RESEARCH ARTICLE

Student attitudes towards smartphone use in a pre-service teacher tech course

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Abstract: In contemporary classrooms, characterized by students who are digital natives with a firm reliance on mobile phones, integrating these devices into educational activities presents an opportunity to enhance learning experiences and increase engagement. This qualitative case study investigates undergraduate pre-service teachers' perceptions of using smartphones for learning activities in a Teacher Education Program (T.E.P.) technology course at a 4-year institution in the U.S. The researchers sought to examine how the use of smartphones influenced the students' learning experiences. Understanding students' experiences can inform the development of strategies to enhance technology-integrated lessons and foster improved learning environments. The findings indicated that students had positive experiences with using smartphones in class. They found the devices to help enhance online learning security and were reliable, versatile, and affordable compared to other forms of technology. The ability of the devices to download and accommodate a variety of educational materials was also a valuable attribute for the students. However, challenges associated with unrestricted phone access in the classroom, including the risk of addiction, distraction, decreased engagement, and concerns regarding academic integrity, were reported. As smartphones become integral to our learning environment, educators should establish policies promoting responsible usage to optimize students' learning potential rather than imposing bans. The researchers propose that institutions invest in innovative software solutions to manage smartphone usage proactively. This approach enables students to enhance their focus and productivity during crucial learning moments while mitigating distractions posed by mobile phones.

Keywords: mobile learning, pre-service teachers, online learning, addiction

1 Introduction

In the thriving realm of Web 3.0, mobile devices are not just tools but gateways, ushering the vast internet world into our palms (Armakolas et al., 2024). This trend is underscored by the fact that the average American adult invests over 5 hours daily in smartphones. As of November 2022, mobile phones seized the lion's share, generating a substantial 60% of website traffic, leaving desktops and tablets trailing at a combined 39% (Layton, 2023). Debates have been raging recently on whether mobile phones affect the teaching and learning process and if it is time they are embraced in the classroom. Many researchers have investigated the impact of mobile technology on academic achievement, and their findings suggest that powerful learning is possible with mobile devices, but only when adequately supported and managed by teachers.

When mobile phones first appeared in the classroom in the 1990s, teachers perceived them as disruptors to the traditional classroom setting and banned them by schools and educational authorities (Selwyn, 2019). Over time, mobile phones have evolved in versatility to perform most tasks a desktop computer performs, with the advantage of being easily portable. Stefanidis et al. (2022) compared mobile phones to a double-edged sword because the same technological affordances provide both benefits and barriers to integration in the classroom. Problems associated with any new technology can also hinder its use. Historically, the most notable complaint against integrating mobile phones in classroom teaching and learning has been the disruption they cause.

Given that modern college classes consist entirely of native digital learners whose daily activities are centred around mobile phones, attempting to prohibit their use of mobile phones during learning would be futile (Cruz et al., 2024). Consequently, educators must embrace innovative strategies and approaches to address this reality and surmount any obstacles to effective learning posed by this ubiquitous technology in the classroom (Papadakis & Kalogiannakis, 2020; Polly et al., 2020). Therefore, banning phones does not apply in college settings, especially with more programs shifting to and embracing many forms of online learning modalities in which

mobile phone technology can be tapped to maximize the benefits of this form of learning (Jurayev, 2023). Given the above realities, an in-depth investigation of mobile phone impacts on student learning in the classroom is needed to make informed decisions about viable ways to incorporate the devices into the classroom with minimal barriers to learning.

1.1   Research questions

This study was conducted to answer the following questions:
(1) What are undergraduate students' experiences using mobile phones in the classroom?
(2) What are students' perspectives about the effectiveness of using mobile phones for learning?

1.2   Significance of the study

While numerous studies have explored the overall influence of smartphones on student learning, there needs to be more literature regarding their specific impact on activity-based courses that involve technology integration (Lavidas et al., 2022). This study aims to fill that void, shedding light on how smartphones affect learning in such settings, which could offer valuable insights for educators and policymakers aiming to optimize educational strategies (Papadakis, 2021). Understanding the students' attitudes is crucial for envisioning potential classroom dynamics and decision-making processes regarding technology integration. Consequently, this study seeks to investigate undergraduate students' perspectives on incorporating mobile devices in technology lessons. By doing so, it aims to uncover adjustments that can be implemented to enrich the classroom learning environment through technology utilization. These insights are significant in informing educational practices and preparing future educators to leverage technology in their teaching methodologies effectively.

