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Mobile Technology In Academia: Analyzing Student Perceptions And Utilization For Enhanced Learning Outcomes

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ABSTRACT
Mobile technology has become integral to modern education, transforming student engagement with learning content. This study investigated perceptions and utilization of mobile technology among higher education students in physics education. A descriptive research design was employed with 116 students from the College of Agriculture and College of Education at Isabela State University, Cauayan, Philippines. The survey questionnaire, adapted from established frameworks, examined demographic profiles, mobile phone usage patterns, perceptions of mobile learning practices, perceived ease of use, and perceived usefulness. Results revealed that younger students and those in earlier academic years were more represented. Mobile phones are widely used for educational purposes, with Internet browsing being most common (94.80%). Virtual classroom apps (73.3%) and learning management systems (60.3%) were the most used mobile educational applications. Students had positive perceptions of mobile learning practices (mean=3.17), perceived ease of use (mean=3.12), and perceived usefulness (mean=3.24). No significant correlations were found between demographic factors and mobile device usage patterns or perceptions. However, a weak but significant positive correlation existed between year of study and both perceived ease of use ($r=0.223$, $p=0.016$) and perceived usefulness ($r=0.223$, $p=0.016$). These findings suggest mobile devices are actively integrated into students' learning practices for accessing materials, collaboration, and online discussions. This study highlights the importance of considering students' academic progression when implementing mobile learning strategies and the need for further research to reconcile these findings with broader literature on demographic factors in mobile learning adoption
Keywords: M-learning, Mobile technology, Physics education, Student perceptions, Technology adoption

1. INTRODUCTION:

Mobile devices have become increasingly prevalent in modern society, particularly among students. The rapid growth of smartphone ownership is evident, with one study reporting a surprising 17% increase in just eight months among university students (Paterson and Low, 2011); this trend is further supported by the finding that 68% of students planning to change their mobile handsets would upgrade to a smartphone (Paterson and Low, 2011). The widespread adoption of mobile technology has significant implications for education in general. All students now own a mobile device, with approximately half owning more than one, making them well equipped for mobile learning (Klímová, 2017). This shift from traditional technologies, such as desktop computers, to mobile devices has created new opportunities for teaching and learning (Lázaro and Duart 2023). The COVID-19 pandemic has further accelerated the adoption of mobile learning, making it a valuable tool in remote education (Lazaro & Duart, 2023). Interestingly, the impact of mobile technology extends beyond formal educational settings. Students use portable devices for various educational purposes, such as exchanging academic messages and files, searching for academic materials, practicing online quizzes, and discussing with classmates (Shonola et al., 2016). Moreover, mobile devices have changed students' news-reading habits, with more content being read on phones and in diverse locations, potentially contributing to their learning (Yu et al., 2021).

Mobile learning (m-learning) has emerged as a rapidly growing segment of higher education, offering students the flexibility to access learning materials and engage in educational activities without temporal or spatial restrictions (Qashou, 2020). The adoption of m-learning has been increasing in public and private not-for-profit institutions, driven by advancements in information and communication technology and mobile devices (Qashou 2020; Yip et al. 2020). Studies have shown that m-learning can positively affect student engagement and learning outcomes. For instance, online learners have reported higher levels of perceived academic challenges, learning gains, satisfaction, and better study habits than face-to-face learners (Paulsen and McCormick 2020). It has also been found to enhance accessibility, engagement, knowledge retention, and the overall learning experience

(Al-Zahrani 2024). Additionally, the use of mobile devices, such as iPads, in educational settings has been perceived as useful and enjoyable for accomplishing educational tasks and improving learning outcomes (Fagan, 2019). However, the adoption and effective implementation of m-learning face several challenges. Factors such as perceived usefulness, ease of use, self-efficacy, and enjoyment play crucial roles in students' intention to adopt m-learning systems (Alowayr, 2021; Qashou, 2020). Cultural differences also influence the adoption of mobile technologies for learning purposes, as evidenced by the varying expectations of students from different regions (Yip et al. 2020). To enhance the effectiveness and adoption of m-learning in higher education, institutions must focus on designing interactive courses, providing beneficial activities, and addressing students' needs through high-quality mobile applications (Drwish et al., 2023).

Students' perceptions and utilization of mobile technology for academic purposes reveal insights but highlight gaps in physics education. Mobile technology, especially smartphones, has become prevalent in higher education, with students using devices for academic activities, such as accessing course materials and collaborating with peers (Dukic et al., 2015). While most studies have focused on general academic use or subjects such as English (Guo et al., 2020; Klimova & Polakova, 2020), limited attention has been paid to physics education. Research specifically addressing students' perceptions and utilisation of mobile technology in physics shows gaps in the literature. Although Darmaji et al. (2019) and Astalini et al. (2019) studied mobile learning in physics practicums, they focused on learning media and electronic guidebooks rather than exploring students' views comprehensively. Research in chemistry education (Garcia & Barrientos, 2023) has identified disparities between general and subject-specific mobile learning games, suggesting similar gaps in physics education. Understanding students' perceptions and use of mobile technology is crucial for improving education. This knowledge helps educators adapt their teaching methods to match students' preferences and increase engagement. By studying mobile device usage, schools can develop better digital resources and address barriers to technology adoption. This enables educators to maximize the benefits while minimizing distractions. These insights can guide policy decisions regarding the integration of technology in education. This study aimed to analyze students' perceptions and use of mobile technology in higher education physics courses by examining demographics, usage patterns, and mobile learning perceptions. This study investigated the relationships between these factors to develop recommendations for better technology integration and suggest strategies for the effective implementation of mobile learning tools.

