we conclude based on the findings that there is a significant association between age and internet access since the $Pr(X^2) = 0.000$. Internet access increases with an increase in household size. Around 52% of respondents living in a household with seven or more member have internet access and it is found to be the highest internet access as per the mean distribution of internet access by household size. The mean difference estimate is statistically significant, implying individuals with a household size of seven have more internet access compared to the combined average of all the remaining groups. Chi-square (Chi^2 henceforth) test for independence shows the $Pr(X^2) = 0.000$, implying that household size and internet access are not independent. Therefore, there is a significant relationship between household size and internet access in rural areas of Bangladesh.

Internet access increases with an increased level of education. Around 70% of the respondents with a graduate degree or higher education have internet access, while it is only 29% for those with below SSC/ equivalent education. Literate individuals have more internet access (47%) compared to those with no literacy (9%). Those belonging to the highest income group have the highest prevalence of internet access (74%), which is a highly statistically significant difference compared to the combined average of all other education groups. Students (70%), unmarried (68%), and male (40%) make a clear-cut distinction in internet access with the other occupation, marital status, and gender groups. Location also plays a role in the means of internet access. Respondents located in Chattogram (55%) and Dhaka (44%) have higher internet access (Column 1 in Table 4 for details). In all cases, the results of the Chi^2 test for independence confirm the significant association of the variables with internet access.

Table 4. Binary relationship of background characteristics with internet access, online skills, and internet usage

Background characteristics	(1) Internet access (Access=1 & No access=0)	(2) Online skills (Skilled=1 & Not skilled=0)	(3) Internet usage (0-9)
Full sample	0.37	0.35	2.99
Age (in years)	Pr(X^2) = 0.000	Pr(X^2) = 0.000	Pr(X^2) = 0.000
Below 15	0.47***	0.39	2.61
15-24	0.65***	0.40***	3.52***
25-34	0.39*	0.34	2.67***
35-44	0.23***	0.25***	2.16***
45-54	0.10***	0.20***	1.44***
55-64	0.06***	0.25	1.75***
>=65	0.03***	0.00*	1.5*
Household size	Pr(X^2) = 0.000	Pr(X^2) = 0.400	Pr(X^2) = 0.394
1	0.09***	0.22	0.89***
2	0.21***	0.29	2.26***
3	0.35**	0.35	2.94
4	0.36	0.37	3.08
5	0.40**	0.38	3.06
6	0.45***	0.35	3.10
>=7	0.52***	0.32	3.04
Education	Pr(X^2) = 0.000	Pr(X^2) = 0.000	Pr(X^2) = 0.000
Not passed any class	0.07***	0.13***	1.39***
Below SSC/equivalent	0.29***	0.22***	2.05***
SSC/HSC/equivalent	0.59***	0.42***	3.46***
Graduate/equivalent or more	0.70***	0.56***	4.39***
Literacy	Pr(X^2) = 0.000	Pr(X^2) = 0.000	Pr(X^2) = 0.000

[Table 4. contd...]

[...Table 4. contd]

Background characteristics	(1) Internet access (Access=1 & No access=0)	(2) Online skills (Skilled=1 & Not skilled=0)	(3) Internet usage (0-9)
Illiterate	0.09***	0.11***	1.32***
Literate	0.47***	0.37***	3.11***
Monthly household income (BDT)	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.153$	$Pr(X^2) = 0.000$
<=10,000	0.21***	0.34	2.75**
10,001-20,000	0.40***	0.35	2.85**
20,001-30,000	0.63***	0.33	3.22**
>30,000	0.74***	0.41**	3.66***
Occupation	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$
Agriculture	0.17***	0.26***	2.20***
Student	0.70***	0.46***	3.99***
Unemployed	0.31***	0.28***	2.16***
Non-agriculture	0.35**	0.32**	2.78***
Marital status	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$
Not married	0.68***	0.43***	3.74***
Married	0.27***	0.29***	2.30***
Widowed/Divorced/ Separated	0.14***	0.26	2.31
Gender	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$
Female	0.32***	0.30***	2.27***
Male	0.40***	0.38***	3.33***
Division	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$	$Pr(X^2) = 0.000$
Rangpur	0.20***	0.41	3.28*
Barishal	0.31***	0.50***	3.08
Chattogram	0.55***	0.28***	2.94
Dhaka	0.44***	0.38	2.92
Khulna	0.40*	0.39*	3.36***

[Table 1. contd...]

