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PAPER

Academic Use of Smartphones in Secondary Level Education in Bangladesh: A Non-Parametric Approach

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ABSTRACT

This study aims to examine the use of smartphones for educational purposes and the acceptance of online learning among secondary students. To investigate the academic utilization of smartphones among secondary students in Bangladesh, a sample of 384 students from different districts of Bangladesh were surveyed. The survey was conducted using a self-administered, semi-tailored computerized questionnaire. The collected data was analyzed using IBM SPSS statistics 26 and the Mann-Whitney U test. The findings indicate that male students used smartphones for educational purposes with greater confidence and less difficulty than female students. On the other hand, students in 8th to 10th grade classrooms reported a greater willingness to use smartphones for academic purposes, with urban students being more enthusiastic than their rural peers. The study's findings have implications for the government, policymakers, educators, and non-governmental organizations (NGOs). They highlight the importance of ensuring equal access to resources and tools that support academic success, as well as addressing the adverse effects of excessive smartphone usage. In addition, the government and NGOs should prioritize the elimination of inequities between rural and urban areas and provide subsidies to rural students.

KEYWORDS

Smartphones, M-W U testing, Secondary students, Rural, Urban, Developing country, Bangladesh

1 INTRODUCTION

The advent of digital technology has brought about significant transformations in modern mobile phones. It has evolved from a singularly purposed gadget into a multifunctional device that possesses capabilities similar to those of a computer connected to the Internet [1–3]. Smartphones, which possess the dual qualities of compactness and computational capability, have gained popularity among students and academic personnel. Consequently, these devices are being used more frequently for

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Internet-based tasks, such as email communication, instant messaging, media sharing, news consumption, and web browsing [4]. The prevalence of students owning these versatile and adaptable mobile devices is rapidly increasing. Presently, due to its effectiveness and ability to serve multiple purposes, mobile learning has become a popular educational approach in both developing and established nations [5–6].

Nevertheless, the COVID-19 pandemic necessitated a worldwide cessation of conventional educational practices, leading to a transition from in-person instruction to online learning for approximately 1.5 billion students and 63 million educators [7]. The current scenario has brought to light both the advantages and disadvantages of transitioning from traditional education to digital platforms [8]. A smartphone has been identified as one of the tools used by students to participate in online lessons [9]. Mobile learning, which allows learning to take place at any time and from any location, has emerged as a valuable tool in the context of remote teaching and learning strategies during the COVID-19 pandemic [5, 6, 10, 11]. Additionally, it has the potential to help students minimize gaps in their studies. Technologically advanced nations have the capacity to provide effective and viable online education [12–14]. However, less developed countries with limited technological resources face multiple challenges in implementing it [13, 15].

However, it is important to acknowledge the challenges faced by students in a least-developed country such as Bangladesh who were compelled to utilize smartphones or other electronic devices for their engagement in online classes during the COVID-19 pandemic. Among these challenges, the digital divide emerges as a particularly noteworthy concern [16, 17]. Among the top 50 countries globally, Bangladesh stands out for its rapid rate of mobile adoption, with approximately eight million smartphone users [18]. However, the country is currently experiencing a digital divide during the COVID-19 pandemic. This divide is primarily attributed to factors such as limited technology skills, high costs, inadequate access to technology, unreliable Internet connectivity, insufficient awareness, and a scarcity of digital devices [16, 19]. Furthermore, the widespread adoption of online education and the increasing availability of digital devices, such as cell phones, laptops, and computers, have had a significant impact on the psychological well-being of students during the pandemic. Its impact has manifested in several forms, including increased levels of pressure, stress, trauma, anxiety, frustration, and difficulties with focus, as evidenced by various studies [19–23]. Despite the existence of a considerable body of research [18] [24–28] examining the impact of smartphones on students, especially those in higher education, there is a lack of studies explicitly investigating the effects on secondary school students in Bangladesh.