1.3   Conceptual framework

Classroom learning environments encompass diverse players who utilize Information and Communication Technology (I.C.T.) to facilitate knowledge transfer and acquisition (Granić & Marangunić, 2019). The acceptance and utilization of specific I.C.T. tools are influenced by the attitudes of students, instructors, and institutional administrators. For instance, administrative attitudes often translate into policy regulations regarding using devices such as mobile phones in classrooms, either endorsing or prohibiting their use for learning purposes. The current study relies on the Technology Acceptance Model (T.A.M.), first proposed by Davis (1989), to explain the acceptance of a technology product based on the flow of causality from perceptions and attitudes. The T.A.M. model views technology usage as extrinsically motivated and driven by concern over performance gains and associated rewards. It suggests that the user's motivation can be explained by three factors: perceived *Ease of Use, Perceived Usefulness,* and *Attitude toward using* (Granić & Marangunić, 2019).

In the educational context, the T.A.M. model has been extensively used to investigate the impact of design features on user acceptance and why users decide to adopt and accept or reject a particular technology (Davis, 2011). Over time, researchers have adapted the model to their unique needs, contextual factors, research goals, and interpretations of the model (Mailizar et al., 2021). Consequently, modified versions have emerged, incorporating additional external constructs such as experience, perceived enjoyment, and self-efficacy within Perceived Usefulness (P.U.) and Perceived Ease of Use (P.E.U.) in the framework. Perceived usefulness (P.U.) is the degree to which an individual believes using a particular I.C.T. tool would enhance their learning or job performance. Perceived Ease of Use (P.E.U.) is the degree to which an individual believes that using a particular technology tool would be free of mental and physical effort.

Davis (2011) noted that behavioural intention is influenced by one's attitude toward using the technology tool. This highlights the importance of attitudes in shaping learners' intentions to use technology tools. Perceived Ease of Use and Perceived Usefulness influence learners' attitudes toward technology adoption. They both directly and indirectly impact behavioural intention by shaping how easily users perceive the technology and how much they believe it will enhance their performance or productivity. When users find technology easy to use and believe it will benefit them, they are more likely to develop positive attitudes and intentions toward adopting it.

Conversely, users are less likely to intend to use if a technology is perceived as challenging or needs more perceived usefulness. Therefore, these factors are crucial in determining users' behavioural intentions regarding technology adoption and usage. Designers, therefore, strive to enhance the perceived usefulness by adding new functional capabilities to their technology tools or making it easier to invoke existing functions.

Additionally, greater ease of use enhances productivity and saves time on extensive learning tasks, creating room for other essential tasks with the additional time created. An easier-to-use tool demands less of the learner's cognitive capacity to operate the system, allowing them to be attentive to the task for which the device is being used, leading to reduced errors and increased task effectiveness. An easier-to-use tool enhances the user's expertise with continued use and enables them to take advantage of the tool's range of capabilities (Mailizar et al., 2021).

2   Literature review

In this literature review section, we delve into the existing body of research concerning the influence of smartphones on student learning. As Stefanidis et al. (2022) observed, using smartphones in educational settings can be likened to a double-edged sword, presenting advantages and obstacles to classroom integration. Therefore, this review scrutinizes the dual effects of integrating smartphones into classroom learning, highlighting their beneficial and detrimental impacts.

2.1   Perceived benefits

Some notable benefits of mobile phones include their portability and adaptability, convenience, and Cost-effectiveness. Mobile learning has led to easy access to educational resources, enhanced engagement, and personalized learning, as students can interact with educational content in various settings. It encourages active participation and fosters retention through experiential learning and self-directed study, empowering students to take charge of their education. Collaborative opportunities abound as students can communicate and work together both in and out of the classroom, fostering peer interaction and project-based learning.

Students have expressed optimism regarding mobile-assisted reading and have demonstrated the ability to continue reading from their phones (Yu et al., 2022). They appreciate the portability of phones and the built-in functions that support mobile reading systems. Additionally, mobile learning offers several key features, such as flexibility, quick access to materials, multimedia learning, and diverse content, all of which have been instrumental in augmenting traditional education (Gupta et al., 2021). Furthermore, mobile learning has emerged as a valuable communication tool that facilitates teaching and learning processes in higher education through asynchronous discussions beyond the classroom. This makes it easier for students to access a wealth of information at the press of a button (Sophonhiranrak, 2021).

Compared to other technology devices like laptops, smartphones are more affordable, easy to carry, and adequate for online learning. Students can easily access learning material, interact with it, and increase their engagement with e-learning (Dehbi et al., 2023). Teachers also found mobile learning potentially helpful in creating online education courses through the platform. This necessitated better connections with their students and enhanced teacher-student communication.

