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### Engagement Theory based Interpretative Phenomenological Analysis of Computer Science Students' Perceptions of Their Learning Engagement Using Mobile Devices

Aleksandar Tomovic

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**Engagement Theory Based Interpretative Phenomenological Analysis of Computer Science  
Students' Perceptions of Their Learning Engagement Using Mobile Devices**

by

Aleksandar Tomovic

A Dissertation

Submitted to the Graduate Faculty of

St. Cloud State University

in Partial Fulfillment of the Requirements

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## Abstract

The use of mobile devices in the college classroom can enhance learning engagement, leading to enhanced learning outcomes. There is scant research on college student perceptions of learning engagement using mobile devices in the classroom. The purpose of this qualitative research was to explore upper-class undergraduate computer science college students' perceptions about their use of mobile devices in the classroom. Research questions were designed to explore how college students believe their classroom engagement is impacted by mobile device technology use. The theory of engagement, including intellectual, social, and behavioral components, served as the theoretical framework. This research applies interpretative phenomenological analysis to explore how interviewees made sense of the observation. The sample included 11 upper-class undergraduate students in a computer science course at a Minnesota university. Transcripts were coded in NVivo 12, and analysis of the interview responses reveal three themes: Making the Most of Mobile Devices for Academic Purposes, Mobile Device Use Improves Social Interaction with Classmates, and Using Mobile Devices Improves Motivation Through Greater Engagement. Interviewees used mobile devices for class purposes, inside and outside of the classroom, and for synchronous and asynchronous online classes. Interviewees reported avoiding distractions and using their mobile devices to enhance learning; overall, they reported better learning experiences with mobile devices. Practical implications of this research include training for instructors and developing guidelines for recommended uses of mobile device technology. Theoretical implications include that behavioral engagement may need to be redefined for college students. Recommendations for further research include theoretical research on behavioral control and identifying a more suitable engagement component than behavioral for college student engagement models, because behavioral engagement may not be as relevant to college students as it is to K-12 students.

### **Acknowledgements**

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## Chapter 1: Introduction

### Introduction

Transformational advancement in information and communication technology has profoundly influenced the delivery of education. The global technological revolution has contributed to the universal adoption and utilization of mobile technologies in educational sectors. Advancement of mobile technologies has furthermore initiated strategic development in learning and teaching by facilitating the use of mobile and personal devices in engaging students (Gezgin et al., 2018). This present research was designed to explore students' perceptions of their learning engagement using mobile devices in the college classroom. Using mobile devices in the college classroom, also referred to as *bring your own device* (BYOD) to the classroom, involves using personal mobile devices as educational tools; devices including smartphones, iPods, tablets, and wearable technology (Heick, 2017). Personal mobile devices help students connect with class material and can facilitate communication in college learning environments (Sharples et al., 2005).

Mobile devices allow information to be distributed virtually through learning environments. College course material can be accessed and delivered at the convenience of both instructors and students. Personal device-assisted classroom learning is an emerging area of research in higher education because such learning can enhance the overall learning experiences of students (Sarrab et al., 2012). Using mobile devices in the classroom involves environments wherein:

Learners can capitalize on mobile, BYOD to classroom learning tools, such as laptops and tablets and their associated high access to broadband Internet. These environments

foster communication beyond the local group, efficiently provide resources and research, as well as empower the user to think more broadly. (Hargis & Cavanaugh, 2015, p. 5826)

Technology-assisted classroom learning has contributed to active learning in the 21<sup>st</sup> Century at the college level by increasing access to educational information. Innovations in the methods of delivering instruction prompted the present research's focus on how mobile devices can influence student engagement (Papas, 2019). Student engagement includes three dimensions; intellectual, social, and behavioral engagement. Intellectual engagement involves students being cognitively invested and absorbed in their academic work, which can enhance students' abilities to meeting learning challenges (Trowler, 2010). Social engagement involves interaction between students, peers, and instructors that can positively contribute to students' overall learning (Jones & Thomas, 2012). Behavioral engagement involves students being absorbed in learning to the extent that they comply with behavioral norms, such as regular attendance and participation, as well as avoiding disruptive and negative conduct (Trowler, 2010). The use of mobile devices can help boost learner passion and curiosity through technology that is familiar, friendly, and always at hand (Papas, 2019). The utilization of mobile phones, tablets, and wearable devices to communicate and gain access to information allows for personalized learning and facilitates note-taking and personal research (West, 2013).

Advancement of learner-centered pedagogies, as noted by Crompton (2014), was promoted by radical innovations in mobile technologies in the 2000s. These innovations featured the adoption of mobile personal devices in the classroom in various institutions in the United States and in multiple countries in Europe (Crompton, 2014). According to Rowan (2019), elements of successful college classroom learning with mobile devices includes:

- Technology-assisted classroom learning objectives.
- Bringing your own device.
- Microlearning on mobile devices.
- Field-based and remote work.
- Encouraging collaboration through forums and applications learners already use.
- Key performance indicators (KPI).

The adoption and use of mobile devices in the college classroom are based on the potential to influence learning processes. The introduction of mobile devices in the classroom has opened new ways to deliver course materials and has changed how students and instructors interact during class. Mobile devices as educational tools can contribute to educational transformation at college level by facilitating contingent learning, authentic learning, situated learning, personalized learning, and context-aware learning, which are all learner-centered approaches that may enhance student engagement (Rowan, 2019).

### **Mobile Devices**

According to the Advanced Distributed Learning Initiative (ADL, n.d.), handheld (mobile) computing devices are easily carried in a pocket or pouch, turn on instantly, have internet connection capabilities, although they are not always connected, and have self-sustaining power. Mobile devices entail user interaction and offer capabilities to enhance learning or performance support (ADL, n.d.). For the purposes of the present research, mobile devices include tablets and smartphones that can run mobile operating systems (i.e., iOS, Blackberry OS, Android, or Windows Mobile operating systems). Laptops and voice-only devices with no smartphone functionality are not considered mobile devices. Mobile devices can be carried,

access the Internet, and be used by one student at the time (e.g., personal use). Users must hold a mobile device in a way that lets them view their screen while providing input. Wearable technology, such as a smart watch, can be considered a mobile device if it satisfies the requirements.

### ***Mobile Devices in the College Classroom***

The use of mobile devices in the college classroom refers to traditional, physical classrooms where students may bring mobile devices and use them as educational tools. The use of mobile devices in the classroom from student perspectives provide convenient access to interactive content. College students can bring their own devices to classrooms, which allows them to have increased control over the pace and timing of presented material (Hu et al., 2007).

### **Background of the Problem**

Learning styles differ for each learner and across generations, including the Baby Boomer, Generation X, Generation Y (Millennial), and Generation Z generations (Coates, 2007; Kriegel, 2013). Most secondary learners, Millennials, and individuals of Generation Z prefer using tablets and smartphones for technologically-assisted learning in the college classroom (Lieberman, 2019). Such learning choices have brought about a shift in how college students learn.

According to Walker (2008), college students appreciate control over their learning sessions and members of Generation Z learners now prefer multiple media to stay involved in the learning process. Videos, podcasts, audio tools, and access to Bite-sized learning, or microlearning, are all generally available and utilized by most learners (Laskaris, 2019). Having

the opportunity to select which modules to complete first is part of the Millennial learner profile and involves a sense of freedom they experience during the educational process (Walker, 2008).

College students, in general, alter their device usage patterns when engaged in mobile learning (Tan et al., 2014). Laskaris (2019) stated that initiatives like BYOD have created a mobile device-based learning atmosphere in the college classroom. Additionally, Laskaris argued that “maturing educational technologies and tools have also added to the trend of using mobile devices in a learning capacity” (p. 1). The use of mobile learning apps and platforms, among other mobile learning tools, are also major contributors to a rise in BYOD approaches. Shifts in learning can create more engaging learning experiences, according to West (2013), providing opportunities for learners to access and interact with course content in the college classroom. However, the efforts of using BYOD and mobile devices on college students’ learning engagement in the classroom are largely unknown.

### **Statement of the Problem**

Russell (2018) states that learning engagement may be facilitated by mobile devices and personal technology in college classrooms. Mobility and individuality are advantages of mobile devices because they involve learning as a process that allows for customization, personalization, and collaboration among learners. A benefit of this process is a greater emphasis on mastery of material versus meeting arbitrary deadlines (Laskaris, 2019). Additional benefits include a potential sense of engagement and motivation, as well as helping learners of diverse abilities and learning styles to stay on track until course completion (Laskaris, 2019).

The ability to provide multi-device assisted learning is perhaps one of the most significant benefits of the use of mobile devices in the classrooms because the same course can

be engaged using mobile devices ranging from tablets, smartphones, and wearable technology (Fu et al., 2019). Additionally, many college students prefer methods that are as unobtrusive to their daily routines as possible (Fu et al., 2019). Since students are already using mobile devices in their everyday lives, mobile devices are easy to incorporate into their daily routines regarding classroom learning. Personal mobile devices are also usually user-friendly, pointing to another advantage of their use in the classroom (Carnevale et al., 2015). College students connected to the class material using personal mobile devices can locate and retrieve the information they need to complete tasks successfully (Lieberman, 2019), which also facilitates their overall learning experience.

Phone-based reminders and organizers are also now integrated with mobile devices, which offers college students a way to get constant notifications and updates on their assignments and courses. In addition, students can check and act on classwork anywhere and anytime, even outside of the classroom if necessary. Students can also quickly and conveniently go back to previous lectures and materials if they need more time or a refresher (Carter et al., 2018). This helps to individualize college learning and allows students to take the time they need to learn at their own pace. The learning paths with mobile devices can be more personalized at the college level than traditional teaching methods (Sung et al., 2015), which may lead to enhanced student engagement.

Laskaris (2019) conjectured that college learning might end up almost exclusively involving the use of mobile devices. Already, there are training programs available for teaching using BYOD friendly learning management systems. Personal mobile devices are hosting applications that support learning programs, and personal mobile devices are already in use on

college campuses. While personal and mobile devices are increasingly being used in higher education, research on the use of mobile and personal devices in classroom learning is a scant but still emerging. Gezgin et al. (2018) noted that more research is needed on the use of mobile and personal devices in the college classroom, especially from the perspective of the students who use them. There is little research on college student perceptions regarding learning engagement and behavior changes. Therefore, the present research was designed to explore students' perceptions of learning engagement when using mobile and personal devices in the college classroom.

### **Description and Scope of this Research**

Mobile devices are starting to play a critical role in redefining the learning process. Unfortunately, its effects on student learning engagement are unknown and still under investigation. Therefore, the purpose of this research is to explore upper-class undergraduate computer science students' perceptions about the use of mobile devices in classroom learning and how mobile devices influence student engagement. This research parameters allowed for exploration of students' perceptions about using mobile devices in the classroom and their perceptions about the influence of mobile devices in the classroom on intellectual, social, and behavioral engagement. The research focused on the college-level computer science classroom. Engagement theory (Kearsley & Shneiderman, 1998) served as the conceptual framework for the research. Engagement theory holds that students that are involved and enmeshed intellectually, socially, and behaviorally leads to enhanced learning (Kearsley & Shneiderman, 1998). The use of mobile devices in the classroom can facilitate engagement and enhance learning because it provides increased connectivity for students to one another, teachers, and relevant course



material, facilitating learning activities through interaction with others and meaningful activities (Heick, 2017).

This research applies interpretative phenomenological analysis (IPA) to interpret interviewee responses. According to Smith and Osborn (2003), the preferred method for interpretative phenomenological analysis methodology is semi-structured in-depth interviews. For data collection, I conducted interviews during 1 semester, over 4 months. I interviewed 11 upper-class undergraduate computer science students, asking questions listed in a preapproved interview protocol and motivating responses with engaging, probing follow-up questions during the research period. This sample of upper-class undergraduate computer science students was best suited for this research because computer science students have a profound understanding of technology and how to use it in class as a learning tool (Kvavik et al. 2005). Kvavik et al. (2005) found that college students' major was an important predictor of preferences for technology in the classroom, with engineering students having the highest preference for technology in the classroom (67.8%), followed by business students (64.3%). Upper-class undergraduate computer science students have advantages as they already use computers and mobile devices to complete their class work. Additional expertise that computer science students have may help them to understand and use technology to its full advantage. As students in computer science classes, they must complete coursework, conduct novel coding, and in many cases, share their expertise. Coding assignments are now performed on both laboratory desktops and on personal mobile devices.

The IPA design, as Smith and Osborn (2003) described, allowed me to focus on processes of personal device-assisted classroom learning, or BYOD (Bring your own device) to

the classroom, and explore how interviewees understand their personal and social world (Smith & Osborn, 2003). In IPA studies, researchers collect detailed interpretative account of interviewees' experiences with a phenomenon, and interviewees' interpretations of those experiences, which allows researchers the opportunity to explore, in more detail, the 'lived experiences' of the research interviewees (Smith & Osborn, 2003).

I used semi-structured interviews to collect data from 11 computer science student interviewees who have personal experiences, attitudes, perceptions, and beliefs (see Harrell & Bradley, 2009) related to the use of BYOD or mobile devices in computer science classes. In semi-structured interviews, researchers devise interview protocols with open-ended questions to elicit responses about interviewees' feelings and what happened (Richards & Morse, 2013). Researchers can use semi-structured interviews to collect new, exploratory data related to a research topic, triangulate other data sources, and validate findings (Harrell & Bradley, 2009). According to DeJonckheere and Vaughn (2019), semi-structured interviews are an effective method for data collection when the researcher wants:

- To collect open-ended qualitative data.
- To discover participant thoughts, feelings, and beliefs about a particular topic.
- To deeply probe into personal and sometimes sensitive issues.

For an optimal number of interviewees, Creswell (2007) recommended a sample of five to 25 interviewees, while Morse (1994) suggested at least six. Smith et al. (2009) suggested that for IPA studies samples should include four to six interviewees. Smith et al. highlighted the importance of a small sample size when answering research questions with individual student experiences. In IPA studies, researchers focus on a detailed account of individual experience that

benefits from concentrated attention on small number of cases. Knowing that recommendations can help a researcher to estimate how many interviewees are sufficient, the required number of interviewees should depend on a data saturation point (Saunders et al., 2017). Data saturation refers to the degree to which new data repeats what was said already in previous data collection (Saunders et al., 2017). I collected data through ZOOM audio and video conferencing tools with 11 interviewees. I used an interview protocol for clarity and consistency, focusing on questions pertinent to the research. Based on all of this, I developed the purpose of the research, described in the next section.

### **Purpose of the Study**

The purpose of this IPA research was to explore students' perceptions about the use of mobile devices in higher educational settings. Since its implementation by the educational community, personal device-assisted classroom learning has played a critical role in expanding the boundaries of the learning process. Unfortunately, its effects on learning engagement and what students think about using mobile devices in the college classroom are largely unknown. The research was designed to explore students' perceptions of use of mobile devices in the classroom and impact this has on students' intellectual, social, and behavioral engagement.

### **Research Questions**

This research seeks to understand how college students believe their classroom engagement is impacted by mobile technology use in classroom.

The primary research question was:

1. What are students' perceptions of learning engagement through using mobile technology in a college computer science class?

The secondary research questions were:

2. How do college students believe their intellectual engagement in class is impacted by using mobile technology?
3. How do college students believe their behavioral engagement in class is impacted by using mobile technology?
4. How do college students believe their social engagement in class is impacted by using mobile technology?

### **Assumptions of the Study**

This research involves several assumptions. First, I assume that college students will be willing and able to discuss their perceptions with the interviewer and will provide honest responses to interview questions. Second, I assume that college students for this research possess and use mobile devices in class. Finally, I assume that student interviewees are in full agreement about the use of mobile devices as tools for learning and have the full support from their higher education institutions to ensure that mobile devices are being used correctly and appropriately in the classroom for learning.

### **Delimitations/Positionality of the Study**

Throughout this research, I am viewing the data through the lens of a white 60-year-old computer science software engineer and teacher. I have never participated in a teacher preparation program or teaching program policy meeting. However, I do prepare syllabi for the classes I teach and use innovative methods to engage students in solving computer science problems. I work as a software engineer in a data analytics company and as an adjunct professor

of computer science at a public university in the Minnesota. Analyzing the use of mobile devices is not part of my daily activities at the college campus.

My reasons for this research have roots in my teaching experiences and research interests. I believe use of mobile devices is beneficial and essential to student learning in the modern classroom. It is my belief that students are knowledgeable enough to benefit from mobile devices as educational tools and not only as ways to access social media. My hope was that college students will be willing to talk openly about their experiences and honestly share their perceptions about using mobile devices as educational tool in the classroom. The scope or delimitations of the research include interviewing upper-class undergraduate computer science students in the computer science program on the campus of a Minnesota University, the pseudonym for a public university in Minnesota.

### **Definition of Terms**

The following terms are defined for use in this research.

*Behavioral Engagement*—Behavior engagement refers to students being involved in learning to the extent that they comply with behavioral norms, such as regular attendance and participation, as well as eschewing disruptive and negative conduct (Trowler, 2010).

*Intellectual Engagement*—Intellectual engagement refers to students being cognitively invested and absorbed in their academic work, which can lead to students going beyond requirements and help them meet learning challenges (Trowler, 2010).

*Mobile Devices*—A mobile device is a global, wearable, portable, handheld device that enables communication using the internet of things feature (Heick, 2017). For the purposes of the

research, mobile devices will include tablets and smartphones that can run mobile operating systems such as iOS, Blackberry OS, Android, or Windows Mobile operating systems.

*Social Engagement*–Social engagement refers to interaction between students, peers, and instructors that positively contributes to students’ overall learning experiences (Jones & Thomas, 2012).

*Student Engagement*–Student engagement refers to the intensity with which students apply themselves to learning in school, and it is regarded as an important component of student learning (Loveless, 2015). Students who are engaged are motivated to complete tasks successfully, are focused on the task at hand, often ask follow-up questions, are willing to take risks, and usually take part in rich content-based discussions with their peers (Loveless, 2015). Student engagement includes three dimensions: intellectual, social, and behavioral.

## **Summary**

In this chapter, I introduced the problem and the reasoning for the proposed research. I also briefly summarized my proposed IPA methodology, proposed research population, the research questions, general assumptions, my positionality statement, and the significance of this research to the field. In Chapter 2, I provide a review of the literature on the use of mobile devices as learning tools in the classroom, with an emphasis on higher education. This literature review includes information that is appropriate to the research questions, and that generates evidence for the need for this research. Chapter 2 also includes a description of engagement theory as the theoretical framework for the research (Kearsley & Shneiderman, 1998). The IPA methodology for the research will be described in more detail in Chapter 3. Chapter 3 also includes a clarification on participant recruitment, the research design, data collection, data

analysis, a dissertation timeline, and human subject approval through the institutional review board (IRB).