2. METHODS

2.1. Research Design

This study utilized a descriptive research design to investigate higher education students' perceptions of mobile learning, examining factors such as demographic characteristics, mobile phone usage patterns, and perceived ease of use and usefulness of mobile learning applications. Descriptive research, as defined by Cresswell and Cresswell (2018), is used to "describe, explain, and interpret the current conditions or relationships" among variables without manipulation. By keeping records of certain occurrences in their natural settings, researchers can provide a detailed picture of the interrelationships between the variables under study.

2.2. Participants

The population for this study consisted of higher education students enrolled at Isabela State University-Cauayan, specifically from the College of Agriculture and College of Education, where students take General Physics courses. This study employed simple random sampling to ensure that each student in the programs had an equal chance of being selected. A total of 116 students were surveyed for this study.

2.3. Research Instruments

The survey questionnaire used in this study on higher education students' perceptions of mobile learning was adopted from frameworks and variables from established research in the field. The mobile learning practices section was adopted from Ahmad's (2020) study. The constructs of perceived ease of use (PEOU) and perceived usefulness (PU) were incorporated following Buabeng-Andoh's (2018) model, as follows: These constructs are critical for evaluating the acceptance and integration of mobile technology in learning processes, reflecting the acceptance model that assesses technology adoption in educational settings. It assesses students' attitudes towards technology's effectiveness and ease of use in their learning environment (Buabeng-Andoh, 2018).

The instrument was divided into three main sections: respondent profiles, mobile phone usage patterns, and students' perceptions of mobile phones. The Profile of the Respondents included demographic information, including age, gender, academic program, and year level, which is critical for analyzing potential variations in mobile learning perceptions across demographic groups. The second section examined students' mobile phone usage habits in the Patterns of Mobile Phone Usage section. It includes items on primary mobile phone function, frequency of use, daily duration, and the balance between academic and personal use. Additionally, it explores students' engagement with various social media platforms (Facebook, Twitter, and Instagram) using a frequency scale. Mobile phone and student perception was the third section, which was divided into three constructs: *Mobile Learning Practices*, *Perceived Ease of Use*, and *Perceived Usefulness*. Each construction uses a 4-point Likert scale,

2.4. Procedures

A survey questionnaire was used to gather participants' perceptions of mobile phone use as a learning tool in the classroom. The survey instrument was divided into two sections.

Section I

The first section was used to obtain information relating to cellphone use and access, ownership, demographic facts, Age, Academic Standing and Degree Program

Figure 1 Gender composition of students

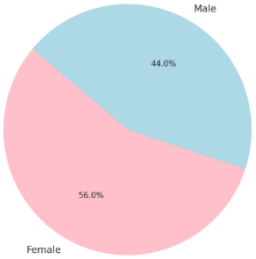


Figure 2 Student's Age Group

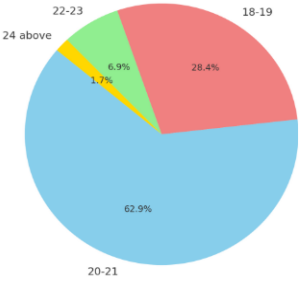


Figure 3 Academic Standing

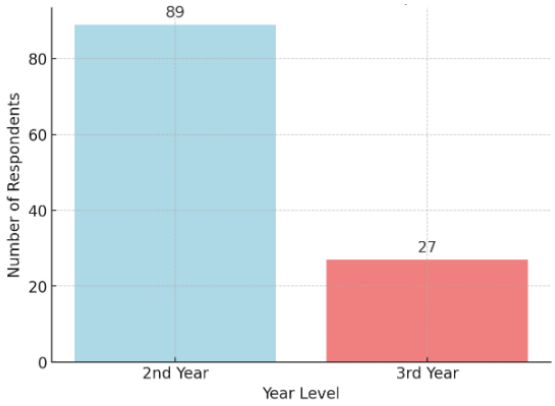
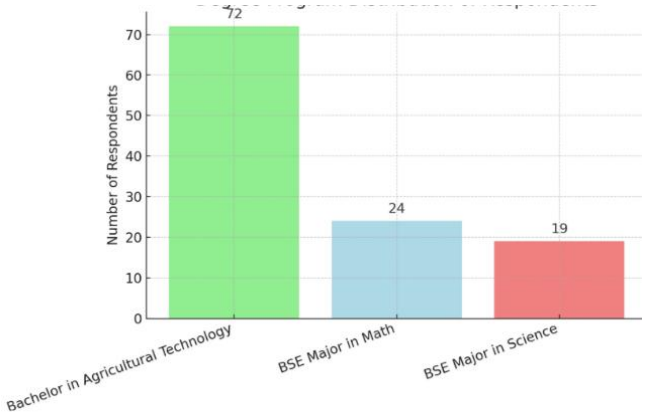


Figure 4 Degree Program Distribution



Section II

The second Section sought the patterns of mobile phone usage among higher education students in terms of

(1) Personal use (e.g., calling, texting, gaming, internet browsing)