Recent studies have highlighted the convenience and accessibility that mobile phones bring to the learning process. Students find mobile-assisted reading particularly beneficial, appreciating the ease with which they can access learning materials from their phones (Nariyati & Pratiwi, 2020). In a study to explore the influence of mobile-based and paper-based learning media on reading comprehension, Yu et al. (2022) established that students expressed optimism about mobile reading systems, highlighting the portability and user-friendly features of smartphones. With built-in functions tailored for mobile reading, such as adjustable font sizes and screen brightness, students could engage with educational content anytime and anywhere and, therefore, preferred mobile devices over the traditional paper-based reading approach.

Another critical feature attracting students to mobile learning is its flexibility, allowing them to access educational resources quickly and conveniently. Gupta et al. (2021) note that mobile learning offers access to a wide range of multimedia content, enriching the traditional learning experience. Through various interactive multimedia applications downloaded on smartphones, students can engage with course content dynamically and innovatively, enhancing their understanding and retention of information. Additionally, smartphones are relatively affordable and accessible to more learners in the higher education context compared to other devices like laptops (Rotondi et al., 2020). This affordability makes mobile learning accessible to a broader range of students, regardless of socioeconomic background. Dehbi et al. (2023) highlight the cost-effectiveness of mobile learning devices, noting that they provide students with an affordable and convenient means of accessing educational content. As a result, students can easily interact with learning materials, participate in online discussions, and engage in context-sensitive learning activities.

Teachers also recognize the potential of mobile learning in enhancing communication with students and fostering a more interactive learning environment. By leveraging mobile learning platforms, educators can create online courses that cater to diverse learning needs and preferences. Mobile phones facilitate seamless communication between teachers and students, enabling real-time feedback, collaboration, and engagement with course materials (Criollo-C et al., 2021). Through mobile learning, teachers can better connect with their students, address their individual learning needs, and create a more personalized and engaging learning experience (Ahmad, 2020).

In summary, mobile phones offer numerous advantages in learning, including convenience, accessibility, flexibility, and multimedia capabilities. Leveraging these advantages, educators can design varied, engaging learning experiences that accommodate diverse learning needs. Students can access educational resources anytime and from any location, facilitating continuous learning beyond the classroom. Integrating these devices into education holds immense potential to promote active engagement, deepen comprehension, and foster academic success among students.

2.2   Perceived barriers

Despite the convenience of mobile phones in accessing learning materials, students often need to focus on various communication channels and applications. According to Yu et al. (2022), students prefer reading from hard copies to mobile devices, citing concerns about note-taking and maintaining focus. The participants in the study by Yu and colleagues noted that constant notifications and messages from mobile phones disrupted their concentration, leading to shallow reading and poor retention of content. As a result, students in such situations have been found to need help to engage deeply with course materials and may experience difficulty in comprehending and retaining information (Lee et al., 2020).

In a similar study that investigated the impact of smartphones on learning and memory among undergraduate students, Tanil and Yong (2020) asked participants to complete a memory task and the Smartphone Addiction Scale (S.A.S.) survey. The researchers found that students who did not have smartphones demonstrated higher recall accuracy than those with the devices in class. Additionally, the mere presence of a smartphone influenced students' ability to learn and remember information, highlighting the detrimental effects of smartphones on learning and memory processes.

Additionally, Gajdics and Jagodics (2022) conducted a study to examine the impact of mobile phone use on high school students' anxiety levels and class engagement. The study compared students' state anxiety levels on a regular school day with those on a mobile-free day when participants did not carry their mobile phones during classes. The results revealed that mobile phone use was associated with increased anxiety levels, particularly among students with higher mobile attachment scores. While the class engagement was not significantly affected by the absence of mobile phones, attachment to mobile devices emerged as a significant predictor of anxiety on mobile-free school days. This suggests that students' reliance on mobile phones may contribute to heightened anxiety levels and detract from their overall engagement in classroom activities (Choksi, 2021).

Relatedly, Sutisna and colleagues (2020) further found a link between mobile phone use and laziness, resulting in students needing to immerse themselves fully in a subject content area to learn. Active learning that includes writing helps students better grasp the material and allows them to experiment and learn from their mistakes, making them conversant and competent in their content area and language of instruction. Efforts, therefore, need to be geared toward integrating mobile learning devices to serve as appropriate complementary learning tools for other conventional forms of course delivery rather than replace them altogether (Pandia et al., 2021). All these barriers point to the significant challenges that mobile phones can present in the learning environment by increasing students' distractions, resulting in shallow reading habits and increased anxiety levels.

3   Methodology

According to Rashid et al. (2019), case study research involves analyzing a specific event or social unit within its real-life setting. This method seeks to delve deeper into understanding the phenomenon's complexities, using various sources like participant quotes, narratives derived from original interviews, and other literary devices to paint a vivid picture of the complex variables at play. Case studies are known for their descriptive nature, clearly showing the many factors involved (Schoch, 2020). Our study chose an exploratory case study approach to explore the students' feelings about using smartphones in the classroom for learning. As Nilmanat and

Kurniawan (2021) explain, exploratory case studies help understand people's thoughts, behaviours, and experiences regarding a particular topic. They help gather detailed data to illuminate complex issues and guide future research and practices.