## Chapter 2: Literature Review

### Introduction

This chapter is a review of research on the primary factors of the research: the use of mobile or personal devices in the college classroom, and student engagement. This research focuses on the use of mobile devices for classroom learning at the college level. Researchers have largely ignored students' perceptions of the use of mobile devices in the college classroom in relation to engagement; therefore, the proposed research is designed to fill this research gap. Mobile technology has saturated the higher education field and is increasingly becoming a part of class content delivery (Thomas & O'Bannon, 2013). Mobile devices appeared in the classroom environment before instructors knew how mobile devices could benefit learning (Siddiq et al., 2016). Mobile devices in education developed at such a pace that it became an ever-changing platform, and changes in mobile device technology can be overwhelming (Loveless, 2015). New, improved mobile device functions rapidly replace existing functions (Yin, 2014).

Purposeful planning for mobile device usage involves learning goals and students' views of the learning process involving mobile and personal devices in class (Loveless, 2015). Additionally, Siddiq et al. (2016) recognized that digital skills are essential to today's life, and younger generations are comfortable with and adaptable to using digital technology. Being adaptable to digital technology, however, does not make students knowledgeable in all areas of technical expertise. Ferrari et al. (2012) noted that students must foster skills to interact with digital content. To fully benefit from having access to digital content presented on mobile devices, college students, now more than ever, need sound training on how to use mobile



technology in the classroom (Strømsø & Bråten, 2014). They are accessing information and connecting through social media with friends and family. However, these skills are not likely to enhance learning in formal university courses without sound pedagogies (Kennedy, 2014). Students can push a button to use their mobile devices to access many functions but that does not mean students know how to use mobile devices to learn at college level.

Student engagement involves the interaction between the time and effort devoted by both students and higher education institutions intended to improve the student experience and enhance learning outcomes. Coates (2007) described engagement as a “broad construct intended to encompass salient academic as well as certain non-academic aspects of the student experience” (p. 122). Kuh (2009) defined student engagement as “the time and effort students devote to activities that are empirically linked to desired outcomes of college” (p. 683). Fredricks (2014) identified three dimensions of student engagement:

1. Intellectual (cognitive) Engagement—Students invested in learning seek to go further than requirements.
2. Emotional (social) engagement—Students’ experiences, interests, and sense of belonging.
3. Behavior engagement—Students comply with behavioral norms regarding attendance and involvement. (pp. 62-63)

Increasingly, learning initiatives must stem from a curriculum that supports learning goals and leverages content in a way that is engaging and device-centric (Loveless, 2015). Using mobile devices in class also exposes potential inconsistencies between teachers’ practices in the classroom and students’ technical skills (Thomas & O’Bannon, 2013).

The effectiveness of using mobile devices in higher education classrooms depends on students having the specialized knowledge needed to complete online assignments, and the quality of instructors involved. However, having that knowledge is not always supported. For that reason, the proposed research focused on college students' expectations and perceptions of teachers and engagement in their digital-assisted classroom using mobile devices.

### **Theoretical Framework**

The theory of engagement derived from experiences teaching with technology (Kearsley & Shneiderman, 1998; Shneiderman, 1994, 1998) will serve as the theoretical framework for the research. Engagement theory holds that students connect with learning activities through interaction with others and through meaningful activity tasks (Kearsley & Shneiderman, 1998). Researchers have applied engagement theory to learning in technology-based environments and observed that technology-based learning involves collaborative efforts and project-based individual and group assignments, which can facilitate creative, meaningful, and authentic learning (Bernacki et al., 2020; Kearsley & Shneiderman, 1998).

Technology-based learning involves the use of e-mail, online audio/video conferencing, web databases, groupware, handheld devices, and educational interfaces, such as Blackboard (Bernacki et al., 2020), all of which can facilitate student participation, interaction, and information access. Technology, including mobile devices, can also facilitate creativity and communication needed to sustain engagement (Bernacki et al., 2020). Engagement theory includes three components, which will be used to guide this research: intellectual engagement, social engagement, and behavioral engagement.

## **Intellectual Engagement**

Intellectual engagement refers to students being cognitively invested and absorbed in their academic work, which can lead to students going beyond requirements and enjoying learning challenges (Trowler, 2010). Technology and personal devices can facilitate intellectual engagement and learning through customization and personalization (Hsieh & Chen, 2016). For example, mobile devices offer customization for peer review opportunities, choices for project sharing during class, and options for peer interaction, which can motivate intellectual learning (Bart, 2010). Personalized learning involves managing the learning process based on personal choices in consultation with teachers, leading to intellectual learning not possible without personal devices (Murphy et al., 2016). In other words, personal devices can help fit the various skills and needs of individual students (Chen & Macredie, 2010). Intellectual engagement is defined by interest and motivation in the class leading to quality instruction (Sefcik, 2013). Willms et al. (2009) defined intellectual engagement as individual cognitive psychological investment in learning.

## **Social Engagement**

Social engagement refers to interaction between students, peers, and instructors that positively contributes to students' overall learning experiences (Jones & Thomas, 2012). Social engagement in learning environments involves the extent to which students communicate and network with others for both academic and social purposes through online channels, forums, and mobile devices (Martin, 2011). Social engagement in learning environments includes communication with teachers and participation in learning communities (Martin, 2011). Such engagement involves social constructivist elements wherein students are actively engaged in

learning and meaning-making through discussions, group work, and formal and social interactions supported by mobile devices (Martin, 2011).

### **Behavioral Engagement**

Behavior engagement refers to students being involved in learning to the extent that they comply with behavioral norms, such as regular attendance and participation, as well as eschewing disruptive and negative conduct (Trowler, 2010). In large classrooms, for example, students often do not have an opportunity to have a personal voice, which leads to diminished participation. The use of mobile devices gives students opportunities to make their voices heard in real time, and technology has changed students' learning behavior so that they feel more engaged and thus are less likely to display undesirable behavior (Wang at.al., 2009). Behavioral engagement can also involve students setting personal goals such as passing an English proficiency test or developing and enhancing research skills under the guidance of the teacher, which can help students change from passive learners to active, engaged learners (Wang at al., 2009). Goal setting and attainment can help diminish undesirable behavior by boosting motivation and encouraging immersion in and engagement with the learning process (Wang at al., 2009).

### **Background on Using Mobile Devices in the Classroom**

Loveless (2010) stated that mobile devices, such as cell phones, in the early nineties were considered a nuisance and distraction in the classroom. Instructors feared that mobile devices could be used for cheating and unethical academic activities in the classroom. By mid-2000s, the role of mobile devices in schools was getting a second look, moving from banning them to simply turning devices off during class, and school administrators could not stop the use of

mobile devices in classrooms (Loveless, 2010). Administrators eventually realized that mobile devices could play an important role in learning, and mobile devices have evolved over the years into teaching and learning tools, especially at the college level. Mobile devices, when used appropriately, may improve learning and student engagement. With their individually oriented properties, mobile devices can facilitate learner-centered pedagogies in higher education (Loveless, 2010).

In the early stages of mobile device technology, mobile devices lacked functionality, processor speed, hardware size, and battery life (Traxler et al., 2011). Mobile devices now offer better web functionalities and are affordable with increased processing power. Additionally, with classroom learning features and applications, the use of mobile devices in learner-centered pedagogies becomes increasingly evident. For example, the use of mobile devices in higher education can include five learning components: contingent learning where learners are allowed to respond and react; situated learning where learning can occur within or outside of the college classroom; authentic learning where tasks are directly related to immediate learning goals; context-aware learning where learning material depends on context; and personalized learning where each learner receives customized lessons recognizing their abilities and preferences (Traxler et al., 2011). Internet technology advances, such as higher data transfer speeds and mobile device affordability, enables higher education to change the distribution and access of class material. However, Thomas (2020) found that cost can inhibit internet access and the acquisition and use of personal devices in the college classroom for some students. The present research, however, is not designed to examine socioeconomic disparities in relation to technology. I will recommend further research in this area in Chapter 5.

Crompton (2014) wrote that a technological transformational revolution, which led to the introduction of mobile technologies such as tablets and other handheld devices, played a central role in the advancements seen on today's campuses. College instructors and students have slightly different attitudes about the use of personal devices for classroom learning, but there is consensus that personal devices should be used in structured and well-defined ways in the classroom (Graham & Gillies, 2016; Thomas, 2020). In an exploratory qualitative research, Graham and Gillies (2016) examined instructors' perspectives on whether BYOD to college classrooms is effective for enhanced student learning. A focus group of 14 instructors identified three categories affecting academic acceptance of BYOD: attitude, responsibility, and device heterogeneity (Graham & Gillies, 2016). In the attitude category, the focus group identified negative concerns such as the impact of mobile phone use in the classroom on school-life balance and people inappropriately using phones during class. For responsibility, the focus group noted concerns such as students remembering to charge devices, installing the correct apps, and having sufficient storage space on devices. For device heterogeneity, using various mobile devices was identified as affecting other psychological elements such self-efficiency (Graham & Gillies, 2016; Rogers, 2003). Graham and Gillies (2016) found that instructors perceived more barriers than enablers regarding the use of BYOD in the college classroom. Negative factors included lack of knowledge, and instructors favored iPad use for all students rather than students to BYOD, especially in instructors who did not have prior experience using mobile devices in the college classroom (Graham & Gillies, 2016).

Extending research of Graham and Gillies (2016) and Heick (2017) observed that using mobile devices in the college classroom, or BYOD, can facilitate social engagement and enhance

learning because it allows for increased connectivity for students to one another, teachers, and relevant course material. BYOD in the classroom can help facilitate learning activities through interaction with others and meaningful activities (Graham & Gillies, 2016; Heick, 2017). Mobile devices enable students to communicate and access course material, as well as facilitate new ways of learning that can enhance students' engagement with course material (Heick, 2017).

BYOD policies can help students in higher education achieve learning objectives (Thomas, 2020), making students' attitudes toward BYOD in the classroom important to understand. Thomas (2020) evaluated attitudes toward a BYOD policy in a 2-semester academic English report writing and presentation program. Interviewees included 135 second-year Japanese university STEM students. Thomas found that although students at the beginning of the first semester were hesitant to fully accept BYOD as a classroom policy, they were fully open to the use mobile devices by end of the second semester. Positive-only comments (112) indicated that students put great value on the use of mobile devices in the college classroom; one negative theme identified through student comments was cost of BYOD (Thomas, 2020). Thomas concluded that students have positive attitudes toward the use of mobile devices to complete structured, defined classroom projects in college.

The introduction of mobile devices in the late 1990s and early 2000s contributed to a remarkable shift from traditional learning approaches to highly modernized technological educational strategies (Giousmpasoglou & Marinakou 2013). According to Sarrab et al. (2014), the introduction of mobile devices in higher education enhanced student-centered learning methods, which can lead to increased student engagement and improved learning. Using mobile devices in classroom learning at the college level also facilitates collaboration among students

and between students and teachers, potentially leading to increased student engagement and improved learning (Sarrab et al., 2014).

### **Mobile Devices and Student Engagement**

According to West (2013), advances in technology have influenced the utilization of mobile devices, tablets, and laptops as educational tools in the college classroom. The introduction and utilization of mobile devices in higher education classrooms may facilitate active learning and student engagement, leading to enhanced learning (West, 2013). Students enjoy and are comfortable using their mobile phone, and the use of mobile devices can increase students' desire to participate actively in the learning process. In active learning, the students engage with the presented information on their terms. West noted that use of mobile devices in college classrooms may enhance student engagement and active learning because students can engage in collaborative activities, such as peer-editing and sharing cloud documents.

Various mobile device applications can enhance the interactive experience in higher education by allowing teachers and students to post answers and questions regarding class material. Research shows that use of mobile devices in the college classroom can positively contribute to student success (De-Marcos et al. 2010; Hwang, et al., 2011; Sad & Akdag, 2010). Sandberg et al. (2011) believed that the use of mobile devices in the college classroom can be helpful for learning. Using mobile devices can help increase student engagement in class since they can access critical sources of knowledge and work collaboratively (Johnson et al., 2011). On the other hand, Kuznekoff and Titsworth (2013) warned that personal devices in the college classroom can be a distraction to learning if they are not used for structured class-related activities.



Mobile devices in higher education classroom learning are contributing to learner-centered education by enabling students to follow teachers' lectures and take notes with their BYOD during class, which in turn may help students increase their knowledge of the material. According to Heflin et al. (2017), the ability to use mobile devices in the classroom has expanded learner perceptions and attitudes towards their studies. For example, instructors in higher education are using mobile applications and classroom response systems that instantly permit student responses to instructor questions based on course content (Heflin et al., 2017). The use of mobile devices in the college classroom can contribute to developing students' perceptions of learning, engagement, and enhancing assessment scores (Jones et al., 2013). Students can access their lectures when they have completed the required reading and are ready to learn. Additionally, Morsy and Rothstein (2019) noted that low-income Black students are more likely than white students to feel frightened or threatened in classrooms, leading to academic and behavioral problems. The use of personal mobile devices in the classroom could help eliminate classroom intimidation for low-income students. McKenzie (2018) argued that smartphones may be an educational equalizer in an era of income inequality on college campuses because students can more easily afford mobile devices than personal computers. However, Thomas (2020) later found that cost can inhibit the acquisition and use of personal devices in the classroom for some students.

### **Student Intellectual Engagement**

The adoption and application of personal and mobile devices for learning in the college classroom are vital because they have transformed teaching and learning processes. Personal devices have facilitated the introduction of a reliable and efficient teaching approach (Dias &

Victor, 2017). Using tablets, for example, tutors can clearly illustrate critical concepts to students (Dias & Victor, 2017). Personal and mobile devices allow learners to engage and comment on learning material individually and in ways that can be shared with the class or groups. Dias and Victor (2017) highlighted that mobile devices can enhance creativity and personalization, which can lead to enhanced intellectual engagement. Intellectual engagement involves personalized learning:

Ensuring that a student's educational path, curriculum, instruction, and schedule personalized to meet her unique needs, inside and outside of school... through a wide range of resources and strategies appropriate for her learning style, abilities, and interests, as well as social, emotional, and physical situation. (Wolf, 2010, p. 6)

Ibáñez et al. (2014) also found that the introduction of gamification in college computer engineering class played a critical role in enhancing student intellectual engagement.

Gamification in education refers to the introduction of game design elements in the learning process (Dichev & Dicheva, 2017). Game design elements in non-game settings can engage individuals and motivate desired behaviors (Ibáñez et al, 2014). In higher education, intellectual engagement in learning is a central component of learner achievement (Dichev & Dicheva, 2017). Exposing students to gaming technology as a crucial aspect of learning has significantly contributed to cognitive engagement due to exposure to exciting and attractive learning activities (Ibáñez et al, 2014). The exposure has initiated learners' interest in embracing creativity and a desire to achieve more despite the challenges and obstacles they face in class (Dichev & Dicheva, 2017).

Ibáñez et al. (2014) further noted that the gamification of learning activities in higher education has contributed to cognitive and intellectual engagement. This is because learners are motivated to invest their time in deeply researching to enhance their understanding and expertise, which suggest that college students desire to go beyond standard requirements and challenges. In the modern world, learners want to understand the critical technical elements associated with their daily activities (Dichev & Dicheva, 2017). Because of this, students can achieve their needs by attaining high learning outcomes (Ibáñez et al., 2014). By encouraging intellectual engagement, the use of mobile devices in the college classroom can help students develop key strategies to transform their problem-solving approaches and understand core concepts in class.

McConnel (2018) noted that goal setting, reflection, engagement, motivation, and student success are connected. These are factors related to intellectual engagement. Over 2 semesters, McConnel observed the use of BYOD in the classroom among a group of unmotivated university students. BYOD helped increase goal setting and self-reflection, leading to increased student motivation (McConnel, 2018). McConnel found that student motivation also improved during the second semester. Laskaris (2019) later confirmed the connection between motivation and intellectual engagement in college students.

Tornwall et al. (2020) conducted an observational research to examine the effects of college students' frequency of response in Nearpod, a student response system (SRS), on academic performance. The SRS is a tool that allows presentation of course content and teachers to see and count student responses to various prompts (Tornwall et al., 2020). Nearpod is a cross-platform, easy-to-use way to engage students in collaborative work giving instant insight into student learning through assessment. The evolution of SRS from older clicker models to more

interactive platforms has potential to capture students' attention, improve motivation, and support their engagement. Results showed no linear correlation between students' frequency of Nearpod use and their final grades ( $r = -004$ ,  $n = 265$ ; Tornwall et al., 2020). Overall, frequency of Nearpod use was not associated with statistically significant increase in the final grade of students in four nursing classes. This finding generally does not align with previous research showing connections between the use of collaborative apps and learning engagement in higher education (Dichev & Dicheva, 2017; Laskaris, 2019; McConnel, 2018). However, because the use of student-owned mobile devices and SRS in student learning has potential to create collaborative, all-inclusive learning environments while enhancing engagement, Tornwall et al. (2020) recommended further research in these areas.

### **Student Social Engagement**

The adoption and application of mobile computing devices such as cell phones and smartphones in higher education can play a substantial role in enhancing student social engagement (Rowan, 2019). Smartphones can connect to the Internet and send and receive data; smartphones are essentially minicomputers (Hargis & Cavanaugh, 2015). Laptops are not considered mobile devices because of their size and cost; not every student has a laptop computer, but almost everyone has a smartphone or mobile device (Hargis & Cavanaugh, 2015). Cengage's student mobile device survey conducted in 2015 by Harris Poll showed that 8 in 10 (86%) college students regularly use a smartphone, up from 83% in 2014 (Pearson, 2015). Smartphones are now close to laptops (89%) as the classroom device college students are most likely to use regularly (Pearson, 2015).

Collaboration is part of social engagement, and Barneva et al. (2017) argued that replacing classroom in higher education with interactive smart surface or tabletop computers can enhance collaboration. Furthermore, college students can use mobile devices as tools to collect and collate notes. Barneva et al. stated that when using mobile devices in the classroom, collaboration is increased by the ability to collect, save, and distribute text files, videos, and pictures with others. Gamification in conjunction with the use of mobile devices can further increase college students' collaborative learning opportunities in ways that are not possible in traditional classrooms (Barneva et al., 2017; Dichev & Dicheva, 2017).