Educational use (e.g., accessing course materials, submitting assignments, scheduling study sessions)

Frequency and duration of mobile usage for academic purposes

Section III

The Least section it includes students' perceptions of mobile learning in terms of

Mobile learning practices

Perceived ease of use

Perceived usefulness

2.5. Data Analysis

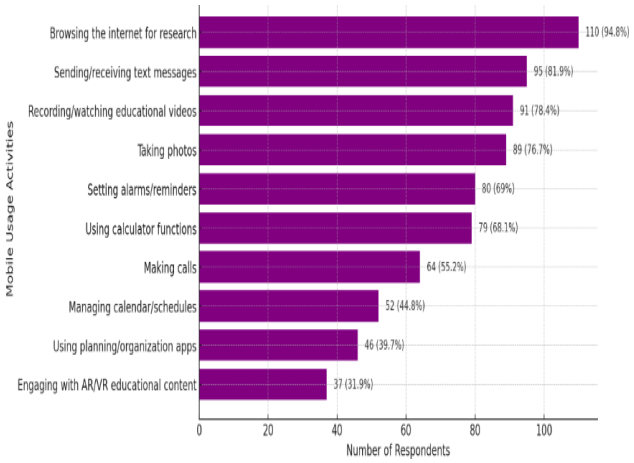
Data analysis was conducted using IBM SPSS version 21. Descriptive statistics, including frequency and percentage, will be used to analyze demographic data and summarize students' patterns of mobile phone usage and their perceptions of mobile learning. The weighted mean and standard deviation were calculated to understand the central tendencies and dispersion of the responses for each survey construct. To explore the relationships between variables, a correlation analysis was employed to examine potential associations between demographic profiles, mobile usage patterns, and perceptions of M-learning.

3. RESULTS and DISCUSION

Patterns of mobile phone usage among higher education students

Figure 5

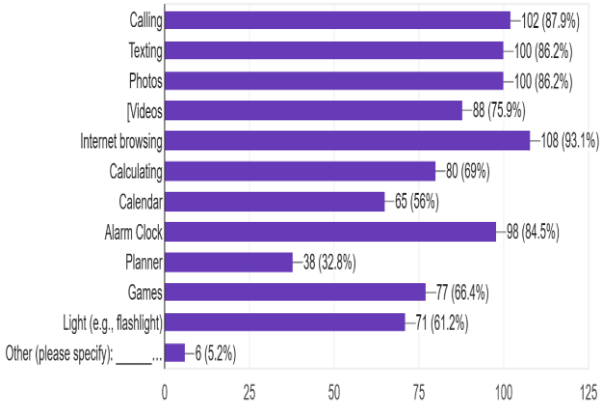
Mobile Phone Activities for Educational Purposes Among Respondents



Mobile phone usage among higher education students is widespread and multifaceted, with devices used for

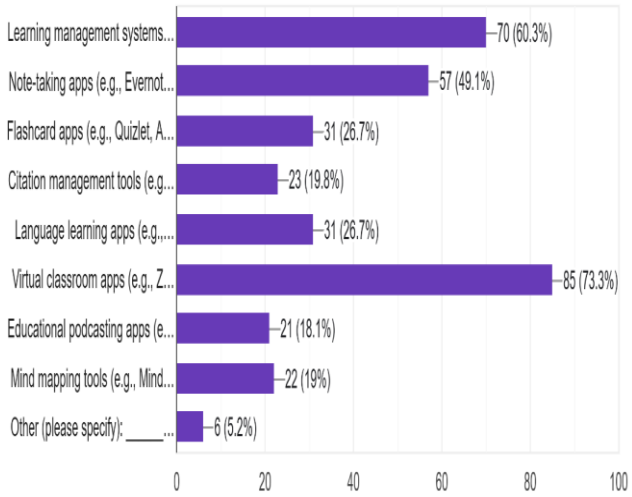
various educational purposes. According to the provided data, the most common educational activity was browsing the Internet for research, with 94.80% of respondents engaging in this practice (Nyasulu and Chawinga 2019). Text messaging is also prevalent, being used by 81.90% of students for educational purposes, which aligns with findings from other studies showing high rates of texting in classrooms (Tindell and Bohlander 2012). Interestingly, although mobile phones are often seen as distractions, the data suggest that they can be used as educational tools. For instance, 78.40% of students used their phones to record or watch educational videos and 69% used them to set alarms and reminders (Nyasulu and Chawinga, 2019). This contrasts with concerns about mobile phones being primarily used for off-task activities during class (Kim et al., 2017). In conclusion, the patterns of mobile phone use among higher-education students reveal a complex picture. While there are concerns about distractions and academic dishonesty (Tindell & Bohlander, 2012), students actively use their devices to support their learning. This suggests that rather than banning mobile phones, educational institutions might benefit from strategies that harness their potential for educational purposes while mitigating distracting elements (Nyasulu & Chawinga, 2017; Nyasulu & Chawinga, 2019).