[...Table 4. contd]

Background characteristics	(1) Internet access (Access=1 & No access=0)	(2) Online skills (Skilled=1 & Not skilled=0)	(3) Internet usage (0-9)
Mymensingh	0.27***	0.45**	2.55**
Rajshahi	0.37	0.32	3.20*
Sylhet	0.30***	0.14***	1.86***
n	6,500	2,405	2,405

***, **, * imply statistically significant at 1%, 5%, and 10% level, respectively

5.4.2. Binary Relationship: Online Skills vs. Covariates

Column 2 in Table 4 presents how age, household size, education, literacy, household income, occupation, marital status, gender, and geographic location related to online skills, which has been measured applying the internet test discussed before. Individuals only with access to the internet have been considered in the sample for analyzing their online skills. We find that the younger sample respondents in the age group of 15-24 years are the savviest (40%). Moreover, the value of $Pr(X^2)$ = 0.000 confirms the significant association between age and online skills. None of the household sizes could play any significant role in making a difference in online skills. Moreover, the probability value of Chi^2 is very high (i.e. $Pr(X^2)$ = 0.400), implying there is no association between household size and online skills.

The relationships of education and literacy with online skills are positive. Respondents with the highest levels of education (i.e. graduate or more) have the highest skill prevalence (56%) among the education groups. Moreover, a significant relationship between education and online skills persists in the data as $Pr(X^2)$ = 0.000. A similar finding is also evident in literacy.

Though income is positively related to internet access, there is no significant difference in online skills across different household income groups up to BDT 30,000. The value of $Pr(X^2)$ is 0.153, implying the absence of association between income and online skills. More specifically, income and online skills are independent of each other.

However, it sharply increases after this threshold income level (41%) and is significantly different from other groups. Similar to internet access, students (46%), unmarried (43%), and male (38%) make a clear-cut distinction in online skills with other occupation, marital status, and gender groups. Geographical location also plays a role in online skills. Respondents from Barishal (55%) and Mymensingh (45%) divisions have higher online skills (see Column 2 in Table 4 for details). Results of the Chi^2 test for independence confirm the significant association of the variables with online access.

5.4.3. Binary Relationship
Internet Usage vs. Covariates

This section presents how covariates relate to internet usage. Considering only individuals only with access to the internet, this study finds a significant association between age and internet usage as $Pr(X^2) = 0.000$. However, no significant association persists between household size and internet usages as the probability value of Chi^2 is very high. Significant positive relationships of education, literacy, and income with internet usages are evident. This implies that respondents with higher levels of education, literacy, and more income have higher values of internet usages. The highest internet usage is evident for the student among the occupational categories. Similarly, unmarried and males use more internet compared to their counterparts. Geographical location also plays a role in internet usage. Respondents from Khulna use more internet compared to other divisions. $Pr(X^2) = 0.000$ confirms the significant association of the variables with internet usage.

5.5. Probit Regression Analyses
Internet Access and Online Skills

5.5.1. Determinants of Internet Access

Probit regression results for internet access show how individuals' socio-economic, demographic, and regional characteristics determine individuals' access to the internet. Taking into account the factors such as age, household size, education, household income, marital status, gender, and region, this study explores how these factors determine internet access in order to identify the first-level digital divide in rural

Bangladesh (see Table 5 for details).

The age of an individual plays an important role in internet access and it is found as one of the most important powerful predictors of the first-level digital divide measured in terms of internet access in rural Bangladesh. Many studies on the digital divide show that young adults have more access to ICTs than older ones. Study results show that age is a statistically significant predictor in determining internet access. For example, about 52% of the individuals aged up to 34 years have internet access as opposed to only 15% among individuals aged above 34 years. The estimated difference is also statistically significant, implying a clear-cut first-level digital divide. The marginal effect associated with age shows that an individual aged up to 34 years is 18.5 percentage point more likely to have internet access than an individual aged above 34 years.