The use of mobile devices in the college classroom may also help enhance student collaboration, leading to increased social engagement. As noted by Wang et al. (2009), the introduction of mobile devices as educational tools in Chinese classrooms increased English learner participation and collaboration. Wang et al. found that the adoption of mobile devices in classroom learning at Shanghai Jiaotong University contributed to high student engagement and active learning. Learners could access lectures via video streaming and with mobile devices, leading to engagement and students asking more questions (Wang et al., 2009). According to Wang et al., the use of mobile devices in class positively influenced students' creativity and innovation, hence changing their perceptions and attitude towards studies, as well as facilitating engagement. Laskaris (2019) later corroborated that access to bite-sized learning, or microlearning such as streaming, are generally available and utilized by most higher education learners and can facilitate learning engagement.

According to Gikas and Grant (2013), mobile computing devices facilitate the use of social media, boosting interactions and collaborations between college students and teachers, and

potentially enhancing social engagement. Social media enables learners to share their perspectives on various discussion topics (Hudson, 2014). Social media refers to websites and applications that allow users to share content quickly, efficiently, and in real-time (Hudson, 2014). Learning via personal devices in the classroom through social media has motivated student participation in class-based interactions. Such growth is directly related to the fact that Generation Z enjoys interacting and collaborating via text while discussing key subject aspects. Gikas and Grant (2013) further noted that the use of personal devices in universities has played a central role in the advancement of social engagement by using websites and social media to learn. Learners in various courses enjoy using smartphones to access reliable sources on the Internet.

In a quasi-experimental case research, Safar (2018) examined the impact and usefulness of a BYOD program for student learning and academic excellence at Kuwait University. Safar found that BYOD significantly improved students' test scores, quality of students' project work, and strengthened their collaboration, communication, and research skills. Safar additionally reported improvement in student interests, motivation, and involvement in learning. Safar's findings confirmed previous research that BYOD in the college classroom can help facilitate learning activities through interaction with others and meaningful activities (Graham & Gillies, 2016; Heick, 2017). BYOD can create a shift from teacher as central facilitator to students becoming more responsible for their own learning and growth. Nevertheless, teachers still need to be well informed about how to use BYOD into classroom (Safar, 2018).

Graham (2019) found increased homework completion using of personal devices in the college classroom because the device helped students organize their work and remind them to do

it. Additionally, students can share information about different websites and social media with their peers and engage in content creation. Social media and web tools with constant connectivity enable college students to enjoy dependable communication meant to strengthen their understanding of various concepts. Graham's findings confirmed those of Aljaad (2016), who found that 99% of college student respondents believed that the use of posting to social media helps reinforce the content they learn in class.

Mobile devices in the college classroom can help enhance social engagement through collaborative learning via mobile instant messaging applications. According to Kim et al. (2014), cooperative learning helped with the use of various tools such as blogs, instant messaging, and discussion boards. Research shows that students in higher education who research in cooperative-research groups do better on tests than those who research alone, especially with critical thinking and reasoning skills (Johnson & Johnson, 1989). According to Slavin (1991), cooperative-learning classes achieved significantly higher test scores than traditional classes. Students who learn in research groups not only like the subject and college better (Dias & Victor, 2017) but have more friends in class and higher self-esteem (Strømsø & Bråten, 2014).

Mobile devices in the college classroom can also help enhance social engagement through texting, in which learners can express their opinions and, at the same time, ask questions without fear of intimidation. According to Sung et al.'s (2017) meta-analysis, which included 48 peer-reviewed journal articles and doctoral dissertations written over 16 years (2000-2015) involving 5,294 interviewees, mobile-computer-supported collaborative learning produced meaningful improvements for collaborative learning. Mobile devices also help alleviate the pressure and feelings of threat experienced by students while expressing their opinions in

traditional classrooms, which facilitate a more active form of learning (Kim et al., 2014).

University science courses are increasingly transitioning from conventional lectures to active learning because, active learning is a more effective way to teach (American Association for the Advancement of Science, 2015). Kim et al. (2014) found that instant messaging supported social bonding between learners and tutors.

### **Student Behavioral Engagement**

According to Chen and deNoyelles (2013), mobile devices facilitate the establishment of virtual social context contributing to learners' potential to research via observing and modeling other's behavior. The popularity of mobile devices and the rapid development of wireless network technologies have revolutionized the way people receive and share multimedia content (Yin, 2014). Interaction among students of Generation Z has created a new form learning behavior where personal data and mutual interests are shared and published through robust social software (Isman et al., 2012). Mobile-based collaborative learning in both social and situated frameworks enables college students to focus on influencing behavioral change via social context interactions.

Chen and deNoyelles (2013) argued that mobile technology's high utilization rate in colleges influences students' learning behaviors. Because the use of mobile devices has positively influenced college students' perceptions and attitudes towards specific subjects, such as in computer science, mathematics, medicine, and foreign language courses, mobile device applications have facilitated the creation of social interaction forums where students can discuss class concepts (Isman et al., 2012; Yin, 2014). By enhancing collaborative learning via social



and situated frameworks, mobile devices have motivated a large percentage of university students to focus on changing their behavior toward their studies.

Tan et al. (2014) discussed the adoption of mobile devices in higher education and how it has contributed to improved behavioral engagement among learners. This view is founded on the fact that mobile devices have initiated a significant change in students' attitudes, leading to enhanced participation in social, academic, and extracurricular activities (Chen and deNoyelles, 2013). Personal device-assisted collaborative learning has a positive influence on college learners' behavioral patterns and is founded on its potential to initiate basic mindful practices toward learning (Tan et al., 2014). Personal devices assisted collaborative learning has also facilitated a remarkable change in students' perceptions of learning, and higher education is concerned with achieving excellent outcomes.

Mobile applications in learning activities are on the rise, and many students welcome the use of mobile devices in the college classroom. In a quantitative research, Klaric et al. (2019) noted the challenges of introducing mobile applications in the classroom for mechanical engineering students. Klaric et al. used surveys to analyze the challenges and benefits related to BYOD in the classroom and found that network issues and downloading and installing applications were challenges. This finding confirms the research of Graham and Gillies (2016) that such technical issues can impede learning and distract students in the college classroom. However, once these issues were resolved, students' behaviors toward learning were more positive and their interactions with course work, as well as their motivation, increased through use of mobile devices in the classroom (Klaric et al., 2019). Klaric et al. also found there are ways to limit distractions when using personal technology in the college classroom, such as

limiting access to certain material and application downloads, as well as excluding nonessential installations during class, which also supports the recommendations of Graham and Gillies to have classroom policies in place for effectively addressing technical issues.

Kay et al. (2017) examined distracting behaviors in BYOD approaches to learning. Both qualitative and quantitative data were collected from 181 students, of which 55 were female and 126 were male, enrolled in three schools in Canada. Kay et al. (2017) included two research questions: What distracting activities do secondary school students engage in during class in the BYOD program? And what factors (i.e., gender, peers, and instructional method) influence secondary school students' participation in distracting activities in the BYOD program? Kay et al. (2017) found that 80% of students reported that they often, frequently, almost frequently, or always engage in on-task behaviors during class, but two-thirds of the students engaged in emailing and web surfing distraction activities. Kay et al. concluded that mobile devices have considerable potential to help improve learning; however, there is the potential for distraction almost equally across both genders respectively. These findings and conclusions reflect the early warning of Loveless (2010) that mobile devices could be nuisances and distractions in the college classroom if not used properly. Kuznekoff and Titsworth (2013) also found that personal devices in the college classroom can be a distraction to learning if they are not used for structured class-related activities.

According to Golonka et al. (2014), mobile devices can have both positive and negative effects on learners' engagement at college level. The utilization of mobile devices in teaching foreign languages, such as French, can help students experience positive interactions and collaborate toward accomplishing tasks in teams (Golonka et al., 2014). However, despite some

of the positive effects on learning, Golonka et al. also warned that mobile devices can actually disengage students from learning because college learners may focus solely on social interactions and ignore the importance of collaborative learning and their academic work.

Golonka et al.'s findings confirmed the research of Loveless (2010) and Kuznekoff and Titsworth (2013) that mobile devices in the college classroom can impede engagement and learning by creating distractions. These findings were also later confirmed by Witecki and Nonnecke (2015) who found a significant negative relationship between student engagement and unstructured mobile device and laptop use during classes; the findings indicated that unstructured use of mobile devices reduces student engagement, necessitating structured behavior and classroom activities with the use of BYOD.

Golonka et al. (2014) recommended that teachers develop and enact classroom policies for the productive use of personal devices to mitigate distractions.

### **Summary of the Research and Research Gap**

The use of mobile devices in college classroom learning can play a central role in the advancement of education and student learning. As noted in the reviewed studies, there may be a connection between the use of personal or mobile devices in the classroom and student engagement. Crompton (2014) affirmed that advancements in mobile device technologies have profoundly influenced learning at the college level. Several studies, such as West's (2013), revealed that mobile devices in classroom learning are important to the higher educational experience. The use of mobile devices in the college classroom may contribute to learners' intellectual, social, and behavioral engagement by energizing attitudes, increasing participation, and enhancing innovation and creativity among students.

Additionally, the use of mobile devices in higher education has influenced students' behaviors regarding learning. Instant messaging, as noted by Kim et al. (2014), may contribute to social engagement more so than traditional learning approaches. Using mobile devices in the college classroom also lets students share their opinions without fear or threats of intimidation, which students sometimes feel in traditional settings (Morsy & Rothstein, 2019). However, researchers have largely ignored students' perceptions of engagement when using personal devices in the college classroom for learning. Some scholars, such as Ibáñez et al. (2014), have researched the influence of mobile devices in college language classes. However, researchers have not sought students' perspectives on learning engagement in higher education involving the use of personal devices in the classroom.

Additionally, Gezgin et al. (2018) noted that while research has been conducted on the use of mobile devices in computer science classes, there is little research on student perceptions regarding learning engagement and behavior changes. The present research was founded on the need to explore whether using mobile devices in the college classroom leads to enhanced student engagement. The research was designed to fill the gap regarding students' perceptions about the use of mobile devices in the classroom and whether mobile devices influence computer science students' learning engagement. The research was guided by learning engagement theory (Kearsley & Shneiderman, 1998), which includes intellectual, social, and behavioral components.

## **Summary**

Chapter 2 is a literature review focused on the use of mobile devices in personal device-assisted college classroom learning. Researchers have studied personal device-assisted classroom

learning, or BYOD to the classroom, to understand student learning and student behaviors in higher education classrooms. Yet, there is little research on college student perceptions regarding learning engagement and behavior changes. There have been many studies on using mobile devices as educational tools to improve student engagement and class activities, as well as tools to help teachers better track student progress. However, there is scant research on students' perceptions of the effect personal devices have as well as on learning, their intellectual, social, and behavioral engagement.

## Chapter 3: Methodology

### Introduction

The purpose of this research was to examine college student perceptions of their learning engagement using mobile devices. Exploring student perceptions allowed a better understanding of what students thought about using a mobile device in a computer science class as an educational tool. Acknowledging student perceptions also helped to evaluate the benefits and drawbacks of using mobile devices as a learning tool. The interpretative phenomenological analysis (IPA) qualitative research methodology (Smith & Osborn, 2003) enabled me to focus my research on the processes, rather than outcomes, of personal device-assisted classroom learning, or BYOD (Bring your own device) to the classroom. The semi-structured questions permitted interviewees to speak freely about their perceptions regarding mobile devices. Building understanding based on students' ideas may be more meaningful to the students as well.

Interpretative phenomenological analysis explores in detail how interviewees are making sense of their personal and social worlds (Smith & Osborn, 2003). According to Smith and Osborne (2003), the interpretative phenomenological analysis approach can afford novice researchers the opportunity to explore, in more detail, the 'lived experiences' of the research interviewees. Interpretative phenomenological analysis studies are conducted with a very small number of interviewees as IPA is committed to a detailed interpretative account of the cases included. There is number of ways to obtain data, the best way to collect data for IPA research have been conducted through a semi-structured interview (Smith & Osborn, 2003). Semi-structured in-depth interviews can prompt individuals and get close to participant's personal words (Conrad, 1987). Qualitative methods, such as open-ended interviews, field notes,

triangulation, and participant observations provide the means to explore a given phenomenon deeply. The setting for this research is in the Computer Science and Information Technology department in a public university in Central Minnesota. The actors are computer science upper-class undergraduate students. The phenomenon of this research is the use of mobile devices in computer science classes as an educational tool to assist and enhance class content delivery to students.

### **Research Questions**

Research questions in an IPA research are framed broadly (Smith & Osborn, 2003). In IPA studies, researchers do not attempt to test hypotheses; rather they aim to explore phenomenon flexibly and with detail (Smith & Osborn, 2003).

The primary research question was:

1. What are students' perceptions of learning engagement through using mobile technology in a computer science class?

The secondary research questions were:

2. How do students believe their intellectual engagement in class is impacted by using mobile technology?
3. How do students believe their behavioral engagement in class is impacted by using mobile technology?
4. How do students believe their social engagement in class is impacted by using mobile technology?

## Research Design

A qualitative approach is suitable for this research to address the complexity of the relationship between mobile technology use in the classroom and student engagement comprehensively (Merriam & Tisdell, 2016). I used an Interpretative Phenomenal Analysis (IPA) design to understand the experiences and perspectives of interviewees. Conducted with small sample sizes, IPA studies enable researchers to say something in detail about the perceptions and understandings of a particular group without making premature general claims (Smith & Osborn, 2003). Qualitative researchers aim to provide rich, descriptive accounts of the phenomenon under research. In qualitative research, a researcher does not theorize about outcomes and enters research with no prior expectations (Sandelowski, 2000).

IPA studies differs from other forms of phenomenology because other types of phenomenological studies are primarily descriptive and not too interpretative (Brocki & Wearden 2006). In IPA research, the primary purpose is to gain insight into individuals' experiences and (Smith et al., 2009). Philosophically, phenomenology allows the philosopher to explore experiences through phenomenology reflections, as researchers rely on interviewees' accounts and on experiences of researcher. IPA studies are well-suited for novice researchers to conduct studies (Willig, 2013). Phenomenological researchers seek to understand the lived experiences of interviewees, but not explanations for why these lived experiences occur. Smith et al. (2009) maintained that IPA uses hermeneutic, idiographic, and contextual analysis to understand interviewees' experiences. This IPA research focused on how college students make sense of their use of mobile devices in the classroom learning environment.



## **Selection of Sample**

Creswell (2007) suggested that “when selecting interviewees for a research, it is important to determine the size of the sample you will need” (p. 146). IPA studies should have homogenous interviewees so researchers can better gauge and obtain a better understanding of interviewees’ lived experiences (Smith & Osborn, 2003). Furthermore, research findings may determine if all interviewees have similar lived experience of the phenomenon being studied (Creswell, 2007). The population from which the sample will be drawn is computer science and information technology upper-class undergraduate students. The sample frame for this populations is upper-class undergraduate students in the computer science program, which introduces core areas of advanced computing, on the campus of Minnesota University, the pseudonym for a state university in Minnesota. According to the university’s services, in 2020, 75% of students were between the ages of 22-29 and 25% were age 30 and over. Upper-class undergraduate students in this program are 70% male and 30% female. Eighty percent of these are international students, and 10% are domestic students of color. The inclusion criteria for this research’s sample included that interviewees were (a) upper-class undergraduate students of computer science, (b) had previous experience with online tools, and (c) used mobile devices in everyday social and classroom activities.

To better understand the process, the I interviewed three computer science students during a pilot research. This small data set did not reflect sufficient category saturation (Corbin & Strauss, 2008). Findings from the pilot research, conducted with interviewees who met the inclusion criteria of the proposed research, were that students’ perceptions of mobile devices in personal device-assisted classroom learning, or BYOD (Bring your own device) to the classroom

were positive, and students liked using mobile devices as tools in the classic classroom setting. However, a classical classroom setting was the preferred mode of instructional delivery. All three interviewees felt that learning through using mobile devices as tools did not impact their social or behavior engagement, but they believe they benefited from the intellectual engagement. Students enjoyed mobile learning, but they still prefer a classic classroom. The research adopted the same criteria with a larger data sample.

Approval was obtained from the computer science department to recruit interviewees and request their help with recruitment efforts. With the department's help, recruitment letters were distributed to the student list (see Appendix C), along with informed consent forms (see Appendix D). Letters were sent to the Department of Computer Science to be distributed to the student list with departmental chair approval and IRB approval. To ensure that criteria were met, a researcher-created screening page was delivered with the recruitment letter (see Appendix E). Only students that met criteria and expressed interest were selected. As per Creswell (2007) and Smith and Osborn (2003), an appropriate sample size for an IPA research may be 6 to 12 interviewees. The required number of interviewees should depend on a data saturation point, which new data repeats what was said already in previous data collection (Saunders et al., 2017). Eleven computer science upper-class undergraduate students participated in this research. I sent a total of four recruitment letters to recruit interviewees. The first recruitment letter yielded five interviewees, the second and third recruitment letters yielded two interviewees each, and the fourth yielded five more interviewees. Four interviewees who originally agreed to participate did not complete the interview, so I was left with a final sample of 11 interviewees. The interviewees

included six men and five women. Seven students were domestic, and four were international studies: two students from Nepal and two students from China.

**Table 1**

*Participant Demographics*

#	Participant (Pseudonym)	Gender	Nationality (National or International)
1	Mike	Man	International
2	Bob	Man	USA
3	Mel	Woman	USA
4	Emma	Woman	USA
5	Dan	Man	USA
6	Eric	Man	USA
7	Iris	Woman	International
8	Pudai	Man	International
9	Carly	Woman	USA
10	Patrick	Man	USA
11	Suzi	Woman	International

After each recruitment event, I waited for 2 weeks after the recruitment letter was sent to see how many interviewees expressed interest to participate in the research. Interviewees did email the researcher using the email provided in the recruitment letter to express their interest to participate in the research. This snowball sampling strategy was based on soliciting the advice and help of the interviewees who have already agreed to participate in the research project to help recruit other interviewees to join in the research project (Smith & Osborn, 2003). I set up Zoom meetings and sent email invitations, so interviews could be done using Zoom. I offered \$20 gift certificates to the campus coffee shop as compensation for a interviewees' time.

## **Data Sources/Collection Methods**

The method of data collection was during semi-structured interviews designed to understand interviewees' perceptions and experiences of using mobile technology in an upper-class undergraduate computer science class. Semi-structured interviews required me to generate a set of questions called an interview schedule. The interview is guided by this schedule but not dictated by it (Smith & Osborn, 2003). During the interview, researchers establish rapport with interviewees. Interview questions were open ended, allowing interviewees to discuss the aspects of topics most important to them (Merriam & Tisdell, 2016). The order of questions was not necessarily important, which provided me the ability to probe interesting topics that arise. Question order also allowed interviewees to freely discuss their interests and concerns within the framework of the schedule.