Focusing on a specific course and students, we aimed to gather as much information as possible about their learning with mobile technology integration. This approach allowed us to collect and triangulate different data types, like interviews and observations, and aggregate them better to understand the topic (Schoch, 2020). By thoroughly examining the details of our case, we could find essential insights that can be useful not only for our study but also for similar situations in education, improving how we understand and use technology in schools.

The methodology employed in this study aligns with the constructivist-interpretive paradigm, which aims to understand and interpret students' learning experiences to inform future educational practices (Sebastian, 2019). Within this paradigm, interpretive researchers recognize the importance of integrating their subjective beliefs into the inquiry process to unravel and share the meanings inherent in qualitative research, whose social truth emanates from the socio-cultural context (Pervin & Mokhtar, 2022). We accessed the intricacies of participants' thoughts, values, prejudices, perceptions, emotions, and perspectives using interactive interviews and classroom observations. This opportunity allowed for a thorough exploration of aspects that may not be readily observable, enriching our understanding of student behaviours with smartphones within the learning context. This paradigm, therefore, enables us to explore learning events and student perspectives to gain insights that deepen our understanding of the subject.

Morrell and Carroll (2010) define Educational research as systematically examining behaviour to improve our understanding of how students learn and how best to teach to facilitate their learning. They highlight the essential role that educational research plays in helping educational practitioners improve their teaching and learning. In such studies, research questions arise from events, problems, or professional interests that the instructors deem necessary (Efron & Ravid, 2020). As insiders intimately involved and familiar with this course, the need to conduct our investigation systematically, reflectively, and critically using appropriate strategies necessitated our choice of the case study approach for this study.

We conducted this research study with five undergraduate students in their third year, taking a technology course in readiness for their clinical field experience. Upon receiving the Institutional Research Review Board approval, we started the recruitment process by seeking consent from the individual students for their lesson observation and individual interviews. All 25 students consented to the lesson observation, while 23 agreed to be interviewed. We then selected 5 participants for this case study by randomly sampling from the 23 students who had returned their signed consent forms agreeing to both be observed and interviewed. With the participants selected, one researcher then scheduled a lesson observation in the computer lab where the class had weekly meetings for this course. The observation primarily focused on student behaviour, particularly their use of phones, interpersonal interactions, and any indications of mobile phone usage policies through classroom artefacts. The researcher was also keen to document the teacher-student interactions during the lesson and the overall impact of mobile device usage on learning.

3.1   Participants

The position of one of the researchers as a teacher of record for this class meant that they could not directly recruit participants. In line with research best practices, we enlisted a colleague not directly involved in the course to help us in the recruitment process. Based on the study's scale and aiming better to manage the whole data collection and analysis process, we settled on a student sample of 5 representing the whole class. As earlier mentioned, this research study focused on third-year students in the Teacher Education Program (T.E.P.) of study at a four-year university in the Midwest region. The participants were drawn from a class of 25 students who had consented to participate in the study. We obtained this sample by generating random numbers and assigning a number to each member in the participant pool. This sampling method was meant to ensure that each student gets an equal chance of being selected for the study.

3.2   Instrument

We carefully developed a semi-structured interview questionnaire for the study, ensuring face and content validity (Aung et al., 2021). The instrument comprised five items that prompted respondents to share their experiences regarding their use of smartphones during learning. To enhance face validity, we enlisted the expertise of experienced qualitative researchers within our department who evaluated the instrument for the relevance and appropriateness of its items (Gani et al., 2020). Their valuable feedback guided us in refining the language and enhancing the clarity

of each item in the instrument. Additionally, we conducted pilot testing with a group of third-year students within the school of education, though not in the T.E.P. program. This step aimed to uncover any potential shortcomings in the instrument, allowing us to further modify it based on received feedback until it comprehensively captured the entire construct under examination. Through this collaborative and iterative refinement process, guided by input from experienced peers, we ensured that the instrument effectively aligned with its intended purpose and accurately measured the targeted concept, thus bolstering its overall validity and reliability (Aung et al., 2021).