The number of members in the households is taken as an indicator of internet access. Findings show that household size has a significantly positive relationship with internet access. This implies that an individual belonging to a larger household size exhibits more internet access. However, the magnitude of the marginal effect of household size on internet access is negligible. The estimated marginal effect shows that as household size increases by one member, an individual is 0.6 percentage point more likely to have internet access.

Table 5. Probit regression results on internet access

Variables	(1) Raw coefficients	(2) Average marginal effect
Age category (=1 if age <=34 and 0, otherwise)	0.730*** (0.048)	0.185*** (0.012)
Household size	0.024** (0.012)	0.006** (0.003)
Education category (Reference category: No schooling)		
Below SSC/equivalent	0.554*** (0.069)	0.132*** (0.015)

[Table 5. contd...]

[...Table 5. contd]

Variables	(1) Raw coefficients	(2) Average marginal effect
SSC/HSC/Equivalent	1.131***	0.302***
	(0.072)	(0.017)
Above HSC	1.449***	0.399***
	(0.102)	(.028)
Income category (Reference category: <= BDT 10,000)		
10,001-20,000	0.327***	0.085***
	(0.044)	(0.011)
20,001 to 30,000	0.774***	0.211***
	(0.066)	(0.018)
>30,000	1.004***	0.276***
	(0.090)	(0.025)
Occupational category (Reference category: Agriculture)		
Student	0.594***	0.149***
	(0.088)	(0.023)
Unemployed	0.661***	0.167***
	(0.080)	(0.020)
Non-agriculture	0.376***	0.091***
	(0.060)	(0.014)
Unmarried (=1 if unmarried and 0, otherwise)	0.426***	0.108***
	(0.065)	(0.016)
Gender (=1 if male and 0, otherwise)	0.698***	0.177***
	(0.061)	(0.015)
Division (Reference category: Rangpur)		
Barishal	0.578***	0.136***
	(0.089)	(0.021)
Chattogram	1.063***	0.267***
	(0.076)	(0.018)
Dhaka	0.816***	0.199***
	(0.072)	(0.017)
Khulna	0.682***	0.163***
	(0.076)	(0.018)

[Table 5. contd]

[...Table 5. contd]

Variables	(1) Raw coefficients	(2) Average marginal effect
Mymensingh	0.508***	0.118***
	(0.089)	(0.021)
Rajshahi	0.591***	0.140***
	(0.075)	(0.017)
Sylhet	0.474***	0.110***
	(0.095)	(0.023)
Constant	-3.593***	
	(0.125)	
Pseudo R^2	0.317	
Observations	6,500	

Note: dy/dx for factor levels is the discrete change from the base level; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The most consistent predictor used in digital divide research is the educational level of attainment (DiMaggio et al., 2004; Katz and Rice, 2002; Van Dijk, 2005). Using no education (i.e. has not attended any school) as a reference category, the positive and significant relationship of internet access with education implies that a higher level of education of an individual indicates more likelihood of access to the internet. The probability of access to the internet, on average, around 13, 30, and 40 percentage points higher for the individuals with Class I-VIII, SSC/HSC/equivalent, and above HSC level of education, respectively compared to the reference category. Therefore, individuals with lower educational levels have significantly less internet access (Van Dijk, 2005).

The economic status measured in terms of household income is widely recognized as one of the most important determinants for internet access (Goldfarb and Prince, 2008; Katz and Rice, 2002; Livingstone and Helsper, 2007; Ono and Zavodny, 2007; Van Dijk, 2005). The findings of the study reveal that households' income and internet access are positively associated. Using household income below BDT 10,001 as a reference category, the Probit results reported in Table 5 indicate that the probability of internet access is positively related to the monthly income of the households, i.e. the individuals from higher-income households are more likely to have internet access as against no internet

access. This implies that the likelihood increases as household income increases from one category to another higher category. Therefore, income creates the first-level digital divide in the case of internet access in rural areas of Bangladesh. The probabilities of access to the internet are, on an average, around 9, 21, and 28 percentage points higher for the people of the income group of BDT 10,001 to 20,000, 20,001 to 30,000, and above 30,000, respectively compared to people belonging to the reference income group comprising monthly income of the household up to BDT 10,000.