In this research, I used a semi-structured interview schedule to interview 11 computer science upper-class undergraduate students (Creswell, 2007; Smith & Osborn, 2003). Ahead of each interview, I provided interviewees a copy of the interview schedule so they knew what kinds of questions to expect and could prepare their responses. According to Smith and Osborn (2003), producing a schedule in advance forces interviewees to think explicitly about the topic.

The interview schedule contained three sets of questions. The first set included questions about what interviewees know and how they felt about the topic. It provided clarity and helped facilitate the interview. At the same time, asking these questions helped build confidence and trust between interviewees and the interviewer. Lastly, question setup helped me better understand interviewees' level of knowledge on the topic (Smith & Osborn, 2003). The second set of questions related interviewees' demographics. The third set of questions covered how

students handle the use of mobile technology in the classroom and what this means to them. The third set of questions explored interviewees' perspective on mobile technology, as a learning tool in the classroom. The third set of included questions about the perceived benefits and drawbacks of mobile technology, and why these tools may be useful. I obtained written and signed interviewees' permission to audiotape all interviews, which later assisted in the transcription and analysis processes. Through an audio-recording produces a better record, it cannot capture non-verbal behavior, so interpretation by the me was necessary to present a fully objective record. In successful IPA studies, researchers use the semantic level, so one must see all the words spoken, including false starts, significant pauses, laughs and other features (Smith & Osborn, 2003).

To accommodate interviewees, provisions for Zoom interviews took into consideration time, distance, and travel expenses. Interviews were conducted using Zoom online communication tool, and interviewees could reserve a quiet place on campus such as a library, campus classroom, or their own room to participate in the interview. I used Zoom interviews to maintain social distancing protocols during the COVID-19 pandemic. A Zoom invitation was sent to interviewees with a set of attachments that consist of an interview protocol, letter of consent (see Appendix D) and interview questions (see Appendix A). I began interviews with a general question, to enable interviewees to talk broadly about the topic. I continued interviews using the funneling technique. The funneling technique is three-stage process which helps to ensure that the right questions are asked, detailed responses are given, and accurate notes of responses are captured (Matsumoto et al., 2015). Funneling begins with opening, continues with probing, and finishes with a closing statement (Smith & Osborn, 2003). Following the interviews and interview transcription, interviewees were given a copy of their interview transcript for

approval or modification, a process called transcript verification or member checking, and an important step in ensuring the trustworthiness of qualitative research (Guba et al., 1994).

### **Analysis**

Interpretative Phenomenological Analysis (Smith et al., 2009) focuses on how people make sense of and interpret their experiences with a phenomenon. IPA assumes that researchers are interested in learning something about the interviewees' world (Smith & Osborn, 2003). This may be in the form of beliefs, suggested by the interviewees' stories, to represent an aspect of interviewees' identities (Smith & Osborn, 2003). The IPA method requires researchers to generate detailed, reflective, first-person accounts from interviewees (Larkin & Thomson, 2011). An IPA requires researchers to analyze each interview separately, before connecting patterns and themes across all interview transcripts (Smith, 2004). The analysis of data collected will represent interviewees' stories in a coherent and meaningful way.

All interviews were transcribed by me, using Zoom advance artificial intelligence software as the supporting tool. Zoom advanced version has live adds-on for Zoom meetings that enable live transcriptions and live note taking for collaborators. The program opens a web page that provide captured and saved both video and audio conversation and presents transcripts after meeting is completed. All transcripts were shared with the participant at the end of the interview for correctness and interviewees' final edit. Each interview transcripts were coded in NVivo 12, a qualitative research software tool that assist researchers with organizing into hierarchical categories. NVivo is a software tool for qualitative research designed to manage data and ideas. In open coding, tasks involve line-by-line coding of the experiential claims, concerns, and understandings of each participant (Larkin et al., 2006).

I conducted an IPA by following the guidelines for IPA studies by Smith and Osborn (2003). I began by reading each interview and making notes of initial impressions and possible codes on the interviews using the annotations feature of the NVivo program. The transcript is read many times, and the left margin is used to annotate the importance of interviewees' responses through memoing. In NVivo 12, this process is a bit different, as memoing was accomplished through creating annotations attached to segments of text. While this does not occur in the left margin of the interview transcript in NVivo 12, the annotations are still attached to text, saved, and retrievable for viewing and analysis. During each reading, there was the possibility of acquiring new insights. In open coding, there is no rule about what or how to memo. Some memos may be attempts at summarizing, some may be associations, and some may be preliminary interpretations (Larkin & Thompson 2011). While analyzing the data, I found similarities and differences between interviewees and their experiences and noted same in memos.

Once this process was completed, the next step in IPA is to return to the beginning of the transcript and use the right margin to document emerging theme titles. Using NVivo 12, instead of documenting emerging theme titles in the right column of the transcript, I highlighted those segments of text identified in earlier memoing, or annotating, and ascribed them a short, descriptive title. Then, I coded each interview using descriptive codes, or brief titles describing the segments of text. I coded for significant sentences, paragraphs, narratives about particular incidents, the structure of the interview, and the interview as whole.

When I finished doing this for one interview, I categorized the codes for that interview based on similarity before moving to the next interview. To do this, I reviewed the list of codes I

generated from that transcript and, using NVivo, dragged-and-dropped similar codes together into larger categories, thereby building support for subordinate themes. These segments of text are then saved as nodes in NVivo 12, so that I can open the node and all segments of text coded to that short, descriptive title was displayed. In this stage the transcript is viewed as data, and there are no attempts to omit or select particular points—all are given equal weight. I completed this process for all interviews.

Once the initial list of emerged themes is generated, I started connecting the themes (Brandão, 2014). Smith and Osborn (2003) suggested that researchers list all coded themes of each transcript and examine theme definitions and search for similarities. Multiple themes are needed to provide objectivity when writing a manuscript (Smyth, 2011). Themes can be organized in NVivo 12 based on similarities among codes. A theme organized in NVivo 12 is like a code library of all coded quotes contained within that theme. Each resultant theme may have any number of quotes from all interviewees. NVivo's node summary presented the number of quotes and number of interviewees who were quoted and recorded in each theme to provide evidence of the prevalence and density of themes, as recommended by Smyth (2011). I used NVivo to develop the final theme structure to keep with idiographic nature of IPA. In NVivo researchers can organize themes and codes into a hierarchical structure for ease of analysis and understanding. Table 2 provides an example of this.



**Table 2***Example of Superordinate Theme and Sample Codes*

Superordinate Theme	Sample Codes
Making the Most of Mobile Devices for Academic Purposes	Recording lectures Streamlining notes and text Pictures of professors' notes Searching unknown terms/concepts Distractions Asynchronous work can be done at other times Asynchronous work can be joined from anywhere

**Trustworthiness**

To establish trustworthiness, I addressed credibility, transferability, confirmability, and dependability of research findings. Polit and Beck (2004) understand trustworthiness as degree of confidence in data, interpretation, and methods used to ensure quality of a research. Lincoln and Guba (2006) outlined criteria accepted by many qualitative studies that include credibility, dependability, confirmability, and transferability.

**Credibility**

To show that research findings are truthful and credible, I used validation by research interviewees. I presented research results to the original interviewees for feedback and correction. Also, after interview, I shared each interviewees' transcript with them audio to validate and confirm or amend the original answers. Second, I systematically and methodically compiled the data, all while, sorting, filling, and coding, analytic notes summaries, and records of process (Polit & Beck, 2004).

**Transferability**

Research transferability was established with thick description (Lincoln & Guba, 2006). I provided a detailed account about where the interview took place, when interviewees were interviewed, and the research setting. I acknowledge that in IPA research, transferability may be limited and difficult to be transferred to another setting (Pietkiewicz & Smith, 2014).

**Confirmability**

I maintained a research log of the recorded notes of the entire research process as an audit trail. I did practice reflexivity during the research process through continual memoing and the constant debriefing of committee members and peers.

I recognized that confirmability includes the researcher's understanding of his influence and effect on data gathering and analysis (Pietkiewicz & Smith, 2014).

**Dependability**

I kept an audit trail of all thoughts and ideas through the conduct of the research, in particular regarding the process of data collection (Lawson et al., 2014). Procedures for dependability contain preservation of an audit trails of process log and peer conversations. My notes were used as process logs, which show all activities that happen during the research, as well as decisions made regarding who is to be interviewed and what is observed (Connelly, 2016).

**Human Subject Approval—Institutional Review Board (IRB) Statement**

Upon the successful defense of my proposal, I obtained from the St. Cloud State University Institutional Review Board approval to conduct this research. Application to the St. Cloud State University Board included an IRB form, informed consent form, and interview

protocol. In addition, I submitted a request and received permission to conduct research through the computer science and information technology department. Institutional review board approval was required because this research involves human subjects, the college students of Saint Cloud State University computer science department.

### **Summary**

Chapter 3 summarized the proposed methodology. Interpretative Phenomenological Analysis is best suited to understand the experiences of computer science students using mobile technology. Chapter 3 outlined the IPA, as well as design, research population, participant information, data analysis, and credibility declaration. IPA method supports co-construction, so interviewees and I could work together to construct meaning and share perspectives of experiences, while keeping focus on the individual experiences (Pringle et al., 2011; Smith et al., 2009). The discovery process is the result of deep conversations with interviewees during the interview (Smith et al., 2009; Willig, 2013). As there is no prescribed hypothesis to confirm (Smith & Osborn, 2003), this allows for more varied discussions of the findings, in terms of how the finding might relate to other theories, models, or approaches (Brocki & Wearden, 2006). IPA analysis does not require the researcher to completely isolate from the research. IPA welcomes prior knowledge that is brought to the research and accepts the role which it can play in making meaning. I did maintain a detailed journal that enabled me to capture initial perceptions, so I did attempt each interview with fresh views. Interpretation is crucial to creating sense, and to the overall purpose of this research, as the research focuses on understanding individual perceptions but also on understanding how those perceptions are connected to the social or behavior engagement.

## Chapter 4: Findings

### Introduction

Research has shown that technology-assisted classrooms have aided in active learning (Papas, 2019). Further, using mobile devices in the higher education classroom may facilitate learning engagement (Russell, 2018). Sharples et al. (2005) suggested that using such devices can help students connect with class learning material and facilitate greater communication. Less clear is how using mobile devices impacts students' learning engagement in the higher education classroom (Gezgin et al., 2018). Therefore, this research was designed to explore college students' perceptions of learning engagement when using mobile and personal devices in the classroom.

I sought to understand how college students believed their classroom engagement is impacted by mobile technology use in the classroom. As such, I developed one primary research question:

1. What are students' perceptions of learning engagement through using mobile technology in a college computer science class?

The secondary research questions were:

2. How do college students believe their intellectual engagement in class is impacted by using mobile technology?
3. How do college students believe their behavioral engagement in class is impacted by using mobile technology?
4. How do college students believe their social engagement in class is impacted by using mobile technology?

I conducted an IPA to address these three questions. The results revealed three superordinate themes related to device use and academics, social behavior, and motivation. Using devices efficiently for academic purposes helped interviewees learn material and using devices to connect with classmates for group projects helped students feel connected. In turn, the use of devices for academic and social purposes helped fuel greater classroom and academic engagement. College students believed their devices enhanced their motivation to learn and connect. Students recognized that this engagement and motivation was predicated on their smart use of devices, by which they meant not allowing themselves to be distracted by social media or email during class time. If they could manage their behavior around smartphones and devices in the classroom, students reaped the benefits of an enhanced learning experience.

## **Results**

### ***Superordinate Theme 1: Making the Most of Mobile Devices for Academic Purposes***

This superordinate theme consists of three subordinate themes all centered around how students used mobile devices such as smartphones for class purposes, both inside and outside of the classroom, and for synchronous and asynchronous classes. Interviewees described how they used their smartphones, and other devices, to improve their efficiency in classes and make the most of their time. However, interviewees also recognized that devices could be distracting, especially social media sites and notifications that came in while they were in class. When interviewees did not succumb to these distractions and, instead, used devices to enhance their learning, they reported better learning experiences.

**Subordinate Theme 1a: Mobile Device Use Outside of Class for Class-Related Purposes Improves Efficiency.** This subordinate theme is about the ways that interviewees used

their mobile devices and smartphone strategically for class purposes outside of the college computer science classroom. Interviewees benefitted from the efficiency of mobile devices to access both synchronous and asynchronous classes. Interviewees used their mobile devices outside of synchronous classes in several ways. Many interviewees used a mobile device to access lectures they had recorded during class, allowing them to review lecture material and research for exams. Interviewees also appreciated the efficiency of using the mobile devices to access class learning management systems (LMS) to stay on top of their assignments and grades. When professors used an LMS, they could relay information to interviewees and their classmates quickly and in a timely manner. Overall, interviewees believed they could use the time they devote to class outside of synchronous class meetings more efficiently, thanks to mobile devices. Further, interviewees who took asynchronous classes and used a smartphone or mobile device in conjunction with those asynchronous classes perceived they were more efficient and productive.

***Synchronous Classes.*** Interviewees reported using mobile devices like smartphones outside of their synchronous classes to help them research for exams. If professors posted PowerPoint presentations to the LMS, interviewees could access those presentations and use them to research. “After professor said that the exam will cover Chapters 3 to 5, I could go to my phone, grab the PowerPoint slides, and research for the exam,” Mike explained. Recorded class lectures were also beneficial for students, especially during the pandemic during which this research was conducted. Time spent in quarantine with relatively little to do could be used more efficiently and for class-related purposes, which Bob discovered early on:

For example, when everything was shut down for COVID-19, I was just walking around. I realized while I’m walking around, I’m not using my time appropriately. I started using

my smartphone a lot; I took my headphones and plugged them into my phone ... I basically listen to my professor's lectures as I'm walking. And I did that a couple of times and then I scored an A on the final. So, that was helpful.

Reviewing class lectures simply by listening to them multiple times appeared to be a helpful research tactic. It also appeared that Bob did not realize prior to this situation that listening to a recorded lecture multiple times was an effective research tactic that yielded an exam score that was perhaps better than if he had not used this research method. This excerpt from Bob demonstrates that the ability to listen to lectures on a smartphone outside of class was viewed as helpful and associated with getting a good exam grade. In addition, this participant also attended synchronous Zoom classes while walking, combining physical activity efficiently with class work.

Other interviewees used a smartphone outside of the college classroom in ways similar to Bob. Mel, who worked full time at a bakery and sometimes covered shifts for other coworkers during class time, liked the portability of a smartphone. The smartphone made it easy to attend lecture even while at work, when necessary. "I don't get to see the screen, but I get to listen and then maybe replay the lecture later," said Mel. Smartphones were also used to download class textbooks, which were more portable than physical books. "Instead of carrying [textbooks] . . . I am a really big supporter of using PDF books as compared to the actual book itself," said Suzi, who also noted that PDF versions of school textbooks were more environmentally friendly, an added benefit.

Bob and Mel were not the only interviewees who found it helpful to view recorded lectures outside of class. Emma said that the smartphone was handy for taking notes. With only

one mobile device and, thus, one screen, the smartphone could be replaying a lecture while Emma took notes in a notebook.

*Asynchronous Classes.* As mobile devices were beneficial for synchronous college classes, they also helped students in asynchronous classes. It appeared as though interviewees viewed mobile devices as best suited for asynchronous classes. Rather than working at a laptop or desktop computer, where interviewees may have needed to be at a given location to complete their schoolwork and which took up more space than a mobile device, a smartphone was an effortless way for students to work on their asynchronous classes. “It’s easier to use the phone,” Dan stated.

The ease of the smartphone was especially helpful for those who had long commutes. Emma commuted an hour to campus every day, and appreciated that for asynchronous classes, the smartphone made it possible to listen to lectures while commuting. “[I] could just stick [the lecture] on [my] phone and listen to it in [my] car as [I] drive there, and that helps,” said Emma. The ability to do this was precisely because “everything becomes portable” with a mobile device, continued Emma. “I am able to pause video, take notes, and move on with asynchronized class,” said Mike of the benefits of the mobile device. Similarly, Iris said, “I can watch class lecture while working, or any time at my convenience,” referring to asynchronous class lectures.

Using a smartphone for asynchronous college classes created a greater sense of productivity, as Pudai explained:

Using mobile phone outside of classes helped me get updated on the course material when the instructor posted something on D2L [LMS]. If I did not use a mobile device, I would have to get back to my PC to see if there is any unread email sent by the instructor.



With a mobile device, any updates and modification to the course material was instantly received. Using mobile device outside of class also allowed me to go through the course material, lectures, and notes while I am on my way to school, or anywhere. It allowed me to make use of time and be more productive throughout the day.

This passage highlights how smartphones especially can be useful in asynchronous classes. Students stayed up to date on what is happening in class, like the class schedule and any assignments, and students can also access course material on a smartphone anywhere they are, making what might usually be unproductive downtime more productive.

**Subordinate Theme 1b: Smart Use of Mobile Devices in the Classroom.** Most interviewees had not been in college classes where instructors integrated the use of mobile devices in the classroom, though a couple of interviewees had. This subordinate theme is about how interviewees used mobile devices like smartphones in their computer science classes either through instructors' integration of the devices or interviewees' own use. Indeed, most interviewees seemed to use mobile devices of their own accord in the classroom. However, interviewees liked it when instructors integrated mobile devices into class lectures.

*Integration of Mobile Devices in Lecture.* When computer science instructors did incorporate mobile devices, interviewees appeared to enjoy this and viewed it as a benefit. "A lot of instructors are very engaged with the technology, and I've always felt better taking classes with instructors who were used to technology," said Bob. When instructors used technology, students could "get engaged in class with smartphone," Bob elaborated. Emma suggested that incorporating mobile devices would lead to greater class interaction and engagement:

If the course material is just being read off the board and written, then there's no interaction and stuff. I feel like it'd be better to have, if you have to use phones, to do it to create interactions with the class. Because I do really bad with just lectures that are just, like, here's the lecture, and then just write it down and then leave and then go research.

