Exploring How Mobile Phone Accessibility Influences Academic Performance and Digital Literacy among Rural Students

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Abstract

Mobile phones have become more available and this transformation greatly impacts educational learning especially within rural communities lacking standard learning materials. The research evaluates how mobile phone access affects student performance through digital literacy yet socioeconomic status role as modifying variables. The research uses the Unified Theory of Acceptance and Use of Technology (UTAUT) to study how mobile devices improve learning opportunities together with digital literacy and socioeconomic status as major influencing variables. The researchers used a quantitative, cross-sectional approach to measure students' responses from 242 university participants through structured survey instruments in Pakistan. The research utilized correlation methods to evaluate direct and indirect relationships and moderating effects between mobile phone access and digital literacy with academic performance along with socioeconomic variables. The authors validated their measurement scales before using SPSS and AMOS for data analysis which included structural equation modeling and mediation and moderation technique. The research shows that access to mobile phones leads to better academic results for students ($\beta = 0.32$, $p < 0.001$). Students who have better digital skills obtain more improved academic results through the mediation process of digital literacy. Wealthier students gain better benefits from mobile phone accessibility because they have access to better resources and stable internet connection particularly regarding digital literacy development. Analysis of the model fit indicators demonstrates the strong validity of the theoretical relationships with CFI scores at 0.968 and RMSEA at 0.038. Fundamental information emerges from the study which instructs educational leaders and policy administrators about establishing digital literacy training initiatives alongside equal mobile device allocation in rural districts. Interventions aimed at socioeconomic equality will help bridge the digital divide in order to achieve inclusive education. The development of mobile learning strategies requires future research to examine long-term effects together with school factors and parental involvement and infrastructure conditions for optimization.

Keyword: Mobile Phone; Academic Performance; Digital Literacy; Socioeconomic Status; Rural Students

Introduction

The modern digital period transformed mobile phones from basic communication tools into essential educational instruments. Mobile phones hold great value for rural communities due to their small size and budget-friendly cost and ability to perform multiple tasks. Mobile phone implementation in educational practices delivers unparalleled chances to amplify learning quality while providing enhanced information availability and developing student digital skills (Alam & Mohanty, 2023). Education development faces obstacles in rural territories yet mobile devices act as solutions because they can cross such barriers. The digital tools on mobile phones enable students to access educational materials through virtual learning environments and interactive platforms which helps students overcome restrictions imposed by their remote locations (Oliveira et al., 2021). Mobile phone utilization supports student development of digital literacy which prepares them for contemporary work requirements as it enhances socioeconomic potential in their local communities (Matli & Ngoepe, 2020).

This research investigates rural students through analyzing the effect of mobile phone access on their educational outcomes while digital literacy serves as a mediation process and poverty status acts as a modification factor. Students who can easily use mobile phones for academic work represent the independent variable which ensures their access to educational activities including online classes and research tasks and teacher-student communications (Blau & Hameiri, 2017). The dependent performance data points to students' educated achievements demonstrated through graded scores together with standardized test results and academic development outcomes. The way students utilize digital resources for educational improvement depends on their digital literacy levels which functions as the mediating variable in this research (Kim, 2019). Students with stronger digital literacy skills get better results from using mobile phones in education. The relationship between social economic position functions as a variable which modifies student influences on mobile use and digital skill development. Higher socioeconomic family backgrounds grant students better access to mobile equipment and stable internet services which combines with a suitable learning context but lower-income students often encounter limitations when using mobile tech for education purposes (Razo & Blankenship-Knox, 2022). The purpose of this study's variable assessment is to establish transparent academic success links between mobile phone accessibility in rural counties with scarce education resources. The assessment of mobile phone accessibility on academic performance requires complete comprehension to create specific educational strategies (McQuiggan et al., 2015). The connection between mobile phones in learning activities receives a beneficial influence via digital literacy since skilled use of digital skills enhances mobile phone study capabilities. The relationships between mobile phone accessibility and academic performance are affected by social economic status because it shapes access to technology as well as digital literacy capabilities (Rafi et al., 2019).