Several studies [29–32] have examined the advantages and disadvantages of utilizing smartphones in educational settings. Nonetheless, there is a knowledge gap in certain areas, such as the urban-rural divide in Bangladesh, which requires further investigation. Furthermore, there is a significant lack of current research on the engagement of the government and NGOs in facilitating a conducive, technology-friendly environment for students in Bangladesh. The purpose of this paper is to identify significant research gaps that need to be addressed in order to develop a comprehensive understanding of the academic use of smartphones and the involvement of governmental and non-governmental organizations in establishing a technology-friendly environment for secondary-level students in Bangladesh. Furthermore, by addressing these gaps, it is possible to gain insights that could contribute to the development of context-specific strategies and policies. These strategies and policies can be utilized to promote equal access to smartphone technology for educational purposes, improve educational outcomes, and bridge the urban-rural divide.

A nonparametric test is defined by the absence of assumptions regarding the underlying distribution, in contrast to a parametric test that relies on such assumptions. The Mann-Whitney (M-W) U test is a nonparametric statistical method used to determine the population source of two sampled groups [33]. The present study utilizes the M-W U test to examine and compare the perceptions of students regarding the benefits and difficulties associated with smartphone usage. This analysis takes into account factors such as gender, educational attainment, and geographic area. This study employed multiple linear regression (MLR) analysis to investigate the relationship between the use of smartphones for academic purposes, the handling of technological difficulties, the costs related to Internet access (independent variables), and the impact of governmental organizations (GOs), non-governmental organizations (NGOs), and educational institutions (dependent variables). The present study will investigate the following hypotheses in order to specifically address the research questions [34].

H1: There is a significant difference in the attitudes of different groups (based on gender, educational level, and location) towards the advantages and challenges of using smartphones in academia.

H2: There is a significant role for educational actors GOs, NGOs, and institutions in utilizing smartphones for academic purposes, addressing technological challenges, and managing the cost of Internet access.

This study aims to contribute to the existing literature and encourage further investigation into the academic use of smartphones in secondary education in both urban and rural areas of Bangladesh. The present study elucidates how students' experiences and responses to this novel learning platform are influenced by gender and the disparities between urban and rural areas. The findings of this study have important implications for stakeholders, including the government, academic institutions, and researchers. They highlight the need for support and resources to be provided to disadvantaged students when accessing online learning activities through smartphones. Furthermore, the research findings can guide policymakers in prioritizing investment in reliable Internet connectivity to ensure equitable access to online resources in both urban and rural areas. Policymakers can also utilize the research to develop comprehensive teacher training programs, create localized digital learning materials, and implement targeted initiatives to provide smartphones and technological support in underserved rural areas. This will promote equal opportunities for academic advancement.

2 RELEVANT LITERATURE

2.1 The benefits of using smartphones in academic settings

The adoption of smartphones in academic contexts has garnered significant attention in academic research, as evidenced by a multitude of studies [28] [31] [35–39]. This increased interest is due to the growing prevalence of smartphone usage in educational settings. Computers have been significantly displaced by smartphones and are universally acknowledged as effective tools for teaching and learning [40–41]. The utilization of this approach facilitates the enhancement of students' learning capacity, technical skills, and the dissemination of knowledge [24] [37]. The use of mobile phones by students has been found to have positive effects on

their psychological well-being, social interactions, practicality, and financial aspects [24]. Hence, the utilization of mobile learning has the potential to enhance students' academic achievements and increase their motivation [35]. It can be argued that mobile learning is a promising pedagogical tool for higher education environments [29]. Furthermore, university students perceive mobile learning as advantageous because it can address gaps in their studies [18]. They use smartphones as educational tools, taking advantage of features such as portability, comprehensive learning experiences, multitasking capabilities across various sources, environmental sustainability, and the opportunity to engage with instructors beyond the confines of the classroom. Additionally, mobile learning facilitates the effective management of group projects and assignments [31].