Figure 6: Primarily use cell phones



The data provided show a range of mobile phone activities for personal use by respondents. Internet browsing was the most common activity, with 93.10% of respondents engaging in it (Abraham et al. 2021; Bailey et al. 2014). This was followed closely by calling (87.90%) and texting (86.20%), which are traditional mobile phone functions (Braitman and McCartt, 2010; Truong et al., 2017). Interestingly, although texting is a popular activity, it is not the most prevalent smartphone use in this dataset. This contrasts with some studies that found texting to be a dominant activity, especially among younger users (Tindell and Bohlander 2012). Additionally, the high percentage of Internet browsing aligns with findings suggesting the increased use of smartphones to access online information and services (Bailey et al., 2014; Ben-Zeev et al., 2012). The data revealed that smartphones are used for a wide variety of purposes beyond basic communication, including photography, entertainment, and productivity. This diverse usage pattern reflects the multifunctional nature of modern smartphones and their integration into various aspects of daily life (Janaka et al., 2023; Jiang et al., 2013). However, it is important to note that usage patterns can vary based on factors such as age, health literacy, and cultural context (Bailey et al. 2014; Ben-Zeev et al., 2012).

Figure 7 Educational Apps use. For Mobile Phones

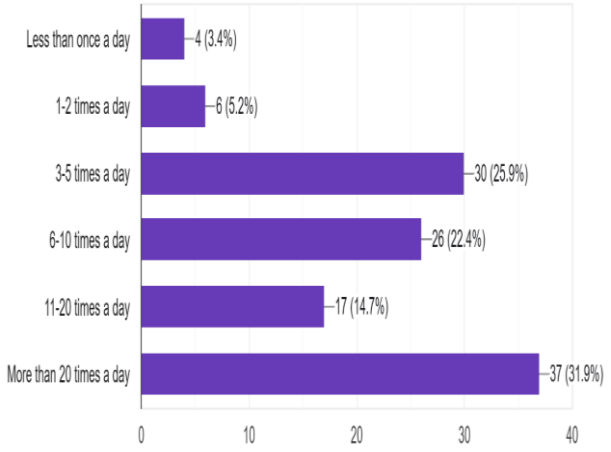


Virtual classroom apps and learning management systems were the most commonly used educational mobile applications among respondents; virtual classroom apps were used by 73.3% of respondents, and learning management systems were used by 60.3%. This high usage aligns with the findings of several studies that discuss the increased adoption of video conferencing and learning management systems during remote teaching, particularly because of the COVID-19 pandemic (Amin and Sundari 2020; Irfan et al. 2020; Lazaro et al. 2020). Amin and Sundari (2020) mentioned the use of Cisco WebEx Meetings for video conferencing and Google Classroom as a learning management system among EFL students. Interestingly, educational podcasting apps were used by only 18.1% of respondents, despite podcasts being highlighted as valuable educational tools in some contexts. Matava et al. (2013) discusses the growing use of podcasts in medical education, with 60% of surveyed anesthesia residents using medical podcasts. This suggests a potential gap between podcast usage in specialized and general educational settings. In conclusion, although virtual classroom apps and learning management systems dominate educational mobile app usage, there is room for growth in other categories, such as educational podcasting. The varied adoption rates across different app types highlight learners' diverse needs and preferences in digital education environments.

Figure 8

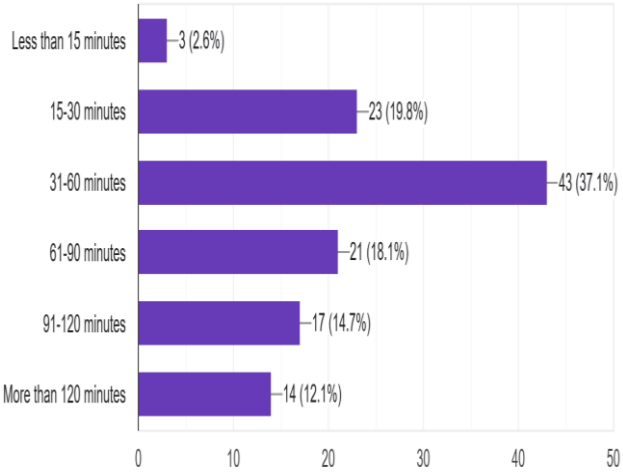
Frequency of Mobile

Phone use



The data show the frequency of daily mobile phone use by respondents. Durusoy et al. (2017) reported that among high school students, 49.4% spoke for <10 minutes and 52.2% sent/received 75 or more messages per day (Durusoy et al., 2017). This suggests a high frequency of mobile phone use among young people, which aligns with the table showing that 31.90% of respondents used their phones more than 20 times per day. Qi et al. (2021) found that mobile phone use, particularly smartphone use, was associated with better cognitive function among older Chinese individuals (Qi et al., 2021). This contrasts with concerns about the potential negative health effects of frequent mobile phone use, as noted by Durusoy et al. (2017). The general trend of frequent mobile phone use was consistent with the findings of several previous studies. However, the health implications of such usage patterns remain a subject of ongoing research, with some studies suggesting potential risks (Durusoy et al., 2017) and others indicating possible benefits for certain populations (Qi et al., 2021).