Emma's explanation here highlights a problem that many college students appeared to have, which was sitting and learning in a traditional college lecture with no other interaction or engagement. Because so many students already have mobile devices or smartphones that they bring to class, it made sense to Emma for instructors to take advantage of this opportunity for greater engagement with the class by incorporating mobile devices. This sentiment was also shared by Eric, who had taken several classes where the instructors used mobile device integration in lecture. Eric noted that in such college classes, the use of mobile devices for polling and quizzing made it so the professor could quickly check student learning and retention, and then the professor could reteach anything that students struggled with. Eric said, "[Classroom polling helps students] researching between classes. ... if you have regular quizzes where you get immediate feedback ... that's easier to do when you have, like, an automated system like on your mobile device." Device integration also made it so instructors could provide feedback more quickly to students, according to Pudai. Pudai explained of taking quizzes using a mobile app, "This is easy and time saving method, rather than having to manually write the answers in the paper. It was also easier and faster for the instructor to grade class work." For students more hesitant to speak out or answer questions in class, Eric also thought that mobile device polling was helpful because students could submit answers anonymously and without judgment from classmates.

*Using Smartphones to Search for More Information About Lectures.* Interviewees appeared to want more information about course topics than instructors had time to cover in class meetings. Keeping a smartphone or other mobile device nearby helped students to search for more information, which helped them understand lectures better. A convenient way to look for an explanation seemed to be especially the case for international students for whom English was not their first language. Iris, one such international student, explained how helpful the smartphone was for translating and understanding unfamiliar words that the professor used:

One [situation in which I use a smartphone] is that when I come to the United States. In the beginning of the class, there are some difficult and complicated words. Like, [one] I remember is synchronization. I don't know this word synchronization means and what [it] is about, why professor used this word in class. So, I need to check for what's the meaning of this word. So, I used smartphone. I am using smartphone to find descriptions for word and terms I do not understand.

Pudai found using a smartphone to search unfamiliar concepts helpful as well. Searching for concepts was especially helped in one particular college computer science class that Pudai recalled was full of “concepts taught by the professor, which was very new to me.” Pudai did not believe the professor spent an adequate time covering the new concepts in detail, so this participant relied heavily on the smartphone to search for more information and stay engaged in the class. This was a common experience. Mike used the smartphone “to search when terminology is complex . . . also if professor is explaining a topic that I never heard of before.”

By using a smartphone to search for a term or concept, interviewees believed they were being more respectful because they did not have to interrupt the class. “Some kinds of research

that you want to do, and you do not want to disturb the whole class...instead of wasting 10 minutes of class time,” a student can just search for something on their smartphone, suggested Suzi. Bob thought using the smartphone in class to search for unfamiliar terms and perform other quick searches was easier than turning on a laptop computer, and therefore preferable in the classroom.

*Using Smartphone to Record Lectures.* Interviewees used their mobile devices to record college classroom lectures, which improved their ability to remain engaged in the class and follow the lecture. In fact, this was “the only benefit” of using a smartphone in class, according to Dan. Dan was, overall, more pessimistic about using mobile devices and smartphones in the computer science classroom than were other interviewees. Handwriting notes made learning easier for Dan, who also said that the use of devices did not aid in retention of material in class. However, when the professor put up notes and went too fast to adequately cover the material, Dan found it helpful to take a screenshot.

Dan was the only participant who appeared to think this way, as other interviewees found the ability to record notes helpful to the learning process. “Just to take a quick snapshot of things is really nice,” Mel explained. Carly did this too, which meant “I don’t have to copy it all down” and that she could easily look through the notes to research later. In addition to taking pictures of notes and slideshows in class, Pudai records lectures on a smartphone. The pictures “saved me time in having to manually write down the notes in my notebook,” Pudai said, and by recording lectures, Pudai “could review them again after the class was done.” Interviewees even took pictures of the notes on the board in classes where smartphone use was discouraged. Iris did this when there was not “time to finish writing notes down as professor moves quickly to another part

of the lecture.” Being able to take a picture of notes made it easier even for students who did not have time to copy down lecture notes by hand. “It’s just a lot easier to take a picture of something or quickly type it in, than it is for me to write it in my notebook, and I like how easy it is,” said Carly.

Patrick had learned from experience that recording the lecture in the college classroom using a smartphone or other mobile device best fit his learning style:

I personally feel it’s better to hear things twice or several times. And I like to take notes during class, I don’t like just recording it and going back to it later. Because then it’s just, it’s less efficient that way; it’s a waste of time. Because if you’re there, just take the notes and everything, because when you write stuff down and that increases your retention by, like, 50%. And so then, when you go back and listen to it again, or, and then you can just complete your notes, what you missed, and that there will also increase your retention and I guess, make it easier to get better grades in the class.

Clearly the ease that mobile devices created in the classroom was something that interviewees appreciated. For some, the ease had to do with recording lecture information, either by audio recording the lecture or by taking pictures of the professor’s notes. By doing these two things, interviewees had an easier time paying attention to the professor’s lecture. Patrick was slightly different, though, as the ease of recording lectures for Patrick had to do with the facilitating retention and getting better grades in class.

**Subordinate Theme 1c: Controlling Behavior Around Mobile Devices Mitigates Distraction.** Using mobile devices in college classes provided interviewees multiple benefits, like ease of notetaking, less effort in retaining information because of increased class

engagement, and increased motivation. However, the potential drawback was that mobile devices “can be a big distraction,” according to Emma. Many interviewees noted distraction as a problem, like Mike, who recognized that mobile device distraction was not limited to personal use. “During class, you could pull up a smartphone and you forget what you want to do, so you lose focus on lecture,” Mike explained. However, Mike also described how another student in class “starts playing movie in the class” on his iPad, which was a distraction because if the movie “is interesting, you focus your attention to movie and away from lecture.”

Mike also noted that in the event of a boring lecture, when students might already be feeling distracted and like they do not want to pay attention, the temptation of distracting oneself with a mobile device might be too much. The experience of using mobile devices in the event of boring lectures was similar for Carly, who said, “If my phone’s right there, I end up getting distracted and then I’m not paying attention to the class as well as I could.”

Interviewees noted social media as a primary source of distraction. “Having the phone out sometimes makes you visit Facebook,” Bob used as an example of the temptation of social media. Additionally, distractions came in the form of notifications for social media posts and emails. “The constant notifications. So, you have your phone right next to your book or your notebook and you are not understanding what the professor is saying,” said Suzi, “There is a ring of any notification; students can’t help it but see the phone.”

Mel happened to have a disability and using mobile devices in the classroom really helped, but Mel also recognized the potential for distraction when using mobile devices:

I mean, there’s such a conundrum because just by the act of having the mobile device, you’re forced to split your attention between the teacher and what you’re dealing with on

the screen, because you can't look at two places at once. I've tried, and it just looks weird. So, inherently, it causes this split of attention, and whether it's the benefits outweigh the cost is really up to the individual.

Interviewees used the word *control* to describe their behavior, or desired behavior, when using mobile devices in the college classroom. Interviewees were able to make the most of their smartphone and mobile device use in the college classroom when they could control their behavior and not allow mobile devices to be distractions. This meant not allowing notifications, social media, and email to become distractions in class. Mike, who used a smartphone extensively to search for unfamiliar terms and concepts in class, said "I understood that I had to control myself or I'll be missing some lecture ... until I decided to control for what I need and use [my] smartphone." Interviewees appeared to really struggle with this control. "It really does come down to a lot of self-control which, like, I'm definitely not perfect at," said Emma. The control was a work in progress for Eric, who said, "I am trying to control myself and not use smartphone for social networking." It was almost as though interviewees had gone through periods of mobile device use in the classroom where they were unable to control their use without distraction, and then something changed to make them realize they needed to gain control over smartphone use.

***Superordinate Theme 2: Mobile Device Use Improves Social Interaction with Classmates***

Interviewees appeared to be in general agreement that using mobile devices like smartphones in the college classroom improved social interaction and communication with classmates. This superordinate theme is about how communication between classmates improved by using mobile devices, contributing to increased engagement. As Dan explained, "Now I do

have the phone, instead to send email I use text to talk with peers and instructors.” Agreement that use of mobile devices improved social interaction was true for synchronous and asynchronous classes.

Mobile devices appeared to work really well for students working on group projects together or in study groups. Interviewees mentioned the app Discord, in particular, for facilitating greater communication and interaction between group members. Bob liked using Discord to communicate with both classmates and instructors:

Using Discord helps us to work in study, communicate, share our ideas and answers to the problems. With smartphones, we can instantly communicate with instructors and follow up on material which is not clear to us. Smartphones help us to access emails, class notification and open PDF materials we need to read. We can also access class recordings while we are walking to the class, for example.

Eric also spoke highly of the ease the Discord app brought to communication in collaborative group projects but was unsure about its use outside of computer science classes. “I don’t know how widespread this is, but for whatever reason, in computer science courses, it seems that for group projects, everyone uses Discord,” said Eric, “It just makes collaborating on group projects really easy ... you know, these meetings with people, some of them who live varying distances from the university ... whereas something like discord makes it really easy to collaborate on group projects.”

Emma found it helpful to be in constant communication with classmates, which smartphone use facilitated. “I think that’s definitely nice to just not only have classmates to talk to during class,” Emma said and elaborated that this was especially nice to be able to quickly text



or message a classmate asking to meet up or talk when they had a moment. For group projects, Emma appreciated the ease with which s/he could be at work but still get on a mobile call or meeting with classmates, if needed. Emma said,

Instead of, like, having to just schedule things in person, all the time, you know, like, we need to all meet here in one place ... Whereas if someone, like even now, with my group members, it's like, oh, I have a meeting at work, but I'll jump into a Zoom call, you know, for half an hour while I'm on break. And, like, you can do it from your phone. It's not hard, and it's, it's a lot easier to just be like yeah, pitch in when you can and it'll still get finished in the end.

Emma compared this to “older group work” where students would have to physical meet in person and work together for “hours and hours to get things done.” By “older group work,” Emma may have meant a time before mobile devices and smartphones.

Dan also found the use of mobile devices helpful when working on collaborative group projects for college classes:

It's a communication tool, and in group projects, communication is key. So, I have no problem with using the phones in a group project. Even if it's in person, when we're looking at stuff on our phone, there's the sort of, you're in a group. So, you're more motivated to not be distracted because all eyes are on you, most likely.

Iris used the smartphone to communicate with classmates slightly differently than just collaboration in classmates in group projects, though she did acknowledge that using smartphones when working in a study group really helped the group communicate when they did not meet in person. Iris described using the smartphone to search for information in class and

then sharing that information with classmates “by texting it or sending link to the interesting site.” The ease of relaying this information can be done “conveniently when we are walking towards class or in the bus, and it can be done without losing precious time,” Iris elaborated. Sharing information like this helped interviewees understand class lectures and helped classmates understand, too, because they all benefitted from discussing the shared information. Using the smartphone to communicate with classmates “makes me a lot more social,” Carly said plainly.

While most interviewees believed that the ease with which smartphones improved communication led to improved socialization, Patrick did not necessarily think this was the case. Instead, Patrick saw this type of interaction as a “pseudo-social interaction,” and actively tried not to let the use of a smartphone or mobile device “get in the way with general social interaction,” which likely meant face to face interaction as opposed to interaction via technology.

***Superordinate Theme 3: Using Mobile devices Improves Motivation Through Greater Engagement***

Interviewees who used their mobile devices, especially smartphones, felt an improvement in their level of motivation to do well in their college classes. This superordinate theme builds on the previous two themes to show how the ways students use mobile devices in the classroom impacts their engagement and motivation, and how the ease of communication mobile devices facilitates students working together, which also improved engagement. The path from mobile device use to motivation was through an increase in focus, which mobile devices facilitated. Mike explained how using a mobile device, like a smartphone, in the classroom could improve motivation:

It's a very, very complex lecture, professor was teaching graphs. A graph search algorithm to be precise. Suddenly, he starts explaining graphs ... We did not have any idea what graphs are. Professor continued to lecture, but my lack of understanding resulted in no motivation to follow this class. [The] topic was great, we all were motivated, but we did not know a few terms, and he did not allow mobile phone use in class. So, I was completely lost and demotivated. If we were able to use [our] smartphones, I would pull up the term, graph, and clarify what he meant. In [this] scenario, if students can find terminology definitions, it will serve as a great motivator.

In this passage, Mike described a time when being unable to look up an unfamiliar term in class led to confusion, which meant he could not follow the remainder of the lecture. In this case, had smartphones been allowed in the classroom, Mike could have looked up the definition of the term to ensure understanding, which meant he would have been able to follow the remainder of the lecture, thus improving overall motivation, according to the participant. When Mike was able to use a smartphone in class, the mobile device "helps me do the work and [is] helping me stay focused on the course ... which, in turn, motivates me to keep learning," Mike explained.

Using mobile devices also led to improved motivation for Mel, though through a different route than Mike. Changes to course lecture delivery during the COVID-19 pandemic at the time this study was conducted led to changes in how interviewees engaged in the college classroom. Mel attended class lectures through a synchronous online platform and believed that using the smartphone's webcam feature improved motivation. "If I don't [turn on my webcam] during class, I'm going to maybe relax a little bit to the extent and I don't pay as much attention,"

reported Mel. The motivation to stay focused in class came from using the webcam as a system of accountability. If the smartphone's webcam was on, then Mel could not be using the phone for other, non-class-related purposes, like social media, which would lead to distraction.

According to Mel, the motivation came from an increase in classroom engagement, which was facilitated by the smartphone webcam. Eric also connected improved engagement with motivation, though not through use of the webcam to attend class. Instead, when instructors used mobile devices to check student learning, this kept Eric engaged in class and, thus, motivated to pay attention and continue learning. This happened through increased collaboration and communication with instructors. According to Eric, “[Mobile devices] let people know what the problem topics are and then the students and teachers can kind of work together and figure out, like, what are we getting wrong, what the students are getting wrong.”

The ease with which interviewees could engage in synchronous college classes through using mobile devices improved engagement and motivation. “Overall, [using my phone in class] makes me more engaged,” said Carly. Suzi appreciated how easy it was to attend class and do class work through the smartphone:

It is super easy to do things on [my] smartphone ... We are always looking for things that are quick and convenient and that we can do fast and quicky in a minute or two.

Smartphone or mobile devices let us accomplish that ... And so, having that advantage, I think it motivates me a lot ... I think having things super easier and motivational, I see now how through using mobile phone, [this] keeps me motivated.

Mobile device use made interviewees' lives in the college classroom a little easier, to which they attributed their greater engagement and motivation. Using mobile devices in

computer science classes decreased the amount of effort required to learn and retain information. “The classes that I’ve done it, with the smartphone, has reduced the amount of effort necessary,” said Bob, “I can focus more and get a higher grade.” Bob elaborated that using the smartphone allowed greater learning from reduced effort. Students could focus on the lecture without worrying about keeping up with notes. Pudai agreed that using the smartphone in the classroom reduced overall effort:

Using mobile device in the class reduced my effort in understanding the course material being taught. This was because the mobile device provided an access to a lot of information in the web. Whenever there was a time [that] I did not understand the course material, I was able to explore the topic in detail on the internet.

With a smartphone in hand, Pudai could search for more information about anything the professor taught in class, and this information was more easily accessible, which reduced effort. This situation was similar to what Carly described, that the smartphone “makes learning effortless” and that when allowed to use smartphones in class, “it just seems to take a lot less time and then I have more time to pay attention during class.”

### **Summary**

To better understand how college computer science students perceived their learning engagement through using mobile devices, I conducted an IPA. In response to the primary research question about students’ perceptions of learning engagement through using mobile technology in a computer science class, IPA showed that students did perceive an improvement and increase in both intellectual (RQ2) and behavioral (RQ3) engagement by using mobile devices. Students did not appear to have a lot of experience using mobile devices in computer

science classes where instructors integrated technology in the classroom. However, students did use mobile devices, especially smartphones, for a variety of purposes in the classroom.

Findings showed that college students especially liked how easy it was to use a mobile device to look up unfamiliar words and concepts when they did not understand something in class. Students believed this enhanced their engagement and, thus, motivation, because they could keep up with the lecture and do so without interrupting the class. College students also used mobile devices for class work outside of synchronous classes and used mobile devices to help them in asynchronous classes. Downloading apps for the class LMS and apps to communicate with classmates allowed students to keep organized and on top of assignment deadlines and collaborate with classmates on class projects without physically meeting. For students to benefit from using mobile devices in class, though, they had to control their behavior, so they were not distracted by social media apps, emails, and notifications. In Chapter 5, a discussion of these findings is presented, along with recommendations for future research on this topic and practical applications.

## Chapter 5: Discussion

### Introduction

While personal and mobile devices are increasingly being used in education generally, research on the use of mobile and personal mobile devices in higher education classroom learning is still emerging (Lieberman, 2019). Since its implementation by the educational community, personal mobile device-assisted classroom learning has played a substantial role in expanding the boundaries of the learning process (Gezgin et al., 2018; Laskaris, 2019). Sharples et al. (2005) argued using such mobile devices can help students connect with class learning material and facilitate learning engagement. Unfortunately, its effects on learning engagement and what students think about using mobile devices in the college classroom were largely unknown (Gezgin et al., 2018; Laskaris, 2019).

The purpose of this IPA research, therefore, was to explore college students' perceptions about the use of mobile devices in higher educational settings and their roles in learning engagement. This research was designed specifically to explore students' perceptions of the use of mobile devices in the classroom and the role of mobile devices in students' intellectual, social, and behavioral engagement. I asked computer science students from a Minnesota University about how their classroom engagement was impacted by mobile technology use in the college classroom. What were college students' perceptions regarding mobile devices' impact on their intellectual, behavioral, and social engagement? Do college students regard the use of mobile technology in the college classroom as a beneficial learning tool, or as a distraction to classroom engagement?

In Chapter 1, I introduced the problem and the reasoning for the proposed research. I also briefly summarized the IPA methodology, research population, the research questions, general assumptions, positionality statement, and the significance of the research to the field. Chapter 2 focused on research on the use of mobile devices in personal mobile device-assisted classroom learning. The review of the research revealed a research gap regarding students' perceptions of the effect of personal mobile device-assisted classroom learning on their intellectual, social, and behavioral engagement. In Chapter 3, I discussed the research's methodology, research population, data analysis procedures, and issues of trustworthiness. Interpretative phenomenological analysis (IPA) was best suited to understand the experiences of computer science students using mobile technology in the classroom; IPA allows researchers to help construct meaning based on the shared perspectives and experiences of individual interviewees (Pringle et al., 2011; Smith et al., 2009). This research's findings were presented in Chapter 4, and the findings are discussed and interpreted in Chapter 5. Chapter 5 also includes recommendations for further research.