2.2 The drawbacks of using smartphones

In addition to diverting students' attention from academic pursuits and promoting an excessive attachment to them, the use of smartphones also correlates positively with students' stress levels [30]. The increasing popularity of smartphone usage has been associated with several negative consequences, such as addiction, nomophobia, perceived risks, disengagement, dependency, and increased distraction. Moreover, it has been observed that students' attentiveness in class is negatively impacted by their smartphone usage [24] [25] [31]. Moreover, the widespread use of technology in online education may have negative effects on students' physical and emotional well-being [26].

Gender differences in smartphone use for learning. A higher proportion of women, compared to men, utilize smartphones, and they tend to experience higher levels of social anxiety [24]. However, when it comes to academic performance, males seem to be more negatively impacted by smartphone addiction than females. Specifically, males exhibit tendencies to neglect their responsibilities, experience heightened levels of concern, and struggle with self-regulation [27].

Academic use of smartphones at different educational levels. A study [32] revealed that the use of smartphones has an impact on the academic performance and productivity of elementary school students. The findings indicated that students who frequently use smartphones in the classroom tend to outperform their peers who use them infrequently. According to Hand (26), the widespread use of technology in online learning can potentially have negative effects on the physical and emotional well-being of students.

Academic use of smartphones at different educational levels. There is evidence to suggest that students residing in urban areas and those with parents who have attained higher levels of education exhibit greater proficiency in time management compared to their counterparts from rural areas, especially in the context of remote learning facilitated by smartphones and other technological devices [42]. During the COVID-19 pandemic in Bangladesh, online education has emerged as a viable alternative to the traditional tertiary education system [7] [13] [39]. One of the primary obstacles encountered by students in embracing the new mode of learning is the lack of essential electronic devices, such as laptops, smartphones, computers, and tablets, which are indispensable for online courses. Additionally, students face various challenges such as limited or nonexistent Internet access, exorbitant costs of mobile Internet packages or broadband connections, disruptions during online classes caused by slow or non-existent Internet connectivity, and frequent power outages in both rural and urban areas [7] [13] [43–48]. Among other issues, the

digital divide is one of the most significant challenges facing students in Bangladesh [16] [17]. Furthermore, unequal access to technology and the Internet may undermine the true purpose of active learning through online classrooms, resulting in a digital divide in education. Students from rural regions may suffer more than those from metropolitan areas [10] [13] [49] [50]. Although one of the government's key goals is to create a digital Bangladesh, the rate of assistance from the government and NGOs for students participating in online classes during the COVID-19 epidemic was insignificant [50].

Numerous studies [29–32] have examined the advantages and disadvantages of student smartphone usage. However, there are a limited number of studies that investigate the impact of student smartphone use at the secondary level in a developing country such as Bangladesh. Furthermore, there has been insufficient research on how the government and NGOs can effectively support students in a technologically friendly environment.

3 METHOD AND MATERIALS

3.1 Study area and settings

The present study collected primary data from secondary school students in two rural Upazilas, Shibpur and Belabo, in the Narsingdi district, as well as two urban regions, Dhanmondi and Mirpur, in Bangladesh's Dhaka district. Shibpur and Belabo were selected as representative rural communities due to their typical socioeconomic characteristics, population density, and educational infrastructure. The study locations were chosen to maximize the generalizability of the findings to other rural areas in Bangladesh. Dhaka, on the other hand, is known for its dense concentration of educational institutions, including some of the country's highest-ranked secondary schools. The selection of Dhanmondi and Mirpur locations for data collection provides insight into students' educational experiences in urban districts in Bangladesh. To achieve the research aims of the study, data had to be collected from both rural and urban locations.