3.3   Setting

The study was conducted at a four-year degree-granting university located in the Midwest region of the United States, boasting a student population of approximately 7,000 and offering diverse undergraduate and graduate-level courses. Specifically, the research focused on the School of Education's pre-service teachers embarking on their second clinical practice. As a prerequisite for clinical practice, the students were enrolled in *EDUC 302 – Reflective Instructional Practices/Technology II*, a clinical field experience course in the Teacher Education Program (T.E.P.) for all education majors seeking licensure. This course explores the strategic integration of technology in classroom teaching and learning, providing students with essential knowledge applicable to their clinical field experience. As part of the course requirements, students are tasked with videotaping their lessons, acquiring proficiency in editing video and sound files, and utilizing various mobile-based apps for their teaching practice.

The selection of this course as the focus of the study was driven by its emphasis on the utilization of technological devices both in the lab for assignments and their classroom teaching practice. Typically, classes were convened on Tuesdays in a computer lab with approximately 25 computers. It was commonplace for students in this class to opt for their portable devices over desktop computers when completing assignments. The 5-week blended course included additional components, such as discussions, readings, and assignments hosted on an asynchronous learning management system (L.M.S.), D2L. These activities could be conveniently done by individual students at their own pace, using either desktop computers or any portable devices, eliminating the need for physical presence in the school's computer lab, hence the suitability of the course for the current study.

3.4   Positionality

The researcher's familiarity with the research site, acquired through their rich experience assisting or instructing in the classroom, provided valuable insights for investigating the students' behaviours. Building rapport with the students over time through classroom interactions facilitated trust (Glesne, 2016), fostering open discussions and yielding more reflective responses during interviews. To investigate how mobile devices have shaped students' perspectives on classroom learning, we must systematically extract as much information from participants as possible while carefully not diluting the findings with our own bias (Wa-Mbaleka, 2020).

3.5   Data generation

We used two data sources to ensure our findings are credible and trustworthy (see Efron and Ravid, 2020). We started by having a 90-minute observation of the students during their *EDUC-302* class session in the computer lab. The observations allowed us to systematically watch and record students' behaviour, class participation, and on-task performance. In addition to the classroom observation, we conducted 30-minute semi-structured individual interviews with each of the 5 participants to gather richer insights into their experiences and perspectives.

3.5.1   Classroom observations and student interviews

Some aspects of behaviour are essential to a study yet cannot be captured in interviews. Such important cues as nonverbal behaviours, gestures, and body language can be best captured through observations. Rashid et al. (2019) pointed out that observations are crucial in guiding researchers toward a deeper comprehension of the case under study by creating vicarious experiences for readers, immersing them in the setting, and enabling them to feel present within the observed scenarios. The observations formed a basis for our interview questions within this research context as we sought to understand some classroom behaviour better. We, therefore, used direct observations to record student behaviour during learning. As participant observers, this allowed us to document the aspects of student behaviour that outsiders might not have (Duesbery & Twyman, 2020) while constantly analyzing our observations for meaning. The observation notes,

reflections, and insights into classroom dynamics were integral in shedding more light on the learning environment in this lesson.

During the second data collection phase, we conducted 30-minute interviews with individual participants to gather their insights on the study topic. Four interviews were recorded using a smartphone and later uploaded to a desktop computer for transcription. The fifth participant, however, withdrew from the interviews at the last minute, citing a busy schedule, but agreed to respond to the questions through an online survey. Consequently, we adapted our data collection strategy to incorporate an online qualitative survey to maximize data collection. Accordingly, we also adjusted the Institutional Research Review Board application to include the survey as an additional data source.

3.5.2 Data analysis

The first step in analyzing my data was transcribing the interview recording using the *Microsoft 365 Word processor* that converts audio to text. We then began carefully reading through the information while correcting and condensing it into a meaningful structure that would enable us to understand it better. At this level, we truncated unnecessary words and phrases irrelevant to the interview and observation while highlighting keywords and phrases or sentences. As we did this, each researcher recorded their insights to capture our understanding of the conversations as we developed codes. The next step was code reduction, which involved reducing similar or related codes from the data. We then grouped the remaining codes with similar contexts in a chart to organize the data into thematic clusters based on the T.A.M. framework's thematic structure (Weyant, 2022).

3.5.3 Trustworthiness

Our obligation as qualitative researchers is to ensure that this study's findings are valid so that they can help shape relevant decisions and future actions. In this regard, we enhanced the trustworthiness of this research by triangulating the data to answer the research questions accurately. Efron and Ravid (2020) identify triangulation, disciplined subjectivity, thick description, member checking, and peer review as some of the most common methods that enhance the trustworthiness of qualitative research studies. Throughout this study, we have tried to be systematic in our steps to ensure its trustworthiness. We involved peers in the initial stages of formulating research and interview questions, being aware of the essence of their feedback in enhancing the trustworthiness of the current study. Using two data sources, as stressed by Efron and Ravid (2020) and Lemon and Hayes (2020), also allowed for the authentication of the findings of this study. Finally, our familiarity with the research site and participants ensured that we remained subjectively disciplined by being as reflexive as possible when reporting the findings, ensuring the trustworthiness of the final report.