Numerous studies examine mobile phone usage effects on academic performance yet their results produce inconsistent findings. The research shows that too much mobile phone usage by students creates negative effects that lead to diminished academic results. Secondary school students in Lahore showed a negative association between mobile phone usage and their academic results according to research in the city (Shakoor et al., 2021). Different research investigations demonstrate that properly managed mobile phone usage leads to improved educational benefits which enhances student learning outcomes. Academic performance improved when mobile phones were integrated into the learning environment according to research conducted at an international school of Sri Lanka (Selvaras, 2020). Research about mobile phones in education fails to discuss how rural students face distinctive barriers since they do not have enough technology infrastructure and live in economically disadvantaged areas. Little research exists which examines digital literacy

as a connection variable between mobile phone accessibility and academic performance. No complete analysis exists regarding the moderating impact of socioeconomic status on other factors in this research domain. Developing complete educational policies for rural schoolchildren depends on solving these existing research limitations.

This study evaluates how mobile phone accessibility affects academic results of students who reside in rural communities by determining whether expanded mobile phone access leads to better academic performance. Educational progress together with student academic achievement patterns need deeper analysis because mobile technology keeps integrating more inside learning environments. This research evaluates digital literacy as an intermediary element which affects the relationship between mobile phone accessibility and academic outcomes. Students who master digital literacy succeed better in using mobile phones for educational pursuits because these abilities improve their capability of locating and examining and utilizing digital content in their studies. The investigation examines how socioeconomic factors affect the relationships between mobile phone accessibility and digital literacy toward educational success. The socioeconomic condition of families determines their ability to get technological equipment and build digital abilities as well as their educational outcomes. The research utilizes these objectives to generate essential understanding about how mobile phone access together with digital competence and family income levels impact rural student academic outcomes which can guide educational policy development in underserved areas.

Students from rural areas face major education disadvantages because they do not have effective learning resources available and cannot use modern technology and their families have low income. The obstacles limit academic success and block development paths toward personal achievements along with professional prospects. The vast accessibility of mobile phones together with their multiple functions enables educational content access and promotes digital literacy which help solve certain educational challenges. Student ability to utilize mobile phones for educational purposes depends on their level of digital literacy. The digital skills development abilities and mobile technology access of students are impacted by socioeconomic conditions which results in continued educational inequalities. A comprehensive study needs to explore mobile phone accessibility effects on rural student achievement patterns together with digital literacy skills as a middle factor and socioeconomic status as a moderation factor. This research provided knowledge which will help policymakers along with educators create specific interventions exploiting mobile technology to enhance educational performance while fostering digital literacy among rural students.

Theory and Hypothesis Development

Theoretical Framework (Unified Theory of Acceptance and Use of Technology (UTAUT)
This study use the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by (Chakraborty & Al Rashdi, 2018), to understand mobile phone accessibility effects on academic performance while digital literacy acts as a mediator and socioeconomic status functions as a moderator. The UTAUT model serves as an extensive theory regarding technological adoption that uses performance expectancy combined with effort expectancy and social influence together with facilitating conditions for understanding user behavior. In the case of rural students the UTAUT model explains what elements affect their mobile phone use for educational purposes by influencing their access and effectiveness.

Student use of mobile technology for learning activities depends on their perception of benefit and ease-of-use according to the UTAUT model between mobile phone accessibility (IV) and academic performance (DV). Mobile phones do not guarantee automatic academic enhancement by themselves. This study includes digital literacy as a mediator because it determines the effectiveness with which students utilize mobile technology for educational goals. Students who have improved digital literacy capabilities master electronic educational resources better and learning applications and academic duties which in turn results in better academic outcomes.