3.2 Sample size and participant recruitment

Using a quantitative cross-sectional research methodology, the primary data for this study were collected from secondary school students in both urban and rural areas across different districts of Bangladesh. A study was conducted following the instructions of the study to develop a self-administered, semi-tailored computerized questionnaire [51]. The questionnaire, designed and refined by professionals in quantitative research, consisted of 28 questions categorized into four areas: sociodemographic data, using a smartphone for academic purposes, challenges and limitations of smartphone usage, and the participation of GOs, NGOs, and institutions. The sample size for this study was calculated using a single proportion formula based on the following assumptions: 50% of students expressed a desire to utilize COVID-19 prevention measures, with a 95% level of confidence and a 5% margin of error [52].

$$N = \frac{\left(Z\frac{\alpha}{2}\right)^2 P(1-P)}{(d)^2} = \frac{(1.96)^2 * 0.5(1-0.5)}{(0.05)^2} = 384$$

Where N represents the required sample size, α denotes the level of significance, z represents the value on the standard normal distribution curve for a 95% confidence level (which is 1.96), p represents the proportion of intention for adapting to the "new normal" COVID-19 prevention practice, and d represents the margin of error.

3.3 Quantitative data collection and instrument

A cross-sectional survey was conducted between June 1 and September 30, 2022, to achieve the objectives of the study. A multistage sampling technique was employed to identify potential study participants, with a specific focus on recruiting students. A sample size of 384 students was chosen as participants for the survey. The survey consisted of a total of 28 main questions, which were systematically divided into four distinct sections: socio-demographic information, the use of smartphones for academic purposes, the challenges and limitations related to smartphone usage, and the participation of GOs, NGOs, and academic institutions. A group of eight research assistants, all of whom possessed at least a bachelor's degree, underwent training in research ethics and were then involved in the data collection process. The KOBO toolbox program was used to create the questionnaire and collect data through a structured questionnaire.

3.4 Data analysis procedure, validity, and reliability

The data analysis was conducted using the statistical package for the social sciences (SPSS version 26). The researchers used descriptive statistical analysis to examine the basic socio-demographic variables and academic information in order to address the research questions. As a result of the inherent ordinal nature of the data obtained through the utilization of a Likert-type scale encompassing a 5-point continuum (ranging from 1 denoting "Strongly Agree" to 5 indicating "Strongly Disagree") to assess the advantages of smartphones in the context of education, several non-parametric analyses were conducted. These analyses aimed to examine the disparities between various demographic and academic variables among students, as well as their perspectives on the benefits and challenges of using smartphones in the classroom. The study employed M-W U tests to examine student perspectives on the advantages and disadvantages of smartphone usage. The variables considered in the analysis included gender, education level, and geography [53]. The M-W U test was chosen as the most suitable method for comparing skewed ordinal data between two independent groups. The test's ability to determine if there is a significant difference between the average ranks of two groups enhances its overall value. The hypothesis being investigated is the null hypothesis, which states that there is no significant difference in the attitudes of the groups regarding the advantages and challenges associated with the use of smartphones in an academic setting. The null hypothesis is considered statistically significant and rejected when the p-value is found to be less than 0.05 ($p < 0.05$). If the conditions are not met, it is generally acknowledged that there is no discernible distinction between the groups, thus supporting the validity of the null hypothesis. Multiple regression analysis (MR), often referred to as MLR, is a robust approach for investigating the associations among multiple independent variables (also known as predictors) and a single dependent variable (or criterion) [54]. This analysis facilitates understanding the relationship between the function of GOs, NGOs, and institutions (dependent variable) and the use of smartphones for academic purposes, addressing technological challenges, and the expenses related to Internet access (independent variables).

3.5 Ethical approval and consideration

The current study received ethical approval from the Institutional Ethical Review Board (Protocol No. Ethics/foaud5/2022) associated with the Faculty of Humanities and social sciences at Daffodil International University, located in Dhaka – 1216, Bangladesh. Throughout the study, the researchers ensured the preservation of the respondents' identity. Prior to each interview, the participants were explicitly requested to provide their consent and were informed of their right to withdraw from the study at any given time without facing any adverse consequences.