### **Summary and Interpretation of Findings**

A sample of 11 computer science upper-class undergraduate students who completed gateway courses CSCI301 & CSCI320 were interviewed to examine perceptions of their learning engagement using mobile devices in a college classroom. Participant groups consisted of six men and five women, where seven students were domestic and four were international. Two international students were from Nepal and two from China. The researcher developed one primary research question:



RQ 1: What are students' perceptions of learning engagement through using mobile technology in a computer science class?

Analysis of the data indicated that students used mobile devices, such as smartphones, for class purposes, inside and outside of the classroom, and for synchronous and asynchronous classes. Interviewees reported how they used their smartphones, and other mobile devices, to improve their engagement in classes and make the most of their time. Interviewees also realized, however, that mobile devices could be distracting, especially social media sites and notifications appearing while in class. Interviewees reported avoiding distractions and using their mobile device to enhance their learning; overall, they reported better learning experiences with mobile devices.

There were two secondary research questions associated with the primary question:

RQ 2: How do students believe their intellectual engagement in class is impacted by using mobile technology?

Social engagement refers to interaction between students, peers, and instructors that positively contributes to students' overall learning experiences (Jones & Thomas, 2012). Social engagement in learning environments involves the extent to which students communicate and network with others for both academic and social purposes through online channels, forums, and mobile devices (Martin, 2011). Social engagement in learning environments includes communication with teachers and participation in learning communities (Martin, 2011). The theory of engagement derived from experiences teaching with technology holds that students connect with learning activities through interaction with others and through meaningful activity tasks (Kearsley & Shneiderman, 1998).

Findings from RQ2 support the social engagement component of engagement theory, social interaction, and communication between classmates for course purposes improved with use of mobile devices, contributing to enhanced social engagement. Students described using mobile devices to stay in contact with classmates about class projects and group work. Mobile devices also helped students communicate with the professor about assignments and course work, further enhancing social engagement.

RQ3: How do students believe their behavioral engagement in class is impacted by using mobile technology?

Behavior engagement refers to students being involved in learning to the extent that they comply with behavioral norms, such as regular attendance and participation, as well as eschewing disruptive and negative conduct (Trowler, 2010). Findings from RQ3 support overall engagement leading to increased motivation; however, behavioral engagement seemed to be missing. Interviewees who used mobile devices in the classroom described feeling engaged in class activities and, therefore, being more motivated. Interviewees also reported the need to control their behavior when using mobile devices in the classroom. While interviewees made the most of their smartphones and mobile devices in the classroom, they controlled their behavior and did not allow their mobile devices to be distractions. It may be that behavioral issues and behavioral engagement are not as important for college students than they are for younger and less mature K-12 students.

I used IPA to address the three research questions, and three themes emerged from analysis of the data: Making the Most of Mobile Devices for Academic Purposes, Mobile Device

Use Improves Social Interaction with Classmates, and Using Mobile devices Improves Motivation Through Greater Engagement. These themes are discussed below.

### **Theme 1: Making the Most of Mobile Devices for Academic Purposes**

This theme captures how interviewees used their mobile devices and smartphones strategically for class purposes outside of the computer science classroom and for synchronous and asynchronous classes. Interviewees believed they benefitted from the efficiency of mobile devices to access both synchronous and asynchronous classes, and they used their mobile devices outside of synchronous classes in several ways. For example, students used mobile devices to access lectures they had recorded during class, which allowed them to review lecture material and research for exams at their convenience. Interviewees also appreciated the efficiency of using the mobile devices to access class learning management systems (LMS) to keep up with assignments and know their grades. Students also reported liking how easy it was to use a mobile device to search for unfamiliar words and concepts when they did not understand something in class. Students believed that the ability to look up unfamiliar words and concepts enhanced their intellectual engagement as well as their motivation because they could keep up with the lecture and do so without interrupting the class. Students also used mobile devices for class work outside of synchronous classes and to help them in asynchronous classes. Downloading LMS apps for the class and apps to communicate with classmates facilitated organization and keeping up assignment deadlines, as well as allowed for collaboration with classmates on class projects without physically meeting.

My findings largely support those of previous research. Lieberman (2019) found that students connected to the class material using personal mobile devices can locate and retrieve the

information they need to complete tasks successfully, which can also facilitate intellectual engagement, leading to overall positive learning experiences for students. I found that interviewees use mobile devices to check on class content on the Desire to Learn (D2L) classroom website, an online learning management platform used by K-12 and higher education institutions. Findings confirmed that students use mobile devices for locating definitions and supplemental information on class topics, which allows students to better follow and understand class presentations, enhancing intellectual engagement.

My findings also showed that interviewees could easily go through lectures posted online, supporting Carter et al.'s (2018) findings that students use personal mobile devices to quickly and conveniently return to previous lectures and materials as needed. While working on assignments, interviewees reported being able to quickly connect to and scan previous lectures, helping them to complete assignments. My findings also supported those of Carnevale et al. (2015) that the user-friendliness of mobile devices further facilitates intellectual engagement by reducing the distractions of technical, user-unfriendly issues. User-friendliness allows students to focus on course content exclusively. My findings confirm that the use of user-friendly mobile devices as educational tools in the classroom help students understand material in and out of the classroom. With better understanding of class material, interviewees were able and eager to successfully complete class tasks and assignments in a timely fashion.

## **Theme 2: Mobile Device Use Improves Social Interaction with Classmates**

This theme captures the use of mobile devices in classes to help improve social interaction between peers and social engagement. Interviewees generally agreed that using mobile device, like smartphones, in classroom improved social interaction and communication

between peers. For example, students liked the Discord application and used it to communicate with peers and instructors. Students found mobile devices helpful to communicate with classmates for study groups and for collaborating on class projects.

My findings support those of previous research that students benefit socially from the use of mobile devices in classroom, including enhanced peer support and increased communication among peers and between students and instructors (Jones & Thomas, 2012). Jones and Thomas (2012) concluded that social engagement involving interaction among students and between students and instructors can positively contribute to students' overall learning. With mobile devices, students in the present research stated that they could quickly and conveniently connect with study groups and classmates. Students could raise and discuss issues about class material immediately, not having to wait until the next day or the next week. Mobile devices facilitated interviewees' interaction, with one another and the professor, resulting in increased social support and enhanced social engagement.

Kennedy (2014) also found that students use mobile devices not only to access information for class but to connect with peers, friends, and sometimes family members regarding course content. In the present research, interviewees reported using mobile device applications to discuss projects within study groups and to exchange comments with instructors to complete their assignments on time. Students reported using specific mobile device and application functions, such as notifications, to help them stay socially connected and on schedule. Notifications allowed interviewees to see new messages from peers and the professor posted on the class platform. Strategies such as using notifications helped students remain socially engaged to better exchange ideas and interact for competing class activities.

### **Theme 3: Using Mobile devices Improves Motivation Through Greater Engagement**

This theme builds on the previous two themes to capture how students' mobile device use in the classroom impacts their engagement and motivation. Using mobile devices in class provided interviewees multiple benefits. Interviewees who used their mobile devices, especially smartphones, felt an improvement in their level of motivation to do well in class through enhanced intellectual and behavioral engagement. Although students did not have much experience using mobile devices in class, mobile device integration allowed instructors to provide feedback more quickly to students, and interviewees reported wanting more information about course topics than instructors had time to cover in class meetings. Interviewees also believed they were being more respectful by using a smartphone to search for a term or concept because they did not have to interrupt the class. My finding supports the research of Wang et al. (2009), who found that keeping a smartphone, or another mobile device, nearby helped students search for relevant information to understand lectures better, which was especially the case for international students for whom English was not their first language.

Interviewees also used their mobile devices to record lectures, which improved their ability to remain engaged in the class by returning to and reviewing lectures as necessary. Additionally, when the professor put up notes or went too fast to adequately explain the material, students found it helpful to take a screenshot. Mobile devices made it easy record lecture information, either by audio recording or by screenshots, helping interviewees stay engaged with course material. My findings for Theme 3 support the research of Loveless (2010), who found that mobile devices can facilitate learner-centered pedagogies to enhance learning engagement.

Using mobile devices in class provided interviewees multiple benefits, including convenient and easy access to lectures and course information, as well as enhanced communication and interaction among peers and in study groups. Researchers have also found that there are some drawbacks to the use of mobile devices in the classroom, which includes them being distractions for students (Kay et al., 2017; Klaric et al., 2019). Interviewees in the present research, however, used the word *control* to describe their behavior, or desired behavior, when using mobile devices in the classroom. Overall, interviewees were able to make the most of their smartphones and mobile devices in the classroom when they controlled their behavior and did not allow mobile devices to be distractions.

In early 1990s, mobile devices such smart phones were considered a nuisance and a distraction in the classroom, largely because of technological novelty and the reduced functionality of early mobile devices (Loveless, 2010), especially when compared to the present mobile devices of 2021. Distractions now come from notifications and contacts from sources not related to classroom use, including social networking, family members, and friends. My findings support the concerns of Kuznekoff and Titsworth (2013) who warned that personal mobile devices in the classroom can be a distraction to learning if they are not used for structured class-related activities. My findings confirm that while mobile devices can help improve learning in the classroom, they can also introduce distractions to learning, which should be guarded against (Kay et al., 2017; Klaric et al., 2019; Kuznekoff et al., 2013).

### **Limitation of the Study**

The results of the research should be interpreted with the following limitations in mind. Because the research approach was qualitative, data were collected from a small sample and at a

single state university setting, a medium-sized university located in central Minnesota. For these reasons, the results are not expected to generalize well to the larger target population. However, this is a common limitation of qualitative IPA research with low samples sizes designed to obtain in-depth information that quantitative studies with large sample sizes cannot provide. For qualitative studies, greater depth provides more information for other researchers to assess trustworthiness, which includes whether the research could be applied to other contexts. Trustworthiness involves the degree of confidence in data, interpretation, and methods used to ensure quality of research (Polit & Beck, 2004). Although, generalizability of findings is not the goal of qualitative research (Lincoln & Guba, 2006), trustworthiness was enhanced in the present research by providing a detailed account about where the interviews took place, when interviewees were interviewed, and the research setting.

Although the research involved subjective phenomenological accounts of interviewees' perceptions, steps were taken to achieve trustworthiness, including member checking and audit trails. Additionally, because of Covid-19 guidelines, I conducted interviews using Zoom, which may have influenced interviewer-interviewee rapport. Non-verbal cues are more easily recognized in face-to-face interviews. Not being fully physically present also may have limited interviewees willingness to talk freely.

### **Implications for Theory**

For the research's theoretical foundation, I used engagement theory, which holds that students' learning is enhanced when they connect with learning activities through interactions with peers and through meaningful tasks (Kearsley & Shneiderman, 1998). Student engagement includes three components: intellectual engagement, social engagement, and behavioral



engagement. Technology and personal mobile devices can facilitate intellectual engagement and learning through customization and personalization (Hsieh & Chen, 2016). Social engagement in learning environments includes communication with teachers and participation in learning communities, study groups, and collaborative projects (Martin, 2011). The use of mobile devices also gives students opportunities to make their voices heard in real time, and technology has changed students' learning behavior so that they feel more engaged and, thus, may be less likely to display undesirable behavior (Wang et al., 2009).

Theme 1 supports the intellectual engagement component of the theory of engagement. Using mobile devices in class provided interviewees multiple benefits, including accessing and reviewing lectures for exams at their convenience, keeping track of assignments and grades, and searching for unfamiliar words and concepts without interrupting the class. Students perceived this enhanced their intellectual engagement and, thus, motivation because mobile devices helped them navigate the class and understand course content. A potential drawback is that mobile devices can become a distraction in class and diminish students' intellectual engagement. However, when interviewees used mobile devices to enhance their learning, they reported better learning experiences.

Theme 2 supports the social engagement component of the theory of engagement. Social interaction and communication between classmates for course purposes improved through the use of mobile devices, contributing to increased social engagement. Students reported using mobile devices to stay in contact with classmates regarding class projects and group work. Mobile devices also helped students communicate with the professor about assignments and course work, furthering social engagement.

Theme 3 supported overall engagement leading to increased motivation; however, behavioral engagement seemed to be lacking. Interviewees who used mobile devices in the classroom felt engaged in class activities and, therefore, more motivated. Interviewees also reported controlling their behavior when using mobile devices in the classroom. Interviewees made the most of their smartphones and mobile devices in the classroom when they controlled their behavior and did not allow mobile devices to be distractions. Goh et al. (2015) and Kanthawongsa and Kanthawongs (2013) argued that behavioral issues and behavioral engagement may not be as important to college students as they are for younger and less mature K-12 students. My findings and the research of Goh et al. (2015) and Kanthawongsa and Kanthawongs (2013) suggested there may be a more appropriate component than behavioral engagement for college student engagement models.

The implication for the theory of engagement is that the behavioral component of the theory may not apply to college students, like it does for K-12 students. This implication means that the engagement theory may need to be modified for college students regarding technology use. So, researchers need to rethink that component of the theory (behavioral engagement) and look for other constructs and components to modify or replace behavioral engagement in the theory regarding technology use for college students.

Methods for avoiding the distractions of mobile devices in the classroom may be more salient components of engagement models for college students than the behavioral engagement component. While conforming to classroom behavioral norms is important for K-12 students (Trowler, 2010), college classroom behavioral norms may not apply to the same extent to older and more mature college students. Additionally, college students pay to attend college courses

and attend by choice, which may also help motivate students and reduce behavioral classroom issues that can hamper learning. My findings confirm that mobile devices can introduce distractions to learning (Kay et al., 2017; Klaric et al., 2019; Kuznekoff et al., 2013), suggesting rethinking and adapting engagement theories and models for college, especially regarding the use of mobile devices in the college classroom.

Researchers have forwarded concepts related to technological distractions that may be salient for engagement at the college level, including cyberslacking (Flanigan & Kiewra, 2017) and technological misuse (Ober et al., 2020). Cyberslacking and technological misuse include users spending time using the internet at work for reasons that are not related to the job. College students are passionate users of technology (Flanigan & Kiewra, 2017) and can likewise be tempted to use the internet in class in ways not related to education and learning activities. Texting, for example, remains a persistent and major misuse of technology and distraction in class for college students (Kornhauser et al., 2016; McCoy, 2016). In a semester-long research, Pettijohn et al. (2015) found between 70% to 90% of college students consistently texted in class during the semester and that nearly 12 text messages were sent per class. Behavioral engagement refers to students being involved in learning to the extent that they comply with behavioral norms, such as regular attendance and participation (Trowler, 2010). However, the ease of personal mobile device use in the classroom in addition to broad access to an array of information and communication options requires special consideration for how college students engage and participate in the college classroom.

## **Recommendations for Further Research**

The following recommendation for further research stem from the research findings and limitations. Although Zoom interviews were necessary and convenient, I nonetheless recommend the research be replicated using semi-structured in-person interviews, which will allow for a deeper rapport between interviewers and interviewees, perhaps yielding more information on the topic. Research on instructors' perceptions of mobile device use in the classroom is also recommended; investigating only student perceptions may not be sufficient to understand the topic comprehensively. Collecting and analyzing administrator and educator perceptions, for example, can add information from stakeholders who set policy and develop course material.

Additionally, research is recommended on the use of applications for students to directly communicate with one another and instructors, as well as accessing class material in course-relevant and non-distractive ways. Based on my findings, I also recommend exploring the use mobile devices in class specifically for international students. International students not fluent in English and English-based idioms and expressions can easily misunderstand course material and class directions, which can lead to disengagement and negative academic outcomes.

Theoretical research is also recommended on behavioral control and identifying a more suited component than behavioral engagement for college student engagement models because behavioral engagement may not be as relevant to college students as it is to K-12 students. For example, I recommend exploration of the constructs of cyberslacking (Flanigan & Kiewra, 2017) and technological misuse (Ober et al., 2020) in relation to behavior control and destruction.

Researchers have identified texting as a form of technological misuse in class (Kornhauser et al.,

2016; McCoy, 2016; Pettijohn et al., 2015). Researchers might conduct additional qualitative studies with students to explore and identify other misuses of technology in the classroom.

Additionally, quantitative research that surveys administrator, educator, and student perceptions is recommended to confirm the connections between intellectual engagement and enhanced learning, as well as between social engagement and enhanced learning. Quantitative confirmation of the relationship between these factors would help to support those components of the engagement model for research on college students using personal mobile devices in class. I recommend exploring degrees of technology integration into pedagogy in various institutional contexts, including different types of colleges, or college programs, and with different student populations. Higher education institutions likely have differing policies and practices about the use of personal mobile devices in the classroom. Looking deeper into demographics trends, I also suggest comparing the use of personal mobile devices in college classrooms by Millennials, Baby Boomers, and Generation Z, who have differing attitudes toward technology. In addition, I recommend studying mobile device use in the college classroom in relation to different racial and ethnic minorities, which may reveal socioeconomic disparities in mobile device access and usage.

### **Practical Implications**

Better understanding student experiences using mobile devices in the college classroom can improve educational instructions. Based on my analysis I suggest that administrators, instructors, and curricula designers should consider and explore incorporating the use of mobile devices into some college classes. I further propose, however, exploring methods to use mobile devices in the classroom voluntarily and not as a change in policy. Technology use should be

driven by research and sound pedagogy to inform adoption of novel technologies; therefore, the use of mobile devices should not be required but encouraged as a valuable option and a potentially useful educational tool.

Various types of mobile devices, including smart phones, smart glasses, smart watches, and smart bracelets, are increasingly becoming pervasive of instructors' and students' lives; it is crucial that pedagogical practice keep pace with the benefits and challenges such innovations present. Training is also recommended to help instructors to effectively include mobile devices into their classes, as well as on how to prevent students from being distracted from course work by their mobile devices. The inclusion of technology into colleges courses does not automatically enhance learning; therefore, it is important that instructors be trained and prepared to use mobile devices to enhance students' learning engagement.

A practical recommendation I suggest includes preparing and distributing clear guidelines for students and instructors on what constitutes recommended or acceptable uses of mobile device in the classroom. I recommend developing in-class presentations or training modules to instruct students and instructors how to use mobile technology in the classroom effectively and acceptably. We cannot assume college students and college instructors know best practices already. Mobile device use training will need to be adapted to the evolving capabilities of mobile devices.

## **Conclusions**

This interpretative phenomenological research offered in-depth accounts of students' experiences using mobile devices in the classroom and how it influenced their engagement. The research provided insight into Minnesota state university students' perceptions about their

learning engagement using mobile devices in computer science classes. Interviewees' responses were positive about working in study groups, and students liked the increased communication and interaction between classmates and instructors. Interviewees highlighted distraction such as mobile device notifications as a liability of using mobile devices in classrooms and suggested applications that temporally stop distracting, non-relevant notifications, so students can fully focus on and interact with class material.