4   Findings and discussions

This study aimed to explore third-year undergraduate teacher trainees' perspectives on using mobile devices in classroom learning activities and to understand how devices affect their learning. Findings from the observations and interviews indicated the powerful effect of mobile phones on classroom learning. This is despite several adverse effects that, if not controlled, can hinder the smooth learning process and the attainment of the intended learning objectives. In our presentation of the findings below, we have organized them into four main themes based on our data analysis. We start by discussing how the college indirectly encourages using mobile phones in class. Then, we outline the participants' perspectives on the beneficial impact of these devices on their learning. Finally, we address the challenges participants identified with mobile phone use, which they believe could hinder their learning and that of the entire class.

4.1   Online security

The technology-focused course we are examining requires students to actively participate in hands-on activities using the institution's online learning platform, Desire to Learn (D2L). To access these activities, students must log in to their university accounts using their standard login credentials (like email address and password) and a multi-factor authentication (M.F.A.) process. The university stresses the importance of M.F.A. for enhancing online security on campus, encouraging students to enrol in this additional security measure at the beginning of the academic year. A notice posted on the lab noticeboard on the university's website states:

> "... M.F.A. requires that users sign in with their institutional credentials — an XXX email address and password — and then accept a 'push notification' delivered via a

phone. This additional step dramatically increases system security as well as that of user accounts and credentials. Users are encouraged to enrol in M.F.A. to increase campus security as the new academic year begins."

As a result, students need to have their mobile phones in class to meet the requirements for accessing their accounts. Apart from using phones for learning, they also use them for extra help through support apps like synchronized calendars and reminders. These apps help students keep track of important events related to their courses during class. The functions of mobile devices mentioned above are crucial for helping students maintain online security and learn better. Even though desktop computers are available, the fact that students heavily rely on mobile phones to access learning materials shows how important it is for them to have their phones in the classroom.

4.2 Versatility

Smartphones demonstrate remarkable versatility as multifunctional tools for various learning activities. They facilitate collaborative activities and provide access to specialized tasks that enable users to engage in various activities and interactions regardless of location. This versatility underscores smartphones' significant role in enhancing communication, collaboration, and productivity across various domains (Alghazi et al., 2020).

When asked which device they prefer for the course activities, Student B replied:

"If I need to access stuff on D2L or watch something fast, it is easier to pull my phone off if I do not have my laptop out. For example, I received an alert about my assignment grade and quickly checked it on my smartphone. It would not have been that fast with the computer."

While student C observed:

"...My smartphone can do virtually everything a computer does, so I find it more convenient—I feel like I am carrying a computer in my pocket! I have many downloaded apps essential for this course and all the others I am taking. The only downside maybe is its size, but I can always zoom."

Beyond the auxiliary function, phones are increasingly becoming smaller and more versatile, and as a result, they are moving towards replacing desktop computers (Ali, 2018). Students can now perform most of the computer functions with their smartphones. Most students in this technology class have state-of-the-art smartphones that allow them to read *PDF*s, Spreadsheets, Word-processed, and play audio-video files. The students, therefore, find it more convenient to use their phones to access their school accounts since they can perform as many learning tasks as computers more efficiently and faster.

This activity-based course sometimes requires students to record themselves while teaching during their practical teaching practice sessions in the lab and upload audio and video files to the online learning platform. Buying a separate camera or voice recorder for this purpose can be expensive for students. They, instead, prefer using smartphones because they already have built-in cameras and recorders, along with other helpful apps that support their work, without any extra cost, and they work just as well. Participants mentioned a drawback of desktop computers: they could not be used during a power or internet outage in the lab. Relying solely on these computers would limit students' access to learning tasks in the event of such disruptions. In contrast, mobile phones have an advantage because they can store power and connect to the internet through the carrier network, reducing these risks and enabling students to learn regardless of time or location.

Relatedly, the ever-emerging new technology applications exclusively supported by mobile devices help students to develop new literacies that include communication in multiple modes, including visual, oral, and audio modes. With the focus of the course being to embrace and use technology, mobile phones become the go-to devices for students during their learning. The shift toward learner-centred constructivist activities like group investigation and discussions calls for learners to be creative as they use the available resources and ideas from their daily experiences. It, therefore, makes it easier for them to construct meaning from learning experiences when allowed to incorporate technologies they are most comfortable with.