4 RESULTS

4.1 Demographic profile of the respondents

A total of 384 students participated in the survey. According to the data shown in Table 1, a significant proportion of participants (56.3%) identified as male. A significant proportion of participants (68.2%) belong to the 8th–10th grade range. In contrast, it is observed that 29.9% of the participants are located in rural regions, while the majority, comprising 70.1%, are situated in metropolitan areas. Nearly 69% of individuals who use smartphones engage with them on a near-constant basis. Approximately 47.1% of the respondents used their smartphones to access online classes. The respondents (65.4%) said that the teachers consistently provided learning resources on smartphones. Approximately 50.8% of the participants reported frequently using their smartphones to submit or receive homework assignments and other academic tasks. A significant proportion of participants (54.2%) frequently used their smartphones for examination purposes.

Table 1. The demographic and academic characteristics of respondents, as well as their smartphone usage

Variable	Options	Frequency	Percentage (%)
Gender	Male	216	56.3
	Female	168	43.8
Class	6–8	122	31.8
	8–10	262	68.2
Location	Rural area	115	29.9
	Urban area	269	70.1
How long do you use a smartphone?	Never	0	0
	Almost never	0	0
	Occasionally	43	11.2
	Frequently	76	69.0
	Almost every time	265	19.8
Do you attend online classes via smartphone?	Never	0	0
	Almost never	0	0
	Sometimes	37	9.6
	Almost every time	181	47.1
	Every time	166	43.2

(Continued)

Table 1. The demographic and academic characteristics of respondents, as well as their smartphone usage *(Continued)*

Variable	Options	Frequency	Percentage (%)
Do you receive learning materials on smartphones provided by the teachers?	Never	0	0
	Rarely	0	0
	Occasionally	37	9.6
	Often	96	25
	Always	251	65.4
Do you use your smartphone to receive and submit homework or assignments?	Never	0	0
	Rarely	0	0
	Occasionally	53	13.8
	Often	195	50.8
	Always	136	35.4
Do you sit for examinations on your smartphone?	Never	0	0
	Rarely	18	4.7
	Occasionally	82	21.4
	Often	208	54.2
	Always	76	19.8

4.2 The advantages of using smartphones in academic settings

Gender-based analysis. The results of a M-W U test comparing male and female students' perceptions of the benefits of using smartphones for academic purposes are shown in Table 2. The test results indicate that there were significant disparities in four out of the five scores. Male students had high mean rank ratings across the board, indicating that they utilized smartphones to enhance their skills and engage in class-related discussions. As a result, male students benefit more from smartphone use in terms of academic achievement compared to female students.

Table 2. M-W U test based on gender

Participants Opinion	Gender	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Makes it easier to search for information relevant to my studies	Male	216	201.25	43470.50	14484	0.046*
	Female	168	181.25	30449.50		
	Total	384				
Improves my study skills	Male	216	202.96	43840.00	15026	0.019*
	Female	168	179.05	30080.50		
	Total	384				
Makes it easier to access and complete my studies	Male	216	198.36	42846.00	16277.5	0.197
	Female	168	184.96	31074.00		
	Total	384				

(Continued)

Table 2. M-W U test based on gender *(Continued)*

Participants Opinion	Gender	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Makes it easier to participate in class-related discussions	Male	216	182.59	39440.00	14216	0.031*
	Female	168	205.24	34480.00		
	Total	384				
Increases my motivation towards completing my studies	Male	216	205.66	44422.50	16669.5	0.002*
	Female	168	175.58	29497.50		
	Total	384				

Note: *Significant at $p < 0.05$.

Educational level-based analysis. Table 3 presents the findings of a M-W U test, which compares the viewpoints of two students' groups regarding the advantages of utilizing smartphones for educational purposes. The test results revealed significant disparities in four out of the five scores. Students in the 8th to 10th grade class received higher mean rank scores than those in the 6th to 8th grade class, indicating a preference for using smartphones for academic purposes. As a result, students in the 8th to 10th grade benefit more from smartphone use in terms of academic achievement than students in the 6th to 8th grade.