Figure 9 Frequency of time Using educational Apps



Most respondents (37.10%) reported using their mobile phones for 31-60 minutes daily. The second most common duration was 15-30 minutes per day (19.80%), followed closely by 61-90 minutes (18.10%). Only a small percentage (2.60%) reported using their phones for less than 15 min per day. Interestingly, self-reported usage duration may not accurately reflect actual mobile phone use. Goedhart et al. (2015) found that participants tended to underestimate their number of calls but overestimated the call duration compared to objectively measured data (Goedhart et al., 2015). Similarly, Vrijheid (2006) noted substantial random errors in the recall of recent phone use, with light users underestimating and heavy users overestimating their phone use (Vrijheid, 2006). In conclusion, while the data suggest that most respondents use their phones for 30-60 minutes daily, actual usage may differ from self-reports. More objective measures, such as smartphone applications that track usage, could provide more accurate data on mobile phone use duration in different populations.

Best Describe use of Mobile Phones

Table I. Most Frequent Patterns of Mobile Phone Use: Academic vs. Personal Purposes

	Most Frequent Answer	Frequency	Percentage
Using educational apps and accessing online course materials frequently	Academics Use	65	56.03
Taking notes and photos of lecture slides	Academics Use	76	65.52
Occasionally checking social media or messaging friends between classes	Personal Use	67	57.76
Regularly using social media, messaging, and entertainment apps	Personal Use	83	71.55
Occasionally looking up quick facts or definitions for coursework	Academics Use	81	69.83
Using the phone's	Academics Use	72	62.07

calendar to keep track of assignment due dates			
Frequently accessing the university's learning management system	Academics Use	82	70.69
Using productivity apps for studying and completing assignments	Academics Use	81	69.83
Occasionally using encrypted messaging or secure file storage for sensitive information	Personal Use	66	56.90
Using encrypted messaging apps as the main form of communication	Personal Use	78	67.24
Regularly employing VPNs when accessing the internet	Personal Use	80	68.97
Frequently using secure cloud storage for personal and academic files	Academics Use	45	38.79

The data revealed diverse patterns of mobile phone usage among students for both academic and personal purposes. Access to online course materials through educational apps (56.03%) and the university's learning management system (70.69%) was prevalent. Students frequently took notes and photographed lecture slides (65.52%), used productivity apps for studying (69.83%), and employed their phone's calendar for assignment tracking (62.07%). Quick fact-checking for coursework was also common (69.83% of responses). Personal use predominantly involved regular engagement with social media, messaging, and entertainment apps (71.55%), with occasional use between classes (57.76%). There is a notable emphasis on privacy and security in personal communications, with 67.24% of respondents using encrypted messaging apps as their primary communication method and 68.97% regularly using VPNs for Internet access. Secure cloud storage was less frequently used for academic and personal files (38.79% of respondents). These patterns highlight the multifaceted role of mobile phones in students' academic and personal lives, balancing educational needs with personal communication and digital security practices.

Table II. Most Frequently Used Social Media Platform per Respondent and Usage Distribution

Platform	Most Frequent	Frequency	Percentage
Use of Social Media Applications	Always	80	68.97
X	I don't use it	71	61.21
Instagram	Frequently	38	32.76
LinkedIn	I don't use it	102	87.93
YouTube	Frequently	57	49.14
WhatsApp	I don't use it	89	76.72
TikTok	Always	67	57.76

The most frequently used social media platform among respondents appears to be TikTok, with 57.76% of users reporting "Always" usage (Yeung et al., 2022). This is followed closely by YouTube, with 49.14% of respondents using it "Frequently" (Aljefree & Alhothali, 2022; Lima et al., 2020). Interestingly, some contradictions were observed in the data. While TikTok shows high usage, other platforms such as LinkedIn and WhatsApp have high percentages of non-users (87.93% and 76.72%, respectively) (Chemnad et al., 2023; Garofolo et al., 2018). This suggests a polarized usage pattern among different social media platforms. Additionally, the data show that 68.97% of respondents "Always" use social media applications, indicating a high overall engagement with social media (Aljefree & Alhothali, 2022; Naslund et al., 2017). The distribution of usage varies significantly across platforms. TikTok and YouTube emerged as the most popular platforms, whereas professional networks such as LinkedIn were used less often. This information could be valuable for healthcare professionals and researchers seeking to disseminate information or conduct studies on social media platforms, as it highlights where they might find the most engaged audiences (Lima et al., 2020; Naslund et al., 2017; Yeung et al., 2022).

Table III. Frequent Mobile Educational Activities Among Respondents

Educational Activities	Most Frequent	Frequency	Percentage
Using Mobile for Educational Activities	Daily	78	67.24
Participating in Online discussions or forums	1-2 times a week	43	37.07
Submitting assignments or quizzes	1-2 times a week	43	37.07
Watching educational videos or lectures	1-2 times a week	46	39.66
Collaborating with classmates on group projects	Daily	56	48.28

The most frequent mobile educational activities among respondents were as follows: The most common daily activity was using mobile devices for educational purposes, with 67.24% of respondents engaging in this behavior daily. Additionally, 48.28% of the respondents reported collaborating with classmates on group projects as a daily activity. For other activities, a frequency of 1-2 times per week was the most common. The highest percentage of respondents reported that watching educational videos or lectures (39.66%), participating in online discussions or forums (37.07%), and submitting assignments or quizzes (37.07%) occurred 1-2 times a week. Interestingly, these findings align with those of some studies in the literature. For instance, Garcia and Yousef (2022) reported high engagement with video lectures, accumulating 47,665 minutes of viewing time (Garcia & Yousef, 2022). Similarly, Green et al. (2013) noted that discussion forums were the most used feature of their learning management systems, with 31,920 hits (Green et al., 2013). These studies support the frequent use of educational videos and online discussions, as observed in this study. The data suggest that mobile devices are widely used in daily educational activities, with particular emphasis on collaboration and communication. Weekly engagement in online discussions, assignment submissions, and video lectures indicates a balanced approach to mobile learning that incorporates various educational tools and techniques.