This research contributes to previous research that mobile device can enhance engagement and learning in college classrooms when used appropriately. Mobile devices can help enhance intellectual and social engagement. The use of mobile devices in the classroom allowed students to access course content, search for and locate course-relevant material, communicate with instructors, and communicate with classmates for study groups and for class project collaboration. Mobile devices can help enhance student engagement and, with appropriate use, can help facilitate improvements to students' learning experiences.

## References

- ADL. (n.d.). Mobile learning overview. *Advanced Distributed Learning Initiative*. <https://adlnet.gov/projects/mobile-learning-overview/>
- Aljaad, N. H. M. (2016). The role of social communication tools in education from the Saudi female students' perceptions. *International Education Studies*, 9(8), 194. <https://doi.org/10.5539/ies.v9n8p194>
- American Association for the Advancement of Science. (2015). *Vision and change in undergraduate biology education: Chronicling change, inspiring the future*. Author. [http://visionandchange.org/files/2015/07/VISchange2015\\_webFin.pdf](http://visionandchange.org/files/2015/07/VISchange2015_webFin.pdf)
- Barneva, R. P., Kanev, K., Kapralos, B., Jenkin, M., & Brimkov, B. (2017). Integrating technology-enhanced collaborative surfaces and gamification for the next generation classroom. *Journal of Educational Technology Systems*, 45(3), 309-325. <https://doi.org/10.1177/0047239516671945>
- Bart, M. (2010). Nine ways to customize learning experiences Faculty focus. *Magna*. <https://www.facultyfocus.com/articles/course-design-ideas/nine-ways-to-customize-learning-experiences/>
- Bernacki, M. L., Crompton, H., & Greene, J. A. (2020). Towards convergence of mobile and psychological theories of learning. *Contemporary Educational Psychology*, 60, 101828. <https://doi.org/10.1016/j.cedpsych.2019.101828>
- Brandão, C. (2014). P. Bazeley and K. Jackson, *Qualitative data analysis with NVivo* (2<sup>nd</sup> ed.) (Book Review). *Qualitative Research in Psychology*, 12(4), 492-494. <https://doi.org/10.1080/14780887.2014.992750>



- Brocki, J. M., & Wearden, A. J. (2006). A critical evaluation of the use of interpretative phenomenological analysis (IPA) in health psychology. *Psychology & Health, 21*(1), 87-108. <https://doi.org/10.1080/14768320500230185>
- Carnevale, A., Smith, N., Melton, M., & Price, E. (2015). *Learning while earning: The new normal*. Georgetown University, Center on Education and the Workforce.
- Carter, J., O'Grady, M., & Rosen, C. (2018). *Higher education computer science: A manual of practical approaches*. Springer.
- Chen, B., & deNoyelles, A. (2013). Exploring students' mobile learning practices in higher education. *Educause, 7*(1), 36-43.
- Chen, S., & Macredie, R. (2010). Web based interaction: A review of three important human factors. *International Journal of Information Management, 30*, 379-387. <https://doi.org/10.1016/j.ijinfomgt.2010.02.009>
- Coates, H. (2007). A model of online and general campus-based student engagement. *Assessment & Evaluation in Higher Education, 32*(2), 121-141. <https://doi.org/10.1080/02602930600801878>
- Connelly, L. (2016). Trustworthiness in qualitative research. *MedSurg Nursing, 25*(6), 435-436.
- Conrad, P. (1987). The experience of illness. *Social Science & Medicine, 24*(8), 700-701. [https://doi.org/10.1016/0277-9536\(87\)90320-0](https://doi.org/10.1016/0277-9536(87)90320-0)
- Corbin, J., & Strauss, A. (2008). *Basics of qualitative research: Techniques and procedures for developing grounded theory* (3<sup>rd</sup> ed.). Sage Publications, Inc.
- Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five traditions*. Sage.

- Crompton, H. (2014). A diachronic overview of mobile learning: A shift toward student-centered pedagogies. In M. Ali & A. Tsinakos (Eds.), *Increasing access through mobile learning*. British Columbia, Canada: Commonwealth of Learning Press and Athabasca University. [https://digitalcommons.odu.edu/teachinglearning\\_fac\\_pubs/72](https://digitalcommons.odu.edu/teachinglearning_fac_pubs/72)
- DeJonckheere, M., & Vaughn, L. M. (2019). Semistructured interviewing in primary care research: A balance of relationship and rigour. *Family Medicine and Community Health*, 7(2), e000057. <https://doi.org/10.1136/fmch-2018-000057>
- De-Marcos, L., Hilleary, J. R., Barchino, R., Jiménez, L., Martínez, J. J., Gutiérrez, J. A., ... Otón, S. (2010). An experiment for improving students' performance in secondary and tertiary education by means of m-learning auto-assessment. *Computers & Education*, 55(3), 1069-1079. <https://doi.org/10.1016/j.compedu.2010.05.003>
- Dias, L., & Victor, A. (2017). Teaching and learning with mobile devices in the 21st century digital world: Benefits and challenges. *European Journal of Multidisciplinary Studies*, 5(1), 339-344. <https://doi.org/10.26417/ejms.v5i1.p339-344>
- Dichev, C., & Dicheva, D. (2017). Gamifying education: What is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education*, 14(1). <https://doi.org/10.1186/s41239-017-0042-5>
- Ferrari, A., Punie, Y., & Redecker, C. (2012). Understanding digital competence in the 21st century: An analysis of current frameworks. *21st Century Learning for 21st Century Skills*, 1(1), 79-92.
- Flanigan, A. E., & Kiewra, K. A. (2017). What college instructors can do about student cyber-slacking. *Educational Psychology Review*, 30(2), 585-597.

- Fredricks, J. A. (2014). *The eight myths of student disengagement: Creating classrooms of deep learning*. Corwin Press.
- Fu, A. C., Kannan, A., & Shavelson, R. J. (2019). Direct and unobtrusive measures of informal stem education outcomes. *New Directions for Evaluation*, 2019(161), 35-57.  
<https://doi.org/10.1002/ev.20348>
- Gezgin, D. M., Adnan, M., & Guvendir, M. (2018). Mobile learning according to students of computer engineering and computer education: A comparison of attitudes. *Turkish Online Journal of Distance Education*, 19(1), 4-17. <https://doi.org/10.17718/tojde.382653>
- Gikas, J., & Grant, M. M. (2013). Mobile computing devices in higher education: Student perspectives on learning with cellphones, smart phones and social media. *The Internet and Higher Education*, 19(19), 18-26. <https://doi.org/10.1016/j.iheduc.2013.06.002>
- Giousmpasoglou, C., & Marinakou, E. (2013). The future is here: M-learning in higher education. *2013 Fourth International Conference on E-Learning "Best Practices in Management, Design and Development of e-Courses: Standards of Excellence and Creativity"* (pp. 417-420). <https://doi.org/10.1109/econf.2013.35>
- Goh, W., Bay, S., & Chen, V. (2015). Young school children's use of digital devices and parental rules. *Telematics and Informatics*, 32(2015), 787-795.
- Golonka, E. M., Bowles, A. R., Frank, V. M., Richardson, D. L., & Freynik, S. (2014). Technologies for foreign language learning: a review of technology types and their effectiveness. *Computer Assisted Language Learning*, 27(1), 70-105.  
<https://doi.org/10.1080/09588221.2012.700315>

- Graham, C., & Gillies, M. (2016). To BYOD or not to BYOD: Factors affecting academic acceptance of student mobile devices in the classroom. *Research in Learning Technology*, 24(1), 30357. <https://doi.org/10.3402/rlt.v24.30357>
- Graham, E. (2019). *Using smartphones in the classroom*. National Education Association. <http://www.nea.org/tools/56274.htm>
- Guba, E. G., Lincoln, Y. S., Denzin, N. K., & Lincoln, Y. S. (1994). Chapter 6: Competing paradigms in qualitative research. In *Handbook of qualitative research* (pp. 105-117). Sage Publications.
- Hargis, J., & Cavanaugh, C. (2015). A one-year federal mobile learning initiative review. *Encyclopedia of Information Science and Technology*, pp. 5826-5834. <https://doi.org/10.4018/978-1-4666-5888-2.ch576>
- Harrell, M. C., & Bradley, M. A. (2009). *Data collection methods: Semi-structured interviews and focus groups*. RAND Corporation. [https://www.rand.org/pubs/technical\\_reports/TR718.html](https://www.rand.org/pubs/technical_reports/TR718.html)
- Heflin, H., Shewmaker, J., & Nguyen, J. (2017). Impact of mobile technology on student attitudes, engagement, and learning. *Computers & Education*, 107(2017), 91-99. <https://doi.org/10.1016/j.compedu.2017.01.006>
- Heick, T. (2017). The definition of mobile learning. *Teach Thought*. <https://www.teachthought.com/the-future-of-learning/a-definition-for-mobile-learning/>
- Hsieh, C.-W., & Chen, S. Y. (2016). A cognitive style perspective to handheld devices: Customization vs. personalization. *The International Review of Research in Open and Distributed Learning*, 17(1). <https://doi.org/10.19173/irrodl.v17i1.2168>

- Hu, P. J.-H., Hui, W., Clark, T. H. K., & Tam, K. Y. (2007). Technology-assisted learning and learning style: A longitudinal field experiment. *IEEE Transactions on Systems, Man, and Cybernetics-Part A: Systems and Humans*, 37(6), 1099-1112. <https://doi.org/10.1109/tsmca.2007.904741>
- Hudson, M. (2014). What is social media? *The Balance Small Business*. <https://www.thebalancesmb.com/what-is-social-media-2890301>
- Hwang, G.-J., Wu, P.-H., & Ke, H.-R. (2011). An interactive concept map approach to supporting mobile learning activities for natural science courses. *Computers & Education*, 57(4), 2272-2280. <https://doi.org/10.1016/j.compedu.2011.06.011>
- Ibáñez, M.-B., Di-Serio, A., & Delgado-Kloos, C. (2014). Gamification for engaging computer science students in learning activities: A case study. *IEEE Transactions on Learning Technologies*, 7(3), 291-301.
- Isman, A., Abanmy, F. A., Hussein, H. B., & Saadany, M. A. A. (2012). Using blended learning in developing student teachers teaching skills. *Turkish Online Journal of Educational Technology*, 11(4), 336-345. <https://www.learntechlib.org/p/55705/>
- Johnson, D. W., & Johnson, R. T. (1989). *Cooperation and competition: Theory and research*. Interaction Book Company.
- Johnson, L., Adams, S., & Haywood, K. (2011). *NMC horizon report: 2011 K-12 Edition*. The New Media Consortium. <https://www.learntechlib.org/p/182017/>
- Jones, R., & Thomas, L. (2012). *Promoting social engagement Improving STEM student transition, retention, and success in higher education*. The National HE STEM Programme.

- Jones, S. J., Crandall, J., Vogler, J. S., & Robinson, D. H. (2013). Classroom response systems facilitate student accountability, readiness, and learning. *Journal of Educational Computing Research*, 49(2), 155-171. <https://doi.org/10.2190/ec.49.2.b>
- Kanthawongsa, P., & Kanthawongs, P. (2013). Perception of primary school students, parents and teachers toward the use of computers, the internet and social networking sites. *Procedia-Social and Behavioral Sciences*, 88, 282-290.
- Kay, R., Benzimra, D., & Li, J. (2017). Exploring factors that influence technology-based distractions in bring your own device classrooms. *Journal of Educational Computing Research*, 55(7), 974-995. <https://doi.org/10.1177/0735633117690004>
- Kearsley, G., & Shneiderman, B. (1998). Engagement theory: A framework for technology-based teaching and learning. *Educational Technology*, 38(5), 20-23. JSTOR. [www.jstor.org/stable/44428478](http://www.jstor.org/stable/44428478)
- Kennedy, D. (2014). M-learning to support learning English in a Hong Kong University. *MERLOT Journal of Online Learning and Teaching*, 10(4), 640-653.
- Kim, H., Lee, M., & Kim, M. (2014). Effects of mobile instant messaging on collaborative learning processes and outcomes: The case of South Korea. *Journal of Educational Technology & Society*, 17(2), 31-42. JSTOR. [www.jstor.org/stable/jeductechsoci.17.2.31](http://www.jstor.org/stable/jeductechsoci.17.2.31)
- Klaric, S., Hadziahmetovic, H., Novoselovic, D., & Havrlisan, S. (2019). Implementation and comparative analysis of mobile phone application for learning and teaching in mechanical engineering education. *Tehnicki Vjesnik-Technical Gazette*, 26(4). <https://doi.org/10.17559/tv-20180920024253>

- Kornhauser, Z., Paul, A. L., & Siedlecki, K. L. (2016). An examination of students' use of technology for non-academic purposes in the college classroom. *Journal of Teaching and Learning with Technology* 5(1), 1-15. <https://doi.org/10.14434/jotlt.v5n1.13781>
- Kriegel, J. (2013). *Differences in learning preferences by generational cohort: Implications for instructional design in corporate web-based learning a dissertation*. Drexel University. <http://hdl.handle.net/1860/4100>
- Kuh, G. D. (2009). What student affairs professionals need to know about student engagement. *Journal of College Student Development*, 50(6), 683-706. <https://doi.org/10.1353/csd.0.0099>
- Kuznekoff, J. H., & Titsworth, S. (2013). The impact of mobile phone usage on student learning. *Communication Education*, 62(3), 233-252. <https://doi.org/10.1080/03634523.2013.767917>
- Kvavik, R., Caruso, J., & Morgan, G. (2005). ECAR study of students and information technology, 2004: Convenience, connection, and control. *EDUCAUSE*. <https://library.educause.edu/resources/2004/10/ecar-study-of-students-and-information-technology-2004-convenience-connection-and-control>.
- Larkin, M., & Thompson, A. (2011). *Interpretative phenomenological analysis* (pp. 9-116). Wiley & Sons.
- Larkin, M., Watts, S., & Clifton, E. (2006). Giving voice and making sense in Interpretative Phenomenological Analysis. *Qualitative Research in Psychology*, 3, 102-120. <https://doi.org/10.1191/1478088706qp062oa>

- Laskaris, J. (2019, March 15). The 7 awesome benefits of mobile learning for learners. *Talent, LMS Blog*. <https://www.talentlms.com/blog/7-awesome-mlearning-benefits/>
- Lawson, S., French, E., Summers, J., Kinash, L., Taylor, T., Herbert, J., . . . Hall, C. (2014). The practice of quality in assuring learning in higher education. *Quality in Higher Education*, 20(1), 24-43. <https://doi.org/10.1080/13538322.2014.889432>
- Lieberman, M. (2019). Students are using mobile even if you aren't. *Inside Higher Ed*. <https://www.insidehighered.com/digital-learning/article/2019/02/27/mobile-devices-transform-classroom-experiences-and>
- Lincoln, Y. S., & Guba, E. G. (2006). *Naturalistic inquiry*. Newbury Park.
- Loveless, B. (2010). *Using cell phones as learning tools (Complete Guide)*. Educationcorner.Com. <https://www.educationcorner.com/cell-phones-learning-tools.html>
- Loveless, T. (2015). *How well are American students learning*. The Brookings Institution. [https://www.brookings.edu/wp-content/uploads/2016/06/2015-Brown-Center-Report\\_FINAL-3.pdf](https://www.brookings.edu/wp-content/uploads/2016/06/2015-Brown-Center-Report_FINAL-3.pdf)
- Martin, R. (2011). *M-learning and student engagement: Factors that support students' engagement in m-learning* (Unpublished doctoral dissertation). Murdoch University, Australia.
- Matsumoto, D., Hysisung, C., & Sandoval, V. (2015). The funneling approach to questioning and eliciting information. *Tactics & Preparedness, January 2015*, p. 7. <http://davidmatsumoto.com/content/TPjan15-info-mat-hwa-sand%201.pdf>



- McConnel, J. (2018). Why are we doing this? Using digital reflection to increase student engagement. *Ubiquitous Learning: An International Journal*, 11(2), 13-22.  
<https://doi.org/10.18848/1835-9795/cgp/v11i02/13-22>
- McCoy, B. (2016). Digital distractions in the classroom phase II: Student classroom use of digital devices for non-class related purposes. *Faculty Publications, College of Journalism and Mass Communications*, 90. <http://digitalcommons.unl.edu/journalismfacpub/9>
- McKenzie, L. (2018). Smartphones for all students: An academic equalizer in an era of income inequality? *Inside Higher Ed*, 12. <https://www.insidehighered.com/news/2018/12/05/college-profs-say-smartphones-can-help-low-income-students-have-academic-success>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and information*. Wiley and Sons.
- Morse, J. M. (1994). Designing funded qualitative research. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2<sup>nd</sup> ed., pp. 220-235). Sage Publishing.
- Morsy, L., & Rothstein, R. (2019). Toxic stress and children's outcomes. *Economic Policy Institute*. <https://www.epi.org/publication/toxic-stress-and-childrens-outcomes-african-american-children-growing-up-poor-are-at-greater-risk-of-disrupted-physiological-functioning-and-depressed-academic-achievement/>
- Murphy, M., Redding, S., Twyman, J., & Learning, I. (2016). *Handbook on personalized learning for states, districts, and schools*. Information Age Publishing, Inc.