The occupation of an individual also determines an individual's access to the internet. Considering individuals' involvement with agriculture as a reference category, individuals belonging to students, non-agriculture, and unemployed categories have significantly better access to the internet compared to the reference category. The probability of access to the internet is, on average, around 15, 17, and 9 percentage points higher for individuals who are students, unemployed, and involved in non-agricultural occupations respectively compared to agricultural workers.

Though the gender gap in internet access has diminished in many developed countries, it still persists in developing countries like Bangladesh. The results show that the variable "gender" is statistically significant in determining internet access. For example, about 40% of the total male individuals have access to the internet as against 32% among female individuals (Table 4). The marginal effect associated with "gender" shows that a male individual is around 18 percentage point more likely to have internet access than a female individual. The significantly positive coefficient of the variable "gender" indicates the presence of a strong digital divide between males and females. Similarly, the likelihood of access to the internet is higher for unmarried people than those who are married and it is consistent with age. For example, the probability of access to the internet is 11 percentage point higher for unmarried people compared to married people.

The divisional location of the individuals is also believed to be an important predictor in influencing internet access in rural Bangladesh. Though most of the literature defines the spatial digital divide among the individuals in terms of rural and urban regions, the present case explores the digital divide within the rural regions across the eight divisions in Bangladesh in terms of various observable characteristics. This provides an idea of the extent of inter-divisional variations in internet

access. The survey includes all divisions in Bangladesh in the sample with a view to providing meaningful comparisons. The Probit estimates in Table 5 indicate the persistence of significant divisional disparity in access to the internet. This study uses Rangpur as a reference division as it is the most poverty prone division among the eight administrative divisions of Bangladesh where the least people have access to the internet. Comparing with the reference division, findings show that the likelihood of internet access is the highest for the Chattogram division. All of the divisions have positive coefficients, which are statistically significant, implying a higher level of access to the internet compared to the Rangpur division. The probability of access to the internet is 27 and 20 percentage points higher for Chattogram and Dhaka divisions, respectively compared to Rangpur.

5.5.2. Determinants of Online Skills

Probit estimates for online skills reported in Columns 1 & 2 of Table 6 show how explanatory variables determine online skills. This provides an idea of the extent of variations in online skills with a view to identifying the second-level digital divide.

Table 6. Probit regression results on online skills

Variables	(1) Raw coefficient	(2) Average marginal effect
Age category (=1 if age<=34 and 0, otherwise)	0.240*** (0.0891)	0.080*** (0.030)
Household size	0.00504 (0.0164)	0.002 (0.005)
Education category (Reference category: No schooling)		
Below SSC/equivalent	0.120 (0.185)	0.033 (0.050)

[Table 6. contd...]

[...Table 6. contd]

Variables	(1) Raw coefficient	(2) Average marginal effect
SSC/HSC/Equivalent	0.620*** (0.184)	0.200*** (0.050)
Above HSC	1.049*** (0.198)	0.362*** (0.057)
Income category (Reference category: <= BDT 10,000)		
10,001-20,000	0.0881 (0.0721)	0.029 (0.024)
20,001 to 30,000	-0.00888 (0.0909)	-0.003 (0.030)
>30,000	0.222** (0.108)	0.075** (0.037)
Occupational category (Reference category: Agriculture)		
Student	0.289** (0.127)	0.097** (0.041)
Unemployed	0.158 (0.132)	0.052 (0.042)
Non-agriculture	0.104 (0.114)	0.034 (0.036)
Unmarried (=1 if unmarried and 0, otherwise)	0.103 (0.0831)	0.034 (0.029)
Gender (=1 if male and 0, otherwise)	0.265*** (0.0815)	0.089*** (0.027)
Division (Reference category: Rangpur)		
Barishal	0.429*** (0.141)	0.153*** (0.050)
Chattogram	-0.118 (0.117)	-0.039 (0.039)
Dhaka	0.148 (0.114)	0.051 (0.039)
Khulna	0.117 (0.121)	0.041 (0.041)

[Table 6. contd...]