4.3 Classroom attention versus multitasking

However, mobile devices also pose several challenges when students have unrestricted access to them in the classroom. A significant concern is that some students might use these devices to communicate with friends and family through social apps and networking sites instead of focusing

on learning. This aligns with Kuznekoff and Titsworth's (2013) findings, which indicated that such distractions have the potential to hinder meaningful learning and the achievement of course objectives.

During interviews, most participants admitted to mobile phones being disruptive and diverting their attention from learning tasks when they need to be appropriately managed. Instances of classmates having their phones unmuted were common and often interrupted lessons. Additionally, playing games on phones instead of focusing on classwork significantly distracted learning. Student A appeared unsurprised by a classmate playing music in class, stating:

> "... I feel like that is when the distracting part comes in because they are either sitting there and looking at something that has nothing to do with the class or playing games. Um, I know of my last class that I just came from, um, music started playing because somebody had their EarPods in and they died, and then the music started playing, and the class just got silent, and it was like..."

Student D, on her part, had this to say:

> ".... I am not tech-savvy or as good as this class's young folks. Dividing my attention between the phone and the lecture would be to my disadvantage- I will miss important aspects of the lesson. The last thing I would need is a distraction from my phone because I need to understand as much class content as possible- that is why I attend the class anyway... I also get distracted by other students' phones ringing. For example, I had to tell my friend to switch off his phone as it vibrated in his pocket. I could not follow the lesson in peace."

These interruptions are not beneficial for learning because they waste valuable time that could be used to achieve the intended learning goals. Such occurrences cancel out the potential benefits of using devices in the classroom for learning purposes. When students are distracted by their phones, they miss important information and opportunities to engage with the lesson, hindering their ability to learn effectively (Hochberg et al., 2020).

From another perspective, the current generation of students, often termed digital natives, was born in an era characterized by technological multitasking. They are used to a learning environment with various technology tools, including desktop and laptop computers, phones, tablets, and other personal devices. Their ability to manage and sustain attention across various streams of sensory input facilitates simultaneous engagement with multiple devices (Schunk, 2020). For example, within a computer laboratory setting in the current, the researcher observed instances where students concurrently used a desktop computer while texting on the phone, seamlessly shifting back and forth between these devices.

Learning within such environments promotes superficial activities characterized by cursory reading, hurried and distracted thinking, and superficial learning. From a cognitive perspective, human attention to stimuli is a limited resource, and sustained use of smartphones in the classroom can bombard and overload the students' capacity to attend to learning (Schunk, 2020). When used for activities unrelated to classroom learning tasks, like texting, working memory tends to be overloaded due to the high cognitive load. Consequently, the efficacy of learning outcomes is compromised, as essential information needs to be adequately encoded or integrated into long-term memory, resulting in minimal learning.

However, despite these abilities, students of this demographic may need more executive attentional networks to regulate attention in alignment with learning objectives and mitigate distractions from the many applications available just within smartphones. Unfortunately, their capacity for self-regulation and gauging their readiness to learn remains underdeveloped (Knowles et al., 2015). Challenges may arise, especially if the instructional environment needs to cultivate essential skills in self-control and self-direction.

Further, the pervasive use of smartphones in learning environments can contribute to a decline in critical thinking skills. Constant access to information via mobile devices may lead students to rely heavily on quick answers and surface-level understanding rather than deep analysis and synthesis of information. Moreover, the frequent interruptions from notifications and messages can disrupt the cognitive processes involved in problem-solving and decision-making. As a result, students may need help to develop essential critical thinking skills such as evaluating evidence, making connections between ideas, and generating creative solutions to complex problems. Thus, while smartphones offer access to a wealth of information, their overuse in educational settings may hinder the development of higher-order thinking skills critical for academic success and lifelong learning. As young adults who are still short of these capabilities, it is critical that the

instructor takes charge of the classroom to ensure that students use their smartphones utilize their smartphones exclusively for activities that enhance their learning.

4.4 Academic integrity

During the observed lesson, a prevalent issue emerged regarding students resorting to A.I. sources to complete their class assignments. In one lab workstation next to the observer, a student referred to ChatGPT as their primary resource for completing assignments, stating, "I used ChatGPT to answer the question on the application of the IPTS for last week's assignment," and proceeded to demonstrate this to peers using a mobile device. During the individual interview with student C, she disclosed having installed *Math Solver* on their phone, an application that offers solutions to fundamental math problems and is freely available for download on Android and Apple devices. However, the student acknowledged that excessive reliance on this application sometimes could have improved comprehension of underlying mathematical concepts taught in class, as the assurance of solving exercises via the application often diminished her focus on the instructor's illustration of the concepts.