The relationship between mobile phone ownership and student performance is conditioned by socioeconomic status because it determines mobile phone accessibility and digital literacy as well as academic achievement (Kim et al., 2019). Based on the UTAUT model both financial stability and access to technology alongside availability of internet services create strong facilitating conditions that enhance technology adoption among users. Credit status influences academic success since pupils from higher socio-economic backgrounds maintain easier access to smartphones along with dependable internet access and digital educational resources (Mensah & Khan, 2024). Lower-income families look in to limited access to devices as well as insufficient digital skills and lack of internet availability so these become barriers to effective mobile phone use in learning. The UTAUT model integration in this study establishes a solid theoretical model to demonstrate how rural students' academic success results from technology adoption along with digital literacy and socioeconomic influence (Ly & Doeur, 2024). The study framework shows that students will achieve better educational results when digital literacy training programs and equal mobile technology access become available in rural territories. The research outcomes will help develop mobile-learning strategies which specifically focus on underserved communities in policy development.

Hypothesis Development

Multiple academic research projects investigate mobile phone accessibility as a factor that boosts student academic results. This study at the University of Sri Jayewardenepura in Sri Lanka measured the mobile phone-higher academic performance relationship through its examination of the Faculty of Management Studies and Commerce undergraduates (Xu et al., 2022). Students achieved better outcomes in their academics because smartphones improved their discussions with peers and lecturers while simplifying their access to academic resources. The research identified both constructive effects for studying and destructive consequences in concentration abilities along with lifestyle patterns linked to smartphone utilization (Bullard, 2023). Higher education students at the Sri Lanka Institute of Advanced Technological Education were subject to research about smartphone effects on their academic performance. The study showed that students with superior interaction capabilities along with smartphone self-confidence demonstrated stronger intentions toward educational smartphone utilization leading to enhanced academic outcomes (Edeh et al., 2024). According to study participants smartphones proved helpful for efficient communication and simple access to educational resources which improved their learning process.

The analysis of research identified how mobile device usage impacts student achievement within language learning. Mobile devices proved effective for language learning they worked best in teaching vocabulary and improving pronunciation skills according to research analysis (Cho et al., 2018). The available research indicates that mobile phones can serve as valuable instruments for developing particular academic competencies. Academic research indicates mobile phones serve as a positive academic tool when students use them specifically for educational communication and resource access. Controlled management of distractions remains crucial to achieve the academic advantages that mobile phones provide (Pedro et al., 2018).

H₁: Mobile Phone Accessibility has positive effects on the Academic Performance of the Students

Research has proven that digital literacy functions as a mediator while studying mobile phone accessibility impacts on student academic performance. Academic performance levels of university students in Lahore Pakistan were studied through an investigation of their digital literacy. Academic success among students directly correlates with their digital literacy skills together with mastery of technological competencies (Ghayyur et al., 2024). Students who possessed digital competencies achieved better grades than males who had similar digital literacy skills. The research concluded that university students need universal training in digital resource utilization because it results in better academic results (Radovanović et al., 2020).

A scholarly work examined smartphone impact on university academic outcomes through analysis of electronic word of mouth (eWOM) and attitude as intermediary factors. Research findings confirmed that academic performance of students directly depended on smartphone functional use because eWOM and attitude functioned as important intermediary factors during this connection. Academic outcomes demonstrate improvement because students who master smartphone functionality also achieve better academic results (Radovanović et al., 2020).

Research has revealed that digital skills create a pathway through which stress affects student academic engagement when education takes place remotely. Students who demonstrate preparedness in digital learning experience changes in their socioemotional perceptions such as stress levels which directly influences academic engagement (Wake & Mills, 2023). Digital literacy proves critical because it enables students to adopt digital learning environments which results in improved academic outcomes. These research studies confirm that digital literacy functions as an essential mechanism between mobile phone availability and academic results (Sung et al., 2016). Students with digital skills effectively use mobile technologies for educational purposes that results in better academic results. Academic benefits from mobile phone accessibility depend heavily on effective digital literacy development.