Table 3. M-W U test based on educational level

Participants Opinion	Class	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Makes it easier to search for information relevant to my studies	6–8	122	202.47	24701.50	14765.50	0.171
	8–10	262	187.86	49218.50		
	Total	384				
Improves my study skills	6–8	122	214.56	26176.00	13291.00	0.003*
	8–10	262	182.23	47744.00		
	Total	384				
Makes it easier to access and complete my studies	6–8	122	168.14	20513.00	13010.00	0.001*
	8–10	262	203.84	53407.00		
	Total	384				
Makes it easier to participate in class-related discussions	6–8	122	142.41	17374.50	9871.50	<0.001*
	8–10	262	215.82	56545.50		
	Total	384				
Increases my motivation	6–8	122	172.97	21102.50	13599.50	0.005*
Assists in completing my studies	8–10	262	201.59	52817.50		
	Total	384				

Note: *Significant at $p < 0.05$.

Location-based analysis. There were significant differences in three out of every five situations, according to the results (Table 4) of a M-W U test comparing student attitudes on the benefits of using smartphones for academic reasons based on their location. Students from urban areas outperformed students from other areas on average. This suggests that the use of smartphones enhanced their motivation to complete their studies, improved their skills, and encouraged them to participate in class-related discussions. As a result, students in urban regions benefit more from using smartphones in terms of academic achievement than students in rural areas.

Table 4. M-W U test based on location

Participants Opinion	Location (Area)	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Makes it easier to search for	Rural	115	190.48	21905.50	15235.50	0.791
Information relevant to my studies	Urban	269	193.36	52014.50		
	Total	384				
Improves my study skills	Rural	115	189.76	21822.50	15152.50	0.724
	Urban	269	193.67	52097.50		
	Total	384				
Makes it easier to access and complete my studies	Rural	115	162.58	18697.00	12027.00	<0.001*
	Urban	269	205.29	55223.00		
	Total	384				
Makes it easier to participate in class-related discussions	Rural	115	171.59	19733.00	13063.00	0.009*
	Urban	269	201.44	54187.00		
	Total	384				
Increases motivation towards completing studies	Rural	115	167.87	19305.00	12635.00	<0.001*
	Urban	269	203.03	54615.00		
	Total	384				

Note: *Significant at $p < 0.05$.

4.3 Problems and challenges of using smartphones in academia

Gender-based difficulties. Table 5 compares the impressions of male and female students regarding the problems and issues associated with using smartphones for academic purposes using a M-W U test. The test findings revealed significant differences in four out of the five scores. According to the mean rank ratings, male students faced more difficulties and challenges when using smartphones for academic work compared to female students.

Table 5. M-W U test based on gender

Participants Opinion	Gender	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Facing technological problem	Male	216	183.43	39620.00	16184.00	0.020*
	Female	168	204.17	34300.00		
	Total	384				
Expensive to maintain Internet cost	Male	216	204.39	44148.50	15575.50	0.008*
	Female	168	177.21	29771.50		
	Total	384				
Sleeping disorder	Male	216	207.52	44824.00	14900.00	0.001*
	Female	168	173.19	29096.00		
	Total	384				
Mental disorder	Male	216	175.13	37829.00	14393.00	<0.001*
	Female	168	214.83	36091.00		
	Total	384				
Difficulty running a smartphone due to technological orientation	Male	216	192.73	41629.50	18094.50	0.960
	Female	168	192.21	32290.50		
	Total	384				

Notes: *Significant at $p < 0.05$.

Educational level-based difficulties. The results of a M-W U test comparing the opinions of students in two classes on the challenges and concerns related to using smartphones for educational purposes are presented in Table 6. The test findings indicated statistically significant differences in two out of the five scores. The mean rank scores of the students indicated that the 6th to 8th grade class had higher scores compared to the 8th to 10th grade class. These results suggest that students encountered challenges related to technological literacy, sleep, and mental health conditions. The use of smartphones for academic purposes has a more negative impact on students in the 6th to 8th grade compared to their peers in the 8th to 10th grade.