This incident presents a significant concern about using mobile phones in learning, which comes with laziness. The phones provide quick and easy access to the internet and allow learners to access enormous amounts of information from different sources. As much as most internet sources are authentic, it can be a problem for learners to determine the authenticity or trustworthiness of the information. For the lazy ones, one way they can use mobile phones to cheat is through plagiarism, when they copy-paste information from the internet as it is. Also, taking pictures of test questions to share with students who may be taking the test in a later class and giving the recipients an unfair advantage is a common malpractice when students are allowed unrestricted access to their phones, even in exam situations. These malpractice forms destroy the foundation and fabric of any educational system. They erode the authenticity of formal assessments, render them unreliable, make educational objectives unattainable, and portend a bleak future for any society. Based on recent research findings by Tacker (2020) and an earlier study by Stefanidis et al. (2022), the emergence of such forms of cheating adds to the challenges of conducting credible and reliable assessments in this technological era, especially when class sizes become more extensive.

Even more worrying is the continuous evolution of these technological devices; they have become smaller and more interconnected. This trend significantly expands the opportunities for misuse by students to engage in academic dishonesty during assessments. With smartphones becoming increasingly compact, easily concealable, and interconnected with smartwatches, earpieces, or even tiny cameras, the chances of cheating are bound to increase. Consequently, educators face the challenge of remaining vigilant and proactive in preventing and detecting cheating before and during testing sessions.

4.5 Self-control and addiction

Mobile phones' portability, versatility, and effectiveness give them an edge over other forms of computers. All these attributes, however, imply that mobile devices become so much a part of students' lives that they can do virtually nothing without them. To justify why he should always have his phone and even use it during the lecture, student A had this to say:

> "...people have become more addicted to their phones because there was the time in 2020 when we were quarantined inside, and many people were on their phones, and so I feel like that put more addiction to it because we spent more time on our phones doing other stuff. So, people would rather sit on their phones than pay attention to class. Moreover, that is when the distracting part comes in because they are either sitting there and looking at something that has nothing to do with the class or playing games. I try not to stay, um, I try to stay off it. To phrase that better- there are some points, like in classes, if you are doing something and it is group work and my group is already done, then I will get down on it because we cannot leave yet, but there is nothing else to do. This is the only time I try to, or if the professor has to run somewhere to take a phone call, I will get on it to pass the time."

This study finding reveals that mobile phones possess unique attributes such as portability, versatility, and effectiveness, making them preferable over other computing devices. However, these characteristics contribute to the pervasive presence of mobile devices in students' lives, to the extent that they struggle to function without them. Student A's testimony sheds light on this phenomenon, attributing increased phone addiction to the significant time spent on devices

during the 2020 quarantine period. The student describes instances where individuals prioritize phone usage over classroom engagement, opting to browse unrelated content or play games instead. Even during group activities or when the professor steps out momentarily, students find it difficult to resist the temptation to use their phones, indicating a dependency that extends beyond educational purposes.

This dependency on mobile phones for non-academic tasks during class time underscores students' challenges in maintaining focus and attention on learning activities. Similar to the findings of Gajdics and Jagodics (2022), student A's account illustrates how the constant availability of smartphones can lead to distraction and diminish classroom engagement. It emphasizes the importance of self-discipline among students to resist the urge to use their phones for unrelated purposes during instructional time. Addressing this issue requires proactive measures to promote awareness and cultivate responsible phone usage habits among students, ensuring they prioritize learning and actively participate in classroom activities without undue distraction from mobile devices.

5   Conclusion

Any future success of education depends on how well the various stakeholders manage technology integration in learning, and educational stakeholders must respect the idea of integrating mobile phones in classroom teaching and learning. Despite a few shortcomings associated with using phones in classroom learning, the results from this study point to the devices as powerful technology learning tools. Concerted efforts should be geared toward developing policies and creating learning environments that produce desirable learning outcomes when learners use mobile devices. Rather than prohibiting mobile devices and obstructing students' full potential to use mobile devices to facilitate learning, schools and policymakers should construct policies that promote the use of mobile devices in the classroom environment.

Teachers should accept that students will bring their mobile devices to class at this age and time. Consequently, the teachers need to be given adequate training on managing and utilizing the devices because the effectiveness of integrating technology will depend on the learning activities students encounter. By helping inform students of the consequences of their actions, teachers can help educate students and lead them to make a more informed decision not to misuse their mobile phones in class.

Learning institutions should strive to invest in innovative software solutions to mitigate mobile phone distractions during learning. One such solution is the Flipd App, which serves as a self-awareness tool for smartphone users, allowing them to preprogram mobile phone usage times to minimize distractions typically encountered in the classroom. By proactively managing smartphone usage, such applications can significantly enhance student learning outcomes and productivity in learning environments and enable students to optimize their focus and productivity during critical learning moments.

Conflicts of interest

The authors declare that they have no conflict of interest.

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