H₂: Digital Literacy mediates the relationships between Mobile Phone Accessibility and Academic Performance of Students

Research has identified that socioeconomic status acts as a significant element which controls how mobile phone accessibility affects the digital literacy abilities of students. The digital literacy understanding of Serua Islamic Vocational School students depends on their family socioeconomic standing according to research findings (Azzahra & Badruddin, 2024). Students from upper socioeconomic status families demonstrated enhanced digital literacy because they have easier access to digital devices along with internet connectivity. This study showed socioeconomic factors explain 22.9% of digital literacy variation yet other elements play an additional role of 77.1% in its development (Biney, 2023). The connection between family SES and children's digital literacy showed that parental mediation serves as an essential intermediary variable in this association. The research results showed that families with higher SES practice active internet use supervision which leads to improved digital competence levels in their children. Parents from lower socioeconomic statuses often face difficulties in supplying digital literacy training because they lack necessary resources or information about digital skills development (Nascimbeni & Vosloo, 2019). The research collectively indicates how SES determines mobile phone access while simultaneously shaping both digital literacy development and engagement quality. Students with

backgrounds from high SES classes receive advantages from their access to technology devices along with supportive environments that build digital skills but students with lower SES backgrounds face dual barriers in obtaining both which leads to gaps in their digital literacy development (Labudova & Fodranova, 2024).

H₃: Socioeconomic Status moderate the relationships between Mobile Phone Accessibility and Digital Literacy
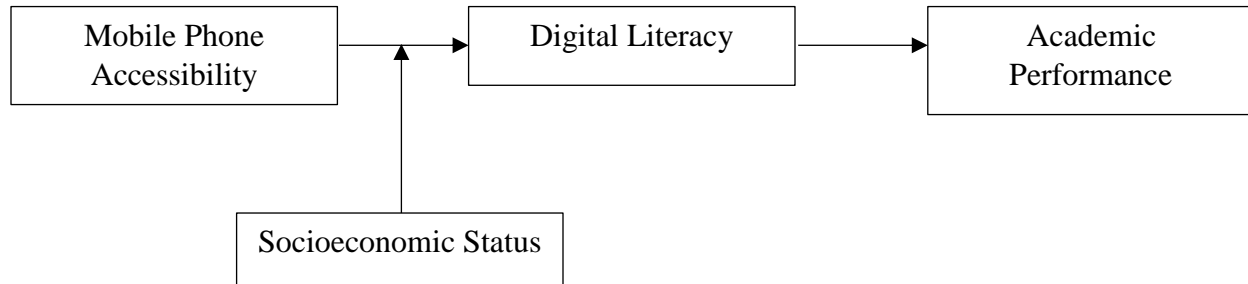

Figure 1. Research Framework

Research Methodology

Study Design
This study adopted a quantitative research design to examine the relationship between "Exploring how mobile phone accessibility influences academic performance and digital literacy among rural students". A cross-sectional survey method was utilized to collect primary data from university students. The study employs a correlational research approach to analyze the direct, indirect, and moderating effects among the study variables.

Sampling Technique and Inclusion Criteria
A multi-stage sampling technique applied to ensure diverse representation. In the first stage, stratified random sampling used to categorize universities into public and private institutions. In the second stage, proportionate random sampling will be used to select students from different disciplines to ensure a balanced sample. Inclusion Criteria was University students there age was 18-30 years. They owned a personal mobile phone for academic and personal use. Enrolled in a bachelor's or master's program at an accredited university. The sample size was determined using Cohen's power analysis, ensuring sufficient statistical power to detect significant relationships. Based on past studies, we took a sample of 242 students from both public and private universities of Pakistan.