[...Table 6. contd]

Variables	(1) Raw coefficient	(2) Average marginal effect
Mymensingh	0.345**	0.123**
	(0.146)	(0.052)
Rajshahi	-0.131	-0.043
	(0.121)	(0.040)
Sylhet	-0.663***	-0.188***
	(0.177)	(0.047)
Constant	-1.598***	
	(0.247)	
Pseudo R^2	0.0931	
Observations	2,405	

Note: dy/dx for factor levels is the discrete change from the base level; standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The age of an individual is a powerful predictor of the second-level digital divide in rural Bangladesh. The results show that age is a statistically significant predictor in determining online skills. For example, about 38% of the people aged up to 34 years have online skills as against only 24% among people aged above 34 years. The statistically significant difference between the age groups implies a clear-cut second-level digital divide. The marginal effect of age on online skills shows that an individual aged up to 34 years is around 8 percentage point more likely to have online skills than an individual aged 35 years or above. Household size and marital status do not play any role in achieving online skills.

Using no education (i.e. has not attended any school) as a reference category, this study finds no significant differences in online skills between no-education and lower than SSC; though internet access was found to be significant in this regard. However, a positive and significant relationship of online skills with the SSC and above level of education implies that a higher level of education of an individual indicates more likelihood of having online skills. The probability of online skills, on an average, around 20 and 36 percentage points higher for the individuals with SSC/HSC/equivalent and above HSC level of education, respectively compared to the reference category. Therefore, individuals with

lower educational levels have significantly lower online skills in rural Bangladesh.

The Probit results indicate that the probability of online skills has no significant association with the monthly income of the households up to BDT 30,000. However, monthly income higher than this amount is positively associated with online skills (i.e. individuals from higher than BDT 30,000 income groups are more likely to have online skills). This implies that the likelihood of online skills increases from a certain threshold of income. Therefore, income creates the second-level digital divide in the rural areas of Bangladesh. The probability of online skills is, on an average, around 7.5 percentage point higher for the individual belonging to the income group of more than BDT 30,000 compared to people belonging to the reference income group of up to BDT 10,000.

Though individuals belonging to the occupation groups of students, non-agriculture, and unemployed categories have significantly better access to the internet compared to the reference category, this study finds significant marginal effects of students on online skills. The probability of online skill is around 10 percentage point higher for students compared to reference occupations (i.e. agriculture). Other occupation categories are found insignificant in the case of determining online skills.

The Probit estimates for internet skills show that the variable "gender" is statistically significant in determining online skills in rural Bangladesh. For example, about 38% of the total male individuals have online skills as against 30% among female individuals (Table 4). A male individual is around 9 percentage point more likely to have online skills compared to a female individual. The significantly positive coefficient of the variable "gender" indicates the presence of a strong digital divide in online skills between males and females.

This study looks at how locations of the individuals influence online skills in rural Bangladesh. Though we find that individuals located in all divisions have more access to the internet compared to individuals located in the Rangpur division, this does not remain the same for online skills. Findings reported for online skills show that the estimated coefficients of Chattogram, Dhaka, Khulna, and Rajshahi are insignificant, implying that there are no differences in online skills among individuals living in those divisions compared to those living in Rangpur. Comparing with the reference division, findings show that the likelihood of online

skills is the highest for Barishal, followed by Mymensingh. People from Barishal and Mymensingh divisions have better online skills compared to people from the reference division (Rangpur). The probabilities of online skills are around 15 and 12 percentage points higher for Barishal and Mymensingh division respectively compared to Rangpur. In terms of online skills, Sylhet division is lagging behind other divisions. The estimated coefficient of Sylhet division is negatively significant, implying an individual located in Sylhet is around 19 percentage point less likely to have online skills compared to an individual located in Rangpur. Therefore, though significant variation across the divisions is present in the case of internet access, variation in online skills remains significant only for Barishal, Mymensingh, and Sylhet. Moreover, the sign gets reversed for Sylhet division. Therefore, this study finds the presence of the second-level digital divide from the regional perspective.

