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Smartphone usage and academic performance: A cross-sectional investigation among statistics students at MBSTU

Sharmin Sultana ¹, Md. Ruknuzzaman ², Md. Ayub Ali ¹, Aysha Seddeque ³, Salma Siddiqua ⁴, Nibas Kumar Pal ¹ and Samiul Islam ^{2,*}

¹ Department of Statistics, Faculty of Science, University of Rajshahi, Bangladesh.

² Department of Statistics, Faculty of Science, Mawlana Bhashani Science and Technology University, Bangladesh.

³ Department of General Education, Faculty of Social Science, Northern University of Business & Technology Khulna, Bangladesh.

⁴ Department of Statistics, Faculty of Science, Khulna University, Bangladesh.

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Abstract

Our research aimed to investigate the influence of smartphone usage on academic performance among statistics students at Mawlana Bhashani Science and Technology University (MBSTU), focusing on usage patterns, self-regulation, and associated academic and health outcomes. Data were collected from 102 undergraduate and postgraduate students using a stratified random sampling technique and a structured questionnaire covering demographics, smartphone habits, study behaviors, and academic results. Descriptive statistics revealed that smartphone usage is nearly universal, with daily use ranging from 2 to 15 hours (mean = 6.52, SD = 2.57), and students reported moderate ability to study effectively with smartphones but better study quality without them. Stepwise regression analysis showed that purposeful use of smartphones for academic activities was positively associated with academic performance, while excessive or non-academic use—especially during study sessions or late at night—was linked to reduced concentration, disrupted study habits, and lower academic achievement. Health-related issues, such as sleep disturbances, neck pain, and mental stress, were also prevalent among frequent users. The final regression model explained 58.2% of the variance in academic results, highlighting that the context and intent of smartphone use are more influential than total usage time. These findings support previous research indicating both the benefits and risks of smartphone integration in academic life, while offering discipline-specific insights for statistics education at MBSTU. Overall, this research provides targeted insights for educators and students, emphasizing the dual role of smartphones as both valuable academic tools and potential sources of distraction and health risk.

Keywords: Academic Performance; Stratified Random Sampling; Self-Regulation; Stepwise Regression Analysis; Sleep Disturbances; Mental Stress

1. Introduction

Smartphone usage has become an essential part of daily life, particularly among university students, who frequently use them for academic and non-academic purposes [1]. The rapid advancement of information technology has resulted in smartphones forming an integral part of modern education, and their influence on the way students communicate, search for knowledge, and get involved in academic life has become profound. Also, the rise of smartphones has changed the way in which users interact with technology, bringing about opportunities and challenges [2], [3], [4]. The fact that students are using smartphones at school and on campus has really characterized post-secondary education today. In addition, smartphones had been highly owned by almost all the university students in recent years when the rapid

* Corresponding author: Samiul Islam.

growth of the internet and the usage of Internet-enabled mobile device have made a smartphone become a primary source to access information, communicate with people, and learning activities [4], [5], [6]. Those students choosing to specialize in statistics are particularly advantageous, as they bring access to statistical software, online databases, and collaborative platforms needed to learn complex quantitative concepts at their fingertips. Nevertheless, the increasing use of smartphones is also associated with worries about distraction, limited ability to focus, and negative effects on education [7], [8], [9].

Smartphone usage among university students is nearly ubiquitous, and its influence on academic performance has been the subject of extensive research. Smartphones have numerous versatile functions, particularly among university students as tools of communication, education, and entertainment [10]. Although some research has pointed out the positive effects of using mobile technologies for education e.g., better access to learning resources, enhanced communication and more flexible learning [5], [6], [11] and others show the risks of misuse or too much use of this technology, such as distraction, procrastination, and lower academic performances [1], [4], [12]. The timing and the context of smartphone use also matter; late use or use during class are linked to negative academic achievements, while strategic and mindful use can lead to better performance [4], [13]. However, the increasing worry following the use of smartphones and their negative effects on students' GPAs is still one of the pressing issues in educational research [14]. Smartphones have become a norm on college campuses and are used by students for various reasons: access to educational materials, for communication and interacting with colleagues, online participation in discussions, and dealing with their academic time schedules [3], [15]. Smartphones offer valuable educational resources, but at the same time present distractions that could deter the ability to concentrate and stay focused in studying [8]. While these technological advancements are beneficial, there are some concerns about the adverse effects of the heavy reliance on smartphones, especially on academic achievement [3].

A substantial body of literature has examined the relationship between smartphone usage and academic performance. Meta-analyses and systematic reviews repeatedly show that PSU is negatively associated with academic achievement, but the magnitude of the effect tends to be small [8], [14], [16]. For instance, a researcher conducted a meta-analysis of 29 studies with 48,490 students and reported a small, yet significantly negative ($r = -0.110$) relationship between PSU and academic achievement, with even larger effects for younger students [8]. In common, it is found that heavy smartphone usage mainly for non-academic purposes led to lower academic achievement of students because of the distraction and time displacement [14].

The exploration of the influence of smartphone use on academic performance among undergraduate students at four tertiary institutions in Northwestern Nigeria [17]. They discovered that smartphones are highly integrated into the academic lives of the students but also present challenges. Their study found that an overwhelming majority (97.22%) of respondents used smartphones primarily for making calls, and most of them (98.23%) utilized them to chat with friends and family via apps like WhatsApp, indicating their key role in social communication. Notably, 76.26% of respondents also use smartphones for academic purposes, including reviewing materials and accessing online information, highlighting the dual roles of these devices in social and academic contexts. However, the study identified significant challenges: 74.24% of students reported a lack of ICT infrastructure, and 74.75% cited insufficient understanding of how to use smartphones for learning as major barriers. Nonetheless, the majority of participants (81.31%) believed they spent more time studying than on smartphones, and that smartphones facilitated their acquisition of material to aid in learning (86.11%). Regarding daily usage, 41.92% of students used their smartphones for 3–4 hours per day, 26.92% for 5–6 hours, and 17.93% for more than 6 hours, suggesting that excessive and uncontrolled use might lead to distraction.