Table IV Most Common Locations Where Mobile Phones Are Used for Educational Purposes

Which of the following locations do you most frequently use your mobile phone for educational purposes?	Frequency	Percentage
At home	105	90.52
On campus	93	80.17
In class	65	56.03
While commuting	25	21.55
In the library	11	9.48
in study groups or meetings	48	41.38
At work	11	9.48
Others	2	1.72

Mobile phones are most frequently used for educational purposes at home, with 90.52% of respondents indicating this location (Ahmad 2020). This was closely followed by on-campus usage at 80.17%, suggesting that students heavily rely on their mobile devices for learning, both in and out of the academic environment. Interestingly, despite the high usage at home and on campus, only 56.03% of the respondents reported using their mobile phones for educational purposes during class time. This contradicts the findings of Silva et al. (2018), who reported that 96.8% of medical students used smartphones during lectures, classes, and meetings. This discrepancy could be due to differences in the study populations or the educational contexts (Ahmad, 2020; Silva et al., 2018). Although mobile phones are used for educational purposes at home and on campus, their use in classrooms is less prevalent than other devices. This suggests that students may be more inclined to use their devices for self-directed learning outside formal class settings. Lower in-class usage could be attributed to institutional policies, instructor preferences, or students' choices to minimize distractions during lectures (Kim et al., 2017). Future research could explore the reasons for these usage patterns and their impact on learning outcomes.

Table V Perception on Mobile learning practices among respondents

Statements	**Mean**	**S. D**	**Interpretation**
I use my mobile phone to seek teacher assistance with assignments.	3.10	0.828	Often applies to me
I use my mobile phone to collaborate with	3.42	0.724	Always applies to me

classmates on projects.			
I submit assignments using my mobile phone.	3.09	0.819	Often applies to me
I use my mobile phone to schedule study sessions with peers.	2.85	0.847	Often applies to me
I access educational materials through my mobile phone.	3.46	0.762	Always applies to me
I use my mobile phone to participate in online class discussions.	3.42	0.793	Always applies to me
I organize my academic calendar using mobile applications.	2.82	0.947	Often applies to me
Overall Mean	3.17		Often applies to me

Students have a positive perception of mobile learning practices, with an overall mean of 3.17, indicating that these practices " often apply" to them (Ahmad, 2020; Izquierdo-Condoy et al., 2024; Santos et al., 2017). The highest-rated practices included accessing educational materials (mean = 3.46), collaborating with classmates on projects (mean = 3.42), and participating in online class discussions (mean = 3.42) using mobile phones (Izquierdo-Condoy et al., 2024; Santos et al., 2017). These findings align with research showing that students value mobile devices for flexible and personalized learning, social connectivity, and collaborative activities (Ahmad 2020; Öz and Yurdagül 2018). Interestingly, while students frequently use mobile phones for academic purposes, they use them less commonly for scheduling study sessions (mean = 2.85) or organizing academic calendars (mean = 2.82) (Santos et al., 2017; Zayim and Ozel, 2015). This suggests that students may prefer other time-management and scheduling tools or methods. In conclusion, the data indicate that students actively integrate mobile phones into their learning practices, particularly to access materials, collaborate, and participate in online discussions. However, there is still room for growth in the utilization of mobile devices for organizational and scheduling purposes in academic contexts (Ahmad, 2020; Izquierdo-Condoy et al., 2024; Santos et al., 2017; Zayim and Ozel, 2015).

Table VI. Perception Of Perceived Ease of Use Among Respondents

Statements	Mean	S. D	Interpretation
I find it easy to use mobile learning to do what I want to do.	3.32	0.787	Always applies to me
My interaction with mobile learning does not require much effort.	2.78	0.835	Often applies to me
It is easy for me to become skillful at using mobile learning technology.	3.11	0.778	Often applies to me
I have control over mobile learning technology.	3.19	0.733	Often applies to me
I have the knowledge necessary to use mobile learning technology.	3.22	0.723	Often applies to me
Overall Mean	3.12		Often applies to me

The data presented indicate that the respondents perceived mobile learning technology as easy to use. The overall mean score of 3.12 suggests that ease of use "often applies" to the respondents' experience with mobile learning (Qashou, 2020). Perceived ease of use is a crucial factor in the acceptance and adoption of mobile learning technology. Multiple studies have found that it is a significant predictor of perceived usefulness, attitude towards use, and behavioral intention to use mobile learning systems (Habibi et al., 2022; Kumar et al., 2020; Naveed et al., 2020). Interestingly, while the perceived ease of use is often considered a direct predictor of behavioral intention, some studies have found this relationship to be insignificant or indirect (Islamoglu et al., 2021; Joo et al., 2016). The data suggest that students find mobile learning technology easy to use, which is likely to positively influence their acceptance and adoption of such systems in the future. However, the relationship between perceived ease of use and other factors in technology acceptance models can vary across different contexts and user groups, highlighting the need for context-specific research when implementing mobile learning solutions (Habibi et al., 2022; Islamoglu et al., 2021; Qashou, 2020).