5.6. OLS Regression Analyses

Internet Usage

For measuring the determinants of internet usage, this study considered a list of activities as mentioned earlier. Using the binary response of those activities, an aggregate measure of the number of activities performed by an individual using the internet was then created, taking on values ranging from 0 to 9.

Table 7. OLS regression results on internet usage

Variables	Internet usage (0-9)
Age category (=1 if age<=34 years and 0, otherwise)	0. 502*** (0.130)
Household size	0. 026 (0 .025)
Education category (Reference category: Not attending school)	
Below SSC/equivalent	0.044 (0. 244)
SSC/HSC/Equivalent	0.834*** (0.246)
Above HSC	1.684*** (0.274)
Income category (Reference category: <= BDT 10,000)	

[Table 7. contd...]

[...Table 7. contd]

10,001 to 20,000	0.116 (0.111)
20,001 to 30,000	0. 493*** (0.139)
>30,000	0. 793*** (0.168)
Occupational category (Reference category: Agriculture)	
Student	0.864*** (0.193)
Unemployed	0. 342* (0.198)
Non-agriculture	0.243 (0.168)
Unmarried (=1 if unmarried and 0, otherwise)	0. 391*** (0.129)
Gender (=1 if male and 0, otherwise)	0.920*** (0.128)
Division (Reference category: Rangpur)	
Barishal	0.086 (0.227)
Chattogram	0.313* (0.185)
Dhaka	0.134 (0.182)
Khulna	0.452** (0.193)
Mymensingh	- 0.303 (0.233)
Rajshahi	0.331 (0.191)
Sylhet	-0.559** (0.245)
Online skills (=1 if individual with online skills and 0, otherwise)	1.421*** (0.093)
Intercept	-0.343 (0.353)
Observations	2,405
R-squared	0.305

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

We run an OLS regression using the number of performed activities using the internet as the dependent variable and the covariates such as their age, household size, education, literacy, household income, occupation, marital status, gender, geographical location, and skills. The OLS regression results reported in Table 7 show how internet usage differs by socio-economic, demographic, and regional characteristics of an individual. More specifically, OLS findings supplement binary analyses reported in Table 4. It also shows which covariates remain significant in explaining the variation in internet usage, holding other covariates as constant. The difference among age categories remains

significant. This implies that individuals belonging to a lower age group (i.e. <= 34 years) use more internet, on average, by 0.5 compared to its counterpart. Therefore, the age of an individual determines the extent of internet usage and thus, the age gap in internet usage persists in rural Bangladesh. Similar to the estimate of online skills, household size remains insignificant.

The education of an individual also determines internet usage in Bangladesh and findings are consistent with the results obtained for online skills. Being in the higher educated groups (i.e. above the HSC level of education in our case) are the most important factors explaining who uses more internet. However, it should be noted here that the difference in internet usage between below SSC and not attending school groups is no longer significant. However, individuals with SSC/HSC/equivalent and above HSC, on average, use more internet by an amount of 0.8 and 1.7, respectively compared to the reference group. These two statistically significant positive coefficients of education categories indicate that higher education implies a higher number of activities performed using the internet.

Household's income level also determines the usage of the internet in rural Bangladesh. Being in the higher income categories (i.e. BDT 20,001-30,000 and above BDT 30,000 in our case) are the most important factors explaining the extent of internet usage in rural Bangladesh. However, the difference in internet usage between the lowest and reference income group is found no longer significant; implying that no income gap in internet usage persists between these two groups. Households of the monthly income level of BDT 20,001 to 30,000 and above BDT 30,000 have more internet activities compared to the reference income level (i.e. <= BDT 10,000). This usage is higher by the amount of 0.49 and 0.79 for individuals belonging to the monthly income level of BDT 20,001 to 30,000 and above BDT 30,000, respectively. Therefore, internet usage variation depends on income variations, implying the presence of the digital divide in internet usage as per income categories.