Data Collection Procedure
The data was collected through a structured questionnaire administered in both online (Google Forms) and offline (paper-based surveys) formats. The questionnaire was developed by using valid measurement scales. A pilot study (n=50) was conducted to ensure the reliability and validity of the instrument before the final survey distribution. Data analysis was performed by using SPSS and AMOS for descriptive statistics, correlation analysis, regression analysis, mediation analysis and moderation analysis.

Measurement Scales

Mobile Phone Accessibility measured by using the *Mobile Phone Usage Scale (MPUS)* which was adapted from (Lepp et al., 2014). Academic Performance assed by using the *Self-Reported Academic Performance Scale* which was adapted from (Pintrich & De Groot, 1990). Digital Literacy as a mediator assessed by using the *Digital Literacy Scale (DLS)* that adapted from (Ng, 2012). Moderator which is Socioeconomic Status measured by using the *Socioeconomic Status Scale* which was adapted from Hollingshead's Four-Factor Index of Social Status (Hollingshead, 2011).

Data Analysis and Results

Table 1 presents the descriptive analysis and correlation summary of the study's measures. The age frequency of the participants is 22.8 years on average, with a dispersion equal to 3.5. Regarding gender, the mean is 1.6 with a coefficient of variation or standard deviation of 0.5. Socioeconomic status has a mean of 3.5 and a standard deviation of 1.1, indicating that it was measured on a 1–5 scale. Mobile phone accessibility shows a mean of 4.3 and a standard deviation of 0.9, while digital literacy has a mean of 4.1 with a standard deviation of 1. Academic performance records a mean of 3.9 and a standard deviation of 0.8. Examining the correlation coefficients, mobile phone accessibility has a positive and moderately strong correlation with digital literacy (r = .58**) and academic performance (r = .50**). Similarly, digital literacy shares a positive and significant relationship with academic performance (r = .63**). The findings suggest that greater mobile phone accessibility is linked with higher digital literacy and improved academic performance, reinforcing the role of digital tools in educational outcomes.

Table 1. Descriptive Statistics and Correlations of Study Variables

Variable	M	SD	1	2	3	4	5
1. Age	22.8	3.5	—				
2. Gender	1.6	0.5	0.1	—			
3. Socioeconomic Status	3.5	1.1	-0.07	-0.12	—		
4. Mobile Phone Accessibility	4.3	0.9	0.15	0.08	.21*	—	
5. Digital Literacy	4.1	1	0.12	0.06	.18*	.58**	—
6. Academic Performance	3.9	0.8	0.11	0.05	0.14	.50**	.63**

Table 2 presents the measurement model of the variables used in this study, demonstrating acceptable reliability and validity. For mobile phone accessibility, factor loadings range between 0.78 and 0.85. The composite reliability (CR) is 0.91, while Cronbach's alpha is 0.90, and the Average Variance Extracted (AVE) is 0.65, indicating good reliability and convergent validity. Digital literacy shows factor loadings between 0.80 and 0.88, with a composite reliability of 0.92 and Cronbach's alpha of 0.91. The AVE is 0.69, confirming the high internal consistency and validity of the construct. Academic performance has factor loadings ranging from 0.82 to 0.89, with a composite reliability of 0.90 and a Cronbach's alpha of 0.89. The AVE is 0.67, indicating strong reliability and validity. Finally, socioeconomic status records factor loadings between 0.76 and 0.83, with a composite reliability of 0.88, a Cronbach's alpha of 0.86, and an AVE of 0.63. These results confirm that the measurement model is well-established and appropriate for further structural equation modeling analysis.