Longitudinal evidence on the causal effect of smartphone use on academic performance is supplied by studies investigating repeated measures of smartphone use (and other related aspects of mobile phone use) and gold standard measures of academic performance. Three years of data on Belgian university students was studied, and they reported that the more students used their smartphones, the less likely they were to pass exams and their exam scores were lower [13]. Laboratory investigation found that even though students used their phones at nearly equal rates, students who used their phones in lectures performed poorly on assessments; these findings emphasize the negative effects of multitasking and distraction [1], [12].

However, when smartphones are used for educational purposes, e.g., to access academic materials, attend online discussion and use productivity apps, they have been found to enhance academic performance [5], [6], [15]. It has been discovered that having profound self-regulation skills and high smartphone self-efficacy can enhance how students use these devices for academic purposes [11], [18], [19].

Nevertheless, the downsides of smartphone addiction are now well-documented. Also some researcher observed that smartphone addiction positively correlated with higher academic-anxiety, procrastination, and lower academic performance [16], [20], [21]. A study showed that the academic anxiety is a full mediating mechanism between smartphone addiction and academic performance but the academic control is a moderator in this association [16]. Indeed, students who cannot control their use of smart phones seem to have impaired cognitive processes, limited ability to concentrate and problems with critical thinking [4], [7], [9].

The effects of smartphone engagement also depend on context and subject. For instance, the use of smartphones among students at a business and statistics school might be distinctive, and the influences of smartphones could have been moderated by other factors like self-regulation, attention, and the curriculum requirements [4], [11], [22]. However, despite such an understanding, little is known about the experiences of statistics students in institutions such as MBSTU.

Significant deficiencies persist for statistics pupils at Mawlana Bhashani Science and Technology University, notwithstanding the heightened study on university students' smartphone and internet utilization. Primarily, the majority of research concerning smartphone or internet use and academic performance has focused on extensive student populations or certain disciplines such as medicine, commerce, or social sciences [2], [23], [24]. Research from MBSTU indicates that internet use for academic purposes enhances academic performance, but non-academic usage detracts from it [23]. Statistics students need certain software, data analysis instruments, and collaboration platforms that may influence their smartphone utilization for both academic and non-academic activities. These results fail to meet their requirements. Secondly, the majority of research on smartphone and internet use employs quantitative methodologies, such as self-reported surveys and regression analyses [2], [23], [25]. These strategies are advantageous; yet, they may neglect the ways in which children learn, manage distractions, and self-regulate in relation to cellphones. Mixed-methods research, integrating surveys with interviews or observational data, is advocated for a more comprehensive analysis of smartphone use, however it is hardly employed in statistics courses [25]. Self-regulation moderates the academic impact of smartphone use, representing a third gap [4], [26]. Certain studies indicate that self-regulation may mitigate smartphone distractions, although little research has investigated how statistics students acquire and use self-regulation. Academic success depends on the ability to set explicit goals, prioritize scholarly tasks, and resist non-academic smartphone use during study periods; nevertheless, the mechanisms via which self-regulation affects smartphone-related academic performance in certain student populations remain unclear [26].

The objective of this study is to investigate the influence of smartphone usage on the academic performance of statistics students at MBSTU. By examining smartphone usage patterns, self-regulation strategies, and their association with academic outcomes, this study aims to provide targeted insights that can inform educational interventions and policies for statistics students. Specifically, the study seeks to assess the extent of smartphone usage among these students, including total time spent, usage during study or class hours, and engagement in social media and gaming. Additionally, the study will explore students' perceptions and behaviors related to smartphone use, including its impact on sleep, concentration, physical discomfort, and emotional dependency. Another key objective is to analyze the relationship between smartphone usage patterns and academic outcomes. Furthermore, the research will determine whether high smartphone usage correlates with changes in study habits, reduced academic focus, or lower academic performance. The study will also identify demographic or lifestyle factors, such as age, gender, rural/urban background, and exercise habits, that may influence the relationship between smartphone usage and academic performance. Finally, the research aims to provide recommendations for both students and educators on promoting healthy smartphone habits that support academic success. Hence, in this study, the research questions are

- RQ1: What is the relationship between smartphone usage and academic performance among statistics students at Mawlana Bhashani Science and Technology University in Bangladesh?
- RQ2: Which patterns of smartphone use, including bedtime use, class use, social media, and gaming, are most associated with academic decline?
- RQ3: Do students believe that smartphone usage affects their academic focus and time management?
- RQ4: What physical or psychological effects, such as sleep disturbance, neck pain, and anxiety, are associated with frequent smartphone use among students?

The remaining part of the study is organized as follows: Section 2 contains the materials and methodology, including a description of the dataset, different statistical tests, and an overview of the evaluation criteria for those statistical tests. Section 3 presents the results of analyzing the example dataset. Section 4 summarizes the concluding remarks and outlines directions for future research.

2. Material and Methods

2.1. Description of Data Set

The study population comprised all undergraduate and postgraduate students in the Department of Statistics at Mawlana Bhashani Science and Technology University (MBSTU) in Bangladesh. From this population, a sample of 102 students was obtained to investigate the influence of smartphone usage on academic performance. A stratified random sampling technique was employed to ensure the sample accurately represented key subgroups (e.g., each year of study). Specifically, students were divided into strata based on their academic year, and participants were then randomly selected from each stratum in proportion to the size of the stratum. There were five strata in total: 1st-year undergraduate, 2nd-year undergraduate, 3rd-year undergraduate, 4th-year undergraduate, and 5th-year postgraduate students. The final sample of 102 students provided adequate representation for both descriptive and inferential analyses.