Table VII. Perception of Perceived Usefulness Among Respondents

Statements	Mean	S. D	Interpretation
Using mobile learning enables me to accomplish tasks more quickly.	3.42	0.687	Always applies to me
Using mobile to learn improves my performance.	3.22	0.735	Often applies to me
Using mobile learning will increase my productivity.	3.12	0.736	Often applies to me
Using mobile learning enhances my effectiveness.	3.20	0.737	Often applies to me
Overall Mean	3.24		Often applies to me

The data presented in the table indicate a generally positive perception of mobile learning's perceived usefulness among respondents. The overall mean score of 3.24 suggests that the statements often apply to the respondents, indicating a favorable view of mobile learning's utility (Habibi et al., 2022; Naveed et al., 2020). Respondents most strongly agreed with the statement "Using mobile learning enables me to accomplish tasks more quickly," with a mean score of 3.42. This aligns with findings from multiple studies that highlight perceived usefulness as a significant predictor of mobile learning acceptance and intention to use it (Habibi et al., 2022; Kumar et al., 2020; Naveed et al., 2020). The other statements also received positive responses, with mean scores ranging from 3.12 to 3.22, suggesting that respondents often perceived mobile learning as improving performance, increasing productivity, and enhancing effectiveness. Interestingly, while the data show a positive perception of perceived usefulness, some studies have found that the relationship between perceived usefulness and mobile learning adoption may not be linear. Kumar et al. (2020) reported nonlinear relationships between perceived usefulness and behavioral intention, indicating that the impact of perceived usefulness may reach a saturation point. Additionally, the importance of perceived usefulness may vary across different contexts and user groups, as suggested by the gender differences in mobile learning adoption reported by Habibi et al. (2022) and Zhai and Shi (2020). These data support the findings of various studies that perceived usefulness is a crucial factor in mobile learning acceptance and adoption. However, it is important to consider that the impact of perceived usefulness may be moderated by other factors, such as ease of use, facilitating conditions, and individual characteristics (Alyoussef, 2021; Moca and Badulescu, 2023; Naveed et al., 2020). Future research should explore how these perceptions translate into actual usage patterns and learning outcomes in different educational contexts and settings.

Table VIII. Relationship between the demographic profile of respondents and pattens of mobile usage

		Frequency of Daily Mobile Phone Use	Duration of Daily Mobile Phone Use	Mobile Phone Utilization for Educational Activities	Social Media Platform Use
GENDER	Pearson Correlation	0.076	0.024	-0.041	-0.131
	Sig. (2-tailed)	0.42	0.799	0.664	0.16
	N	116	116	116	116
COURSE	Pearson Correlation	-0.035	0.136	-0.031	0.07
	Sig. (2-tailed)	0.708	0.144	0.739	0.454
	N	116	116	116	116
AGE	Pearson Correlation	-0.083	-0.083	-0.165	0.131
	Sig. (2-tailed)	0.374	0.375	0.077	0.16
	N	116	116	116	116
YEAR	Pearson Correlation	0.029	0.059	-0.08	0.015
	Sig. (2-tailed)	0.758	0.532	0.391	0.871
	N	116	116	116	116

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The analysis of the relationship between demographic profiles and mobile device usage patterns revealed no significant correlation. Gender showed weak positive correlations with the frequency (r=0.076) and duration (r=0.024) of daily mobile phone use, but a slight negative correlation with educational activities (r=-0.041) and social media platform use (r=-0.131). The course of study demonstrated minimal correlations across all usage patterns, with the strongest being a weak positive

relationship with daily usage duration (r=0.136), suggesting that the field of study has a limited influence on mobile phone usage habits, although students in certain disciplines may tend to use their phones for slightly longer periods (Arora et al., 2024; Miller et al., 2012). Age exhibited weak negative correlations with the frequency, duration, and educational use of mobile phones (r=-0.083, r=-0.083, r=-0.165, respectively), but a slight positive correlation with social media use (r=0.131), suggesting that as students get older, they may use their phones less frequently, for shorter durations, and less for educational purposes, but slightly more for social media (Miller et al., 2012; Xiao et al., 2024). However, it is important to note that none of these correlations were statistically significant (p>0.05), suggesting that demographic factors may not strongly influence mobile usage patterns in this sample. These findings highlight the complex relationship between demographic factors and mobile phone usage patterns in students. While the correlations are weak, they point to subtle differences that may be worth considering in educational and health-related contexts (Arora et al., 2024; Bekalu et al., 2019; Jose et al., 2024

Table IX. Relationship between the demographic profile of respondents and pattens of mobile usage

		Perception on Mobile Learning Practices	Perception of Perceived Ease of Use	Perception of Perceived Usefulness
GENDER	Pearson Correlation	-0.05	-0.041	-0.041
	Sig. (2-tailed)	0.595	0.664	0.664
	N	116	116	116
COURSE	Pearson Correlation	0.028	0.078	0.078
	Sig. (2-tailed)	0.768	0.408	0.408
	N	116	116	116
AGE	Pearson Correlation	0.036	0.044	0.044
	Sig. (2-tailed)	0.705	0.637	0.637
	N	116	116	116
YEAR	Pearson Correlation	0.154	.223*	.223*
	Sig. (2-tailed)	0.1	0.016	0.016
	N	116	116	116

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

The table shows the correlations between demographic factors and students' perceptions of mobile learning. No significant correlations were found between gender, course, or age and perceptions of mobile learning practices, perceived ease of use, or perceived usefulness. The correlation coefficients for these factors were close to zero and were not statistically significant ($p > 0.05$). However, there was a weak but statistically significant positive correlation between the year of study and both the perceived ease of use ($r = 0.223$, $p = 0.016$) and perceived usefulness ($r = 0.223$, $p = 0.016$) of m-learning. This suggests that as students' progress in their studies, they tend to find mobile learning easier and more useful. These findings contradict those of previous studies.