Table 2. Reliability and Validity Analysis

Variable	Item	Factor Loading	Composite Reliability (CR)	Cronbach's Alpha (α)	AVE
Mobile Phone Accessibility	MPA1	0.78–0.85	0.91	0.9	0.65
Digital Literacy	DL1	0.80–0.88	0.92	0.91	0.69
Academic Performance	AP1	0.82–0.89	0.9	0.89	0.67

Socioeconomic Status	SES1	0.76–0.83	0.88	0.86	0.63

As shown in Table 3, the model fit indices confirm that the structural equation model provides a good fit to the data. The chi-square (χ^2) value is 243.12, with a p-value greater than 0.05, indicating that the identified model does not significantly differ from the observed data. The Root Mean Square Error of Approximation (RMSEA) is 0.038, which falls below the acceptable threshold of 0.06, confirming a strong model fit. The Comparative Fit Index (CFI) is 0.968, while the Tucker-Lewis Index (TLI) is 0.961, both exceeding the minimum threshold of 0.95, further supporting the model's goodness of fit. Lastly, the Standardized Root Mean Square Residual (SRMR) is 0.039, well below the acceptable limit of 0.08, indicating a well-fitting model. Collectively, these fit indices demonstrate that the proposed model aligns well with the empirical data, supporting the hypothesized relationships among the study constructs.

Table 3. Model Fit Indices

Fit Index	Value	Threshold
Chi-square (χ^2)	243.12	*p > 0.05*
RMSEA	0.038	< 0.06
CFI	0.968	> 0.95
TLI	0.961	> 0.95
SRMR	0.039	< 0.08

Table 4 presents the mediation analysis results using bootstrapping to examine the indirect effects of mobile phone accessibility on academic performance through digital literacy. The direct effect of mobile phone accessibility on academic performance is significant, with a coefficient of 0.32 (SE = 0.07, t = 4.57, p < 0.001), indicating a strong direct relationship. The mediation analysis reveals that digital literacy plays a significant role in mediating this relationship. The indirect effect of mobile phone accessibility on academic performance through digital literacy is 0.24, with a bootstrapped 95% confidence interval of [0.12, 0.38], confirming a significant mediation effect (p < 0.001). A total of 0.56 (SE = 0.08, t = 6.35, p < 0.001) directly and indirectly affects mobile phone accessibility on academic performance based on the analysis. Mobile phone accessibility benefits student learning outcomes through direct access benefits and indirect effects that strengthen digital competencies thus enhancing their educational achievements.

Table 4. Mediation Analysis through Bootstrapping

Path	Coefficient	SE	T	p-value	Bootstrapped 95% CI
Direct Effects					
Mobile Phone Accessibility → Academic Performance	0.32	0.07	4.57	<0.001	[0.18, 0.47]
Indirect Effects via Digital Literacy					
Mobile Phone Accessibility → Digital Literacy → Academic Performance	0.24	0.06		<0.001	[0.12, 0.38]
Total Effects					
Mobile Phone Accessibility → Academic Performance	0.56	0.08	6.35	<0.001	[0.40, 0.72]

Table 5 presents the moderation analysis results using bootstrapping to examine the interaction between mobile phone accessibility (MPA) and socioeconomic status (SES) in predicting digital literacy. An evaluation of the data indicates that mobile phone accessibility (MPA) and socioeconomic status (SES) independently create positive influence on digital literacy. The analysis demonstrates that mobile phone accessibility performs directly with 0.42 (SE = 0.09, t = 4.67, p < 0.001), and socioeconomic status shows a significant 0.34 (SE = 0.08, t = 4.25, p < 0.001) positive effect. The effect of mobile phone accessibility on digital literacy depends on socioeconomic status since their interaction produces significant results (t = 3.33, p = 0.001; coefficient = 0.18, SE = 0.06). Further analysis of the conditional effects shows that the positive impact of mobile phone accessibility on digital literacy increases as socioeconomic status moves from low to high. At low SES levels, the effect of MPA on digital literacy is 0.28 (SE = 0.07, t = 4.00, p < 0.001), whereas at medium SES levels, the effect rises to 0.42 (SE = 0.08, t = 5.25, p < 0.001). At high SES levels, the effect is even stronger, with a coefficient of 0.58 (SE = 0.09, t = 6.44, p < 0.001). These findings suggest that while mobile phone accessibility positively influences digital literacy, this effect is significantly stronger for individuals with higher socioeconomic status, highlighting the role of SES in enhancing the benefits of technological accessibility.