Table 6. M-W U test based on educational level

Participants Opinion	Class	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Facing technological problem	6–8	122	175.18	21371.50	13868.50	0.007*
	8–10	262	200.57	52548.50		
	Total	384				
Expensive to maintain Internet cost	6–8	122	181.38	22128.50	14625.50	0.139
	8–10	262	197.68	51791.50		
	Total	384				
Sleeping disorder	6–8	122	202.87	24750.50	14716.50	0.172
	8–10	262	187.67	49169.50		
	Total	384				

(Continued)

Table 6. M-W U test based on educational level *(Continued)*

Participants Opinion	Class	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Mental disorder	6–8	122	213.87	26092.00	13375.00	0.004*
	8–10	262	182.55	47828.00		
	Total	384				
Difficulty running a smartphone due to technological orientation	6–8	122	202.82	24744.50	14722.50	0.172
	8–10	262	187.69	49175.50		
	Total	384				

Note: *Significant at $p < 0.05$.

Location-based problems. An M-W U test (Table 7) was conducted to assess student perspectives on the challenges associated with using smartphones for academic purposes, taking into account their respective locations. The results indicated statistically significant differences in three out of five cases. Students from remote regions consistently showed higher average rank ratings, indicating that they faced challenges related to technological limitations, increased expenses for Internet connectivity, and difficulties in using cell phones. The use of cell phones, especially for academic purposes, poses greater challenges for students residing in rural areas compared to their urban peers.

Table 7. M-W U test based on location

Participants Opinion	Location	N	Mean Rank	Sum of Ranks	M-W U	Asymp. Sig (two-tailed)
Facing technological problem	Rural area	115	174.20	20033.50	13363.5	0.007*
	Urban area	269	200.32	53886.50		
	Total	384				
Expensive to maintain Internet cost	Rural area	115	199.60	22954.50	14650.5	0.365
	Urban area	269	189.46	50965.50		
	Total	384				
Sleeping disorder	Rural area	115	216.66	24916.00	12689.0	0.002*
	Urban area	269	182.17	49004.00		
	Total	384				
Mental disorder	Rural area	115	208.34	23959.50	13645.5	0.041*
	Urban area	269	185.73	49960.50		
	Total	384				
Difficulty running a smartphone due to technological orientation	Rural area	115	181.26	20845.00	14175.0	0.154
	Urban area	269	197.30	53075.00		
	Total	384				

Note: *Significant at $p < 0.05$.

4.4 MLR analysis considering stakeholders' role

The dependent variable in this analysis is the role of various stakeholders, such as GOs, NGOs, and EIs. The analysis focuses on their involvement in using a

smartphone for academic purposes, addressing technological issues, and covering the cost of Internet access. Using a smartphone for academic purposes increases the significance of GOs, NGOs, and EIs by 30%. Overcoming technological challenges enhances their value by 16%, while the expense of Internet connectivity amplifies their importance by 32%. The independent variable is considered statistically significant when the t-value exceeds 2 and the p-value is less than 0.05. All p-values in this study are less than 0.05, and all t-values are greater than 2 (refer to Table 8 and equation 2). It indicates the statistical significance of each independent variable. This analysis shows that as the use of smartphones for academic purposes increases and Internet costs rise, the involvement of GOs, NGOs, and EIs also increases. On the other hand, the emergence of technical issues expands the role of GOs, NGOs, and EIs on a smaller scale.

Table 8. MLR analysis

Variables	Beta Coefficient	t-value	p-value
Using Smartphones for Academic purposes	0.304	4.241	<0.001
Facing Technological Problems	0.160	2.372	0.018
Internet Cost	0.318	4.320	<0.001

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

$$Y = 1.995 + 0.304X_1 + 0.160X_2 + 0.318X_3$$

t-value = (3.963) ** (4.241) ** (2.372) ** (4.320) **

p-value = (0.001) * (0.001) * (0.018) * (0.001) *

Here,
Y = Dependent Variable (Role of GOs, NGOs, and EIs)
X = Independent Variables where,
X_1 = Using Smartphones for Academic Purposes
X_2 = Facing Technological Problems
X_3 = Internet Cost
α = Intercept
β = Slope coefficient