We then look at how the occupation of individual matters for the usage of the internet. Findings show the significant marginal effects for students and unemployed, respectively. However, the coefficient of the employees in non-agricultural sectors is no longer significant, implying that there is no occupational gap in internet usage that persists between agricultural and non-agricultural groups. The number of internet usage is higher for the students and unemployed compared to the reference

occupation (i.e. agriculture). This study also confirms the gender gap in internet usage, as it finds that males use the internet significantly more than females do. Using marital status as one of the determinants of internet usage, this study finds that unmarried people perform more internet activities than married people. Regional variation in internet usage is not significant for many divisions except for Khulna and Sylhet. Khulna division performs significantly more internet activities than Rangpur division (reference category). In contrast, Sylhet division is in the worst position in terms of internet usage as it performs significantly fewer internet activities in comparison to Rangpur.

Performing the Breusch-Pagan test to check for the presence of heteroskedasticity in the model, this study does not reject the null-hypothesis of homoskcedasticity even at a 10% level of significance. Therefore, the model used for measuring the determinants of internet usage in rural Bangladesh does not suffer from the heteroskedasticity in the error term. Moreover, the variance inflationary factor (VIF) is used to check the issue of multicollinearity among the explanatory variables. The overall mean VIF of this model, which is 2.96, is much lower than the threshold value of 10 (see Table A, Annexe). Therefore, no issue of multicollinearity persists in the model.

6. Conclusion

This study comprises two-fold goals in addressing the first- and second-level digital divides in terms of internet access, online skills, and internet usages among the people living in rural Bangladesh. First, this paper explores whether and how internet access differs across observable characteristics. Findings reveal very clear-cut variations or first-level digital divide in internet access among various groups considered in the study. More specifically, groups with younger ones, those with relatively larger household size, the more educated, literate, student, those with more income, unmarried, male, and those located in Chattogram and Dhaka have much more internet access. Second, this study tests whether rural people with internet access differ when it comes to second-level digital divide measured in terms of "web know-how" (i.e. online skills and internet usages) and finds that online skills and internet usages both vary within and across the categories analyzed. This study applies the theory of digital inequality to internet access, online skills, and internet usages and demonstrates how they vary by socio-demographic and economic characteristics and advantages the privileged ones. Considering the results altogether, findings of the study play a role in suggesting few key thoughts for future research, technology design, technology adoption, third-level digital divide, and policies to get the rural people involved in the digital platform in an inclusive manner.

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Annexe

Table A. VIF estimation

Variable	VIF	1/VIF
Age category (=1 if age<=34 and 0, otherwise)	1.35	0.739599
Household size	1.13	0.881220
Education category (Ref. category: No attending school)		
Below SSC	7.60	0.131557
SSC/HSC/Equivalent	8.41	0.118297
Above HSC	3.80	0.263110
Income category (Reference category: <=BDT 10,000		
10001 to 20000	1.73	0.577675
20001 to 30000	1.65	0.605976
>30,000	1.53	0.654402
Occupational category (Ref. category: Agriculture)		
Student	4.70	0.212645
Unemployed	4.21	0.237561
Non-agriculture	3.43	0.291560
Unmarried (=1 if unmarried and 0, otherwise)	2.33	0.429506
Gender (=1 if male and 0, otherwise)	2.00	0.500962
Division (reference category: Rangpur)		
Barishal	1.81	0.553102
Chattogram	3.33	0.300569
Dhaka	3.29	0.304248
Khulna	2.55	0.391399
Mymensingh	1.72	0.582539
Rajshahi	2.59	0.385377
Sylhet	1.72	0.579779
Internet skill (Dummy)	1.13	0.886842
Mean VIF	2.96	

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