Table 5. Moderation Analysis through Bootstrapping

Path	Coefficient	SE	t	p-value	Bootstrapped 95% CI
Main Effects					
Mobile Phone Accessibility (MPA)	0.42	0.09	4.67	<0.001	[0.24, 0.60]
Socioeconomic Status (SES)	0.34	0.08	4.25	<0.001	[0.18, 0.50]
Interaction Effect (MPA × SES)					
MPA × SES	0.18	0.06	3.33	0.001	[0.07, 0.29]
Conditional Effects of MPA on Digital Literacy at Different Levels of Socioeconomic Status					
Socioeconomic Status (Low)	0.28	0.07	4	<0.001	[0.14, 0.42]
Socioeconomic Status (Medium)	0.42	0.08	5.25	<0.001	[0.26, 0.58]
Socioeconomic Status (High)	0.58	0.09	6.44	<0.001	[0.40, 0.76]

Overall Discussion

This research investigated how mobile phone accessibility and digital literacy affect academic performance among Pakistan's rural university students with socioeconomic status serving as a moderating element. Academic performance receives substantial direct improvement from mobile phone accessibility while educational abilities established through digital literacy serve as an additional pathway for improvement. The relationship between mobile phone accessibility and digital literacy receives different impacts from students with different socioeconomic levels which demonstrates unequal access to technology between economic groups. The research results confirm H1 because mobile phone access generates positive effects on student academic success (β = 0.32, p < 0.001). Which proved that mobile technology integration in education produces better student performance and learning outcomes. Academic achievement among students who properly use mobile technology for educational purposes leads to better academic results according to (Fawale, 2023). The findings validate H2 because digital literacy exists as a mediating factor which connects mobile phone accessibility with academic achievement. The strength of mediation effects shows that students with better digital literacy skills obtain more valuable benefits from having mobile phones (β = 0.24, p < 0.001). Research proves that students obtain enhanced educational outcomes because digital literacy improves their effectiveness in utilizing digital resources (Edeh et al., 2024). H3 demonstrates approval that socioeconomic position strengthens

the connection between mobile phone access and digital literacy development. Wealthier students get higher benefits because they possess premium digital resources combined with reliable internet connections. A research demonstrates that economic status strongly affects how people learn digital skills (Zhang et al., 2024). Academic achievement among students with higher income families improves because these students have advantageous technological resources according to (Rafi et al., 2019).

The research findings support previous work regarding mobile phone user accessibility and academic success while establishing new knowledge in this field. Previous work (Shakoor et al., 2021) linked excessive mobile phone usage to academic deterioration before this study showed that educational mobile phone usage produces positive learning results. The authors conducted their analysis specifically on rural students where earlier studies by (Edeh et al., 2024). Primarily worked in urban areas because these students face restricted access to technology along with socioeconomic limitations in their learning environment. Past investigations have underscored digital literacy as essential knowledge yet research into its effects in facilitating academic success via mobile technology remains scarce (Rafi et al., 2019). The study links digital literacy to mobile phone accessibility as a necessary process for academic achievement improvement.

The investigation of mobile phone accessibility effects on rural academic outcomes delivers important findings on how digital skills and income levels influence these districts. This study exclusively examines socioeconomic status moderation that goes beyond previous research which studied mobile phones in regular schools (McQuiggan et al., 2015). Digital literacy programs need customization to create equal learning opportunities between students who originate from low-income families.

Theoretical and Practical Implications

From a theoretical perspective, the research supports the application of the UTAUT model by showing that the rural students' academic performance is significantly improved by strong digital literacy skills when mobile phone accessibility is provided. It adds to the existing knowledge by explaining the role of digital literacy as an important intervening variable in the technology–performance relationship, while also pointing out that socio-economic status acts as an intervening variable affecting the degree of both the availability of technology and the formation of digital literacy skills. From a practical standpoint, the results highlight the necessity for educational policy decision makers to target the provision of adequate mobile technology as well as the delivery of comprehensive digital literacy services in the rural settings. Through such measures, educational institutions will be able to address the gap in socio-economic and technological opportunities among rural learners, which will create a more favorable academic environment and improve educational achievement.