Suner et al. (2019) found significant differences in m-learning attitudes based on gender, whereas Pratama (2020) noted that perceived usefulness was less influential for male and middle school students than for female and high school students (Pratama, 2020; Suner et al., 2019). This discrepancy could be due to differences in the study population or methodologies. While the provided data show a minimal impact of most demographic factors on mobile learning perceptions, the year of study appears to have a small positive effect on the latter. This finding highlights the importance of considering students' academic progression when implementing mobile learning strategies. Further research is needed to reconcile these findings with the broader literature on demographic factors in mobile learning adoption.

Table X. Multiple Linear Regression Predicting Perceived Usefulness of Mobile Learning

Predictor	B	SE B	β	p-value
Gender	0.042	0.061	0.043	0.497
Age	-0.015	0.025	-0.038	0.563
Year Level	0.287	0.087	0.295	0.002
Course	0.105	0.076	0.109	0.174
Frequency of Use	0.089	0.056	0.122	0.098
Duration of Use	0.198	0.068	0.218	0.007
Educational Usage Score	0.152	0.059	0.205	0.011

Multiple linear regression analysis showed that several factors strongly influenced the usefulness of mobile learning. The most important factor was the year level ($\beta = 0.295$, $p = 0.002$). This means that students in higher grades found mobile learning tools more helpful, probably because they used them more and had more schoolwork. The time spent using mobile devices for school ($\beta = 0.218$, $p = 0.007$) and the extent of their use for learning ($\beta = 0.205$, $p = 0.011$) were also important. Students who used mobile devices more for schoolwork valued them more highly. However, gender, age, and course did not affect the students' views of mobile learning. This suggests that how students use and engage with technology is more important than their personal backgrounds. These results highlight the need to encourage students to use mobile devices for learning early in their education to improve their learning experience.

Implications and recommendations

Several strategies can be considered to effectively implement and enhance mobile learning in physics education. First, institutions should develop subject-specific mobile applications and resources tailored for physics, including interactive simulations, virtual laboratories, and problem-solving tools optimized for mobile use. Structured training should be provided to students, particularly those in their early academic years, to promote effective mobile learning strategies and best practices for using educational apps. Integrating mobile learning activities into the curriculum, such as using mobile devices for data collection in experiments or collaborative problem solving, can further enrich the learning experience. Existing learning management systems and virtual classroom applications should be optimized for mobile access to ensure seamless student engagement. To mitigate digital distractions, clear guidelines for the appropriate use of mobile devices during class should be established. Ensuring reliable internet connectivity and device accessibility is essential for promoting equitable access to mobile learning resources. Continuous assessment of mobile learning effectiveness through feedback from students and instructors supports ongoing improvement. Additionally, professional development opportunities should be provided to instructors to effectively incorporate mobile technology into teaching practices. Exploring emerging technologies such as augmented reality and adaptive learning systems can further enhance mobile-based physics instruction. Institutions should also develop supportive policies to guide the integration of mobile learning into higher education curricula and consider partnerships with mobile technology companies to create physics-specific educational tools. Finally, conducting longitudinal studies will help assess the long-term impact of mobile learning on students' performance and their conceptual understanding. These combined efforts can enable institutions to harness the full potential of mobile technology to advance physics education in the future.

Limitations and future research direction

The limitations of this study include its focus on a single university, which may limit its generalizability. Although the sample size was adequate, it could be expanded in future studies to enhance statistical power. Additionally, the cross-sectional design prevented causal inferences, suggesting that longitudinal studies should be conducted in the future to address this limitation. Reliance on self-reported data may introduce bias, warranting the inclusion of objective measures in future studies. Future research should explore the impact of specific institutional policies on student engagement and investigate potential moderating factors such as socioeconomic background and prior academic performance. Comparative studies across multiple institutions and diverse cultural contexts can provide broader insights. Qualitative research methods can complement quantitative findings and offer a deeper understanding of students' experiences. Finally, examining the long-term effects of engagement on post-graduation outcomes would be valuable for understanding broader implications of student engagement in higher education.

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Research Ethics. This study addresses the key ethical considerations. Participants provided informed consent after being briefed on the study's purpose and risks. Privacy and confidentiality were maintained throughout the research and publication processes. Physical, psychological, and social risks were assessed and minimized. Fair representation and unbiased selection were ensured in this study. Methods, limitations, and conflicts of interest are disclosed. Data integrity and objective result presentation were ensured. Sources were properly cited to respect the intellectual property rights. Environmental impacts were minimized, technology was used responsibly, and cultural sensitivity was maintained. The long-term implications were also considered.

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