The stratified random sampling technique involves dividing the target population into distinct strata, with samples selected from each stratum either by simple or systematic sampling. The number of individuals selected from each stratum is either fixed or proportional to the size of the stratum in the population. In this study, the sample size from each stratum was proportional to the size of the stratum in the population, calculated using the formula:

$$n_i = \left(\frac{N_i}{N} \right) \times n$$

- n_i : Sample size to be taken from stratum i
- N_i : Population size of stratum i
- N : Total population size (sum of all N_i)
- n : Total desired sample size

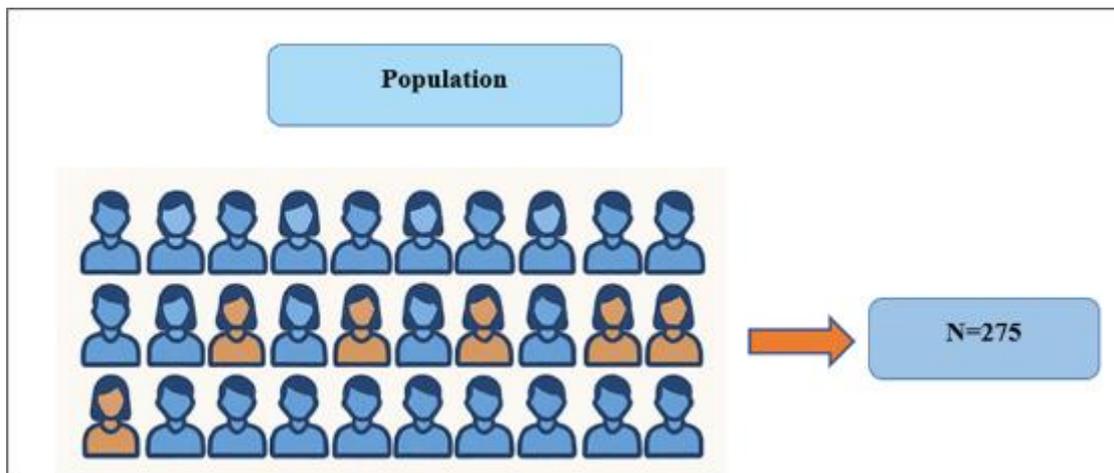


Figure 1 Students from department of Statistics at MBST

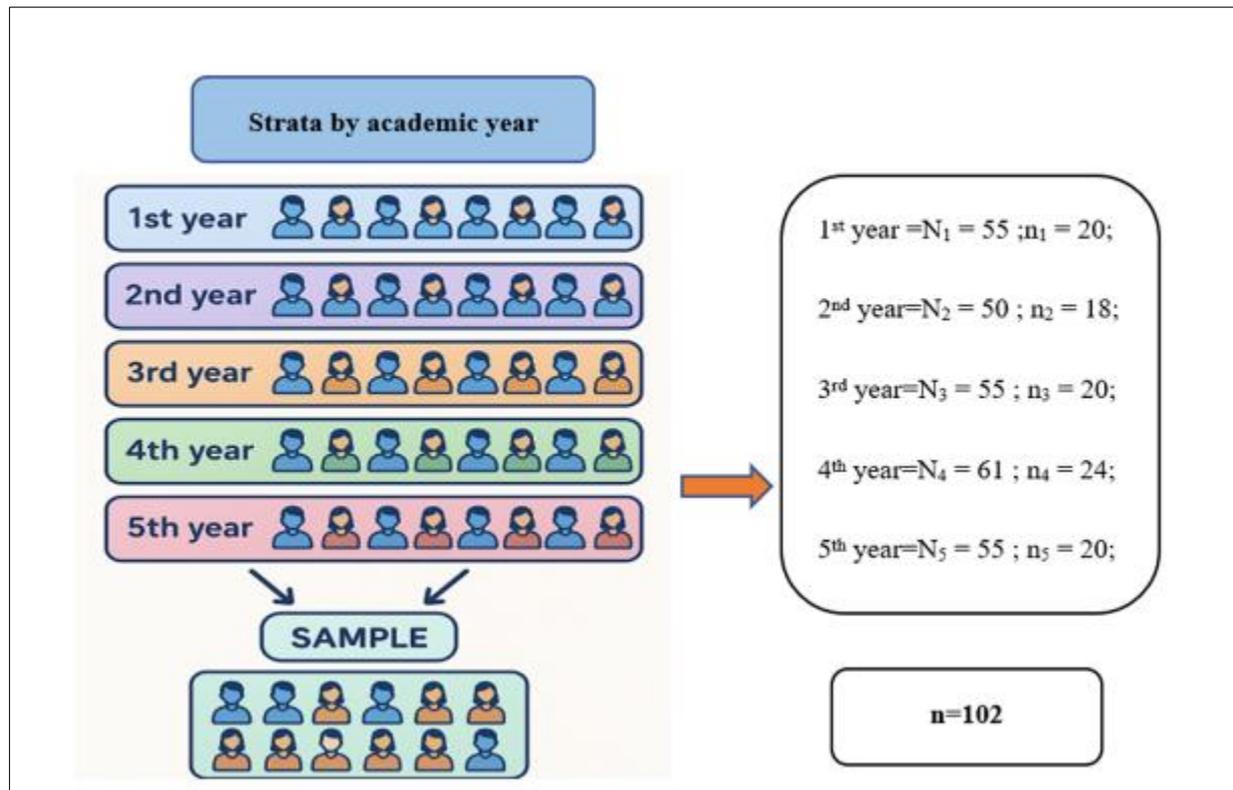


Figure 2 Stratified Sampling Diagram

2.2. Material Properties

This cross-sectional study examined the relationship between MBSTU Statistics students' academic performance and smartphone usage. A pre-designed questionnaire containing four sections—demographics, smartphone use, study habits, and indicators of academic achievement—was utilized to gather data. The questionnaire covered aspects of smartphone use such as social networking, gaming, learning, and other activities. The study evaluated students' academic performance, emotional stress, smartphone distractions, and sleep patterns.

Both closed-ended and open-ended questions were included in the survey. Participants were asked to record all aspects of their daily smartphone use, including social media, gaming, and schoolwork. Students were asked how often they used their smartphones for studying and how this affected their focus and performance. The additional survey examined people's mental stress levels, sleep habits, and the alleged negative impacts of smartphone use on academic performance, such as disturbed sleep and missed meals. To determine the effect of smartphone use on academic achievement metrics like GPA, focus, and study quality, the data were analyzed descriptively. The effects of cellphones on sleep disturbances, psychological stress, and distractions were evaluated. These studies aim to understand how university students' use of smartphones influences their academic performance.