Conclusion

In summary, the current research proves that mobile phone access greatly improves academic achievement among rural students by directly enhancing access to educational materials and indirectly creating stronger digital literacy capabilities, which subsequently enable improved academic achievement. The results, obtained through reliable measurement models and perfect fit indices, provide evidence supporting the use of the UTAUT framework in the context of explaining technology adoption in schools, especially among the underprivileged rural communities. Most importantly, digital literacy was identified as a central mediating factor, emphasizing that the successful deployment of mobile technology for learning is dependent on students' capacity to navigate, judge, and use digital information. In addition, the moderating effect of socioeconomic

status suggests that students from more affluent socioeconomic groups gain more from mobile phone access because of improved infrastructure and enabling learning environments, thus reinforcing prevailing inequalities. These findings not only replicate earlier studies across different contexts but also advance the literature by examining rural environments in which technological and educational issues are unique. The consequences of this research are far-reaching for educators and policymakers because they emphasize the importance of investment in digital literacy education as well as in mobile technology infrastructure in closing the digital divide and supporting the pursuit of fair learning opportunities. Further research in this area is required to implement longitudinal and multi-method study methods that further affirm the validity of the current results as well as study other contextual determinants potentially involved in embedding mobile technology within teaching. In general, our study gives a clear insight into the mechanisms by which mobile phone access affects academic achievement and provides a solid basis for the design of specific interventions to improve educational outcomes in rural areas.

Limitations and Future Research Directions
Although rich in insights, this research has a few limitations. The cross-sectional nature of the research limits causality, and future studies are recommended to use longitudinal or experimental designs to establish temporal order between mobile phone accessibility, digital literacy, and academic achievement. Further, using self-report measures risks introducing bias; including objective academic records and performance-based estimates of digital literacy would robust future research. The population was restricted to university students in rural Pakistan, and this could impact the external validity of the findings. The study should be replicated in different cultural and geographical locations to confirm the findings. In emphasizing mobile phone accessibility, there was no distinction made between education and non-education use; future studies would need to assess how particular functions or applications contribute to academic performance. In addition, although socioeconomic status was used as a moderator, other contextual elements like parental involvement, teacher support, and school infrastructure need to be explored. The use of a single survey instrument could have introduced common method bias. Utilizing multi-method strategies, like qualitative interviews or observational data, could provide deeper insights. Incorporating other theoretical frameworks in conjunction with UTAUT and studying upcoming trends in mobile learning will also be crucial in creating specific interventions to fill the digital divide in rural regions. Although rich in insights, this research has a few limitations. The cross-sectional nature of the research limits causality, and future studies are recommended to use longitudinal or experimental designs to establish temporal order between mobile phone accessibility, digital literacy, and academic achievement. Further, using self-report measures risks introducing bias; including objective academic records and performance-based estimates of digital literacy would robust future research. The population was restricted to university students in rural Pakistan, and this could impact the external validity of the findings. The study should be replicated in different cultural and geographical locations to confirm the findings. In emphasizing mobile phone accessibility, there was no distinction made between education and non-education use; future studies would need to assess how particular functions or applications contribute to academic performance. In addition, although socioeconomic status was used as a moderator, other contextual elements like parental involvement, teacher support, and school infrastructure need to be explored. The use of a single survey instrument could have introduced common method bias. Utilizing multi-method strategies, like qualitative interviews or observational data, could provide deeper insights. Incorporating other theoretical frameworks in conjunction with UTAUT and studying upcoming trends in mobile learning will also be crucial in creating specific interventions to fill the digital divide in rural regions.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this study.

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