5 DISCUSSION

In Bangladesh, the use of mobile phones for various reasons, including education, has expanded in recent years [53]. However, the advantages of smartphone use vary by gender, educational level, and rural-urban region [1]. In this scenario, research found that male students (56.3%) used smartphones more frequently and encountered more problems and challenges. By utilizing smartphones, 68.2% of students in the 8th to 10th grade class and 70.1% of urban students enhanced their motivation to complete their studies, improved their skills, and participated in class-related discussions. This suggests that using smartphones for academic purposes benefits students. Similar findings on age, gender, and socioeconomic inequalities in relation to the UK reveal that boys start using the Internet at a younger age (16–19 years) compared to girls [56]. Hasudungan et al. [42] discovered that students who live in

cities and have educated parents spend their time more effectively than those who live in rural areas, especially when learning remotely using smartphones and other technological devices.

Students' academic success and motivation can possibly be enhanced through the use of mobile devices to acquire knowledge [38]. However, it also posed some challenges and obstacles for the students, particularly those in secondary school. In this regard, we found that 6th to 8th graders (31.98%) and rural students (29.9%) encountered more challenges and barriers, such as technical issues, sleep and psychiatric disorders, and higher Internet costs, when using smartphones for academic purposes. Therefore, it is possible to say that the use of smartphones has a negative impact on academic performance. Monika and Rahman [55], who investigated the use of mobile phones for educational purposes among secondary pupils in rural areas, discovered similar results. In addition, several researchers [13] [32] [44–48] have demonstrated the challenges and concerns related to the use of smartphones in educational settings.

Due to network difficulties and equipment shortages, implementing distance learning can be challenging in various scenarios [42]. There is a digital divide between developing and developed countries, with the Global South having the least developed digital infrastructure [56] [58] [59]. Distance learning works well with a robust internet connection, familiar professors and students, smartphones, and Internet constraints [42]. However, the study indicated that GOs, NGOs, and institutions lose influence when technological issues become more sophisticated. In contrast, GOs, NGOs, and institutions increase smartphone subsidies to reduce Internet costs and promote academic smartphone usage. Similar results were found in a study conducted by Chukwuma et al. [57]. They discovered that the government provides subsidies for mobile health applications in order to address financial obstacles.

6 CONCLUSIONS AND IMPLICATIONS

Data from a cross-sectional quantitative study of 384 secondary school students in Bangladesh was analyzed to provide insights into this subject. Students in grades 8th to 10th exhibited a stronger tendency to utilize cell phones for educational purposes, and male students were more confident than female students in using smartphones for academic purposes. In addition, learners in urban areas were more enthusiastic about using smartphones for schoolwork, while those in rural areas faced greater challenges in adapting to this new technology. This research elucidates the complexities of students' smartphone use for school in developing nations and emphasizes the importance of addressing potential barriers and gender imbalances to successfully integrate smartphones into the educational landscape. This study is noteworthy for several reasons. It provides educational policymakers with information on how secondary-level pupils use cell phones, helping them determine whether these devices aid or impede academic progress. This research may also assist teachers in adapting their practices to incorporate smartphone-friendly devices. It also examines levels of digital literacy, discusses the involvement of families and schools in smartphone regulation, and provides methodological insights through its non-parametric technique. It contributes to a global understanding of smartphone use in education by comparing data from various regions, which has potential long-term implications for higher education and workforce readiness.

Nonetheless, it is critical to recognize that this research study does have certain limitations. The investigation was conducted solely using quantitative methods.

Future studies could involve qualitative or mixed-method approaches, as qualitative research typically provides extensive and nuanced insights into the subject at hand.

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8 CONFLICT OF INTEREST

The researchers affirm that there were no financial or commercial ties that could be perceived as a potential conflict of interest during the execution of the research.

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