2.3. Statistical Analysis

The data for this study were collected via a structured questionnaire and subsequently entered into SPSS (IBM, version 25) for comprehensive analysis. Descriptive statistics were first computed to summarize the demographic characteristics, smartphone usage patterns, study behaviors, and academic performance indicators of the participants. To assess the normality of the data distribution, the Shapiro-Wilk Test was conducted. The results indicated that the data approximated a normal distribution, as confirmed by the histograms and P-P plots. To examine the relationship between smartphone usage and academic performance, multiple statistical techniques were employed. Stepwise regression analysis was employed to identify the key predictors of academic performance, with a particular focus on smartphone usage time, frequency of social media engagement, and other relevant variables, including sleep quality and perceived distractions. Additionally, independent samples t-tests were performed to compare the academic performance (GPA) across different groups based on variables such as gender, smartphone usage during study hours, and sleep habits. These statistical analyses were used to uncover significant relationships between smartphone usage and academic performance among Statistics students at MBSTU.

2.4. Stepwise Regression Analysis

Stepwise Regression is a method to select the most significant variables for inclusion in a regression model. It combines forward selection and backward elimination techniques, making it a highly efficient approach for identifying key predictors in a model [27]. In this study, Stepwise Regression was employed to identify significant predictors of the Perfusion Index. The process begins with all potential predictor variables. Iteratively adds or removes variables based on specific criteria, such as the Akaike Information Criterion (AIC) or the Bayesian Information Criterion (BIC). This ensures that only the most relevant predictors remain in the final model, thereby improving the model's explanatory power and interpretability [28]. Below is an illustration [29] of the Stepwise Regression process, showing the forward selection and backward elimination steps. The process proceeds as follows

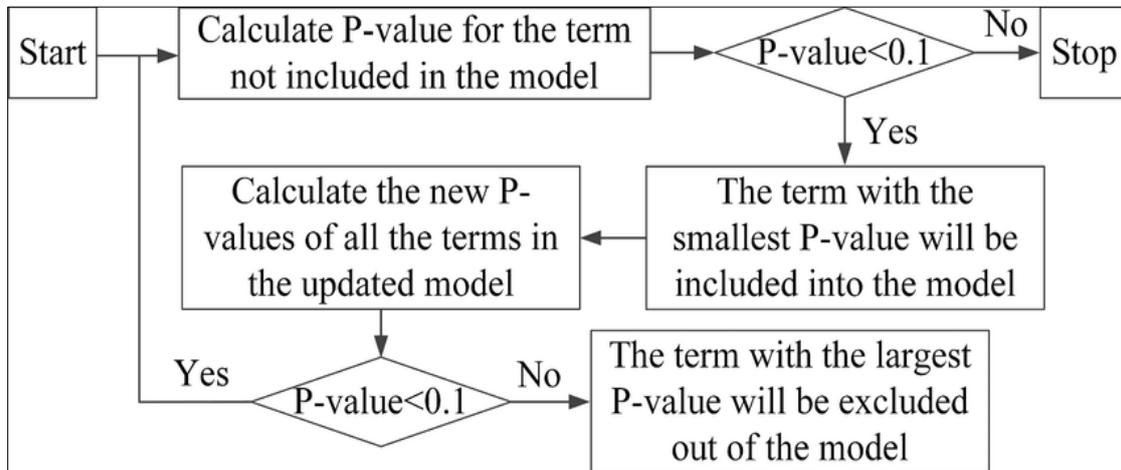


Figure 3 Stepwise Regression

- Forward Selection: The model starts with no predictors. Predictors are added one by one based on their significance.
- Backward Elimination: Starts with all predictors and removes those not statistically significant.

In Stepwise Regression, the inclusion or exclusion of predictors is determined based on the p-value of each variable, typically with a threshold of $p < 0.05$ for inclusion and $p > 0.10$ for exclusion [30]. This method helps identify the most important predictors while avoiding overfitting [31].

2.5. Association Test Analysis

To examine the associations between categorical variables, such as smartphone usage during study sessions and self-reported academic performance, the Chi-square test of independence was employed. This test is used to determine whether there is a significant association between two categorical variables. The formula for the Chi-square statistic is given by

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

where

- χ^2 is the Chi-square statistic,
- O_i represents the observed frequency for each category,
- E_i represents the expected frequency for each category.

The Chi-square test was applied to determine whether significant associations exist between categorical variables such as academic performance, including study quality and self-reported GPA. A p-value less than 0.05 was considered statistically significant, indicating that the observed frequencies differed significantly from the expected frequencies, suggesting an association between the variables under investigation.

3. Results and Discussion

The descriptive statistics in Table 1 provide an overview of smartphone usage and its perceived impact on academic performance among statistics students at MBSTU. The age of the participants ranged from 18 to 28 years, with an average age of 23.10 years (SD = 1.86), indicating that our sample represents a comparatively young student population. Regarding smartphone usage, students used their smartphones for 2 to 15 hours per day (M = 6.52 h, SD = 2.57), suggesting considerable variation in daily phone use. The number of mobile apps installed on their smartphones varied between 2 and 77, with a mean of 17.16 apps (SD = 15.74), demonstrating a wide range of smartphone engagement among respondents. In terms of the quality of study experience, students reported their ability to study effectively using a smartphone as moderate (mean = 5.73, SD = 2.09), which negatively affected academic focus. However, students indicated that study quality improved without utilizing the smartphone, with an average value of 6.67 (SD = 2.27), suggesting that, in general, students believe their study is better without the presence of a smartphone. These results highlight the various effects of smartphone use on students' academic experiences, as smartphones can influence not only study quality but also distractibility during academic tasks.

Table 1 Descriptive Statistics of Smartphone Usage and Study Quality Among Statistics Students at MBSTU

Variable	Minimum	Maximum	Mean	Standard Deviation
Age (years)	18	28	23.10	1.86
Phone use per day (in hours)	2	15	6.52	2.57
Number of mobile apps used	2	77	17.16	15.74
Study quality rating with smartphone	1.0	10.0	5.73	2.09
Study quality rating without smartphone	1.0	10.0	6.67	2.27

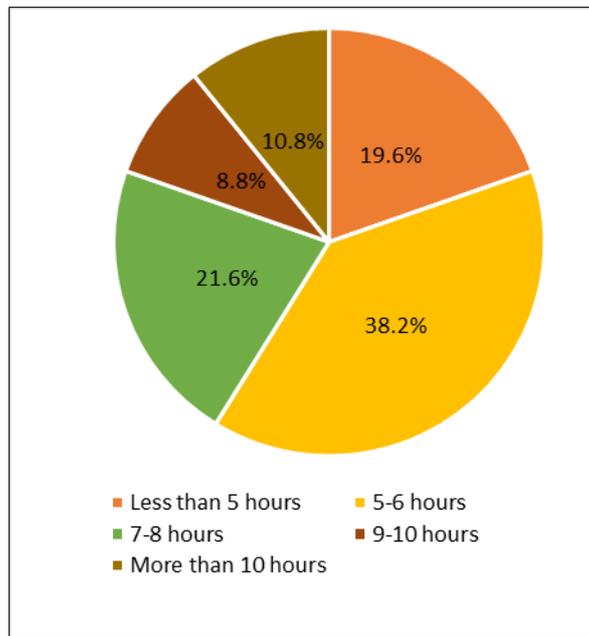


Figure 4 Total Duration of Mobile Phone Usage in a Day

Figure 4 illustrates the total duration of mobile phone usage in one day, represented through a pie chart. The data indicates that a significant portion of individuals (38.2%) use their mobile phones for more than 10 hours daily. The next largest group (21.6%) reports using their phones for 7-8 hours, while 19.6% spend 9-10 hours on their devices. Additionally, 10.8% use their phones for 5-6 hours, and 8.8% use them for less than 5 hours.

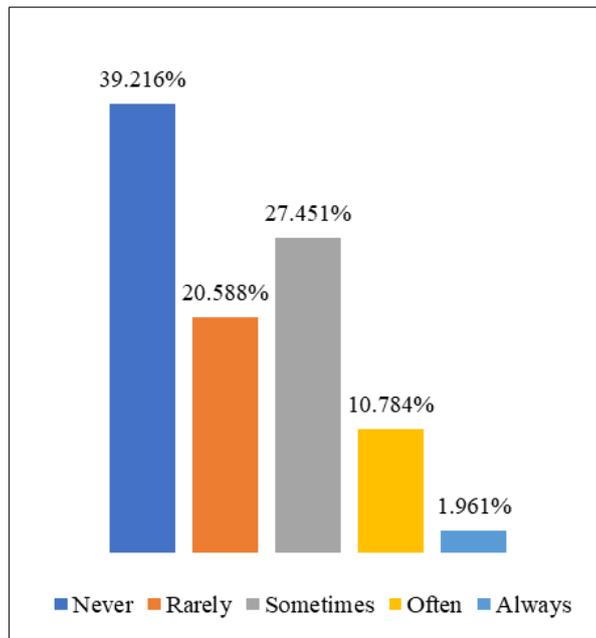


Figure 5 Use of smartphones during class time

Figure 5, a bar graph, depicts smartphone usage during class time. It reveals that 39.216% of individuals never use smartphones during class, with 27.451% reporting usage sometimes. Furthermore, 20.588% use their smartphones rarely, 10.784% use them often, and only 1.961% use them always. These figures highlight the varying patterns of mobile phone usage, both in general daily use and within the academic context.

Table 2 Frequency and Percentage Distribution of Health-Related Issues Among Smartphone Users

	Neck Pain		Insomnia		Sleep Disturbance		Mental Stress		Concentration Break	
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
Never	25	24.5	30	29.4	30	29.4	14	13.7	7	6.9
Rarely	27	26.5	39	38.2	39	38.2	26	25.5	16	15.7
Sometimes	32	31.4	16	15.7	16	15.7	31	30.4	28	27.5
Often	10	9.8	9	8.8	9	8.8	21	20.6	30	29.4
Always	8	7.8	8	7.8	8	7.8	10	9.8	21	20.6

The table 2 presents the frequency and percentage distribution of health-related issues, such as neck pain, insomnia, sleep disturbance, mental stress, and concentration breaks, among participants who use smartphones. It shows that those who report higher frequencies of smartphone use may experience a variety of health-related concerns. For instance, neck pain was reported by 24.5% of participants as never experienced, while 26.5% reported it rarely. Those who use smartphones more frequently may face higher instances of neck pain, as excessive screen time and poor posture are common among smartphone users. Regarding insomnia, 38.2% of participants reported it rarely, with 15.7% reporting it sometimes. Frequent smartphone users often experience disrupted sleep patterns due to late-night screen exposure, which can negatively impact sleep quality. Sleep disturbance was reported as never occurring by 29.4% of participants, but a notable 38.2% experienced it rarely and 15.7% sometimes, suggesting that smartphone usage, particularly before sleep, may be linked to disturbances. Mental stress was reported frequently, with 30.4% of participants indicating it occurred sometimes, and 20.6% often, a common issue among individuals who are frequently on their phones due to work, social media, and communication pressures. Lastly, concentration breaks were

experienced by 29.4% of participants often and 27.5% sometimes, suggesting that smartphone distractions may significantly impact students' focus and academic performance. Overall, these findings highlight a clear association between smartphone usage and various physical and psychological issues, pointing to the potential negative effects smartphones may have on the well-being and concentration of users.

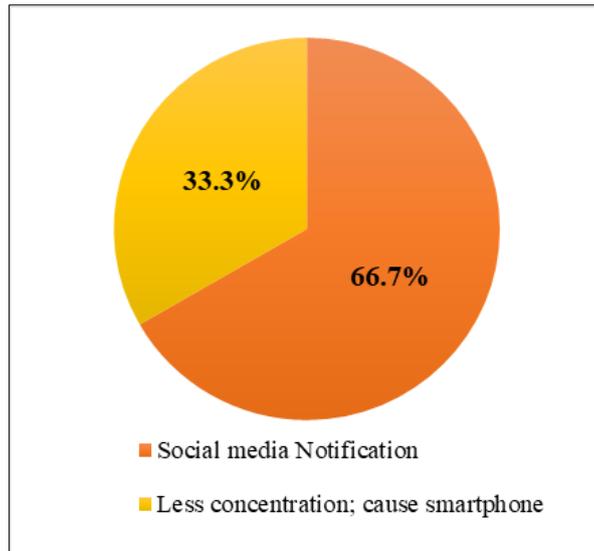


Figure 6 The biggest distraction while studying with a smartphone

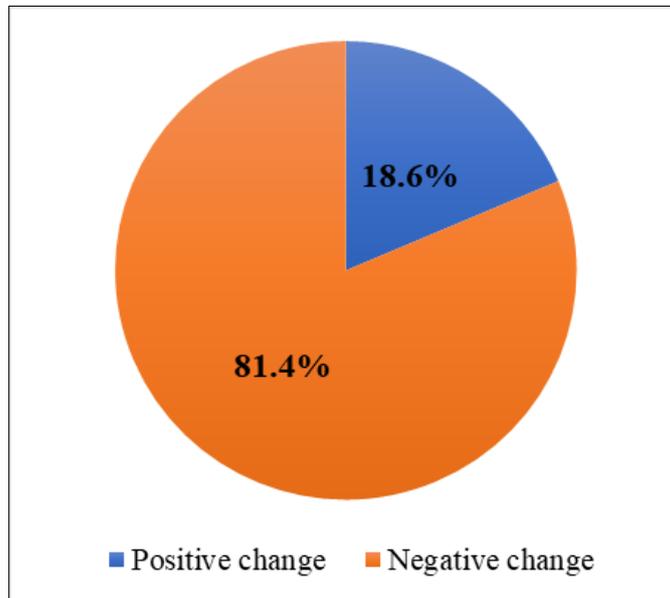


Figure 7 Notice changes in study habits after using a personal phone

The two pie charts presented in Figures 6 and 7 provide insights into the impact of smartphone usage on academic performance among students at MBSTU. Figure 6 depicts the primary distractions encountered by students while studying with a smartphone. The chart indicates that 66.7% of students perceive social media notifications as the biggest distraction, while 33.3% report that reduced concentration, attributed to smartphone use, is the primary cause of their study interruptions. Figure 7 explores the changes in study habits noticed by students after incorporating a personal phone into their study routines. A significant majority, 81.4%, observe a negative change in their study habits, whereas a smaller proportion, 18.6%, note a positive change. These findings underscore the substantial negative effect of smartphone usage on student concentration and academic habits, particularly through the distraction of social media notifications.

This following Table 3 highlights the statistically significant correlations ($p < 0.05$) between smartphone usage and study habits. A weak positive correlation ($r = 0.195$, $p = 0.050$) between age and daily phone use suggests that older students tend to use their phones slightly more each day, possibly due to increased digital dependence or responsibilities. A weak but significant positive correlation ($r = 0.202$, $p = 0.041$) between daily phone use and study quality with smartphones indicates that students who use their phones more perceive their study quality with smartphones to be slightly better, perhaps due to effective multitasking or use of academic tools. The strongest correlation ($r = 0.221$, $p = 0.026$) is between the number of mobile apps and study quality without smartphones, suggesting that students with more mobile apps tend to report better study quality when not using their smartphones, likely because they are more aware of the potential distractions apps create.

Table 3 Statistically Significant Correlations Between Smartphone Usage and Study Habits

Paired Variables	Pearson Correlation (r)	Significance (p-value)	Interpretation
Age ↔ Daily Phone Use (Hours)	0.195	0.050	Weak positive correlation; older students tend to use smartphones slightly more. Marginally significant.
Daily Phone Use ↔ Study Quality With Smartphone	0.202	0.041	Weak positive correlation; increased phone use slightly improves perceived study quality using a smartphone. Statistically significant.
Number of Mobile Apps ↔ Study Quality Without Smartphone	0.221	0.026	Weak positive correlation; using more apps is slightly linked to better study quality even without smartphones. Statistically significant.

Also the tables illustrate the relationship between social media usage (hours) and honours results among students. It shows that students with honours results below 3.00 tend to spend more than 5 hours on social media, with six students in this group. In contrast, students with honours results between 3.00 and 3.33 and those between 3.33 and 3.70 display a more even distribution of social media use, with a significant number spending 1–2 hours and 2–3 hours. Interestingly, the group with honours above 3.70, representing the highest academic achievement, mainly spends 1–2 hours or 2–3 hours on social media, with a noticeable decline in those spending over 5 hours. These findings suggest that higher academic performance correlates with more moderate social media use, particularly within the 1–2 hours and 2–3 hours ranges. In addition, Table 5 presents the results of three statistical tests: Pearson Chi-Square, Likelihood Ratio, and Linear-by-Linear Association. The Pearson Chi-Square test yields a p-value of 0.081, indicating no significant association between the variables. In contrast, the Likelihood Ratio test ($p = 0.049$) and the Linear-by-Linear Association test ($p = 0.013$) both show statistically significant associations, suggesting meaningful relationships between the variables.

Table 4 Correlation between Social Media Usage and Academic

Honors Result	Social Media spending(hrs)					
	< 1 hr	1–2 hrs	2–3 hrs	4–5 hrs	> 5 hrs	Total
Below 3.00	0	0	4	1	6	11
3.0-3.33	0	9	7	6	8	30
3.33-3.7	2	9	8	5	6	30
Above3.70	8	11	9	3	0	31
Total	10	29	28	15	20	102

Table 5 Statistical Test Results for Association Between Variables

Test	Value	df	Asymptotic Sig. (2-sided)
Pearson Chi-Square	31.788	12	0.001
Likelihood Ratio	40.173	12	0.000
Linear-by-Linear Association	23.387	1	0.000

Table 6 Coefficients of Forward Linear Regression (Final Model)

Predictor Variable	Unstandardized Coefficient (B)	Standard Error	Standardized Coefficient (β)	t-value	Significance (p-value)
(Constant)	3.519	0.195	-	18.083	0.000
Phone use total in a day	-0.037	0.013	-0.234	-2.894	0.005
Study on smartphone	0.107	0.030	0.271	3.615	0.000
Study year	0.090	0.020	0.304	4.416	0.000
Phone use without study purpose during study	0.167	0.065	0.193	2.548	0.012
Concentration break during study by smartphone	-0.068	0.028	-0.196	-2.416	0.018
Social media usage	-0.035	0.025	-0.108	-1.381	0.171

The final model from the forward linear regression analysis provides a clear picture of how various aspects of smartphone usage and student characteristics influence Honours academic results among university students in Bangladesh. Phone use total in a day ($B = -0.037$, $p = 0.005$) shows that increased total smartphone use is significantly associated with lower academic performance. Concentration breaks during study caused by smartphones ($B = -0.068$, $p = 0.018$) indicate that disruptions in focus due to phone usage negatively impact academic outcomes. Using smartphones for academic purposes ($b = 0.107$, $p = 0.000$) positively contributes to better grades. Study year ($B = 0.090$, $p = 0.000$) suggests that higher academic year levels are linked with improved results, possibly reflecting maturity or adaptation over time. Phone use without purpose during study ($B = 0.167$, $p = 0.012$) surprisingly shows a mild positive effect, which might indicate multitasking or individual differences in handling distractions. Social media usage ($B = -0.035$, $p = 0.171$) appears negatively associated with results; however, this effect is not statistically significant in the final model. Adjusted $R^2 = 0.582$ means that the final model explains approximately 58.2% of the variation in Honours results. All variables included in the model collectively offer a statistically robust prediction of academic performance. The analysis reveals that how smartphones are used is more important than whether they are used. Purposeful use (e.g., studying with a smartphone) is beneficial, whereas excessive or distracting use can hinder academic outcomes. This nuanced understanding can assist educators and students in developing more balanced smartphone usage habits.

Table 7 Residual Table

Statistic	Minimum	Maximum	Mean	Standard Deviation
Predicted Value	2.4917	4.2467	3.4146	0.3214
Residual	-0.6402	0.7407	-0.0005	0.2548
Standardized Predicted	-2.887	2.581	-0.011	1.001
Standardized Residual	-2.411	2.790	-0.002	0.960

The dependent variable in this analysis is the Honours Result, with the predicted values ranging from 2.49 to 4.25, indicating a strong model output within the scale of academic results. The mean predicted value of 3.41 aligns closely with expected academic averages, demonstrating the model's effectiveness in predicting outcomes.

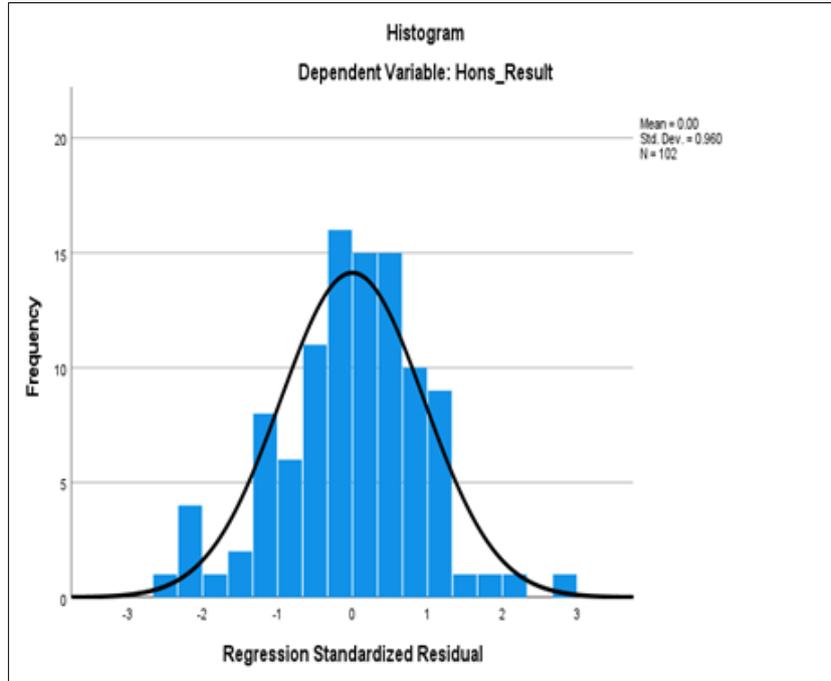


Figure 8 Histogram of Regression Standardized Residual

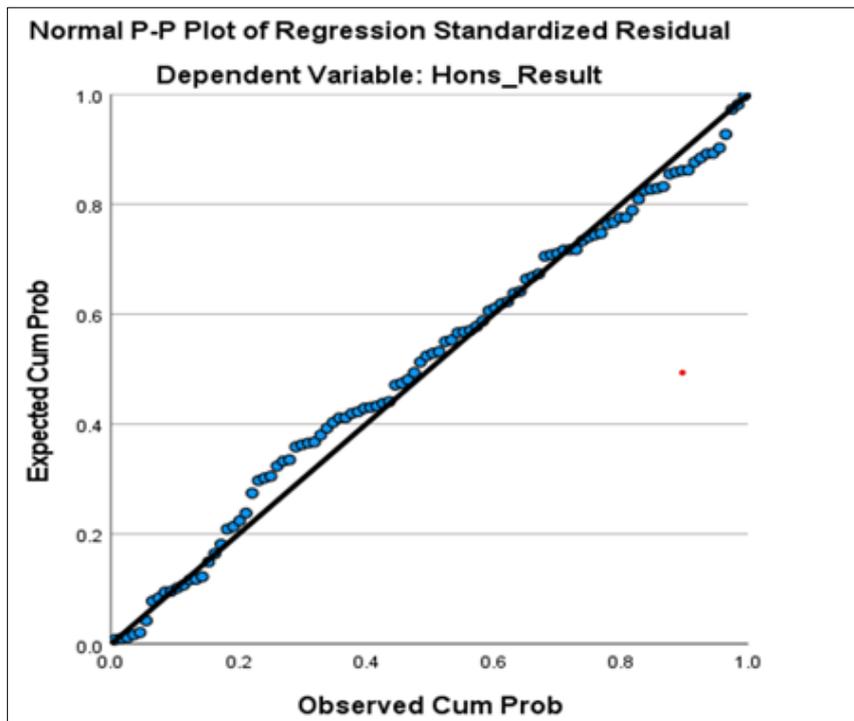


Figure 9 Normal P-P plot of Regression Standardized Residual

The residuals (errors) have a mean of -0.0005, suggesting minimal bias in the predictions. The standard deviation of 0.2548 indicates that the residuals are tightly clustered around zero, a sign of good model performance and precision in predictions. The standardized residuals range from -2.41 to 2.79, which are well within the ± 3 threshold, confirming the absence of influential outliers or violations of model assumptions. Similarly, the standardized predicted values spread within a normal range (± 3), further supporting the assumption of normality. This residual analysis confirms that the model is robust, well-fitted, and free from significant bias or extreme outliers. The residuals exhibit normal distribution with small variance, and the predicted results are in close alignment with the actual academic scores, reinforcing confidence in the regression model's ability to predict academic performance effectively.

In the regression analysis of the dependent variable Hons_Result, two diagnostic plots were examined to assess the normality of the residuals. The histogram of the standardized residuals in Figure 8 shows a bell-shaped curve with a mean of -0.0005 and a standard deviation of 0.2548, indicating a normal distribution with no significant skewness. The P-P plot in Figure 9 confirms this, as most data points align with the diagonal line, suggesting the residuals are approximately normally distributed, with only a few minor outliers. These findings support the normality assumption, indicating that the model's predictions are unbiased and reliable.

4. Conclusion

This research examines the impact of smartphone use on the academic achievement of statistics students at Mawlana Bhashani Science and Technology University (MBSTU), Bangladesh. The growing integration of smartphones into everyday life has raised concerns about their potential effects on academic performance, particularly in a university environment where academic success is crucial. Our findings provide empirical evidence that smartphone usage, particularly for non-academic purposes, negatively impacts academic performance, supporting prior research that highlights the detrimental effects of smartphone distractions [1], [12] (RQ1).

Smartphone use during study hours, especially for non-academic activities such as social media and gaming, leads to significant academic decline. This aligns with previous studies, which note that excessive smartphone use detracts from students' focus and productivity [14]. We found that students who spent more time on their smartphones, especially for leisure activities, experienced substantial deterioration in academic outcomes. Regression analysis ($B = -0.037$, $p = 0.005$) further confirms that increased phone use correlates with worsened academic performance, even when overall smartphone use appears high (RQ2).

In contrast, this research also highlights that the influence of smartphone use on academic achievement varies based on its purpose. Our study identified a positive correlation between smartphones used for academic purposes, such as accessing educational resources or engaging in online academic discussions, and improved academic performance. These results corroborate the conclusions that suggest that strategic use of smartphones for educational tasks can enhance learning outcomes [4], [11]. Smartphones, when used appropriately, can function as critical tools for improving student engagement and providing access to resources, particularly for statistics students who rely on specialized software and collaboration platforms for their studies (RQ3).

Regression analysis further validates this observation. While smartphone use for academic purposes positively influences academic performance ($B = 0.107$, $p = 0.000$), the use of smartphones for non-academic activities like social media and gaming significantly harms academic achievement. This finding is consistent with previous studies that emphasize the importance of context in smartphone use, showing that excessive use of smartphones for non-educational purposes undermines concentration, while purposeful use for academic tasks can enhance performance [4], [9] (RQ4).

In addition to academic performance, this research also examined the physical and psychological impacts of smartphone use, such as its correlation with sleep disturbances and mental stress. Our findings reveal a significant association between excessive smartphone use and sleep disruptions, echoing other research that highlights the negative effects of late-night smartphone use on sleep quality [8]. Furthermore, students who used smartphones frequently reported higher levels of mental stress, which aligns with previous studies [7], [15], highlighting the psychological strain linked to excessive smartphone use (RQ4).

While social media use had a negative correlation with academic performance, the effect did not reach statistical significance in the final regression model. This suggests that the relationship between social media use and academic achievement may be complex, potentially influenced by personal traits such as self-regulation and multitasking skills. Our study supports the assertion that the impact of social media on academic performance is dependent on how students manage their smartphone use [11].

Despite its contributions, this study has several limitations. The cross-sectional design restricts the ability to establish causal relationships between smartphone usage and academic performance, as data were collected at a single point in time. The reliance on self-reported data introduces biases such as recall and social desirability bias, which may affect the accuracy of the findings. Additionally, the study's focus on a single department at MBSTU limits the generalizability of the results to other disciplines or institutions. The role of self-regulation in smartphone usage has been acknowledged, but it has not been thoroughly explored. Future research should investigate how self-regulation strategies influence academic outcomes. Lastly, the study did not account for other external factors such as socioeconomic status, access to resources, or cognitive abilities, which could moderate the relationship between smartphone use and academic performance. These factors should be addressed in future research to provide a more comprehensive understanding of the issue. Besides different future scopes have opened from our research. Such as:

- Monitor smartphone uses and academic achievement over time to determine causal correlations using longitudinal research.
- Utilize screen time monitoring applications or device usage records to get more precise information about smartphone utilization.
- Examine how students manage their smartphone use and its effect on academic performance.
- Analyze the correlation between smartphone addiction and academic achievement.
- Incorporate students from various academic fields, institutions, and geographical areas to evaluate the generalizability of the results.
- Examine the functions of applications or solutions designed to assist students in mitigating smartphone distractions during study periods.
- Utilize machine learning algorithms to forecast academic achievement based on smartphone usage trends, allowing tailored interventions.

In conclusion, this study emphasizes that smartphone use, especially for non-academic purposes, negatively affects academic achievement, while intentional use for academic tasks can enhance learning outcomes. The study also highlights the physical and psychological effects of excessive smartphone use, including sleep problems and mental stress. These findings lay the groundwork for future research to explore the role of smartphone use in academic settings and to develop strategies that help students manage their smartphone habits effectively and boost their academic performance.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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