- Ober, T. M., Brodsky, J. E., Yannaco, F. D., & Brooks, P. J. (2020). College instructors' and students' views of the use (and misuse) of personal mobile devices. *Scholarship of Teaching and Learning in Psychology*. <https://doi.org/10.1037/stl0000214>
- Papas, C. (2019). How to leverage a mobile learning strategy to increase learner engagement. *E Learning Industry*. <https://elearningindustry.com/how-leverage-mobile-learning-strategy-increase-learner-engagement-free-ebook>
- Pearson. (2015). *Pearson student mobile device survey 2015 national report: College students*. <https://www.pearsoned.com/wp-content/uploads/2015-Pearson-Student-Mobile-Device-Survey-College.pdf>
- Pettijohn, T., Frazier, E., Rieser, E., Vaughn, N., & Hupp-Wilds, B. (2015). Classroom texting in college students. *College Student Journal*, *49*, 513-516.
- Pietkiewicz, I., & Smith, J. (2014). A practical guide to using interpretative phenomenological analysis in qualitative research psychology. *Czasopismo Psychologiczne Psychological Journal*, *20*(1). <https://doi.org/10.14691/cppj.20.1.7>
- Polit, D. F., & Beck, C. (2004). *Nursing research: principles and methods*. Lippincott Williams & Wilkins.
- Pringle, J., Hendry, C., & McLafferty, E. (2011). Phenomenological approaches: Challenges and choices. *Nurse Researcher*, *18*(2), 7-18. <https://doi.org/10.7748/nr2011.01.18.2.7.c8280>
- Richards, L., & Morse, J. M. (2013). *Readme first for a user's guide to qualitative methods* (3<sup>rd</sup> ed.). Sage.
- Rogers, E. M. (2003). Diffusion of preventive innovations. *Addictive Behaviors*, *27*(6), 989-993. [https://doi.org/10.1016/s0306-4603\(02\)00300-3](https://doi.org/10.1016/s0306-4603(02)00300-3)

- Rowan, A. (2019). 6 essential elements of a successful mobile learning strategy. *E Learning Industry*. <https://elearningindustry.com/mobile-learning-strategy-6-essential-elements-successful>
- Russell, D. (2018). Mobile phones in the classroom: What does the research say? *Teacher*, 4. <https://www.teachermagazine.com.au/articles/mobile-phones-in-the-classroom-what-does-the-research-say>
- Sad, N., & Akdag, M. (2010). Comparison of oral performance homework produced with mobile phones in English lesson with written performance homework. *Türk Eğitim Bilimleri Dergisi*, 8(3), 719-740.
- Safar, A. H. (2018). BYOD in higher education: A case study of Kuwait University. *Journal of Educators Online*, 15(2). <https://doi.org/10.9743/jeo.2018.15.2.9>
- Sandberg, J., Maris, M., & de Geus, K. (2011). Mobile English learning: An evidence-based study with fifth graders. *Computers & Education*, 57(1), 1334-1347. <https://doi.org/10.1016/j.compedu.2011.01.015>
- Sandelowski, M. (2000). Whatever happened to qualitative description? *Research in Nursing & Health*, 23(4), 334-340. [https://doi.org/10.1002/1098-240x\(200008\)23:4<334:aid-nur9>3.0.co;2-g](https://doi.org/10.1002/1098-240x(200008)23:4<334:aid-nur9>3.0.co;2-g)
- Sarrab, M., Alzahrani, A., Alwan, N. A., & Alfarraj, O. (2014). From traditional learning into mobile learning in education at the university level: undergraduate students' perspective. *International Journal of Mobile Learning and Organization*, 8(3/4), 167. <https://doi.org/10.1504/ijmlo.2014.067014>

- Sarrab, M., Elgamel, L., & Aldabbas, H. (2012). Mobile learning (M-Learning) and educational environments. *International Journal of Distributed & Parallel Systems*, 3, 31-38.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., . . . Jinks, C. (2017). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality & Quantity*, 52(4), 1893-1907. <https://doi.org/10.1007/s11135-017-0574-8>
- Sefcik, M. (2013). Intellectual engagement, good grades and doing school. *Ed Canada Network*. <https://www.edcan.ca/articles/intellectual-engagement-good-grades-and-doing-school/>
- Sharples, M., Taylor, J., & Vavoula, G. (2005). Towards a theory of mobile learning. *Proceedings of MLearn*, 1. [https://www.researchgate.net/publication/228346088\\_Towards\\_a\\_theory\\_of\\_mobile\\_learning/link/0912f50d101578027e000000/download](https://www.researchgate.net/publication/228346088_Towards_a_theory_of_mobile_learning/link/0912f50d101578027e000000/download)
- Shneiderman, B. (1994). *Education by engagement and construction: Can distance education be better than face-to-face?* <http://www.hitl.washington.edu/scivw/EVE/distance.htm> 127  
October 20031
- Shneiderman, B. (1998). Relate-create-donate an educational philosophy for cyber-generation. *Computers and Education*, 31(1), 25-39.
- Siddiq, F., Scherer, R., & Tondeur, J. (2016). Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education. *Computers & Education*, 92-93(1), 1-14. <https://doi.org/10.1016/j.compedu.2015.10.006>
- Slavin, R. (1991). *Student team learning: A practical guide to cooperative learning* (3<sup>rd</sup> ed.). <https://eric.ed.gov/?id=ED339518>

- Smith, J. (2004). Reflecting on the development of interpretative phenomenological analysis and its contribution to qualitative research in psychology. *Qualitative Research in Psychology, 1*(1), 39-54.
- Smith, J., & Osborn, M. (2003). Interpretative phenomenological analysis. In J. A. Smith (Ed.), *Qualitative psychology: A practical guide to method* (pp. 53-80). Sage Publications.
- Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method, and research*. Sage Publications.
- Smyth, R. (2011). Enhancing learner-learner interaction using video communications in higher education: Implications from theorizing about a new model. *British Journal of Educational Technology, 42*(1), 113-127. <https://doi.org/10.1111/j.1467-8535.2009.00990.x>
- Strømsø, H., & Bråten, I. (2014). Students' sourcing while reading and writing from multiple web documents. *Nordic Journal of Digital Literacy, 9*(2), 92-111.
- Sung, Y., Chang, K., & Liu, T. (2015). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers and Education, 94*. <https://doi.org/10.1016/j.compedu.2015.11.008>
- Sung, Y.-T., Yang, J.-M., & Lee, H.-Y. (2017). The effects of mobile-computer-supported collaborative learning: Meta-analysis and critical synthesis. *Review of Educational Research, 87*(4), 768-805. <https://doi.org/10.3102/0034654317704307>
- Tan, G. W.-H., Ooi, K.-B., Leong, L.-Y., & Lin, B. (2014). Predicting the drivers of behavioral intention to use mobile learning: A hybrid SEM-Neural Networks approach. *Computers in Human Behavior, 36*(c), 198-213. <https://doi.org/10.1016/j.chb.2014.03.052>

- Thomas, K., & O'Bannon, B. (2013). Cell phones in the classroom. *Journal of Digital Learning in Teacher Education*, 30(1), 11-20. <https://doi.org/10.1080/21532974.2013.10784721>
- Thomas, S. (2020). Student's evaluation of a classroom bring-your-own-device (BYOD) Policy. *The JALT CALL Journal*, 16(1), 29-49. <https://doi.org/10.29140/jaltcall.v16n1.208>
- Tornwall, J., Lu, L., & Xie, K. (2020). Frequency of participation in student response system activities as a predictor of final grade: An observational study. *Nurse Education Today*, 87(6), 104342. <https://doi.org/10.1016/j.nedt.2020.104342>
- Traxler, J., Cornelius, S., Gaved, M., Gemmell, A., Marston, P., Scanlon, E., ... Martin, S. (2011). Making mobile learning work: Case studies of practice. *Advance Learning and Teaching in Education*, 4-12. [https://www.researchgate.net/publication/279693158\\_Making\\_mobile\\_learning\\_work\\_case\\_studies\\_of\\_practice](https://www.researchgate.net/publication/279693158_Making_mobile_learning_work_case_studies_of_practice)
- Trowler, V. (2010). Student engagement literature review. *Department of Education Lancaster University*. [https://www.researchgate.net/publication/322342119\\_Student\\_Engagement\\_Literature\\_Review](https://www.researchgate.net/publication/322342119_Student_Engagement_Literature_Review)
- Walker, P. (2008). What do students think they (should) learn at college? Student perceptions of essential learning outcomes. *Journal of the Scholarship of Teaching and Learning*, 8(1), 45-60.
- Wang, M., Shen, R., Novak, D., & Pan, X. (2009). The impact of mobile learning on students' learning behaviours and performance: Report from a large blended classroom. *British Journal of Educational Technology*, 40(4), 673-695. <https://doi.org/10.1111/j.14678535.2008.00846.x>

- West, D. (2013). *Mobile learning: Transforming education, engaging students, and improving outcomes*. Brookings Center for Technology Innovation. <https://www.brookings.edu/research/mobile-learning-transforming-education-engaging-students-and-improving-outcomes/>
- Willig, C. (2013). *Introducing qualitative research in psychology*. McGraw Hill Education, Open University Press.
- Willms, J., Friesen, S., & Milton, P. (2009). *What did you do in school today? Transforming classrooms through social, academic, and intellectual engagement*. Canadian Education Association.
- Witecki, G., & Nonnecke, B. (2015). Engagement in digital lecture halls: A study of student course engagement and mobile device use during lecture. *Journal of Information Technology, 14*, 73-90. <http://www.jite.org/documents/Vol14/JITEv14ResearchP073-090Witecki0720.pdf>
- Wolf, M. (2010). Innovate to educate: System [re] design for personal learning. A report from the 2010 symposium. *Software and Information Industry Association*. <https://library.educause.edu/resources/2010/1/innovate-to-educate-system-redesign-for-personalized-learning-a-report-from-the-2010-symposium>
- Yin, R. K. (2014). *Case study research design and methods* (5<sup>th</sup> ed.). Sage Publishing. <https://doi.org/10.3138/cjpe.30.1.108>

## Appendix A: Interview Questions

### RESEARCH QUESTIONS:

1. What are students' perceptions of learning engagement through using mobile technology in a computer science class?
2. How do students believe their intellectual engagement in class is impacted by using mobile technology?
3. How do students believe their behavioral engagement in class is impacted by using mobile technology?
4. How do students believe their social engagement in class is impacted by using mobile technology?

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### INTERVIEW QUESTIONS:

1. Tell me about your educational history.
  - **PROBES:** Why did you chose computer science program?
2. Tell me about using smart phone or mobile device in your computer science class?
  - **PROBES:** Which class was it?
  - **PROBES:** What semester?
3. How have you used a mobile device-smart phone during the class?
  - **PROBES:** Was part of class activity or outside of class?
4. What do you like about using mobile devices - smart phone in the computer science classroom?
5. What do you dislike about mobile devices in the computer science classroom?



6. How do you think using mobile device affects your motivations?
  - **PROBES:** How do you see changes in actions you are taking during the class (behavioral)?
  - **PROBES:** Have you find doing class work more enjoyable and do you find that you notice change in positive feelings towards work in the class (social)?
  - **PROBES:** Have you notice that use of mobile devices-smart phones may improve or reduce amount of effort you need to invest to learn or retain material?
7. For your F2F or synchronous online classes, describe your experiences using your smartphone *during* your class period for class-related purposes.
8. For your F2F or synchronous online classes, describe your experiences using your smartphone *outside of* your class period for class-related purposes.
  - **PROBES:** For your asynchronous online classes, describe your experiences using your smartphone for class-related purposes?
9. What is your perception about amount of effort you need to invest to learn or retain material using mobile devices in the classroom?
10. Do you feel your actions in class has changed after using mobile devices in the classroom?
11. What is your perception about your actions in class (behavior)?
12. Do you feel your focus in class has changed after using mobile devices-smart phones in class?

13. Do you feel your social interaction with peers and teachers has changed after using mobile devices in class?
14. Is there anything else about your use of your smartphone for class that my previous questions didn't address?

## Appendix B: Recruitment Letter

October 20, 2020

16783 Oster Point Rd  
Cold Spring, MN 56320

Dear Student \_\_\_\_\_,

I am currently a doctoral student at St. Cloud State University, in the Higher Education Administration program. I am inviting you to participate in my dissertation research study about college student perceptions of their learning engagement using mobile devices in a computer science class.

Understanding the experiences of computer science students using mobile devices as tool in computer science class is valuable to university administrators, educators, and online content providers. Understanding experiences will also assist in providing students and educators to support online class development. Exploring the experiences of computer science students is also valuable for improving class material with engaging content. Learning from experiences will also provide understanding into career advancement, strategies used to conquer barriers, and plans of action used to design, develop, and present online material on mobile devices.

You will be asked to participate in one face-to-face interview or videoconference interview at a time that is convenient for you. The interview will take approximately 2 hours and will be audio recorded. The researcher will transcribe the interview and provide the transcribed interview to you for review and edit. The edited transcript will be considered the primary source of data for the study. All interviewees will be referred to by a pseudonym protect their identities.

If you are willing to participate in this study, or would like more information or clarification, please contact me in one of the following ways.

Email: [atomovic@stcloudstate.edu](mailto:atomovic@stcloudstate.edu)  
Phone: 320-685-7506

Thank you for considering participation in this study. I look forward to hearing from you.

Aleksandar Tomovic

**Appendix C: Screening Page**

- (1) are you majoring in Computer Science?
- (2) did you complete both gateway courses (CSCI301 & CSCI320)?
- (3) do you have smart phone?
- (4) have you used your smart phone in any way of your computer science courses for academic purpose?

## **Appendix D: Consent to Participate**

**Title:** College Student Perceptions of Their Learning Engagement Using Mobile Devices in A Computer Science Class  
**Primary Investigator:** Aleksandar Tomovic  
**Telephone:** 320-685-7506

### **WHAT IS THE PURPOSE OF THIS STUDY?**

You are invited to participate in a research study about Perceptions of Computer Science students. This dissertation research study is being conducted by Aleksandar Tomovic (researcher) from the Department of Educational Leadership and Higher Education at St. Cloud State University. The purpose of this study is to investigate the perceptions of current computer science students' perceptions of their learning engagement using mobile devices in computer science class.

### **WHAT ARE THE BENEFITS OF THIS STUDY?**

Understanding the experiences of computer science students using mobile devices as too in computer science class is valuable to university administrators, educators, and online content providers. Understanding experiences will also assist in providing students and educators to support online class development. Exploring the experiences of computer science students is also valuable for improving class material with engaging content. Learning from the experiences will also provide understanding into career advancement, strategies used to conquer barriers, and plans of action used to plan, develop, and present online material on mobile devices. Understanding and learning from the experiences will also add valuable insight to the other classes, as the lessons may be transferable.

### **HOW MANY PEOPLE WILL PARTICIPATE?**

To protect the identity of interviewees, all eight computer science students will be interviewed, but two interviews will not be included in the aggregated results or analysis. A random selection will include numbering each participant, putting those numbers in an envelope, and picking out two numbers (interviews) to exclude.

### **WHAT TO EXPECT DURING THE STUDY?**

During the study, you will be asked to review an informed consent document. This document outlines all the steps, benefits, and risks associated with the study. Once an agreement has been made to participate in the study, the consent form must be signed and submitted to the researcher. If you agree to participate in the study, you will be asked to schedule an in-person or Zoom interview. The interview will last approximately 2 hours and will be audio recorded. The in-person interview will take place at a location and time agreed to by the researcher and participant. The Zoom interview will be scheduled at an agreeable time for the researcher and participant. The interview protocol consists of 14 open-ended questions. You are free to decline to answer a particular question if you choose. Once the researcher transcribes the interview, you will have the opportunity to read and edit your interview transcript. The edited transcript will be considered the primary data source for the study.

**HOW WILL THE RISKS OF THE STUDY BE MINIMIZED?**

It is understood that eight computer science students will be interviewed. To protect the identity of interviewees, the study will consist of a maximum of 6 computer science students. All 8 computer science students will be interviewed, 6 will be randomly selected for inclusion in the study. Interviewees will not know if they were excluded or included. You will be referred to by pseudonym in the study, and you may decline to answer any question or withdraw from the study at any time.

**IS THE DATA COLLECTED CONFIDENTIAL?**

Data collected will remain confidential. Data will be reported and presented in aggregate (group) form or with no more than two descriptors presented together. Responses will be kept confidential; your name will not be disclosed with direct quotes, direct quotes will be used with a pseudonym. During the interview you may refuse to answer any question. After the completion of the interview, you will receive your transcript. At that point, if you wish to expand responses or note omissions to the transcription, you may do so.

**ARE MY RECORDS CONFIDENTIAL?**

The records associated with this study will be kept confidential. In any report about this study that may be published, or any presentation, you will only be identified by pseudonym. Confidentiality will be maintained by means of securely archiving the data on a computer that is password protected and paper documents will be locked in the researcher's home office. Names will not be used in the written documentation.

Participating in this study is entirely voluntary. Your decision to participate or not will not affect your current or future relations with St. Cloud State University or the researcher. If you decide to participate, you are free to withdraw at any time without penalty.

If you have questions about this research study, you may contact Aleksandar Tomovic by phone at 320-685-7506 or by email [atomovic@stcloudstate.edu](mailto:atomovic@stcloudstate.edu). You may also contact his Faculty Advisor, Dr. Rachel Friedensen, by email at [rfriedensen@stcloudstate.edu](mailto:rfriedensen@stcloudstate.edu). The results of the study may be requested from the researcher or the St. Cloud State University Repository.

Your signature indicates that you are at least 18 years of age; you have read the information provided above, and you have consented to participate.

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 Signature

---

 Date

## Appendix E: IRB Approval



### Institutional Review Board (IRB)

720 4th Avenue South AS 210, St. Cloud, MN 56301-4498

**Name:** Aleksandar Tomovic  
**Email:** atomovic@stcloudstate.edu

### IRB PROTOCOL DETERMINATION: **Exempt Review**

**Project Title:** College Student Perceptions of Their Learning Engagement Using Mobile Devices in a Computer Science Class

**Advisor:** Rachel Friedensen

The Institutional Review Board has reviewed your protocol to conduct research involving human subjects. Your project has been: **APPROVED**

Please note the following important information concerning IRB projects:

- The principal investigator assumes the responsibilities for the protection of participants in this project. Any adverse events must be reported to the IRB as soon as possible (ex. research related injuries, harmful outcomes, significant withdrawal of subject population, etc.).

- For expedited or full board review, the principal investigator must submit a Continuing Review/Final Report form in advance of the expiration date indicated on this letter to report conclusion of the research or request an extension.

- Exempt review only requires the submission of a Continuing Review/Final Report form in advance of the expiration date indicated in this letter if an extension of time is needed.

- Approved consent forms display the official IRB stamp which documents approval and expiration dates. If a renewal is requested and approved, new consent forms will be officially stamped and reflect the new approval and expiration dates.

- The principal investigator must seek approval for any changes to the study (ex. research design, consent process, survey/interview instruments, funding source, etc.). The IRB reserves the right to review the research at any time.

If we can be of further assistance, feel free to contact the IRB at 320-308-4932 or email [ResearchNow@stcloudstate.edu](mailto:ResearchNow@stcloudstate.edu) and please reference the SCSU IRB number when corresponding.

**IRB Chair:**

Dr. Mili Mathew  
 Chair and Graduate Director  
 Assistant Professor  
 Communication Sciences and Disorders

**IRB Institutional Official:**

Dr. Claudia Tomany  
 Associate Provost for Research  
 Dean of Graduate Studies

#### OFFICE USE ONLY

SCSU IRB# 1996 - 2593	Type: Exempt Review	Today's Date: 11/23/2020
1st Year Approval Date: 11/20/2020	2nd Year Approval Date:	3rd Year Approval Date:
1st Year Expiration Date:	2nd Year Expiration Date:	3rd Year Expiration Date: