A Causal-Comparative Study of Cell Phone Policies and Students' Test Performance

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Abstract

Regulating the distractions that the indiscriminate use of cell phones in classrooms poses has become a challenge for K–12 schools. The problem is that no specific cell phone use policy has guaranteed the attainment of higher learning outcomes among young adolescents. As cell phone distractions in secondary classrooms become a ubiquitous problem, this study is essential due to the lack of convergence in empirical evidence for validating the effects of cell phone regulation on students' mathematics achievement. The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. Self-determination and constructivist learning theories served as the theoretical framework for this study. Sixty-five public high schools were selected based on strict inclusion criteria. One research question was posed to test for significant differences among schools' aggregate math scores based on pre–COVID-19 cell phone use policies. Data were analyzed with SPSS, using an independent *t*-test. There was not enough evidence to suggest that a statistically significant difference existed between the math scores achieved at cell phone permissive (M=56.83, SD=12.96) versus prohibiting (M=56.88, SD=10.88) schools. Educators were challenged to devise strategies for channeling cell phones toward instructional use. Further research on a larger scale across diverse demographics was recommended.

Keywords: cell phones, prohibition, permissivism, causal-comparative, BYOD

Dedication

This scholarly work is dedicated to my Lord and Savior Jesus—the source of my life, my provider, and infallible help—and in honor of my late father, James Akinyosola Akintounde. Dad, I made you proud. May your gentle soul continue to rest in peace. This dissertation is dedicated to all aspiring African researchers and ethnic minority scholars across all developing nations and diaspora. Never forget the relentless labor of our ancestors as you persevere. Our toil will never be in vain. Out of ashes, hope will arise—Amen!

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Table of Contents

List of Tables

Table

List of Figures

Figure

Chapter 1: Introduction

Although researchers have documented mobile devices' suitability as a pedagogical tool, some teachers dissent regarding permitting cell phone use during instruction (Berry & Westfall, 2015; Thomée, 2018). If left unregulated, the use of cell phones could interfere with students' focus, hamper attention to detail, and result in poor academic performance (Glass & Kang, 2018). Permitting cellular devices during instruction could interrupt learner engagement and dissipate attention (Lee et al., 2017). Prohibiting mobile phone use during instruction constitutes a conundrum for teachers around the world (Bennett, 2019). Schools across the United States have attempted diverse rules to mitigate students' disruptive use of cell phones in classrooms, spanning from permissive access policies to outright prohibition (Brown, 2014; Charles, 2017).

Cell phones have been relegated as an external disruption and an insidious waste of classroom instructional time (Kraft & Monti-Nussbaum, 2021). However, with the advent of 21st-century cell phone capabilities, more schools are reconsidering the role of cell phones in improving educational outcomes (Valk et al., 2010). The National Council of the Teachers of Mathematics (NCTM) has advocated for the strategically integrating technology in classroom instruction to enhance mathematic proficiency (NCTM, 2012). The rapid ubiquity and unlimited didactic functionalities of cell phones began to elicit attention to the need for mobile learning interventions with significant connotations for classroom management and curriculum design (Kizito, 2012).

Research efforts to explore the relationship between cell phone use in the classroom and students' academic performance have only yielded discrepancies in results. Researchers at the McCombs School of Business at the University of Texas in Austin reported a significant reduction in students' cognitive capacities with the mere presence of a cell phone in their classrooms even when it was switched off (Ward et al., 2017). Students' long-term retention and final exam performance were also observed to be significantly lower with the permissive use of cell phones during lectures (Glass & Kang, 2018). On the contrary, others have accentuated the benefits of embracing the permissive use of cell phones during instruction through inclusionary policies, such as Bring Your Own Device (BYOD). Researchers conducting an experimental study in Taiwan argued for more cellular device integration into classrooms, as BYOD was found to enhance the long-term transfer and retention of learning outcomes (Chou & Chang, 2017). Results from a quasi-experimental mixed methods study also indicated a significant difference in the mathematics performance of students using mobile technologies during instruction with a *t*-statistics of 4.57 and a *p*-value of 0.005 (Fabian et al., 2018). In a meta-analysis survey of schools across the United States, researchers observed a significant positive relationship between classroom technology incorporation and mathematics achievement across public schools (Cheung & Slavin, 2013).

This current research study was conducted to examine if statistically significant differences existed between high school students' performance on standardized mathematic test based on the enacted schoolwide cell phone use policy. The background of the problem was explored, along with the purpose and significance of the study. The problem was clearly stated with a related research question and hypotheses posed. Underlying assumptions, the scope of the study, delimitations, definitions of key terms, and limitations of this study were identified. It was envisaged that the findings of this research study would proffer insights into effective policymaking for digital integration and classroom management for high schools in the study sample and beyond.

Background of the Problem

Schoolwide regulations regarding the use of cell phones have remained vague, leading to inconsistencies and a fractured approach to students' misuse of cellular devices from one classroom to another (Cavey, 2019). Some schools that have enacted sanctions to prohibit cell phone usage recorded significantly greater academic performance on high-stakes tests compared with schools with no restrictions in place for cellular devices (Beland & Murphy, 2015). In contrast, some teachers have reported academic gains from integrating smartphones for instructional purposes in the classroom, as evident across schools with BYOD policies in place (Ahmad, 2020). The gap in empirical evidence to substantiate the impact of cell phones on academic performance in mathematics classrooms requires extensive research (Tetzlaff, 2017).

Statement of the Problem

The problem is that no specific cell phone use policy has guaranteed the attainment of higher learning outcomes among young adolescents (Odgers, 2018). Determining the right approach to regulating students' use of cell phones has become a complex challenge for K–12 schools (Cavey, 2019). Teachers' stances and the implementation of cell phone use regulations vary across and within schools. Failed attempts at enacting diverse technology use policies across various classrooms were premised on the premonition that prohibiting cell phone use in class would efficiently redirect students' attention and lead to higher academic gains (Weimer, 2018).

Some teachers have lamented the futility of withholding students' mobile devices, as this move has not significantly enhanced learning, whereas other teachers pointed to evidence that prohibitive cell phone use policies enhanced student achievement (Bennett, 2019). From a desk study of BYOD schools conducted at the University of Hull, Scotland, researchers observed increased students' motivation, class participation, and proficiency in learning outcomes when mobile devices were integrated into instructional methods (Burden & Male, 2013).

On the contrary, other researchers have reported a negative impact of permissive cell phone use policies on students' academic performance (Ruston et al., 2017). Even when classroom teachers enacted the prohibition of cell phones by switching them to off/silent mode, the mere presence of cell phones in classrooms undercut students' cognitive performance (Ward et al., 2017). Researchers conducting a quasi-experimental study observed higher motivation and learner autonomy in BYOD classrooms embracing permissive device policies, but they could not establish a significant effect on the attainment of learning outcomes (Sánchez et al., 2020).

Educators are admonished to continuously examine the affective and academic consequences of enacted technology restrictions (Brown, 2014). Benesch (2009) argued for educators to more critically evaluate classroom policies to guide decision-making regarding policies that are beneficial or detrimental to the teaching and learning environments. The perceived effects of classroom cell phone policies on students' learning outcomes are not well documented and should be investigated for effective policy decision-making.

Purpose of the Study

The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. A sample size of 65 high schools was selected based on strict inclusionary criteria for this study. This study was conducted to examine the difference between the standardized test scores achieved in schools with prohibitive cell phone use policies and schools with permissive cell phone use policies, such as BYOD. Students' math achievement (dependent variable) was compared based on the schools' cell phone use policies (independent variable), either prohibitive cell phone use or permissive policies, such as BYOD.

Some teachers endorse the legitimate pedagogical use of cell phones, whereas others exhibit a teacher-knows-what-is-best approach to outrightly ban cell phones (Brown, 2014). About 69% of teachers whom researchers surveyed believed that cell phones were beneficial for engaging and motivating learners (Thomas et al., 2013). Teachers have conflicting perspectives about the impact of cell phones on learning. In addition to the daunting task of classroom management amid cell phone disruptions, teachers are continuously charged with ensuring the implementation of effective instructional practices to enhance student achievement (Ruston et al., 2017). Thus, the need to investigate the effects of cell phone use policies on students' learning outcomes has become imperative.

Significance of the Study

The findings of this study may add to the growing body of literature on the dynamics of cell phones in the classroom by conceptualizing the topic by contrasting prohibitive cell phone use policies with the integrative permissive use of cell phones for instructional purposes. Researchers have emphasized the lack of rigorous studies to drive the need for mobile technology as an effective instructional strategy (Carter, 2014). Researchers have advocated for the critical need for rigorous data on cell phone use policies and learning in secondary classrooms (Tandon et al., 2020). Teachers, parents, administrators, and policymakers in society look to research findings on the potential academic effects of cell phones in the classroom today to inform their decision-making (Barnwell, 2016). This study was critical to closing existing gaps in empirical evidence for substantiating higher mathematics achievement through cell phone integration in learning. The results of the current study may inform the enactment of a more consistent cell phone use policy from an evidence-based, achievement-driven, and learner-centered perspective.

Research Questions

The independent variable in the study was the implemented cell phone policy (prohibitive or permissive), and the dependent variable was the standardized test performance of high school students on the 2018-19 Smarter Balanced Assessment (SBA) in 10th-grade mathematics. One research question was developed to espouse the purpose of this causal-comparative study.

Research Question: Does a statistically significant difference exist between the aggregate math test scores of high schools with prohibitive cell phone policies and other high schools with permissive cell phone use policies based on the 2018-19 10th-grade SBA?

Hypotheses

This causal-comparative study also tested the following hypotheses:

H1o: No statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10th-grade SBA from 2018-19.

H1a: A statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10th-grade SBA from 2018-19.

Theoretical Framework

The self-determination theory (SDT) and constructivism learning theory served as the theoretical framework for this study. The perceived effect of cell phone policies on students' learning achievement was examined in relation to the SDT. External regulations, such as cell phone ban, serve as a locus of causality for motivating behavioral change (Deci & Ryan, 1985).

The degree of perceived autonomy versus coercion concerning enacted policies impacts students' motivation toward desirable actions or decision-making (Mills & Allen, 2020; Moller et al., 2006). The constructivist school of thought promotes the adoption of cognitive tools to enhance higher-order thinking (Vygotsky, 1978).

Proponents of the BYOD initiative are social constructivists who argue for stimulating learner engagement through the self-regulated use of smartphones to enhance academic achievement (Zohri & Laghzaoui, 2015). Both constructivism learning and self-determination theories relate factors such as autonomy, choice, and control, to the motivation to exhibit certain learning behaviors. The social constructive theory and SDT guided this study's hypotheses regarding the association between implemented cell phone use policies and student learning outcomes as measured by the SBA for mathematics. Constructivists argued that mobile technology integration espouses self-directed and contextual learning in the classroom (Elfeky & Masadeh, 2016). In contrast SDT theorists have advocated for autonomy, self-regulation, and motivation, which are inherent in permissive cell phone use policies and could impact self-competence and booster achievement (Jeno et al., 2017). The constructivism learning and self-determination theories were instrumental in exploring how autonomy, choice, and control inherent in permissive and prohibitive cell phone policies impact student learning behavior and inadvertently alter the landscape of student achievement (Rajasingham, 2011; Zohri & Laghzaoui, 2015).

Definitions of Terms

Terminology that emanated from the review of literature relevant to this study included cell phones, prohibition, permissivism, causal-comparative, and BYOD.

Bring Your Own Device (BYOD) is a constructivist approach connoting the integration of personal technologies in classroom instruction to enhance self-regulated learning (Ahmad, 2020). For this study, high schools that endorsed using cell phones for BYOD were classified as permissive in their cell phone use policies.

Causal-comparative describes a research methodology for examining the relationships between a dependent and an independent variable when it is impossible to assign participants to control experimental groups (Salkind, 2010). The characteristic trait delineating the independent study groups was pre-existing and could not be altered.

Cell phones connote all forms of devices meant for calling and texting with internet browsing capacities for both instructional purposes and off-task learner behavior, such as social media distractions. These include but are not limited to smartphones, Androids, Apple iPhones, i-Watches, and Nintendo gaming devices (Ng et al., 2017).

Permissivism implies diverse degrees of leniency displayed by educators towards regulating cell phone affordances, ranging from utilitarianism, which embraces volition for its inherent happiness and rationality of potential benefits derivable from behavior to a non-challan hands-off approach with no intention to curtail a behavior (Brown, 2014). For this study, all forms of cell phone allowance in the classroom were tagged as permissive, including BYOD with regulated with cautionary and discretional limitations and laissez-faire cell phone use policies with no intention to regulate use.

Prohibition means enforcing rules to impede students from accessing cell phones during instruction, with or without punitive disciplinary measures (Brown, 2014). Cell phone prohibition at the high school level ranges from a mandatory blueprint warning about stowing phones away to the proactive confiscation of cell phones if found in use during instruction (Beland & Murphy, 2015).

Assumptions

Assumptions are basic elements of research that are perceived as true and plausible, without which the research problem itself could not exist (Leedy & Ormrod, 2018). A critical assumption of this study precluded the notion that cell phones with simultaneous capacities for accessing learning and disrupting learning have become ubiquitous among high school students. Another assumption was the notion that unregulated use of cell phones during instruction was a distraction to students' learning with a consequential impact on summative test performance. Researchers who reported the long-term effects of dividing students' attention with cell phone distractions on final exam performance reiterated this assumption (Glass & Kang, 2018). In addition, students utilizing their cell phones in BYOD classrooms are assumed to be self-regulated learners, or teachers implementing such permissive policies have devised protocols for channeling the effective use of cellular devices toward intended instructional activities (Vázquez-Cano, 2014). It was also assumed that by selecting closely homogenous groups based on strict inclusionary criteria, other confounding variables, such as school differences, classroom sizes, student differences, socioeconomic, and disciplinary statistics, would not interfere with the dependent variable being studied.

These underlying assumptions were pivotal to drawing conjectures about students' test performance for this causal-comparative study. The high selected schools for this study were assumed to have implemented the advertised cell phone use policy with fidelity. This assumption was verified verbally or electronically using a single-item survey (see Appendix A) to contact all 65 high schools selected for this study. This causal-comparative study was conducted using high schools with homogenous profiles based on the assumption of a negligible effect of teacher, student, and classroom differences on the measured dependent variable.

Scope and Delimitations

Delimitations refer to boundaries that researchers set to ensure that study objectives are met (Creswell, 2012). The focus of this study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10^{th}-grade aggregate math test scores based on the implemented cell phone policy (prohibitive vs. permissive) for high schools in Washington state. This study was strictly a test of significant differences in the 2018 SBA math performance of 10^{th} graders among schools with various cell phone use policies. Regarding time, this study focused on a comparative causal analysis of cell phone use reforms before the COVID-19 pandemic. Hence, results might not be transferable given the shift in dispositions towards cell phone use for remote learning since the onset of the pandemic (Kamenetz, 2020).

Limitations

Limitations espouse the potential weaknesses inherent in a study—which are usually beyond the researchers' control—such as the research design, sample size, sampling strategies, sample representation, instrument reliability, or time (Creswell, 2012). Since this study only compared statistically significant differences in the 10th-grade math scores for 2018-19 for 65 high schools, its restricted focus might limit findings to the sample only. The results might not be generalizable to the test performance of high school students outside of the scope of this study. The use of purposeful sampling, a non-random sampling procedure, threatened the internal validity of this research and made this study susceptible to bias (Topp et al., 2004). This study utilized publicly available archived secondary data on the Washington State SBA Math 2018-19 as an instrument. Hence, the validity of the study's findings was subject to this standardized SBA's reliability.

A causal-comparative research design, at its best, can be utilized only to decipher a difference in the pre-existing conditions between two groups based on an independent variable that the researcher cannot manipulate (Schenker & Rumrill, 2004). In contrast to a true experimental design, the causal-comparative analysis is less persuasive in assessing the locus of causality, as one cannot control the influence of other confounding variables on the differences observed in the studied construct among groups (Salkind, 2010). Cell phone use policies in the selected high schools represent only one of several intervening factors in student achievement (Maarouf, 2022). Other explanatory variables, such as variability in student readiness and preparation, teacher quality, instructional methods, and the curriculum implemented, were not within the scope of this study. The threat posed to the external validity of findings via purposive sampling could be mitigated by increasing the homogeneity among subjects based on strict inclusionary criteria (Porzsolt et al., 2020). The schools selected for this study had less than 25% ethnic minority (African American and Hispanic) students. The average attendance rate for the chosen schools was above 70%, and less than 10% of students at these schools had any disciplinary record. Less than 20% of students at each school received special education services, and the free and reduced lunch program eligibility was not more than 40% at all the high schools selected. The English language learner population was less than 10% at all high schools in this study, and the 10th-grade proficiency score in the 2018-19 SBA reading of English language was at least 60%. An additional inclusion criterion was a moderate consistency in the schoolwide teacher implementation of either a prohibitive cell phone ban or a permissive cell phone use policy in the 2018-19 school year.

The causal-comparative methodology utilized for this study did not explain the locus of causation for any significant difference observed. To enhance the external validity of this study, a validated sample size calculator was used to establish the minimum number of schools to select for the study sample (Blackford, 2017). The independent *t*-test chosen for data analysis in this study was considered robust if the sample sizes from the two groups (permissive vs. prohibitive) being tested were fairly equal (Larkens, 2015). Using strict inclusionary criteria helped with achieving more homogeneity among the selected sample and thus reduced the bias and threats to internal validity associated with the non-randomized sampling procedure in this study.

Chapter Summary

Regulating cell phone use during classroom instruction has been enigmatic for school leaders and teachers across the globe (Bennett, 2019). Many school leaders have attempted various strategies to mitigate students' disruptive use of cell phones in classrooms, ranging from permissive and integrative cell phone policies to a stringent ban on all cellular devices (Charles, 2017). The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. Secondary data were gathered from 65 selected high schools with similar profiles defined by strict inclusionary criteria. Permission was obtained from selected school districts and the Washington State Department of Education to access the archived aggregate math scores for 10^{th} graders on the 2018-19 SBA (see Appendix B).

These cell phone regulations' resulting impact on student achievement on high-stakes tests have been incoherent, as some researchers observed a rise in students' performance when cell phones were banned (Beland & Murphy, 2015). Ahmad (2020) reported significant gains in test performance in self-regulated classrooms with permissive use of cell phone technologies in learning. This study utilized a causal-comparative methodology, using independent *t*-statistics to examine if a statistically significant difference existed between the 10th-grade math performance (dependent variable) and the implemented schoolwide cell phone use policy (independent variable) in selected Washington state high schools in the 2018-19 academic year.

Chapter 2: Literature Review

The problem is that no specific cell phone use policy has guaranteed the attainment of higher learning outcomes among young adolescents (Odgers, 2018). A lack of consensus on the effectiveness of various cell phone use policies on student learning achievement impedes teacher's integration of cell phones as classroom technology tools (Mohammadi et al., 2020). Kaliisa and Picard (2017) cited a lack of structured policies as a constraint to the teacher's integration of cellular devices for facilitating learning across classrooms. A clear understanding of the effects of cell phone use on learning achievement could inform teachers' development of effective policies (Fulbright, 2013). A causal-comparative quantitative study was used to test for statistically significant differences from the 2018–19 Smarter Balanced 10th-grade aggregate math test scores based on the implemented cell phone policy (prohibitive vs. permissive) for high schools in Washington state. Previous studies have elaborated findings regarding the benefits and setbacks of cell phone usage in the classroom, teachers' perception of cell phone usage, a variety of existing cell phone policies across high school classrooms, and existing research regarding the distractive use of cell phones and students' grades (Brown, 2014; Chou & Chang, 2017; Fabian et al., 2018; Glass & Kang, 2018; Thomas et al., 2013)

Literature Search Strategy

A systematic review of literature for the proposed research was initiated with a broad Google search of articles related to the research questions and the theoretical framework. The general search included phrases such as "the constructivist theory of cell phone use," "self-determination theory and mobile technology," "self-determination and Bring Your Own Device (BYOD)," "autonomy in cell phone use and learning," and "theoretical framework behind cell phone ban and on learning." The results generated were then filtered by date, article type (journals, dissertations, and published books), and the inclusion criteria (peer-reviewed) to identify the cognate literature.

Citation searches were conducted on the secondary sources until the primary sources were located by their digital object identifiers (DOIs). Using filters and sorting literature by the inclusion criteria helps eliminate irrelevant publications as researchers streamline their searches toward more pertinent information (Higgins et al., 2011). Searches were refined where necessary, and articles were tabulated based on a literature synthesis framework for the extraction of relevant information pertaining to the research topic. Specific words in the research questions were utilized in creating a broad search and then refined based on the inclusion criteria and dates.

Theoretical Framework

The SDT and constructivism learning theory served as the theoretical framework for this study. Both constructivism learning and self-determination theories relate factors such as autonomy, choice, and control to the motivation to exhibit certain learning behaviors (Rajasingham, 2011). The application of the SDT to mobile technology learning environments is novel (Turner, 2019). Hence, further research was necessary to examine how teachers can optimize learner motivation through cell phone integration in classroom instruction.

Self-Determination Theory

Proponents of the SDT postulate that sustained behavioral changes are either facilitated or undermined by the extent of the autonomy or control implied (Deci & Ryan, 2002; Hagger et al., 2020; Moller et al., 2006; Ryan & Deci, 2017). The SDT of Deci and Ryan (1985) primarily focuses on human psychological needs from three perspectives: feeling governed versus feeling self-endorsed (autonomy), feeling effective or achieving self-efficacy (competence), and feeling loved and connected (relatedness). People become fragmented when these needs are not fulfilled. These three needs are cognate in the classroom. Teachers who support learners' fulfillment of all three needs experience significant student engagement (Hsu et al., 2019; Reeve, 2013).

Following the SDT, this study explored if learners' gravitation toward learning outcomes differed based on the extent of volition or coercion implemented regarding cell phone usage. Martela et al. (2020) conveyed that endorsing autonomy does not necessarily mean that a learning environment is void of rules. Instead, it connotes voluntary consent to laws, which might motivate learners who no longer perceive themselves as untrusted subordinates who must be surveilled, but as trusted and responsible individuals. Deci and Ryan (2002) submitted that autonomous choice facilitates more profound learning and higher conceptual understanding. Deci and Ryan (1985) proposed that external regulations serve as a locus of causality for motivating behavioral change. Researchers have observed that the extent of perceived autonomy versus coercion concerning enacted policies impacts an individual's motivation toward desirable actions or decision-making (Mills & Allen, 2020; Moller et al., 2006). The SDT guided this study's hypotheses regarding the existence of significant differences in students' test performance based on enacted schoolwide cell phone policies.

Deci and Ryan (2002) postulated that three human needs underlie the SDT via autonomy, competence, and relatedness. The concept of autonomy connotes that people prefer to self-regulate their behavior; competence refers to a feeling of self-sufficiency experienced during the performance of an activity; and relatedness indicates the innate desire to connect with others (Hsu et al., 2019). With personalized technology usage, relinquishing control of student cell phone use confers agency and autonomous decision-making to the individual learner, whereas integrating cell phones into instruction could elicit the motivation to collaborate with peers, as students feel successful while using their devices without interruption (Roca & Gagné, 2008). Teachers' willingness to leverage the regulation of mobile device is contingent on their self-efficacy, their innovativeness, cell phone ubiquity, the content being taught influence, and use perceived trust in students (Nikou & Economides, 2017).

The SDT has been exemplified in self-regulated learning classrooms, such as those employing the BYOD initiative. Teachers who endorse one-to-one handheld technology differentiate instruction and allow students to negotiate their learning goals and interests with curiosity (Turner, 2019). Students exhibit relatedness when undeterred by rules that might limit peer interactions, global discourse, and the acquisition of the vast communication skills emerging from classrooms in which teachers embrace mobile technologies (Oblinger & Oblinger, 2005). In contrast to traditional classrooms, in which students are conditioned to learning via rote memorization, BYOD provides a less restrictive technology-driven environment for students to harness myriads of learning competences via personal devices (Turner, 2019).

Motivation can be voluntary (self-driven by interests or shaped by values) or external (through coercion and control). The SDT conveys that the source of motivation determines the dynamics of learning behavior (Ryan & Deci, 2017). Most people prefer autonomy-supportive practices, which embrace agency and validate their identities; therefore, researchers have advocated that when control is warranted, educators should communicate regulations in supportive ways (Chirkov et al., 2003; Jang et al., 2009). Deci et al. (1994) submitted that restrictions might incite discomfort among students, so teachers should avail learners with option alternatives without compromising essential etiquette. The fair enforcement of classroom rules confers credence and attracts learners' willingness to comply (Ryan & Deci, 2017). Researchers have delineated two types of motivational inclination, namely appetitive and aversive motivation

(Lang & Bradley, 2013). Appetitive motivation is activated when one encounters a stimulus that one finds attractive and appealing, whereas aversive motivation drives one to withdraw and remain distant from an appalling stimulus (Cacioppo et al., 1997).

Deci and Ryan (2002) distinguished four forms of extrinsic motivation, ranging from completely external regulation to partially external (interjected), partially internal (identified), and (completely internal) integrated regulation. Some teachers perceive that a student should be externally motivated to learn (Ally, 2008). Autonomy does not mean lawlessness; it only connotes that one values people's dignity enough to avail them with choice and agency, rather than constraining them and monitoring their compliance (DeCaro et al., 2017).

Banning a given communication style to ensure compliance might be detrimental and counterproductive to the learning behavior that such a restriction was meant to foster (Nyhan et al., 2014; Van Petegem et al., 2017). Aitken et al. (2016) recommended competence-supportive practices, which entail a collective goal setting by teachers and their students, with stakeholders equally vested in selecting appropriate strategies for reaching such goals. In contrast to controlled motivation, under which individuals feel pressured to perform, autonomously motivated people derive intrinsic value in their behavior. Where control is inevitable, researchers have emphasized the need to ensure that regulations are portrayed in supportive ways (Chirkov et al., 2003; Jang et al., 2009). Assuring people of the benefits of cell phone integration in classrooms and how cell phone policies will be enforced drives more individuals to willingly adhere to the regulations (DeCaro et al., 2017).

Constructivist Learning Theory

Ford and Lott (2009) distinguished three types of constructivist theories, including social constructivism (which promotes interactions and exchanges among students and teachers), situated learning (which posits that collaboration is fundamental to effective learning achievement), and the activity theory (which promotes that knowledge is curated through self-inquiry and engagement with tools and the surrounding environment). Researchers have drawn conjectures to the constructivist learning theory to advocate for cell phone integration into classroom learning (Wang et al., 2009). White and Martin (2014) advocated for teachers to tap into students' existing expertise in the use of mobile technology. The constructivist school of thought promotes the adoption of cognitive tools to enhance higher-order thinking (Vygotsky, 1978). Some researchers have emphasized the benefit with which cell phone usage endows teachers through effective collaboration, engagement, and shared learning among students (Switzer & Csapo, 2005). Proponents of the BYOD initiative are social constructivists who theorize that stimulating learner engagement through the self-regulated use of their smartphones can enhance academic achievement (Zohri & Laghzaoui, 2015).

In contrast to behaviorists who project teachers as transmitters of knowledge and students as passive receptors who learn in response to stimuli, social constructivists perceive learning as a collective transaction, requiring the elements of negotiation, collaboration, and choice among students (Vygotsky, 1978). In a social constructivist classroom, learning is characterized by active participation, interactions, and continuous conversations through multiple means and access to myriads of tools that can help students access a vast meaning of their world (Sharples, 2002). The appropriation of learning is perceived as a joining enterprise; therefore, knowledge is co-constructed with students as active participants (Taylor, 2015).

The social-constructivist theory underlies classroom learning environment, while technology serves as a stimulus for active engagement among learners (Kim et al., 2011). In socially constructive classrooms, teachers provide students choice and access to various tools that can enable them to grasp concepts via self-regulated learning (Grant & Osanloo, 2014). Teachers who embrace cell phone integration believe students can access new learning by tapping into inherent competencies, such as mobile technology prowess (White & Martin, 2014).

Convergence in the Underlying Theories

Researchers have advocated for the alignment of appropriate theoretical frameworks with research on the effective integration of mobile technologies into classroom learning (Economides, 2008; Park, 2011). A mesh of self-determined, interactive, and constructivist frameworks is deemed essential for understanding mobile technology's pivotal role in classroom learning (Rajasingham, 2011). The SDT underlies the relationship between several affordances in the classroom and their consequential effects on student learning and engagement (Turner, 2019). Constructivism and self-determination theories relate constructs such as autonomy, choice, and control to the motivation for exhibiting certain learning behaviors.

The Independent Variable and Dependent Variable in the Study

This causal-comparative study posed cell phone use policies (prohibitive vs. permissive) as the only independent variable and students' attainment of learning outcomes (measured by 2018–2019 Smarter Balanced 10th-grade aggregate math test scores) as the dependent variable for this research. The review of existing literature espoused topics such as the benefits and setbacks of cell phone usage in the classroom, teachers' perception of cell phone usage, and the variety of existing cell phone policies across high school classrooms, as well as existing research on cell phone use and learning outcomes.

Cell Phone Use in the Classroom

During the past 2 decades, hand-held cellular devices have advanced with a myriad of capabilities beyond serving as a voice call tool (Doree, 2019). Cell phones have become a force to reckon with in both teenagers' social terrain and educational environments (Gómez-García et al., 2020). With the rapid development of various social media applications and an endless list of interactive tools, users are becoming untamable in their inordinate use of cell phones in classrooms (Harrison & Gilmore, 2012). Cell phones have become tremendously pervasive in society, and classrooms are not exempt. Based on a national survey of middle school students, researchers reported that 78% of middle schoolers utilize phones for accessing grades, 69% of respondents claimed that their cellular devices aided them in notetaking, whereas 56% of the students surveyed indicated that they relied on cell phones for completing their homework (Project Tomorrow, 2013).

Researchers have earmarked portability, connectivity, flexibility, and ubiquity as the desirable features that make cell phones adaptable for classroom use (Reychav et al., 2015). The portability and connectivity of cell phones make them more popular among students than laptops and tablets are (Sung et al., 2016). Cell phones' robust capacity makes them amenable to educational use for remote learning. In some countries, smartphones have become integral to classroom instruction, given their limited internet connectivity (Gowthami & VenkataKrishnaKumar, 2016). The inherent features of mobile phones, such as their ubiquity, ease of use, and communication functions, make them appealing for student use in the classroom (Vázquez-Cano, 2014). Cell phone connectivity is not limited in space and time, thus making its classroom integration pivotal to instilling lifelong communication skills, critical thinking, participation, and problem-solving among students (Abidin & Tho, 2018). Embracing mobile phones as pedagogically complementary tools could provide digital access to low-income families and students in rural areas, giving them equitable footing as affluent urban school communities (Kim et al., 2011). The vast number of mobile applications (apps) on Android and iPhone makes them adaptable to classroom learning and distractions (Yang et al., 2015). Therefore, cell phone use in the classroom poses a mix of positive and negative effects on student learning (Rodriguez, 2018).

Kent (2016) submitted that smartphones aid information transfer and facilitate the exchange of ideas beyond the scope of the classroom. Researchers have recommended mobile devices' suitability as a pedagogical tool; other teachers condemn them, claiming that their disruptive use impacts learning (Berry & Westfall, 2015; Thomée, 2018). Innovative learning is easily accessible to 21st-century learners with the advent of smartphones (Emerson & Berge, 2018). Cell phone integration in classrooms could increase learners' social participation and exchange of ideas (Kent, 2016). The International Standards for Technology in Education (ISTE, 2018) advocated for the integration of up-to-date technology that could enhance student productivity and competitiveness in the 21st-century.

On the contrary, others have warned that cell phones might interrupt student engagement and extinguish their attention if teachers permit their indiscriminate use (Lee et al., 2017). Some students have also attested to the fact that smartphones distract them (Kuznekoff et al., 2015). Students who advocate for cell phones in classrooms claim that they can multitask, switching their attention back and forth the learning platform and social media conveniently (Barnwell, 2016). The illusion that students can multitask with learning and social media distracts them from realizing the debilitating effects of cell phone misuse on their intellectual development and academic performance (Earl, 2012). Researchers have refuted the notion that students are capable of multitasking with instruction and distractions while using their cell phones, dismissing the possibility that students can simultaneously manage learning responsibilities and the entertainment or interactive social features of cellular devices (Ophir et al., 2009; Wilmer et al., 2017). Kirschner and De Bruyckere (2017) emphasized that task switching shortchanges learning and concluded that multitasking was a myth. Wilmer et al. (2017) argued that students who divided their focus between classroom instruction and gratification from cell phone distractions on social media diminished their cognitive performance and overall productivity.

An attempt at splitting attention between instruction and the off-task capabilities of smartphones has an insidious but negatively significant impact on learner long-term retention while also distracting peers who are passive observers of such a disruptive use of cell phones (Glass & Kang, 2018). Without adequate supervision, students' obsessive use of cell phones could have severe consequences on their academic performance (Samaha & Hawi, 2016). Although educators have decried the disruptions that technology incites in their classrooms, if appropriately integrated, digital tools could foster choice, social engagement, and interdependence among students, thereby increasing student achievement (Darling-Hammond et al., 2020). Mobile technologies can enhance self-directed inquiry and access to higher-order thinking (Day & Erturk, 2017; Weichhart et al., 2018). Brooks and Pomerantz (2017) warned that although about 78% of students reported that the productive use of their cell phones enhances their academic success, more educators are limiting or banning the use of cell phones across classrooms than ever before. About 70% of more than 43,000 students surveyed stated that cell phones were either discouraged or banned in their classes, and only a few faculty members were flexible in integrating cell phone use during learning (Brooks & Pomerantz, 2017). Project Tomorrow (2013) reported that 40% of students considered teachers' restrictive policies to be barriers to their learning with digital tools in the classroom.

Teachers' Perceptions of Classroom Cell Phone Use

Substantive divergence exists in the faculty-student notion of cell phones in the classroom. Educators perceive students' use of cell phones as distractive, whereas students consider their online engagement during classes cognate to their learning (Dahlstrom et al., 2015). Teachers' positions on the role of cell phones in academia also vary from one classroom to the other. Berry and Westfall (2015) reported that many teachers detest cell phone disruptions in the classroom. Students are considered as digital natives who have been reared in an era in which technology use was predominant, whereas teachers are digital immigrants who are novice to the latest digital applications (Prensky, 2001). Some of these digital immigrants demonstrate dissonance in their perceptions of effective learning and the potential roles of technology in the classroom (Lockhart, 2016). Mittal et al. (2017) defined teachers' mobile learning acceptance as a general disposition of educators toward mobile technology and the intention to adopt such technology in their instructional practices. Researchers observed a low teacher disposition toward smartphones and other mobile devices in a Korean study of teacher attitudes toward mobile learning (Baek et al., 2017).

Smartphones can enhance teachers' integration of 21st-century innovations in instruction, leading to higher student engagement and the attainment of learning outcomes (Emerson & Berge, 2018). Ahmad (2018) observed both teachers and students in classrooms where cell phones were integrated into classroom activities and found that both stakeholders affirmed the importance of mobile phones in learning. In a study of teachers' perceptions of cell phone benefits, researchers observed that about 69% of teachers who allowed students to utilize their cell phones for schoolwork reported engagement and motivation as benefits. Still, they lamented disruptions and inequity in access as constraints to cell phone integration in lessons (Thomas et al., 2013). Despite the accentuated benefits of cell phone use in the classroom, distractions, cheating, bullying, and the abuse of privacy rights make it compelling to restrict cell phone use in school. Nonetheless, the benefits still outweigh the challenges (Gowthami & VenkataKrishnaKumar, 2016).

Mishra and Koehler (2006) posited that the optimum balance of technology, content, and pedagogy could enhance student motivation and improve cognitive access. Studies have reported teachers' perceptions of cell phones as both a disruptive object and a mediating learning infrastructure (Ott, 2017). Students obsessed with cell phones will defy any odds to access them during class. Hence, instead of aimlessly attempting to ban cell phones from classes, teachers could embrace the safe integration of cell phones' technological tools for educational use (Graham, 2012). Rather than waging war against smartphones, educators should reckon with their potential benefits and devise strategies to incorporate cell phones into their instruction (Pennsylvania State University, 2017).

Factors Influencing Teacher Cell Phone Use Perspectives

Prensky (2001) observed a disposition gap between teachers who are digital natives and older teachers who are digital immigrants. Digital natives are baffled by teachers' hesitation to accept cellular device use from one classroom to another (Raby, 2008). Researchers reported a strong positive correlation between stakeholders' attitudes toward technology standards and their integration of technology in the classroom (Styron & Styron, 2013). Nielsen and Webb (2015) argued that teachers who consciously limit students' access to cell phones do so out of concern for inequitable access and digital distractions.

Some of the factors undermining the integration of mobile phones into classroom instruction include inadequate technology infrastructure, teachers' lack of technological competence, distractions, cheating, inequity in device availability, inappropriate conduct, the violation of privacy, and a lack of guiding policies on acceptable technology use (Mohammadi et al., 2020). Other factors interfering with the adoption of technology integration include the school profile, the availability of digital tools, relevance to teachers' content, educators' demographic characteristics (age, gender, and years of teaching experience), teacher self-efficacy or readiness, the pressure to use technology, and professional training (Dogan et al., 2021). Researchers have conveyed that classroom technology studies should integrate the perspectives of educators regarding the appropriate use of smartphones for teaching and learning in their classrooms (Lötter & Jacobs, 2020). Some researchers recommended the expansion of research into cell phones and secondary student achievement to account for diverse variables, such as school type, socioeconomic status, and subject areas (Gómez-García et al., 2020).

Concerns About Cell Phone Misuse in Classrooms

Researchers have also reported that cell phones constitute an inequity concern in classrooms, with only 88% of teenagers having access to personal devices (Lenhart et al., 2015). When researchers surveyed text messaging and the misuse of cell phones in the classroom, about 95% of college students reported that they kept their phones in class, 92% of them texted during class, and 10% confessed to texting during examinations (Tindell & Bohlander, 2012).

Cell phone access in schools has also been associated with a myriad of misconduct and ethical violations, such as sexting, pornography, the cyberbullying of staff and students, and the sexual exploitation of minors in some K–12 schools (Quaid, 2009; Richards & Calvert, 2009). In addition, researchers have itemized theft, cheating, distraction, and the division of attention as cell phone-induced disciplinary concerns in school (Leung & Wei, 2000). In some schools where restrictions on cell phones are non-existent, violations of media use and test insecurities have been major concerns (Ullman, 2011). These concerns underlie the inadvertent enactment of various cell phone use policies in public schools (Kemerer, 2012; O'Donovan, 2010). Educators and school leaders are often bewildered by societal expectations for them to police children's use of cell phones in their school environments (O'Donovan, 2010). Given the plethora of behavioral concerns emanating from cell phone misuse, many schools are perplexed about how to develop optimum cell phone use regulations for students across their classrooms (Lockhart, 2016).

Cell Phone Use Policies in Classrooms

Public schools are tasked with devising cell phone use policies that balance teachers' discretionary integration of digital technology with the emergent need to regulate online behavior and digital citizenship (Lockhart, 2016). School district leaders, administrators, and teachers must decide if cell phone restrictions or allowance significantly impact student learning, or if it connotes substantial disruptions to learning or causes cyber infractions that could undermine staff and student's safety and privacy rights (Pike, 2008). Mohammadi et al. (2020) submitted that a dearth of effective policies for guiding the classroom implementation of mobile technology had deterred cell phone implementation among educators.

Researchers have observed divergent perspectives among school leaders, teachers, and students regarding the roles of cell phones and the adequacy of cell phone regulatory policies in the classroom (Obringer & Coffey, 2007; Raby, 2008). Raby (2008) suggested that more research was imperative for investigating the dispositions of all stakeholders, including teachers, on the effectiveness of policies guarding the use of personal mobile technology in the classroom. In a national survey of high school administrators across the United States, researchers found that many schools implemented a myriad of blanket policies regarding cell phone use; however, no single policy is most effective in enhancing learner achievement and eliminating classroom distractions (Obringer & Coffey, 2007).

Many school administrators and teachers are in a dilemma regarding how to define cell phones' role in their classrooms (Lockhart, 2016). The challenge is to find an effective cell phone use policy that meets both educators' and learners' needs (Lockhart, 2016). Stakeholders in education have yet to reach a consensus on whether to embrace cell phone technology as an effective learning infrastructure or to restrict students' access due to its attention-dissipating capacities (Whitford, 2018). The perspectives regarding cell phone bans and cell phones' useful applications in the classroom vary among districts, schools, and teachers (Raby, 2008).

Prohibition versus Permissivism

Prohibitionists forbid the use of cell phones, and they vehemently implement punitive disciplinary measures for violations of their rules of no cell phones (Pahomov, 2015). In contrast, an extreme variant is permissivism, which embraces and encourages the use of cell phones in class (Lancaster, 2018). Teachers who enact strict bans on cell phones perceive that doing so would eliminate student distractions and divert their attention toward learning (Lieberman, 2018). Notably, restrictive cell phone policies alone cannot eradicate distractions in the classroom. More than 76% of respondents in a teacher-student perception survey affirmed that a mere verbal reprimand is ineffective for preventing cell phone disruptions. Enacting a strict cell phone ban might give students an uninterrupted learning environment (Berry & Westfall, 2015). Teachers have reported a variety of smartphone use policies ranging from a complete cell phone prohibition to a partial prohibition (regulated integration or permissive integration), usage at students' discretion, and non-existent control (Weimer, 2018).

Teachers who enforce limiting cell phone use in the classroom might incite a power tussle and become labeled with a control-seeking teacher-centered pedagogy in contrast to their colleagues who are flexible in availing students of active learning opportunities via personal device integration (Evans, 2017). Technology integration into teaching is critical to student learning (Buckenmeyer, 2008). Glass and Kang (2018) warned that the evidence for students' inability to multitask with learning and social media habits is not conclusive enough to warrant a full-fledged ban on cell phones. Lieberman (2018) discarded the punitive use of cell phone bans as futile in classrooms, insisting that students who were desperate to engage online would still find ways to circumvent such rules in any classroom. In a college-wide study of more than 44,000 undergraduate students, researchers reported that one-third of the students affirmed their frequent use of cell phones during instruction despite the indication that 70% of all respondents were drawn from classes with stringent bans on smartphone use in the classroom (Brooks & Pomerantz, 2017). Pahomov (2015) considered choice an important mediator in the classroom and therefore advocated for teachers to treat young adolescents as responsible adults by embracing cell phones in classrooms rather than prohibiting them.

A college professor who adapted the Snapchat app for birdwatching assignments after observing the perpetual use of this social media tool among students has admonished educators to quit wasting time gate-keeping adherence to zero-tolerance cell phone policies (Lieberman, 2018). Given that banning mobile device use incites tension and ensues disdain for learning, teachers should consider the potential impact of smartphone technology on learning (Lieberman, 2018). Researchers have admonished educators to treat young adolescents with respect by incorporating choice via pragmatic classroom policies that are tailored to meet the needs of their diverse learners (Brooks & Pomerantz, 2017).

Bring Your Own Device (BYOD)

Some schools have taken a more student-centered approach, such as BYOD, to integrate students' cellular devices into their instructional practices (Ohler, 2011). BYOD policies enable the regulated or democratic use of personal technology, such as iPads, tablets, cell phones, and laptops (Maxwell, 2013). Educators have strategically embraced BYOD in their attempt to channel students' disruptive cell phone use toward instructional purposes. Panagos (2013) opined that imposing BYOD policies have allowed teachers to invigorate their instruction with evolving trends in digital technology to divert students' use of mobile devices toward a productive course. BYOD policies promote learner engagement and self-directed learning (Sánchez et al., 2020). Although BYOD has been touted as an effective way to arouse students' interest in learning and improve learner engagement through choice and agency, some teachers dissent on the autonomy it confers on students for discretional use for both academic and off-task purposes (Emmanuel, 2014). The self-determination theory underlies students' motivation and teachers' willingness to negotiate the integration of digital technology devices into their learning environments (Hartnett et al., 2011).

Self-Determination Theory and Teacher Cell Phone Use Policies

One renowned benefit of mobile technology in the classroom is the access it avails students to self-directed learning (Day & Erturk, 2017; Weichhart et al., 2018). Such autonomous motivation is pivotal to sustained behavioral change and learning outcomes (Hagger et al., 2020). A self-determined learner is an intrinsically motivated student who perceives a sense of agency in taking responsibility for and desires to be in control of their decision-making (Ackerman, 2021). The self-determined student makes choices based on personal values rather than out of external pressure. For some individuals, autonomy may feel self-directed, whereas others who are compelled by force to comply with rules do not experience independence (Ryan & Deci, 2017). Controlled motivation is externally perpetuated by rewards and the fear of consequences, while introjected motivation elicits from trying to preserve one's ego, approval-seeking, and shame avoidance (Ackerman, 2021).

Zero-tolerant teachers who mandate a cell phone ban perceive that students' use patterns could be externally regulated if more students adhere to policies due to threat of disciplinary action or consequences (Adams, 2020). In contrast, educators with permissive use policies perceive that their learners are extrinsically motivated by autonomous cell phone policies; thereby increasing the engagement and desire to learn (Vanwelsenaers, 2012). Fletcher (2016) identified interpersonal communication and interaction with friends and family on the phone as external sources of motivation for learners. Significant correlations have been established between students' interest and attention, as well as between learners' attention and academic achievement (Yang et al., 2015).

About 92% of students claimed that cell phones were easier to utilize for accessing information, and 95% of students opined that their interpersonal communication was faster with cell phones (Adeboye, 2016). Cell phone use efficiency is often misconstrued as productive efficacy (Raptis et al., 2013). Kamenetz (2020) opined that teacher perspectives on the efficiency and effectiveness of smartphone-based learning vary widely.

Researchers admit that obsessive student behavior should be regulated, yet they caution that such regulations should acknowledge the feelings that the individual experiences while been detached from the behavior (Deci et al., 1994). Autonomous classrooms also require competence-supportive guidelines that stipulate the required behavior and learning goals, and instructional guidelines to help learners to understand the rationale for teacher expectations

(Aitken et al., 2016). Student motivation is contingent on teacher support, structure, and level of involvement (Lietaert et al., 2015). Teachers' understanding of autonomous motivation can enhance their implementation of interventions and classroom policies (Hagger et al., 2020).

Self-determination proponents advocate for facilitating student engagement by minimizing coercion, maximizing choice and student autonomy, and providing a compelling rationale for regulations via feedback (Schewe, 2016). In contrast to frustration experienced in classrooms with coerced compliance (Reeve & Cheon, 2014), researchers have reported that engagement, learning, and socio-psychological well-being were higher in classrooms with autonomy and choice (Cheon & Reeve, 2015; Reeve, 2009). In a study of the role of motivation in personalized learning, autonomy in learners' choice of technological tools was found to significantly impact students' motivation and engagement (Netcoh, 2017). Although the vast functionality of cellular devices makes them susceptible to misuse as distractions, some teachers have effectively utilized cell phones for enhancing the motivation of disinterested students in self-regulated learning (Vázquez-Cano, 2014). However, Abdulfattah (2019) contended that cell phone-induced student motivation does not guarantee a higher academic achievement.

Researchers concluded that policies which permit technology integration into classroom teaching and learning could position students to become independent thinkers who self-regulate their mobile technology use as champions of self-learning, rather than stringent ban which portray students as victims of an addiction to technology (Craig & Van Lom, 2009). Teachers could facilitate self-awareness and self-regulation among students, many of whom already use smartphones frequently and efficiently (Sung et al., 2016). Asides the self-determination theory, teachers' propensity for embracing technology is also rooted in the constructivist theory of learning (Isik, 2018).

Constructivist Theory and Teacher Cell Phone Use Policies

Researchers have recommended that educators substitute archaic teacher-centered pedagogy with constructivist learning approaches, which involve engaging learners in real-time interactions and collaboration with peers and teachers, and tools that facilitate authentic knowledge curation (Lötter & Jacobs, 2019). One of these types of constructivist strategies is the student-centered BYOD. The benefits of integrating cell phones as a social constructivist pedagogy cannot be underestimated (Lötter & Jacobs, 2019). In constructivist classrooms, technology is strategically interwoven into interactive lessons, assessments, polls, feedback, discussions, projects, alternative student work, and data analysis and reporting (Lötter & Jacobs, 2019). Securing attention and participation in classroom instruction requires teachers to deploy didactic tools that might arouse and elicit student interest in learning (Gómez-García et al., 2020).

Educators have a fundamental role in creating and maintaining stimulating environments that allow students to take autonomous ownership of their learning, controlling what and how they learn (Bill & Melinda Gates Foundation, 2014). The Berkman Klein Center for Internet and Society (2018) posited that understanding young adolescents' interest in cell phone usage and analyzing the harnessing of such technology to enhance learning remain pivotal to any effective educational regulatory policy aimed at advancing the public good. Any paradigm shift in instructional practice should prioritize optimizing teachers' adoption of best practices instead of limiting learners' technology use behavior (Buckenmeyer, 2008). Rather than banishing cell phones from classrooms with blanket policies, educators should examine how various classroom cell phone use policies interfere with students' attainment of learning trajectories.

Cell Phone Use Policies and Student Learning

According to Seidman (2005), without regulations, cell phone use might inhibit students' engagement in classroom teaching and learning. In a quantitative study investigating the effect of cell phone use on motivation for physical activity, it was reported that excessive cell phone usage correlated with demotivation, meaning that students who persistently engaged in the distracting use of cell phones were less autonomously motivated (Doree, 2019). Lancaster (2018) conveyed that both permissive and restrictive levels of cell phone use in class affect students' cognitive and affective learning. Cognitive learning describes the knowledge acquired and demonstrated through students' abilities to apply and recall what was taught (Bloom et al., 1956). Affective learning denotes students' emotional attachment and motivations toward the lesson taught or the instructor teaching it (Plax et al., 1986). Classroom policies, such as cell phone restrictions, influence both forms of learning. Miller (2018) reported that students' use of cell phones for learning only aroused leaners' emotional engagement. On the contrary, researchers conducting a multiple group analysis of college students' smartphone utilization reported significant differences in both self-efficacy and academic competence when students could incorporate cell phones into their classroom learning (Han & Yi, 2018).

Researchers concluded that high dependence on cell phone usage undercuts students' cognitive capacity and hinders their performance (Ward et al., 2017). An experimental study indicated that students without cell phones attained 12% more study goals than their peers with phones (Cutino & Nees, 2016). Researchers have lamented the associated cognitive cost of cell phones in classrooms following the report that the mere presence of cell phones in proximity dissipates students' attention, even when their devices were switched off (Ward et al., 2017). Students were most productive in classrooms in which cell phones were not physically permitted

(Ward et al., 2017). Fox et al. (2008) reported that students who expended more time on mobile phones demonstrated lower levels of reading comprehension. The findings of a quantitative study of the impact of smartphones on students' academic performance indicated that the obsessive use of cell phones deterred both the academic achievement and progression of students (Ifeanyi & Chukwuere, 2018). Cell phones were concluded to be time wasters, as 71% of students affirmed that the use of their cell phones distracted them, 69% engaged in texts during class, and about 72% of the participants in the quantitative study reported that cell phone distractions hampered their academic progress (Ifeanyi & Chukwuere, 2018).

Researchers concluded that students who reported the consistent use of cell phones in the class experienced significant decline in their grade point averages (GPA) by a margin of 0.36 ± 0.08 compared with their peers without cell phones during instruction (Duncan et al., 2012). Based on a quasi-experimental study of college students' technology use, Patterson, and Patterson (2017) concluded that mobile device use in the classroom undermines students' academic performance. In addition, the effectiveness of cell phone use in raising learner engagement and performance was insignificant compared with the outcomes obtainable from using desktop computers and laptops (Miller, 2018). Some studies also reported a negative correlation between GPAs and students' use of cell phones in the academic setting (Chen & deNoyelles, 2013).

On the contrary, conclusions drawn from impact studies indicated that the appropriate integration of technology in classroom teaching facilitates student engagement, attendance, and learning achievement in both reading and mathematics (Sauers & McLeod, 2018). Researchers reported that students demonstrated significantly more positive attitudes toward cell phone integration into classroom instruction compared with desktop computers or laptops (Sung et al., 2016). A strong positive correlation ($\sigma = 0.786$ *and* $r^2 = 0.617$) was observed between cell phone usage for learning and student on-time graduation during a comparative study of how secondary school students' cell phone use impacts their academic performance (Gómez-García et al., 2020). Studies have also supported that mobile technology use for notetaking improves efficiency and speed; however, researchers warned that students are prone to remember less and are likely to be distracted more when online on their devices (Mueller & Oppenheimer, 2014). Researchers have reported significant relationships between teachers' adoption of mobile technology and academic achievement in other correlation studies (Fernández-Batanero et al., 2019; Sung et al., 2016). Teenagers are attached to their phones for social interaction, keeping abreast of news and social media information, and communicating their wellbeing and safety to their loved ones (Schaeffer, 2019).

Learning cognition was impacted by removing cell phone distractions, as reported in a previous study on anxiety and cell phone separation (Lavenda, 2017). Depending on how intricately attached a student is, researchers observed that iPhone separation impacted some students' attention during cognitively demanding tasks (Clayton et al., 2015). Unrestricted access to technological devices during class was negatively correlated with summative indicators of academic performance, such as exam grades and GPAs (Fried, 2008; Sana et al., 2013).

The quality and dynamics of learning behavior are dependent on whether students are afforded self-authorship and volition or whether they are pressured or coerced (Ryan & Deci, 2017). Keane and Keane (2017) submitted that the appropriate integration of technology into classrooms could enhance teaching and learning outcomes. Schools must reckon with the ubiquitous use of smartphones for social interactions, and educators should therefore tap into students' wealth of experience in media and technology use for socio-educational possibilities

(Croteau et al., 2012). Turner (2019) concluded that establishing a learning environment that fosters autonomy, competence, and relatedness can stimulate motivation, creativity, higher performance, and socioemotional wellbeing among students. Kim et al. (2011) submitted that cell phones could impact student engagement, interest, and motivation for learning. In learning environments where teachers incorporated one-to-one personalized device use, students were more motivated, self-directed, and engaged (Varier et al., 2017). Comparable results were obtained in mixed study research of one-to-one technology-driven classrooms that was conducted in New Zealand (Lindsay, 2016). Rather than autocratically banning the use of mobile phones, schools should update their technology reforms to embrace mobile technology for higher student achievement (Gómez-García et al., 2020).

The inseparable dynamics of 21st-century digital natives and their cell phones demand that teachers broaden their knowledge of strategies for adopting smartphones to transform teaching and learning curricula and assessments (Lötter & Jacobs, 2019). Rather than banning cell phones, May (2012) suggested embracing new models of teaching and learning by integrating on-demand learning, digital assessments, and diverse learning management systems with instantaneous feedback. Students' need for and inadvertent use of mobile technology cannot be wished away or denied. Instead, educators and stakeholders should facilitate inclusive dialogues on how to embrace these devices for classroom engagement with fewer distractions (Brooks & Pomerantz, 2017). Keeping up with cell phone use policies that could effectively mitigate disruptions, ethical violations, and inequitable access has been a conundrum for educators who have considered adopting technology integration into their classrooms (Davies & West, 2018; Lockhart, 2016). The need for a robust inquiry into the potential cognitive effects of students' cell phone-related use patterns is therefore imperative (Wilmer et al., 2017).

Test Scores as a Measure of Student Achievement

Standardized tests have become the bedrock of accountability and the main index of student achievement for public schools across the United States. Although supporters of high-stakes testing have argued that it remains the quickest and most objective means of gauging learning outcomes (Ravitch, 1995), others have condemned the pressure that one-off high-stakes test exerts on educators and learners, as well as its lack of alignment with the implemented curriculum and classroom realities (Henry, 2007). The validity of high-stakes tests as a measure of students' growth and achievement is contingent on the extent to which the assessment truly assesses students' ability and knowledge acquired over time (Hawthorne et al., 2015). The Washington state SBA for mathematics is a valid Common Core–aligned examination that gauges high school students' college and career readiness skills (Smarter Balanced Assessment Consortium, 2019). It is important to note that instructional technology is only one of several factors that could interfere with students' performance on high stake assessments (Maarouf, 2022). School differences, student readiness, teacher efficacy, instructional curriculum, and the rigor embedded in assessments are vital for student achievement (Maarouf, 2022; Machucho, 2018).

Potential Confounding Factors Influencing Students' Test Performance

A significant positive correlation was observed between consistent attendance and students' test performance (Cassell, 2007). Student achievement has also been found to be contingent on smaller classroom sizes with low student-to-teacher ratios; schools with overwhelming student-to-teacher ratios struggle with low achievement (Machucho, 2018; Nizamettin & Bekir, 2015). A student-teacher ratio of about 20:1 is the maximum capacity perceived as conducive to effective learning (Glass & Smith, 1978). Researchers observed that students who attended classes continuously improved their test performance by as much as 9% to 18% (Chen & Lin, 2008). Compared with peers from affluent backgrounds, students from low socioeconomic backgrounds perform poorly on high-stakes assessments (Croizet & Dutrévis, 2004). Per-capita income and poverty have the strongest correlation with student achievement (Orlich & Gifford, 2006). The percentage of students earning free and reduced lunch has historically been the indicator of students' socioeconomic statuses, as the United States Department of Agriculture's Food and Nutrition Services provides free lunch programs to students from households earning below 130 % of the poverty threshold for family income. Meanwhile, those from households earning between 130% and 185% of the poverty level are provided with subsidized/reduced lunch prices (The United States Department of Agriculture, 2013).

The proportion of teachers with advanced degrees and relevant teaching qualifications impacts student achievement, with the effect being more prominent on mathematics tests than in reading (Clotfelter et al., 2007). Students from low-income backgrounds are less likely to have access to high-quality resources and highly qualified teachers (Wilson, 1997). Lower test scores among struggling English learners and special education (SpEd) students impact the overall test scores in K–12 schools, meaning that the higher the percentage enrollment of special needs students, the poorer the school test scores (Crain, 2019). A strong correlation exists between race and students' exam performance, with a higher proficiency reported among White and Asian students, while a higher population of African Americans and other racial minorities correlates with lower test scores (Wilson, 1997).

Other interacting variables, such as curriculum structure, teaching methods, and parental involvement, are also considered influential variables in determining student achievement on high-stakes tests (Silva, 2020). Student motivation and effort interfere with test performance and achievement (Hawthorne et al., 2015). An enacted cell phone use policy or cell phone restriction mediates both the learning environment and students' motivation, which are both critical determinants of achievement (Doree, 2019; Mockus et al., 2011). Researchers observed that students from cell phone permissive classrooms failed by as much as half a letter grade lower when they attempted to multitask with their devices during instruction (Ladieri, 2018). When researchers controlled for self-efficacy and previous academic achievement, distractive cell phone use correlated with lower test scores in the classroom (Felisoni & Godoi, 2018). The task-switching habits of students who are attempting to learn and text or use social media were negatively correlated with their test scores (Wood et al., 2012). However, results from an experimental study indicated that no significant difference existed between the cognitive learning of students in permissive and restrictive cell phone use learning environment (Lancaster, 2018).

Chapter Summary

This study aimed to fill research gaps in examining the impact of cell phone use policies on student achievement. This research used the constructivist learning theory to convey the cognitive and affective learning effects of permissive cell phone use, such as BYOD (Zohri & Laghzaoui, 2015). The self-determination theory (SDT) was also employed to explain the effect of autonomy versus control on learners' motivation to adopt sustained behavioral changes (Deci & Ryan, 2002). This study aimed to impact the growing body of literature on the dynamics of cell phones in the classroom by conceptualizing the topic via contrasting prohibitive cell phone use policies with the integrative permissive use of cell phones for instructional purposes. The causal-comparative design of this research is suitable for examining the relationships between a dependent and an independent variable when it is impossible to assign participants to control experimental groups (Salkind, 2010). This study explored if significant differences existed between students' test performance on the 2018-19 Washington state SBA for math based on the cell phone use policy enacted in the selected high schools.

Chapter 3: Research Methodology

Managing the invasion of mobile phones across classrooms constitutes a conundrum for teachers in the 21st century (Bennett, 2019). Although the benefits of integrating cellular devices into teaching are well documented in pedagogy, teachers' perspectives vary widely regarding the levels of cell phone restriction necessary during instruction (Berry & Westfall, 2015; Thomée, 2018). Although some teachers claim that their cell phone prohibition policies have enhanced students' academic performance (Beland & Murphy, 2015), others promote adopting smartphone technology for teaching and learning, such as the popularized Bring Your Own Device (BYOD) policies (Ahmad, 2020). The notion that prohibiting cell phone use in class would efficiently redirect students' attention and result in higher academic gains has motivated teachers to attempt various mobile technology use policies (Weimer, 2018).

The problem is that no specific cell phone use policy has been proven to guarantee higher learning outcomes among young adolescents (Odgers, 2018). The association between enacted cell phone use regulations and student achievement requires an in-depth examination (Guldvik & Kvinnsland, 2018). Although researchers have reported a statistically significant difference in student engagement based on cell phone use policies, no statistically significant difference was observed between the academic grades in classrooms with cell phone bans and others with permissive usage policies (Hutcheon et al., 2019). A difference in students' demonstration of learning outcomes based on the cell phone policies enacted in their classrooms is not well documented and should be investigated for effective policy and decision-making (Tetzlaff, 2017).

The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. This study examined the difference between the standardized test scores achieved in schools with prohibitive cell phone use policies and schools with permissive cell phone use policies, such as BYOD. The independent variable in the study was the implemented cell phone policy (prohibitive or permissive), and the dependent variable was high school students' standardized test performance on the 2018-19 10^{th}-grade SBA for mathematics. A research question was posed to espouse the purpose of this causal-comparative study.

Research Question: Does a statistically significant difference exist between the aggregate math test scores of high schools with prohibitive cell phone policies and other high schools with permissive cell phone use policies based on the 2018-19 10^{th}-grade SBA?

This causal-comparative study also tested the following hypotheses:

H1o: No statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10^{th}-grade SBA from 2018-19.

H1a: A statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10^{th}-grade SBA from 2018-19.

Research Methodology, Design, and Rationale

This research study employed a quantitative methodology because the multifaceted nature of the topic required empirical data to assess differences among the hypothesized variables. The quantitative methodology lends itself to statistical analysis, thereby allowing researchers to assign numerical values to differences between groups. By assigning numerical values to the data collected, the quantitative methodology standardizes data for researchers to make statistical comparisons and to draw inferences for generalizing findings to a larger population (Madrigal & McClain, 2012). A causal-comparative design was employed for this study because this design was suitable for examining the differences existing with one independent variable between two or more groups retrospectively. When the random assignment to groups is impossible, the causal-comparative design simply helps researchers examine differences in the variable of interest among pre-existing or naturally occurring groups (Gay et al., 2012).

In contrast to a true experimental design aimed at drawing causal conclusions regarding relationships between constructs by systematically manipulating the independent variable, the causal-comparative design is conducted when it is impossible to manipulate the intervening to assess outcomes (Schenker & Rumrill, 2004). Therefore, causal-comparative studies are conducted to assess the magnitude of differences between intact groups that are pre-existing based on the desired variable being studied without any attempt to infer causal connections. In this study, as it was not feasible to experimentally manipulate the schools allotted to permissive or restrictive cell phone use policy groups, only schools fitting strict inclusionary criteria were selected. Instead of drawing inferences regarding cause and effect, this design examined only group differences in test performance (Salkind, 2010). Researchers conducting a similar study relating cell phone usage and academic performance intentionally controlled for known predictors of student performance. The purposive selection of schools fitting a strict inclusionary criterion, such as racial and ethnic makeup, school enrollment size, teacher qualification, special education, and English learner profile, and similar student-teacher ratio limited the potential influence of confounding variables. Although the causative relationship between the independent and dependent variables was more or less suggestive than proven (Johnson, 2000), the goal of the causal-comparative design is purely to explain differences between identified groups based on the variable of interest (Fraenkel & Wallen, 1996), which was students' aggregate test scores on the 10th-grade SBA math in 2018-19.

The Role of the Researcher

As the primary researcher in this study, I had no previous experience or affiliation with any of the selected schools in Washington state. The Office of the Superintendent of Public Instruction (OSPI) was contacted, and site permission was granted to access the school-level aggregate 10th-grade math test scores for 2018-19 in Washington state (see Appendix B). The OSPI list of schools was reviewed to ensure that all high schools matched the defined inclusion criteria for this study. The archived electronic student handbook for each of the selected schools was accessed to identify the 2018-19 cell phone use policy. School administrators, departmental heads, and other knowledgeable staff members were contacted electronically and by phone to corroborate the advertised cell phone policies using a scripted single-item multiple choice question to categorize schools as either permissive or prohibitive based on the prevalent cell phone use policies implemented in 2018-19 prior to the SBA administration (see Appendix A). For this study, all forms of cell phone allowance in the classroom were tagged as permissive, including BYOD with regulated with cautionary or discretional limitations, as well as laissez-faire cell phone use policies with no intention to regulate students' cell phone access. Any high school with stringent warnings about stowing phones away was considered prohibitive, regardless of the levels of disciplinary consequences advertised. All archived data accessed for the study were screened to ensure the removal of any identifiable and traceable information.

The Research Procedure

The research procedure entails the target population and sampling methods utilized for selecting the sample for this study, the archival data which served as the instrument for this research, and measures taken to clean and prepare data for analysis.

Population and Sample Selection

The sample population for this study included 65 selected high schools in a Northwestern region of the United States with a myriad of restrictive and permissive cell phone use policies. Purposeful sampling is recommended when researchers seek to examine a phenomenon of interest among information-rich groups of individuals that are clearly defined by the attribute (Cresswell & Plano Clark, 2011; Palinkas et al., 2015). Purposive sampling entails the exclusive selection of respondents based on the possession of the specific traits being studied. The delineation of participants by the desired categorical characteristics for recruitment in a purposive sample makes this method less costly than sampling an entire population (Andrade, 2021).

The participating schools and students were not randomly selected due to the difficulty, time, and cost associated with designing experimental groups. However, the threats to the validity of purposive sampling can be ameliorated by intentionally selecting homogenous groups based on the selection criteria (Salkind, 2010). The inclusion criteria were urban/suburban high schools with student populations between 1,000 and 3,000. The selected schools had less than 25% ethnic minorities (specifically, the total percentage of African American and Hispanic students). The average student attendance for the selected schools was greater than 70% and less than 10% of students at the high schools chosen had any disciplinary record. The mean classroom sizes were less than 25 students, and the average teaching experience of the faculty was at least eight years. No more than 40% of students at the chosen schools qualified for the free and reduced lunch programs. Also, less than 20% of the students qualified for special education services and less than 10% of population were English language learners. It was also stipulated that each high school selected had at least 60% proficiency on the 10th-grade reading English language arts. Teacher implementation of the school-wide cellphone use policy was at least a moderate. The geographical sites for this study were in Washington state, where many students are White (53.3%), Hispanic students make up 23.4% of the population, Asian students represent about 7.9% of the population, and Black students represent only 4.5% of the public schools' population (Duffin, 2021). Minority students are often classified as students from diverse racial and ethnic backgrounds when observed to be fewer in population size in comparison with their White peers; this includes, but is not limited to, Black, Hispanic, Pacific Islander, and American Indian/Alaska Native students, as well as students from mixed races (National Center for Education Statistics, 2020).

About 1,016 high schools exist throughout the state, 884 of which are public schools (National Center for Education Statistics, 2016). Out of the 884 public high schools in Washington state, 65 schools were selected for similarities in their enrollment sizes; geographical, socioeconomic, and demographic composition; and the use of the same standardized state assessments.

Research Instrument

This research instrument for this study was the publicly available archived data on the Washington state 2018-19 10th-grade SBA scores for each high school selected. Although individual student SBA test scores were reported on an interval scale ranging from 2000 to 3000, the publicly available aggregate school level SBA math score is a percentage that espouses how many students met the 2,614-threshold set for performance demonstrating college and career readiness (Smarter Balanced Assessment Consortium, 2021). This school-level SBA aggregates score is a continuous variable that espouses the percentage of students who are performing at Levels 3 and 4, meaning that scores represent the percentage of students who demonstrate either an adequate or a thorough mastery of the mathematics competencies required for success in college and careers as stipulated by the Common Core state standards (Smarter Balanced Assessment Consortium, 2013). Although the ranked student-level data are preferred, the use of aggregate school-level scores that define group means as a continuous variable can equally yield robust results, where the heterogeneity of group treatment is controlled (Jacob et al., 2014). The SBA 10th-grade math score is a dichotomous group mean (a continuous variable stated in percentage form) and depicts how many students hit or missed the threshold benchmark for college and career readiness.

Electronic permission was secured to modify a pre-existing validated national survey of school cell phone use policies (Obringer & Coffey, 2007) into a single-item multiple choice script for school administrators to identify their 2018-19 cell phone policies (see Appendix C.) The public high schools selected advertised their enacted cell phone use policies in the student handbook annually. The scripted multiple-choice script was not a survey instrument for recruiting participants; it was solely used to confirm the publicly available records in the student handbook regarding the schoolwide cell phone use policy implemented at the selected schools in the 2018-19 school year.

Data Collection

Aggregate scores for the 2018-19 SBA in 10th-grade math (geometry) were obtained from the Office of the Superintendent of Public Instruction (OSPI), which is publicly available on the department of education's website. Following institutional review board (IRB) approval, informed consent letters were electronically disseminated to the high school instructional coaches, 10th-grade counselors, department chairs, mathematics teachers, and administrators of each school by email, along with a link to a single-item multiple choice survey to clarify their prevalent schoolwide cell phone use policies for the 2018-19 calendar prior to the COVID-19 pandemic. This electronic informed consent request and survey were followed up with reminder phone calls, during which the informed consent was read verbatim to both educators and administrators, who had significant knowledge of the pre-COVID classroom policies. Archived aggregate 2018-19 10th-grade SBA math test score data were obtained from the OSPI public record for 65 schools that matched the selection criteria.

Data Preparation and Cleaning

All responses from the single-item school survey of cell phone policy were coded on an SPSS spreadsheet. All de-identified test score data were coded for each high school using an SPSS spreadsheet. The responses were used to screen schools for their eligibility to be included in the study. A three-column Excel spreadsheet was used to tabulate data for this study, including a column for de-identifier codes for each high school, another column for their confirmed 2018-19 cell phone use policy (prohibitive vs. permissive), and a final column for their 2018-19 aggregate math SBA test scores.

Data Analysis

The posed hypothesis was analyzed using an independent *t*-test for significant differences in the standardized test scores between schools given their implementation of permissive versus prohibitive cell phone use policies. Data were analyzed using SPSS analysis software. A *t*-test is considered to be a robust test when the goal is to assess if a difference exists in the test performance between two samples from a population with a normal distribution (Moore et al., 2013). The independent *t*-test is a parametric test that is contingent on six fundamental assumptions, including the two distinct independent groups with prevailing independence of observations, the assumption that the dependent variables exist on a continuous scale, the pre-requisite of no significant outliers, the assumption of an approximately normal distribution of data, and the requirement of the homogeneity of variance (Kim & Park, 2019).

To ensure the independence of the categorical variable's, which was the cell phone use policy, all 65 schools selected for this study were contacted to verify if the implemented cell phone use policy was either prohibitive or permissive as a criterion for inclusion in this study. Their selection was corroborated with their published schoolwide cell phone use policies. The 2018-19 SBA math scores was the dependent variable for this study. The 10th-grade SBA math scores were measured on a continuous scale. The 2018-19 SBA math test scores for all selected high schools were vetted and plotted on box and whisker plots to identify and eliminate any school with scores that were outliers in the study.

Although the independent *t*-test is considered robust for a moderate deviation from a normal distribution, a Shapiro-Wilk test was performed on SPSS to verify normal distribution of the SBA 2018-19 test scores. Levene's test was also performed on SPSS to ensure the homogeneity of variance (Laerd Statistics, 2018). Using an optimum sample size increases the power of the normality test and enhances the reliability of a *t*-test (Kim & Park, 2019). A sample size calculator was used to determine that 65 schools was sufficient for a 90% confidence interval and no greater than a 10% margin of error, given a total of 884 existing high schools in Washington state. The student population, the demographics, and the percentage of each cell phone use policy type were illustrated descriptively using tables and charts. The data for the *t*-test were displayed on tables to show the statistical significance, means, standard deviation, and standard errors for the test of means between subjects. When comparing the group means of two distinct samples for a statistically significant difference in an observed variable of interest, an independent *t*-test is required (Mishra et al., 2019).

Reliability and Validity

The research instrument for this study was the 2018-19 archived data for the 10th-grade math test scores on the SBA in Washington state. The SBA is a valid and reliable standardized assessment that aligns with the Common Core State Standards (Smarter Balanced Assessment Consortium, 2019). The high school assessment has a marginal reliability estimate of 0.925, and it was reported as being a fair and internally consistent assessment of college and career readiness for diverse student populations (Smarter Balanced Assessment Consortium, 2020).

Purposive sampling was used to select the participating schools for this study. This sampling method involves the exclusive selection of respondents known to possess the specific traits being studied. Additional measures will be taken to safeguard the validity and reliability of this non-probabilistic sampling procedure. A lack of randomization incited biases and limited the findings' generalizability to the entire sampling population (Topp et al., 2004). Despite the inherent intentional bias, purposive sampling has been reported to yield robust and reliable results (Lewis & Sheppard, 2006). Although this study's internal validity might be threatened due to the lack of randomization in the sampling of targeted high schools, the threat to the validity of purposive sampling was ameliorated by intentionally selecting homogenous groups based on the selection criteria (Salkind, 2010). All 65 schools in the study sample were homogeneous groups based on clearly defined selection criteria. Utilizing diverse stringent inclusionary criteria enhanced the homogeneity and mitigated the threats to internal validity (Porzsolt et al., 2020). With strict inclusionary criteria, a balance between internal and external validity was improved, thereby limiting the tendency of other confounding variables to impact the SBA 10th-grade math test performance (Palinkas et al., 2015). The credibility of the archived SBA test score data was verified by cross-checking the archived district school test scores with those of the Office of the Superintendent of Instruction (Devault, 2019; Tongco, 2007).

The sample size should not be too small to ensure the plausibility of making extrapolations from findings. In addition, it should not be too large to avoid exaggerating the statistical differences detected (Faber & Fonseca, 2014). Through standardizing the sample size and statistical analysis in purposive sampling, reliability and validity could be enhanced. Sample size calculators were recommended to avoid undermining internal and external validity (Blackford, 2017). An online sample size calculator was used to establish 65 high schools as an optimum sample size for this study, given a 90% confidence ratio and a margin error of 10% (Qualtrics, 2020). Variability in the study population is beyond the control of any researcher; however, with meticulous data collection and optimum sample size, the propensity for variation in findings can be ameliorated. The margin of error is minimized with an adequate sample size (University of California, Los Angeles, 2010).

The independent *t*-test analysis employed in this research study is considered to be robust as long as the tested groups are not significantly different in size (Rusticus & Lovato, 2014). Utilizing equal sample sizes is recommended to lower the chances of a Type I error and to increase the statistical power of the *t*-test (Salkind, 2010). If the sample sizes in both categories are equal, the *t*-test is very robust against unequal sample sizes (Overall et al., 1995). However, an equivalent number of high schools could not be established for each category of cell phone use policy (prohibitive vs. permissive). Alternatively, Welch's *t*-test, which is a non-parametric test, was employed for data analysis because equal sample sizes were not obtainable for this study (Larkens, 2015).

The single-item multiple choice verification of the schoolwide implementation of the advertised 2018-19 cell phone policies was disseminated by telephone and email (See Appendix A). This multiple-choice script was validated through pilot studies and peer-reviewed by a panel of subject matter experts (SMEs) (Holler, 2019). The first two choices on the survey were categorized as prohibitive cell phone use policy, whereas other variants selected were deemed permissive cell phone use policies.

Ethical Procedures

When one is conducting research, precautionary measures must be taken to protect the integrity, wellbeing, and rights of the participants, as well as those of the groups represented in the study (Pisani et al., 2016). Risks must be reasonable in relation to the study's importance; the researcher's need to advance knowledge cannot undermine the protection of subjects from harm (Fischer, 2006). The findings of this study, as well as any inferences made regarding the beneficial or detrimental impact of cell phone use policies, did not become instrumental in the evaluation of any of the selected schools. All test scores from the archived data were de-identified, and the single-item surveys utilized to clarify the selected schools' cell phone use policy were anonymized to protect the privacy and confidentiality of all high schools selected for this study. The autonomy of the participants should be integral to a study's research design and should be communicated through informed voluntary consent (Varkey, 2021). Valid informed consent requires the full disclosure of the research study's purpose and intentions, the voluntary assent to participate or withdraw at will, steps taken to ensure privacy and confidentiality, and opportunities for researchers to ask questions or access research outcomes (Shah et al., 2021).

Although the archival data of all high schools in the study site are publicly available online, site permissions were secured from the district and the OSPI to utilize these existing data for this research. No known conflict of interest existed for this research study. To avoid any inordinate pressure to influence research outcomes, the site permission and intent letter for this research unequivocally stipulated that this study was solely an anonymous causal-comparative study of standardized test performance between diverse cell phone use policies, forestalling any premonition of an external audit of schools' cell phone policies. During the reporting of the research findings and the publishing of the results, all survey responses and school test data were coded with anonymity to protect the selected schools' confidentiality.

Chapter Summary

Cell phones have become an inevitable conundrum across the globe and are becoming pervasive in the classroom. The notion that prohibiting cell phones use in class will redirect students' attention efficiently and result in higher academic gains has driven several schools to attempt a myriad of cell phone use policies, including prohibition and the permissive integration of cellular devices, such as BYOD (Weimer, 2018). The impact of cell phone use regulation on students' performance requires a closer examination to inform effective decision-making (Lee et al., 2017). The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. This study utilized publicly available test scores for Washington state high schools that implemented permissive or prohibitive cell phone use policies before the COVID-19 pandemic. The use of 2018-19 policies and data was imperative due to the unprecedented shift in the technological landscapes of public schools since the

COVID-19 pandemic (Vegas & Winthrop, 2020). About 65 schools were sampled from a total population of 884 high schools. An independent *t*-test was used to test for significant differences among aggregate math test scores between schools with prohibitive cell phone use policies and other schools with permissive cell phone policies, such as BYOD.

The subsequent section of this dissertation includes the descriptive and inferential analyses of data, including the testing of assumptions and hypotheses on a 95% confidence interval. The results of the descriptive analyses were displayed on tables and charts, while the findings from the inferential analyses of the archival data obtained in this study were elaborated on box and whisker plots, normal distribution curves, and q-q plots. Based on the p-values obtained, conclusions were made regarding rejecting the stated null hypotheses for the parametric and non-parametric tests conducted. The reliability and validity of the results obtained were also discussed in detail.

Chapter 4: Research Findings and Data Analysis Results

Mitigating the insidious distractions that cell phones incite in the learning environment has remained a topical issue for educators in the 21st century (Kraft & Monti-Nussbaum, 2021). Some researchers have attenuated the impact of restricting cell phones on learners' academic achievement (Beland & Murphy, 2015), whereas some other studies have documented increased academic proficiencies due to inclusive cell phone policies, such as the renowned BYOD reforms in public schools (Ahmad, 2020). A lack of the convergence of empirical evidence to validate the influence of cell phone use on students' test performance in mathematics classrooms calls for extensive research (Tetzlaff, 2017).

The problem is that no specific cell phone use policy has guaranteed the attainment of higher learning outcomes among young adolescents (Odgers, 2018). The association between enacted cell phone use regulations and student achievement requires an in-depth examination (Guldvik & Kvinnsland, 2018). The purpose of this causal-comparative quantitative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. The methods of data collection for this study will be elaborated. The procedure for analyzing the data and results obtained will also be discussed, along with the reliability and validity of the findings.

Data Collection

This quantitative causal-comparative study utilized archival electronic data. Site permission was approved to access school-level data from the Public Record Office of the Washington State OSPI (see Appendix B). Archived 2018-19 continuous school-level data were retrieved for 75 public high schools from the OSPI website, including school demographic data and SBA test scores. Site permissions for de-identified student data were obtained from three school districts for nine of the schools (see Appendix B). Some strict inclusionary criteria were defined apriori for selecting the high schools that were as closely homogenous as possible for this study. This included the following: less than 25% were ethnic minorities (specifically, the total percentage of African-American and Hispanic students); the average student attendance was greater than 70%; less than 10% of the students had disciplinary incidence records; classroom sizes were less than 25 students each; the average teaching experience of the faculty was at least eight years; not more than 40% of students qualified for the free and reduced lunch programs; less than 20% of the students qualified for special education services; less than 10% of the students were English language learners; and the 10th-grade proficiency score in reading English language arts was at least 60%. Although the statewide classification of minority students on the OSPI archival data was inclusive of all non-White students in the state of Washington, this study accounted for only the percentage of Black and Hispanic students in its inclusion criteria. Researchers have emphasized that Black and Hispanic students account for the most underserved group and are marginalized by the academic achievement gap (Carnoy & García, 2017; Shockley, 2021).

From the compiled list of 75 public high schools that met the two criteria of the enrollment size and having an English language reading proficiency greater than 60%, 10 high schools were excluded for not meeting one or more of the remaining strict inclusionary criteria, given that they had more than 10% English learners, more than 25% ethnic minorities, or greater than 40% of students qualifying for free and reduced lunch (the federal threshold qualification per Title 1). Initially, the designated criterion for inclusion in the study was 25% or less for free and reduced lunch program eligibility. However, only 30 schools met this strict inclusionary criterion of less than 25% of students on free and reduced lunch programs, so the stipulated indicator of socioeconomic status was adjusted from 25% to 40% on free and reduced lunch programs, which also matches the federal description of low income for Title 1 eligibility (Dynarski & Kainz, 2015). An approved adjustment of the inclusion criteria to include schools with less than 40% of their students qualifying for free and reduced lunch led to 65 high schools as the final sample size (see Appendix D).

The cell phone use policies at the 65 high schools selected were assessed via their archived and current student handbooks. In addition, a voluntary single-item survey was electronically sent by email to the school administrators of each school for corroborating their advertised 2018-19 cell phone use policies (see Appendix A). Only a 2% response rate was achieved from the single-item multiple choice survey that was electronically sent to schools to clarify their prevalent schoolwide cell phone use policies for 2018-19. The voluntary survey was resent electronically to the high school instructional coaches, 10th-grade counselors, department chairs, and mathematics teachers, who had significant knowledge of the pre-COVID classroom policies. This reminder was followed up with direct phone calls to the selected knowledgeable staff or administrator, during which phone use categories were read verbatim to teachers, department leads, or responding counselors for the selection of the prevalent 10th-grade cell phone use policies for each high school. The policies were furthermore identified through follow-up phone calls that were placed over a span of the three-week period from January 20, 2022, to February 11, 2022. The archived 2018-19 SBA test scores and data collected on the variables in the inclusionary criteria were also arranged on the Excel spreadsheet. Data were de-identified by alphanumeric codes, scrutinized for outliers, and arranged by columns with labels in preparation for the descriptive and inferential analyses.

Data Analysis and Results

The raw data obtained from the OSPI website was arranged on an Excel spreadsheet. The collected data were first de-identified using alphabetical and numerical codes. The prevalent pre-COVID-19 cell phone use policies for 2018-19 were grouped into two categories, permissive or prohibitive, based on the severity of the consequences and the fidelity of adherence to zero-tolerance or inclusive BYOD policies. The de-identified school data were then sorted by Code 1 for permissive and Code 2 for prohibitive. The continuous variables on the demographics and the de-identified SBA test scores were differentiated into two distinct colors (green for permissive and red for prohibitive). These sorted data were imported from the Excel CSV file into SPSS. Descriptive data and inferential statistics tests were analyzed on SPSS.

Descriptive Analysis

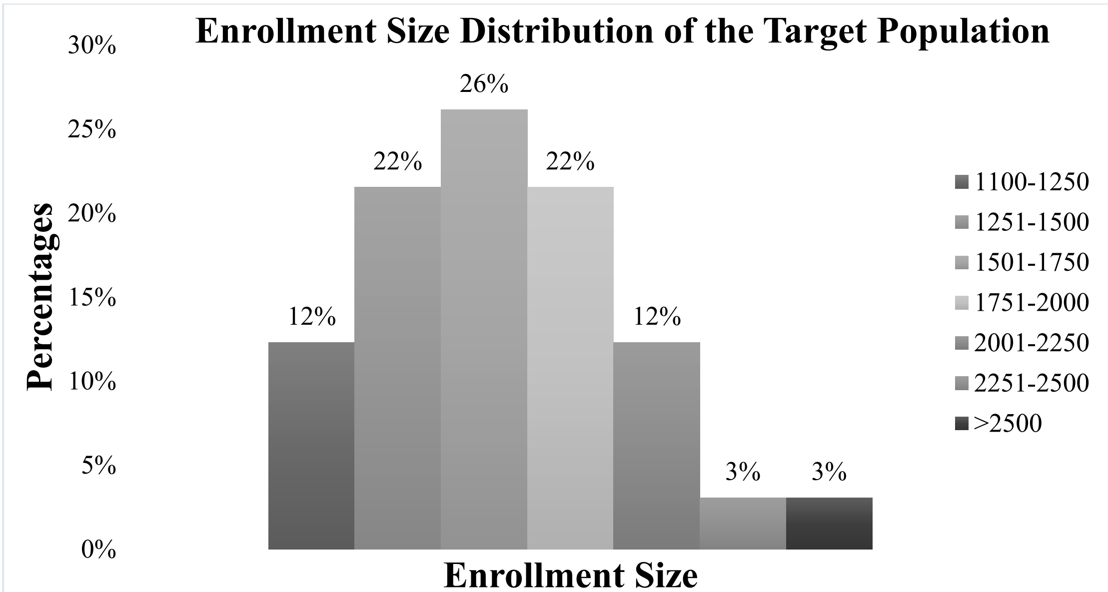
The inclusionary criteria for selecting the schools in this study were analyzed descriptively using histograms, circle graphs, and frequency tables to discuss the school-level characteristics, student demographics, cell phone use policies, and SBA test performance.

School-Level Characteristics

The enrollment size of all 65 high schools in the study sample ranged from 1,124 students to 2,677 students. Many of the high schools selected (72%) had between 1,250 and 2,000 students in the 2018-19 school year (see Figure 1).

Figure 1

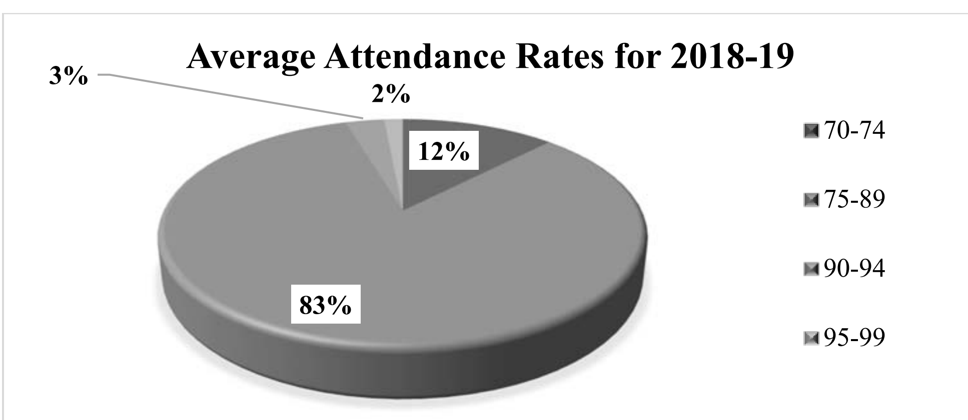
Enrollment Size Distribution of High Schools in the Target Population



The average classroom size for schools in the study was about 18 students. Only few schools (22%) had more than an average of 20 students per classroom. About 87.7% of the selected high schools indicated consistent attendance rates, with only fewer than one-fourth of their students missing more than two instructional days per month in 2018-19 (see Figure 2).

Figure 2

Average Daily Attendance Rates for Students Throughout the 2018-19 School Year

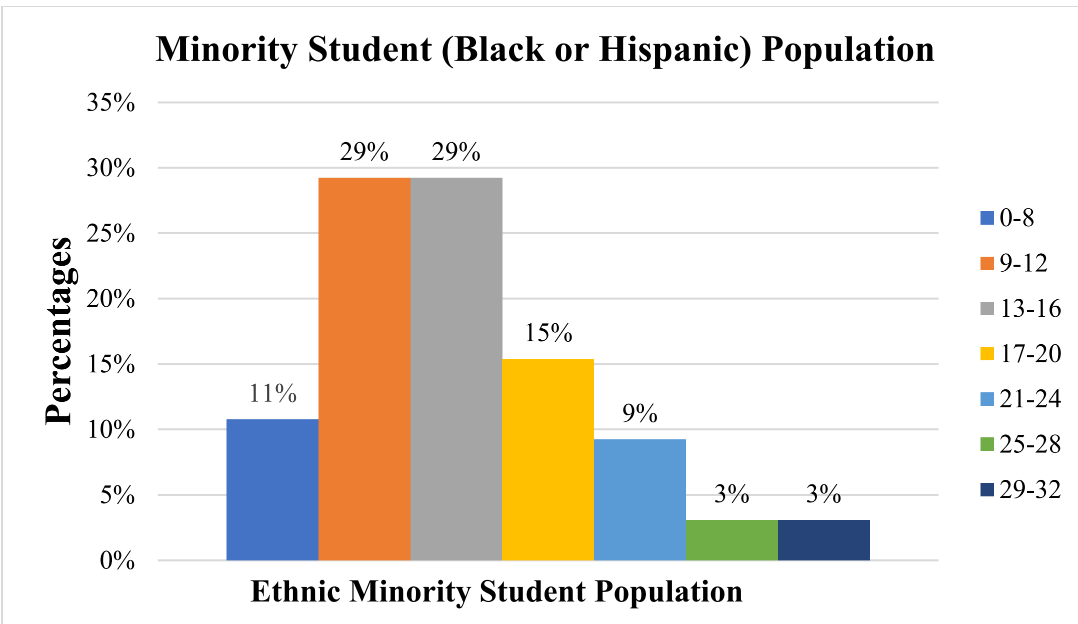


Student Demographics

On average, African American and Hispanic students accounted for only 15% of the entire student population in the selected 65 high schools for this study. Most of the schools selected (85%) had fewer than 20% Black or Hispanic students in 2018-19 (see Figure 3). The percentage of students who faced exclusionary disciplinary actions (suspension and expulsion) was low across the selected schools. About 91% of the high schools in the sample population had only 0–5% exclusionary disciplinary incidences recorded.

Figure 3

The Distribution of Black and Hispanic Minorities in the Target Population in 2018-19

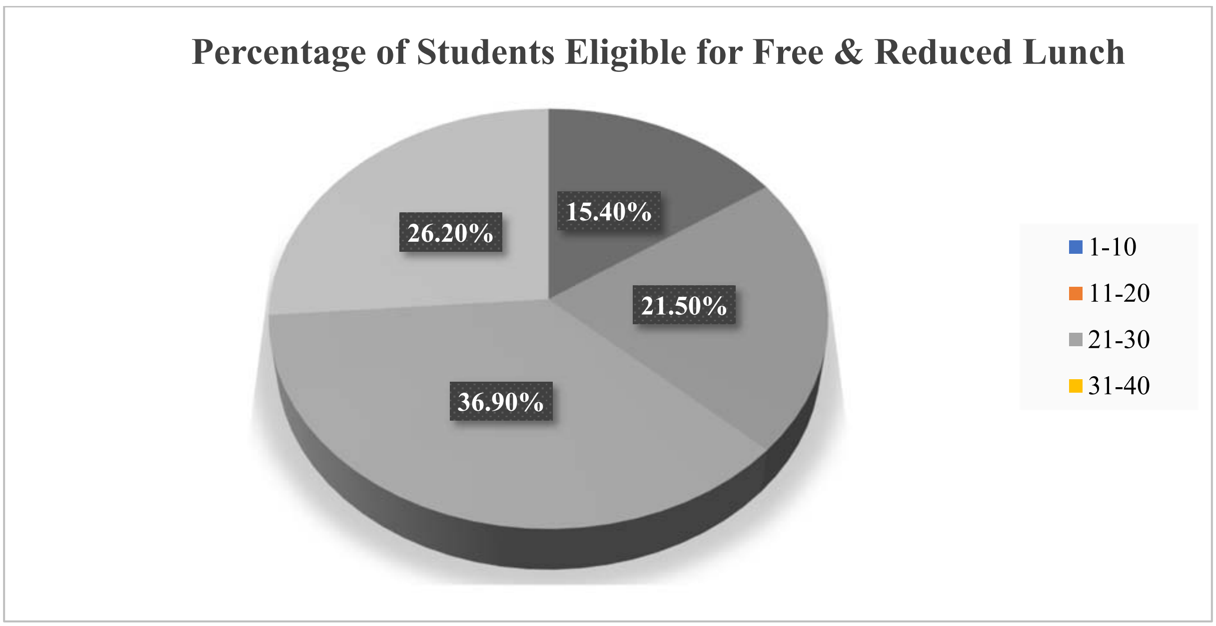


Note. Although the OSPI's ethnic minority demographics include Asian, Native Hawaiian, Native Americans, and Pacific Islanders, only the percentage of African American and Hispanic students are of interest to the inclusionary criteria defined for this study.

None of the selected high schools in this study qualified as a low-income Title 1 school, which the United States Department of Education defines as a school where 40% or more of the student population is eligible for free and reduced lunch by family income (Dynarski & Kainz, 2015). The average proportion of students qualifying for free and reduced lunch programs across all 65 high schools was 23%. About 74% of the high schools had fewer than 30% of their students eligible for the free and reduced lunch programs (see Figure 4).

Figure 4

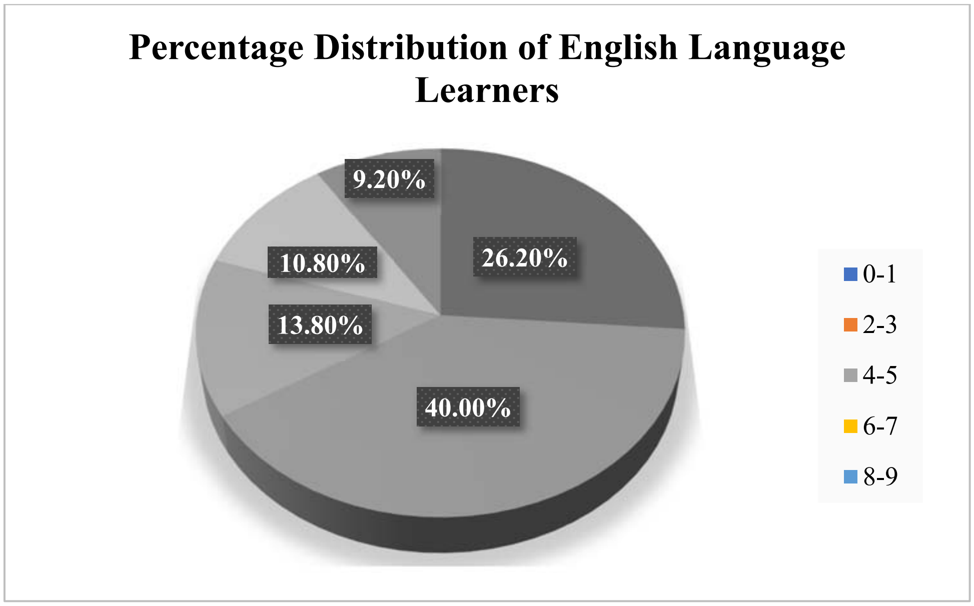
Students' Socioeconomic Status Measured by Free and Reduced Lunch Eligibility in 2018-19



Most students at the selected schools were proficient or native English speakers. The average English learner enrollment was about 3.7% across the selected schools. English language learners represented only fewer than 5% of the entire student body in the majority (80%) of the selected high schools in this study (see Figure 5).

Figure 5

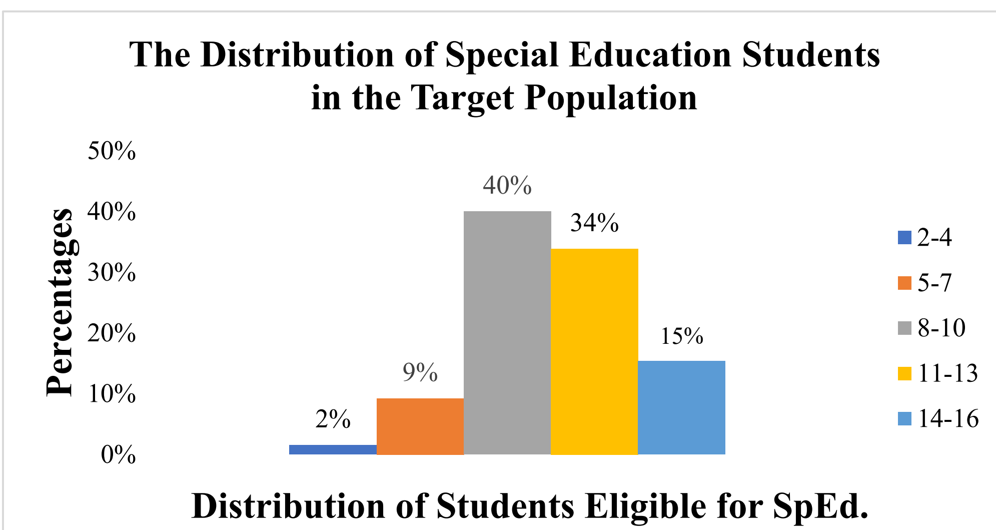
The Percentage Distribution of English Language Learners in 2018-19



The average share of students receiving special education services across the 65 high schools selected was only about 11%. More than half of the schools in the sample had fewer than 10% special education needs among their enrolled students in 2018-19 (see Figure 6).

Figure 6

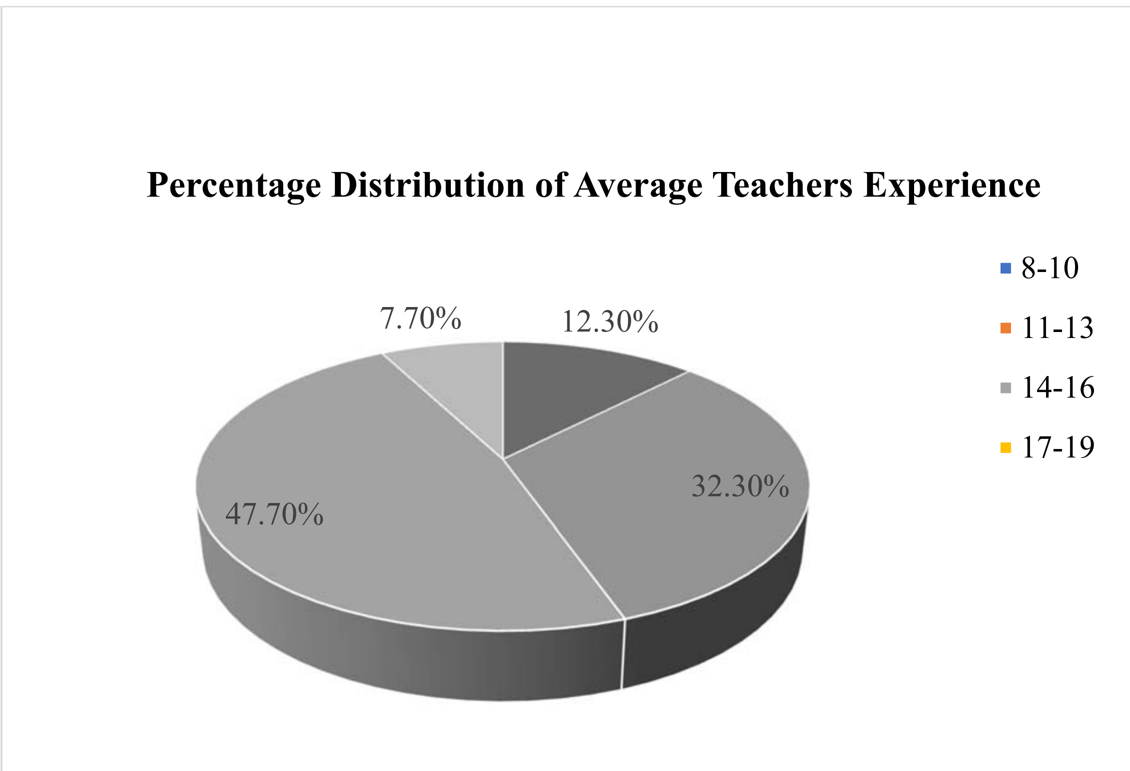
The Percentage Distribution of Special Education Students in 2018-19



About 88% of the high schools selected had more than 10 years recorded for their teachers' average professional teaching experience (see Figure 7). The average proficiency rate on the 10th-grade SBA in English language Arts across the 60 high schools selected for this study was about 82%. In contrast, the average performance on the 10th-grade SBA mathematics test was 57%.

Figure 7

Teachers' Average Length of Teaching Experience

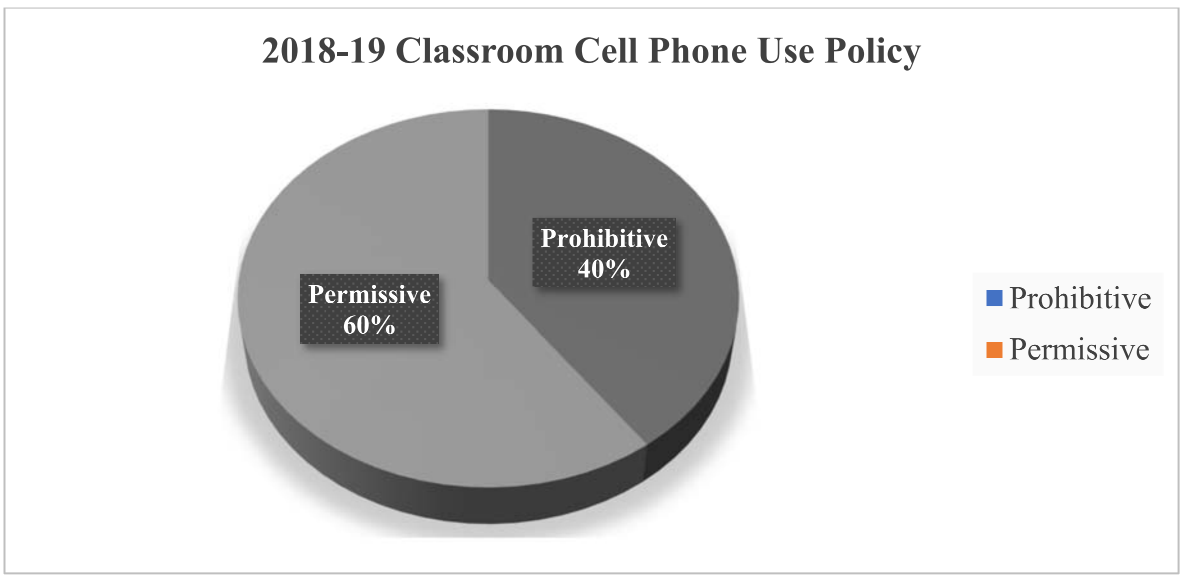


Classroom Cell Phone Use Policy

About 60% of all the 65 high schools implemented one form of permissive cell phone use policy in 2018-19, including BYOD, teacher discretion and laissez-faire or non-existent policy. The remaining 26 schools (40%) outrightly banned and prohibited cell phones in the instructional areas, and they stipulated progressive disciplinary actions to punish students who hesitated to comply with their schoolwide prohibition (see Figure 8). About 42% of the high schools had fluid policies, leaving the decision to restrict or allow cell phone use on a case-by-case basis among teachers. At least three of the high schools in the study population gained public attention, and some were applauded for outrightly banning cell phones before the COVID-19 pandemic. They did this by providing caddies and lockers for all cell phones to be completely stowed out of sight before students entered instructional areas of the school (Dornfeld, 2019; Henry, 2018; Philipose, 2019).

Figure 8

The Distribution of Cell Phone Policies Across the Target Population



The demographic characteristics were disaggregated by the categories of classroom cell phone use policy. The mean SBA English language arts test proficiency score for schools with prohibitive cell phone use policies was 82.17%, whereas the average ELA proficiency of the permissive use policy in high schools was 81.59%. The math scores at schools with cell phone bans averaged about 56.88%, whereas SBA math scores at high schools permitting cell phone use in the classroom averaged 56.83% with a standard deviation of about ±12.96, which indicates about two percentage points less variability in math scores across classrooms where cell phones were outrightly prohibited (see Table 1).

Table 1

Sociodemographic Characteristics of High Schools in the Target Population

	Permissive Policy		Prohibitive Policy		Full Sample	
	*M**	*SD*	*M**	*SD*	*M**	*SD*
English Lang. Scores	81.59	±7.19	82.17	±6.51	81.82	±6.88
Mathematics Scores	56.83	±12.96	56.88	±10.88	56.85	±12.08
Attendance	81.94	±5.64	80.83	±5.15	81.49	±5.43
Discipline Rate	3.28	±1.95	3.26	±2.04	3.27	±1.97
Class Size**	18.44	±2.95	18.12	±2.42	18.31	±2.74
Teacher Experience**	14.25	±2.25	13.75	±2.66	14.05	±2.41
Ethnic Minority	14.01	±5.10	16.47	±5.97	14.99	±5.55
English Learner	3.24	±1.98	4.44	±2.77	3.72	±2.38
Free Reduced Lunch	23.20	±10.24	22.12	±9.92	22.77	±10.05
Special Education	10.68	±2.66	10.90	±2.80	10.76	±2.70

Note. * Mean in percentages except stated otherwise. ** Raw units, and not in percentages

The average disciplinary infraction rate was about 0.02 less at schools with prohibitive cell phone use policies than at other high schools with permissive use. With a mean attendance rate of 81.94%, student truancy was about 0.11 percentage points higher at schools with prohibitive cell phone bans. Schools implementing the strict prohibition of cell phones had a

2.46-percentage-points-higher average distribution of Black and Hispanic minority students and enrolled an average of 1.20 percentage points more English learners than contemporary high schools with permissive cell phone use policies did.

Inferential Statistics

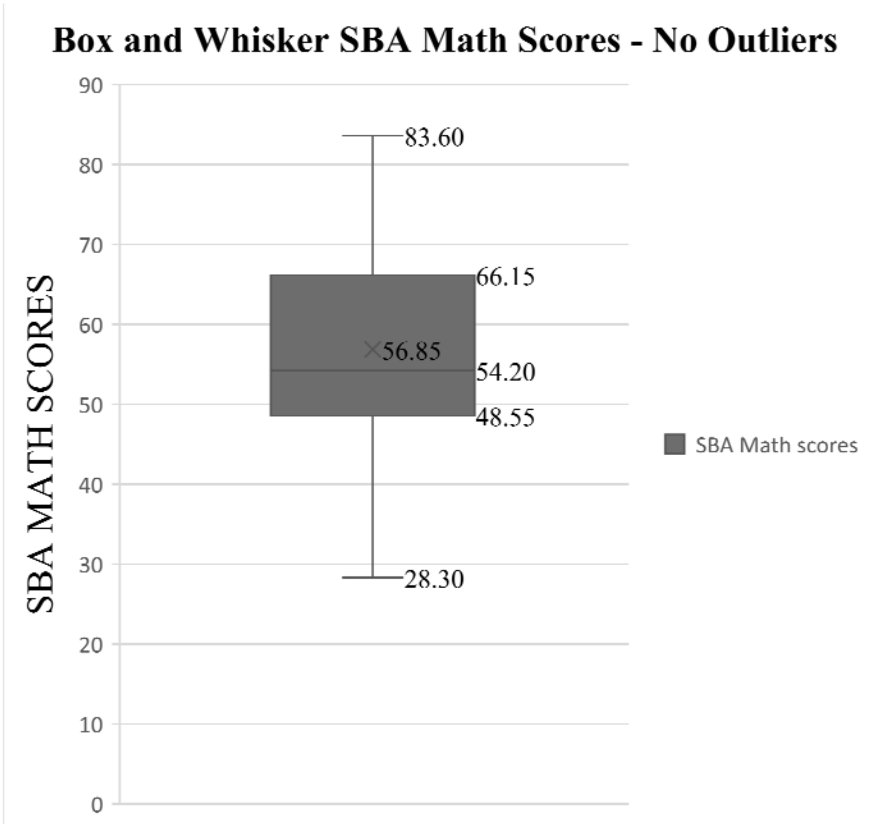
Assumptions Testing

The independent *t*-test that was utilized for analyzing the hypothesis of this study is a robust parametric test for examining statistically significant differences between two independent variables if certain assumptions are met (Kim & Park, 2019). A violation of one or more of these assumptions could jeopardize the *t*-test's reliability and validity (Vetter, 2017). The assumptions for making valid inferences from an independent *t*-test include a dependent variable measured on a continuous scale, distinct independent groups with exclusively independent observations, the normal distribution of data for each group, no significant outliers in data, and the homogeneity of variance (Vetter & Mascha, 2017). A sample size of at least 30 is adequate for the normality and reliability of a *t*-test (Schober & Vetter, 2019). Therefore, a sample size of 65 high schools was optimum for this study.

The dependent variable for this research was the archived aggregate school-level data on the Washington State SBAs, which the OSPI reported on a continuous scale in percentages, thereby meeting the first requisite assumption. The advertised 2018-19 cell phone use policy for each school was verified by contacting knowledgeable administrators, counselors, coaches, math teachers, and department chairs directly to corroborate the categorization of their pre-COVID policies as permissive or prohibitive for their 10th-grade math classes, thereby meeting the assumption of the independence of groups and observations. The dependent variable data on test scores were plotted on a box and whisker plot to identify and eliminate outliers (see Figure 9).

Figure 9

Box and Whisker Plot to Identify Outliers



The parametric assumptions for the normal distribution and homogeneity of variances in a *t*-test can be validated by performing a Shapiro-Wilk's test and a Levene's test (Rochon et al., 2012). The results of the Shapiro-Wilk test performed (W (65) = .982, p = .451) did not indicate a significant departure from the normality (see Table 2).

Table 2

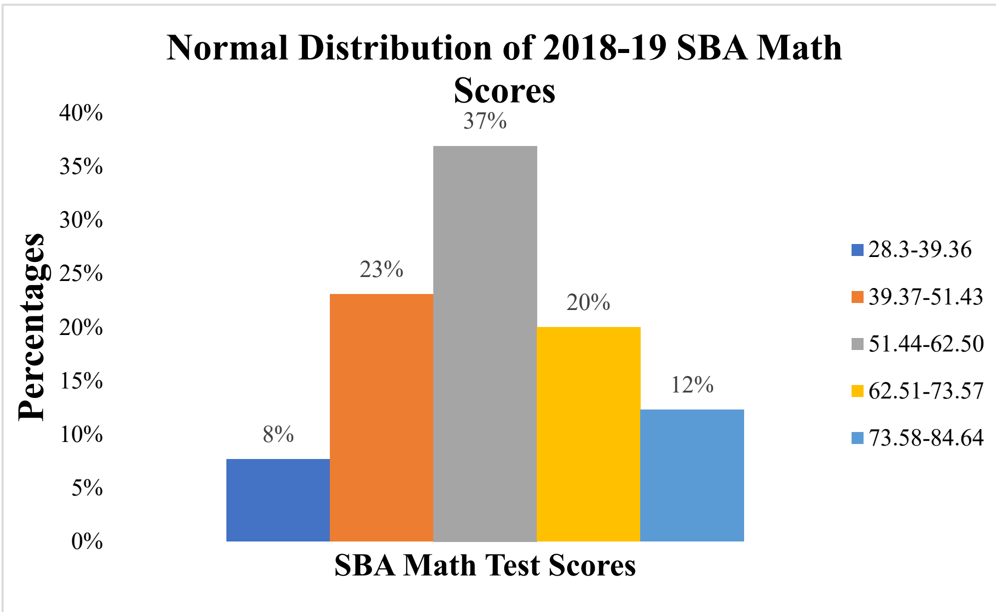
Shapiro-Wilk's Test of Normality

Shapiro Wilks	df	Sum of Square	Mean	*SD*	*W* Statistic	*p*-value
	65	9339.3225	56.85	12.08	0.982	0.451

A histogram of the 10th-grade math SBA scores for the 65 schools selected for this study espouses a normal distribution with a modal group ranging from 51.44% to 62.50%. The distribution of school-level SBA math test scores to the left and right of the modal group was evenly distributed (see Figure 10).

Figure 10

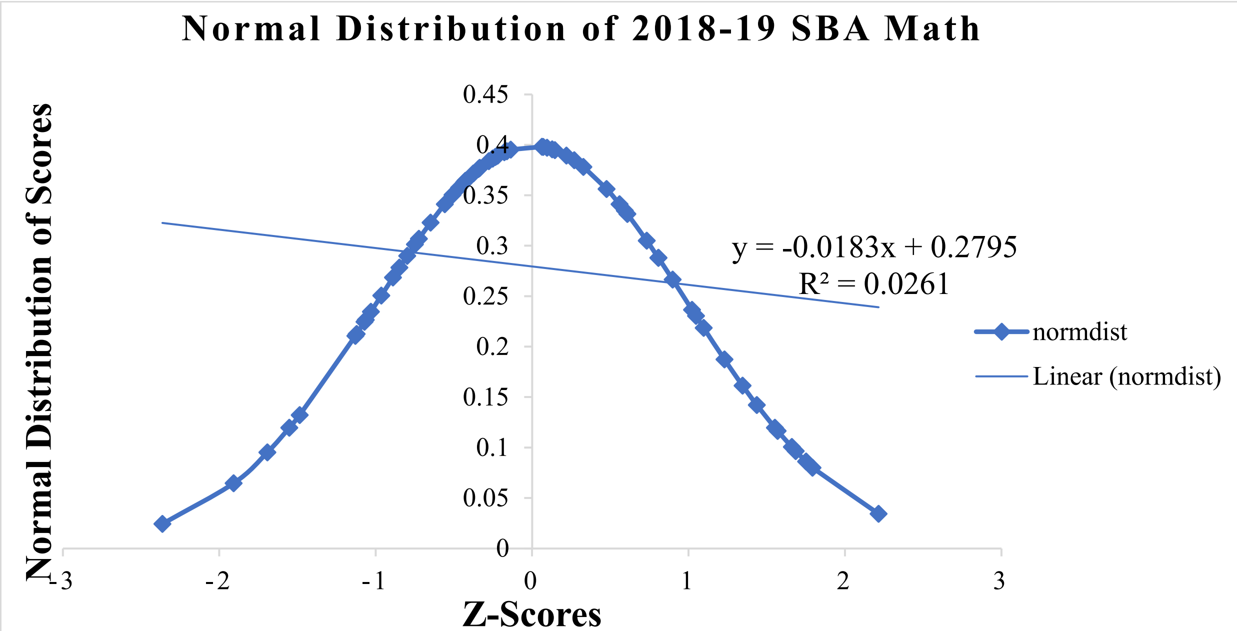
Histogram of Normal Distribution of the Dependent Variable



A normal distribution curve plotted to test for a continuous probability distribution of the 2018-19 SBA math scores shows that the test score data for the selected schools were potentially symmetrical with no outliers (see Figure 11).

Figure 11

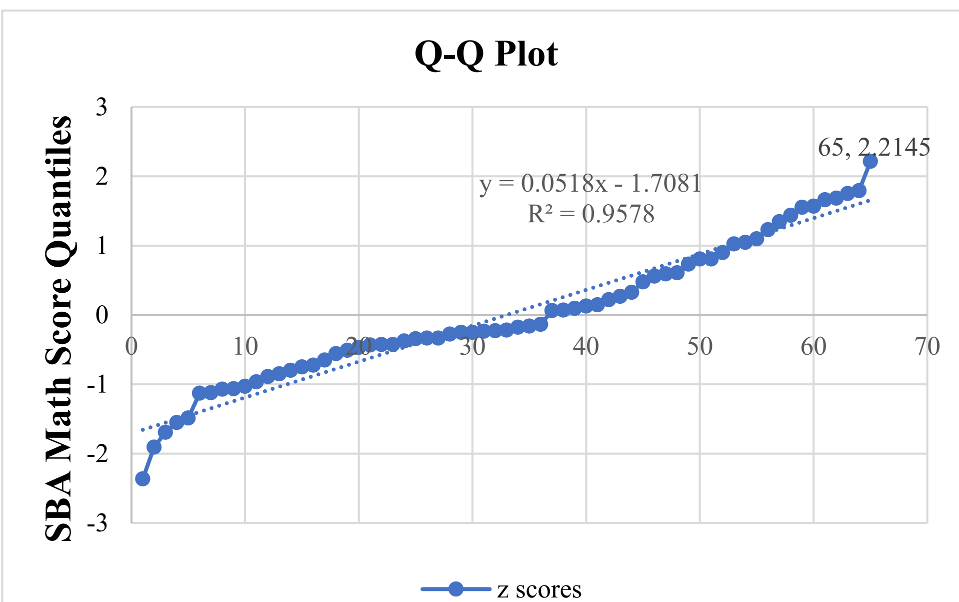
Normal Distribution Curve Validating t-test Assumption of Normality



A quantile-quantile (Q-Q) plot shows that the two independent samples of high schools with permissive cell phone use policies and those with prohibitive cell phone policies were both normally distributed (see Figure 12).

Figure 12

Q-Q Plot of Normality for Permissive and Prohibitive Cell Phone Policies High Schools



The assumption for the homogeneity of variance was tested by using Levene's test, based on which the variances of the schools with 39 permissive cell phone use policies were not found to be significantly different from those of 26 high schools with prohibitive cell phone use policies (see Table 3). The null hypothesis H_0 that groups were equal failed to be rejected; meaning that there is no sufficient evidence to conclude that a significant difference existed between the variances of the permissive versus prohibitive cell phone use policy schools, $F(1,63) = 1.087$, $p = .301$.

Table 3

Levene's Test for the Equality of Variance (Homogeneity)

	df	Sum of Square	Mean Square	*F* Statistic	*p*-value
Groups (between groups)	1	67.126	67.126	1.087	0.301
Error (within groups)	63	3890.261	61.750		
Total	64	3957.387	61.834		

Research Questions and Hypothesis Testing

An independent *t*-test was used to analyze the hypothesis posed in this study.

Research Question 1**:** Does a statistically significant difference exist between the aggregate math test scores of high schools with prohibitive cell phone policies and other high schools with permissive cell phone use policies based on the 2018-19 10th-grade SBA?

$H1_0$: No statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10th-grade SBA from 2018-19.

$H1_a$: A statistically significant difference exists in the aggregate math test scores between high schools with prohibitive cell phone policies and high schools with permissive cell phone use policies based on the 10th-grade SBA from 2018-19.

Given a *p*-value of 0.985, which is greater than the .05 alpha value, the null hypothesis failed to be rejected; therefore, one can conclude that not enough evidence suggests that a statistically significant difference existed in the 2018-19 10th-grade SBA math proficiency scores between high schools that allowed cell phone use in classrooms (*M*=56.83, *SD*=12.96) and high schools that prohibited the use of cell phones during instruction (*M*=56.88, *SD*=10.88), *t*(63) = -0.019, p = n.s. (see Table 4).

Table 4

A t*-test of Differences in the SBA Math Scores Between High Schools with Permissive versus Prohibitive Policies*

Variables	Cell phone policy in schools		*t*-test	df	*p*-value
	Permissive Mean±SD	Prohibitive Mean±SD			
Math proficiency score	56.83±12.96	56.88±10.88	-0.019	63	0.985

In addition to testing the main hypothesis for this study, 2018-19 SBA 10th-grade ELA scores were also analyzed for significant differences among the selected high schools based on their cell phone use policies. Given a *p*-value of .740, the null hypothesis failed to be rejected (*t* (63) = -0.033, *p* = 0.740). There was not enough evidence to conclude that a significant difference existed between the 2018-19 SBA ELA scores of high schools with permissive (*M*= 81.59, *SD*= 7.19) and prohibitive (*M* = 82.17, *SD*= 6.51) cell phones use policies (see Table 5).

Table 5

Independent t*-test of Difference between SBA ELA Test Scores for Permissive versus Prohibitive*

Variables	Cell phone policy in schools		*t*-test	Df	*p*-value
	Permissive Mean±SD	Prohibitive Mean±SD			
ELA proficiency score	81.59±7.19	82.17±6.51	-0.033	63	0.740

Reliability and Validity

The archival secondary data employed in this study were based on the 2018-19 Washington state SBA mathematics assessment, which has been reported to have a 0.925 reliability estimate and has been deemed an internally consistent test for measuring Common Core college and readiness standards (Smarter Balanced Assessment Consortium, 2020). The threat to the internal validity of the causal-comparative analysis stems from a researcher's inability to manipulate the independent variable of concern, which was the reported cell phone use policy for the selected high schools in this study (Salkind, 2010). Due to the lack of randomization associated with the non-probabilistic sampling method utilized in this study (Topp et al., 2004), extra precautionary measures were taken to ensure that the threats to internal validity were mitigated. Although purposive sampling has been observed to be subject to internal bias, taking decisive precautions to limit variability within samples enabled the results to be deemed robust and reliable (Lewis & Sheppard, 2006). Despite the accentuated weakness of the purposive sampling implemented, the selection of close high schools based on a set of strict inclusionary criteria enhanced group homogeneity, thereby improving the internal validity of the methodology (Porzsolt et al., 2020).

The selection of the high schools in this study based on a set of validated inclusionary criteria that are correlates of student achievement also reduced the chances that the results were merely coincidental and decreased the possibility that SBA test scores were associated with other uncontrollable extraneous factors (Palinkas et al., 2015). In addition to the voluntary single-item surveys shared with school administrators to help to corroborate the advertised student handbook 2018-19 cell phone use policies, direct phone calls were placed to all 65 high schools to speak with knowledgeable staff members about the 2018-19 cell phone policies for an accurate delineation of the implemented policy as permissive or prohibitive. The inclusionary criteria were correlated to investigate relationships among constructs and to examine their covariance with the dependent variable. All requisite assumptions for conducting a valid *t*-test statistic were tested by using robust non-parametric tests, including the Shapiro-Wilk test for normality and Levene's test for heteroskedasticity. Both statistical analyses validated the assumption that the data were normally distributed with no outliers and that variances were not unequal. The external validity of this study relates to the limitations in the generalizability to the entire population from which the selected schools were drawn or to other high schools outside of the study population (Bell et al., 2016). Although the results of this study are generalizable to the 65 high schools selected for this study, the findings and conclusions might not be generalizable to the larger population due to the possibility of the interaction of effects, such as test-related challenges, differences in teacher instruction efficacy, student readiness, and other school-based factors that were not accounted for in the strict inclusionary criteria.

Chapter Summary

The purpose of this causal-comparative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. Sixty-five public high schools across Washington state that fit a set of strict inclusionary criteria were purposely selected for this study. Archival student data were retrieved from the OSPI on the dependent variable (math test scores). Data on cell phone use policies were directly obtained from the published student handbook for the selected schools, and they were corroborated by instructional personnel and administrators with prior knowledge of the 2018-19 classroom cell phone policies at the selected schools. The student demographics, school descriptors, instructional programs eligibility, and teacher characteristics were analyzed by using descriptive statistics displayed in tables and charts.

The SBA math scores were found to have a statistically significant correlation to some of the strict inclusionary criteria selected, including classroom sizes, the average classroom teaching experiences of the faculty, income, ethnic minority enrollment, and the proportion of special education. Schoolwide English language art test performance was a strong predictor of the 10th-grade SBA math performance. An independent *t*-test was used to analyze the independent variable (cell phone use policy) and the dependent variable (2018-19 SBA test scores). Based on the results of the independent *t*-test, not enough evidence was found to conclude that a statistically significant difference existed between the aggregate 2018-19 SBA math test scores achieved by students at high schools with prohibitive cell phone policies and the 2018-19 SBA math scores achieved by students at high schools with permissive cell phone use policies. The results of the *t*-test analysis of the 2018-19 SBA English language art scores did not identify a statistically significant difference between the performance of students on ELA at high schools with cell phone policies that are permissive and other high schools that implemented prohibitive cell phone policies. Implications of these results were further discussed in detail, and recommendations were proffered to guide teachers, school districts, and policymakers on regulating and integrating cell phones into secondary mathematics instruction.

Chapter 5: Discussions and Conclusions

The purpose of this causal-comparative study was to test for statistically significant differences between the 2018-19 Smarter Balanced 10th-grade aggregate math test scores of selected high schools in Washington State based on their implementation of prohibitive versus permissive cell phone use policies. Secondary archival data were obtained with permission from the Washington State OSPI (see Appendix B). As shown in Table 1, purposive sampling was used to select 65 homogenous high schools for this study based on strict inclusionary criteria, including high English language reading performance, high attendance rates, moderate classroom sizes, adequate access to experienced teachers, low disciplinary infraction rates, low special education, low English learner enrollment, and low free and reduced lunch eligibility.

A research question was posed to test for significant differences between the aggregate SBA mathematics score of the selected high schools based on their pre–COVID-19 cell phone use policies. Sixty percent of the high schools in the study implemented permissive policies, whereas 40% prohibited the use of cell phones in the classroom. Forty-two percent of the high schools in this study reported that their cell phone use policies were fluid, differing from one teacher to another. The math scores at schools with cell phone bans averaged about 56.88%, whereas SBA math scores at high schools permitting cell phone use in the classroom averaged 56.83%. A p-value of 0.985 was obtained. Hence, not enough evidence was found to conclude that a statistically significant difference existed between the 2018-19 10th-grade SBA math proficiency achieved at high schools with permissive cell phone policies (M=56.83, SD=12.96) and the SBA math scores of high schools with zero-tolerance cell phones policies (M=56.88, SD=10.88).

Based on the report of the data analysis, the findings in this study will be interpreted in the context of the selected theoretical framework. The critical conclusions from the research outcomes will be discussed within the scope of this study, in addition to the limitations of this study. Recommendations will also be proffered for policymaking, school leadership, and further research.

Findings, Interpretations, and Conclusions

The results of this study were interpreted vis-à-vis disconfirmation or alignment with social constructivism and self-determination, which served as the theoretical framework for this study's hypothesis regarding differences in student mathematics achievement based on the use of autonomy versus coercion in enacting cell phone use policies in the studied population. Conjectures were drawn to existing evidence from previous studies conducted on a myriad of cell phone use policies and secondary mathematics achievement, which espoused the scope of this research.

Based on the social constructivism theory, some researchers have argued that democratizing classroom management and technology access through permissive cell phone policies enhanced learner achievement (Lötter & Jacob, 2020). However, the outcomes of this study did not indicate that any statistically significant difference existed between the mathematics test performance of selected high schools permitting cell phone use in classrooms and those of comparable high schools where cell phones were banned.

The results obtained from this study contradicted the premonition of self-determination theorists that permitting students to use cell phones in classrooms elicits self-regulation and motivation, thereby boosting student achievement (Jeno et al., 2017). Also, the results of this research did not corroborate the hypothesis of the contenders of self-determination, which conveyed that coercion and control were more effective strategies for increasing student achievement. In this study, the average mathematics performance of schools with coercive cell phone bans was not up to one percentage point higher than the mathematics performance of schools permitting cell phones in the classroom.

The findings of this study contradicted the notion that embracing technology integration in the classroom facilitates higher learner performance (Elfeky & Masadeh, 2016; Fabian et al., 2018). These pro-permissive cell phone studies were premised on the postulate that higher academic performance was driven by autonomy, self-motivation, self-regulation, and engagement, which are tenets of social constructivism and the SDT (Roth, 2018; Ryan & Deci, 2020). The findings of this study also disconfirmed existing empirical evidence that has correlated cell phone bans with higher levels of student achievement (Beland & Murphy, 2015; Beneitoa & Vicente-Chirivella, 2020).

However, the outcomes of this study reiterated the previous results obtained by researchers who found no significant effect in an econometric analysis of the impact of a cell phone ban on the mathematics performance of Swedish ninth graders on a national high-stakes test (Kessel et al., 2020). The findings of this research study also reinforced comparable results obtained from a 10-year longitudinal difference in differences analysis of the effect of the implementation of cell phone bans on mathematics and reading performance in Norwegian public and private secondary schools (Guldvik & Kvinnsland, 2018). The outcomes of this research connote that neither autonomy nor coercion in cell phone use regulation was a significant factor in driving students' mathematics achievement in the high schools selected for this research. Other explanatory variables that significantly influence student achievement need to be further explored.

Limitations

This research study was subject to certain flaws beyond the control of the researcher, which threatened the study's internal validity. The use of purposive sampling, a non-probabilistic technique, might have incited internal bias in this study due to a lack of randomization associated with the non-probabilistic sampling methods (Topp et al., 2004). The scope of this study was limited to the 2018-19 SBA math test scores for 10th graders based on their schools' self-reported prevalent cell phone use policies. As the regulation of mobile technology represents only one of several factors that impact student achievement, this study's outcome was susceptible to other confounding variables, such as student motivation, teacher instructional quality, and school climate factors (Porzsolt et al., 2020). Despite confirming that 60% of the high schools in this study implemented permissive cell phone use policies, their actual integration of cell phones as teaching and learning tools could not be verified. Many schools in the study did not publicize their pre-COVID cell phone policies in the online student handbooks, so the implemented policies were verified by contacting administrators and knowledgeable staff members with a single-item survey (see Appendix A) designed to corroborate the prevalent 10th-grade cell phone policies in 2018-19. The reliance on self-reported accounts of the historical cell phone use policies enacted across the selected high schools also jeopardized this study's internal validity.

The study's external validity was limited to only the selected 65 high schools in Washington state. Hence, the findings from this sample cannot be generalized to a larger population of other high schools outside of the study (Bell et al., 2016). Given the stringent control of potential confounding variables enacted by defining strict inclusionary criteria apriori, the reproducibility of this study was not threatened (McDonagh et al. 2013).

Using archival aggregate school-level data instead of raw student test scores limited the findings' reliability in this research study. The inability to verify the actual integration of cell phones into instructional activities in schools with permissive cell phone use policies also limited the reliability of the study outcomes (Morris & Sarapin, 2020). Nonetheless, the outcomes of this study contribute to the existing body of literature on the role of digital technology reforms in instructional pedagogy.

Recommendations

Before deciding to banish cell phones or to embrace cell phone technology in secondary classrooms, administrators and policymakers should consider other factors that are cognate to student achievement (Guldvik & Kvinnsland, 2018). Instead of expending time and resources on futile policies aimed at controlling students' access to cell phones, educators should consider deliberate strategies for channeling these potential classroom distractions to purposeful academic use. The mere presence or absence of mobile digital devices does not constitute fidelity in teachers' implementation of digital instruction or the alignment of instruction with the level of rigor required on standardized assessments. To support the achievement of at-risk learners, teachers should consider embracing cellular technology for students to explore self-interest, networking, collaboration, content creation, skill remediation, knowledge sharing, interactive gaming, modeling, and simulation (Darling-Hammond et al., 2014).

Without adequate teacher support for integrating digital tools into instruction, teacher efficacy stagnated, with no significant effect noticeable in student engagement, even in BYOD classrooms (Boyd, 2015). Teachers should be supported with continuous professional development on digital technologies to enhance student achievement. For teachers to be effective gatekeepers of cell phone use and misuse in the classroom, ongoing professional development should be provided on best practices for curtailing cyberbullying, plagiarism, cheating, pornography, and other illicit cell phone activities (Aubussona et al., 2009). Digital citizenship should become integral to classroom instruction, as students require guidance on the etiquette of acceptable device use during instruction.

A consistent evaluation of classroom management policies should become embedded in school culture (Bennett, 2017). No one-size-fits-all approach exists for enacting effective acceptable technology use reforms (Gerson, 2015). Meeting the learning needs of 21st-century learners demands the implementation of culturally responsive classroom management policies that cater to the holistic needs of students. If teachers, school leaders, and stakeholders determine that a cell phone ban is an optimum strategy for curbing infractions and distractions, such a blueprint should be enacted with clarity on the rationale or empirical evidence informing their decision-making. The schoolwide stance on cell phone policies should be stated in the student handbook, including the acceptable use policy, and consequences for violating such policies. Advocates for digital integration have argued that a strategic plan should be a higher priority compared with a blanket ban on cell phones (Klein, 2019). Schools should proffer compelling research evidence on the benefits and constraints of cell phone technology when crafting policies (Mupinga, 2017).

Educators should channel the efforts devoted to controlling cell phone distractions towards pursuing of alternative approaches that could productively divert cellular devices as useful tools for engaging students in their curriculum. Administrators and school district leaders should continuously engage their students, educators, families, and other stakeholders to analyze the role of technology in student achievement. As cellular devices become more ubiquitous among students, teachers should be supported with adequate professional development and training on best practices for integrating cell phone technology to complement their pedagogy.

Since the coercion of 21st-century learners to put away their devices has not been found to guarantee higher achievement; innovation should begin to drive school leaders and teachers toward progressive classroom management reforms. Educators should consider incentivizing students' adherence to cell phone use guidelines. Digital applications, such as Lock & Stock, could track students' compliance with screen time norms and self-restraint from social media usage during instruction (Hosseini, 2001). Other secondary schools should embrace tangible extrinsic rewards, such as scholarships, coffee, fast-food coupons, and shopping discounts for learners who earn points for espousing self-restraint from devices during instruction. Where BYOD is permitted, school districts should invest in content filtering and firewalls to confine students' device use to academic purposes.

Although this study contributes to the existing knowledge on instructional technology and classroom management reforms, further research is needed to establish a link between cell phone use policies and student achievement. The scope of future studies should be expanded to incorporate student and educator perspectives, as well as the influence of cell phone regulations on students' self-regulation, motivation, and socio-emotional health. Because the scope of this study was limited to 2018-19 schoolwide cell phone use policies, further research is needed to examine how the demand for remote instruction, following the COVID-19 pandemic, has altered the demand for classroom regulation and integration of cell phone technologies across secondary classrooms. Any attempt at enacting zero-tolerant cell phone regulations should encompass the envisaged stress, anxiety, and dissonance that device separation might ensue among teenagers who have become obsessed with these portable devices (Abi-Jauode et al., 2020). In addition, further studies should be conducted on the influence of cell phone use policies on various aspects of school climate, including learner motivation, engagement, socioemotional wellbeing, and classroom behavior management.

Implications for Leadership

The effective regulation of cell phone intrusion in the academic environment has become a recurrent dilemma for school administrators across the globe (Mohammadi et al., 2020). In a national study of 6–12 secondary schools across the United States, researchers reported that more than 90% of principals endorse the stringent restriction of cell phones from classrooms due to the touted academic distractions associated with students' engagement via social media in classrooms (Tandon et al., 2020). Before the COVID-19 pandemic, the repulsion of cell phones in classrooms was popular. However, the unprecedented revitalization of digital technology via virtual learning in the wake of the pandemic has aroused school leaders' interest in negotiating the role of cell phones in the learning environment (Klein, 2020).

Understanding the role of mobile technology in pedagogy is pivotal to making informed decisions regarding the regulation and integration of cell phones in the learning environment. Administrators should harness a balanced perspective of the benefits and challenges of cell phone technology in classrooms. School leaders should harness research evidence and stakeholder buy-in when devising schoolwide or district-wide policies for students' access to cell phones during classroom instruction. Administrators should utilize townhalls, parent newsletters, and other home communication strategies to inform students' families about research evidence on the impact of cell phones on students' grades. In addition, school leaders should create deliberate opportunities for students and adults to discuss contemporary research, such as the Rutgers University report indicating that the invasive presence of cell phones in the classroom not only impacts the user's grades but also distracts others and deters peers' academic achievement as well (Glass & Kang, 2019). Another example is a recent nomophobia research study indicating that the mere presence of cell phones in proximity to the classroom dissipated students' attention even when switched off (Mendoza et al., 2018). School leaders could garner more parental support and compliance with enacted school policies by familiarizing stakeholders with undisputable evidence regarding cell phone policies.

Researchers have advocated for school leaders to replace vague and blanket cell phone use policies with more evidence-based reforms developed in collaboration with students, parents, teachers, and other stakeholders (Domitrek & Raby, 2008). School leaders are responsible for communicating the threshold for acceptable behavior and defining the consequences for any aberration from such norms (Bennett, 2017). Researchers have warned against laissez-faire approaches to classroom management through permissive indulgence (Johnson, 2018; Wenning & Vieyra, 2020).

Wavering school policies that fluctuate from teacher-to-teacher obscure students' understanding of schoolwide expectations. On the contrary, the top-down coercion of cell phone bans has implications for inequitable access to instructional technology (Kiema, 2015; Marler, 2018). Ensuring equitable access to devices should become a priority for school leaders. Where possible, a 1:1 technology device should be provided to eliminate the urge to rely on cell phones for technology access during instruction. Through school partnerships with businesses and mobile communication companies, affordable Wi-Fi services should be provided for families demonstrating the excruciating need for internet access.

Conclusion

The independent *t*-test results in this study did not indicate a statistically significant difference between the 2018-19 SBA mathematics achievement of 10th graders at schools with stringent cell phone bans and comparable high schools with permissive cell phone use policies in Washington state. The outcomes of this study imply that future research could be extended to evaluate the unintended consequences of cell phone use policies on equitable access to digital technology, social connectedness, self-regulation, motivation, and other indicators of students' socioemotional wellbeing (Guldvik & Kvinnsland, 2018).

This study exposed the inefficient reliance on vague technology use policies of many selected high schools. Administrators in more than 40% of the high schools in the study left the enactment of acceptable device use and digital citizenship policies to teachers as gatekeepers. Many of the selected schools failed to stipulate clear guidance on the schoolwide stance along the permissive versus prohibitive policy continuum. Despite the clear demarcations in demographics, socioeconomic indicators, and performance among the selected schools, the perspectives regarding cell phone technology remained conventionally permissive or prohibitive, lacking innovation.

With the onset of the COVID-19 pandemic, the demand for digital technology in classrooms has increased with the paradigm shift to virtual and blended learning. The replacement of the inefficient blanket regulations of cell phones with more intentional, coherent, and evidence-based policies for digital citizenship is long overdue. Teachers, students, and their families defer to school leaders on consistent classroom policy regarding the use of cell phones. As this study was limited to a few selected homogenous high schools in Washington state, a clearer understanding of the distinct effect that various cell phone policies exert on student achievement requires more extensive research that is wider in both geographic and demographic scope. It is noteworthy that instructional technology is only one of several factors that are attributable to the teaching and learning environment. Student achievement in mathematics requires a multidimensional focus, including students, the school, the curriculum, and the teacher effects (Maarouf, 2022). Future studies should evaluate the interaction between classroom cell phone use policy and other factors associated with students' academic performance.

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Appendix A

Scripted Telephone/Email Single-Item Survey Modification

Causal Comparative Study of Cell Phone Policies and High School Math Achievement

Doctoral Dissertation Research of 100 Purposely-Selected High Schools Based on Cell Phone Policies

* Required

This survey is strictly a dissertation research focused on exploring the effects of cell phone policies. Your participation is being solicited, but it is COMPLETELY voluntary. Your responses are COMPLETELY ANONYMOUS and NONE of your entries or school information will be disclosed nor identifiable for this study. You will be able to access the data and findings from this study once completed. The results of this study may inform decision-making for educators. Thanks for your participation. Please, check the box if you wish to continue *

- ◯ Yes, I wish to participate in the survey and hereby give voluntary consent
- ◯ No, I do not wish to participate in the survey

High School Name *

Your answer

Which Cell Phone Use policy was implemented for most students at your school in 2018/2019? *

- ◯ No cellphones at school. Must be locked in student's lockers/switched off. Away for the Day.
- ◯ Cell phones were allowed in our common areas, but NOT in the classroom in 2018/2019.
- ◯ Bring Your Own Device (including Iphones/Cellphones) for use if permitted by teachers.
- ◯ Cell phones were permitted throughout the school, but students must adhere to guidelines (ex. No videos/Use earbuds)
- ◯ There was no set policy for students' use of cellular devices in 2018/2019
- ◯ Other: ____________

Appendix B

Site Permission Letters

[redacted], General Counsel
[redacted]

[redacted]

Via Electronic Transmission
ABIMBOLA.AKINTOUNDE4229@MY.ACE.EDU

August 10, 2021

Abimbola Akintounde
American College of Education
[redacted]

Re: Public Records Request

Dear Abimbola:

This will acknowledge receipt of your August 6, 2021 public records request to [redacted] Your request was forwarded to my office, which oversees all public records requests. In response to your request, we are submitting the following information:

Request: "I will appreciate it if you could provide me with the raw student test scores in Math and ELA for the 2018/2019 school year for BYOD high school [redacted]"

Response: Please see the attached Excel spreadsheet.

In response to this request, no records were withheld in their entirety or redacted based on a statutory exemption (RCW 42.56 Washington State Public Records Act). With the submission of this information, we believe we have fully complied with your request and we will close the file.

The district desires to provide you with the fullest assistance possible. If you believe this response does not fully comply with your public records request, please contact our office.

Sincerely,

[redacted]

General Counsel

MS/ja
Attachment

[redacted] Public Records Request

[redacted]

Tue 8/10/2021 4:58 PM

To: Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>

Please be cautious

This email originated from outside of ACE organization

Dear Abimbola,

The [redacted] School District is in receipt of your public records request dated August 5, 2021, requesting [redacted] detailed 10th Grade Math and ELA Student Scores 2018/2019.

Per the Washington Public Records Act, RCW 42.56, the district has five working days from receipt of your request to provide a timeline for delivery of the requested documents. The district estimates a fulfillment date of September 7, 2021. Information that is subject to Public Records Act exemptions, privileged, confidential, or otherwise protected, may not be provided.

Please contact me if you should have any questions regarding this public records request.

[redacted]

--

[redacted]

PRR 08062021-AA RE: SECONDARY DATA REQUEST

[redacted]

Wed 8/11/2021 6:55 PM

To: Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>

C[redacted]

Please be cautious

This email originated from outside of ACE organization

PRR 08062021-AA

Dear Mr. Akintounde:

On behalf of th[redacted] District, I acknowledge and am responding to your request for public records, which I understand to be:

> raw test scores in Mathematics and English Language will be compared across ten high schools with similar student enrollment, demographics and similar socioeconomic characteristics. All data will be treated as confidential, and no identifiable details will be revealed in the publication of the findings of this study. I will greatly appreciate it if you could provide me with the raw student test scores in Math and ELA for the following schools in the 2018/2019 school year.
>
> [redacted]
>
> [redacted]Scores 2018/2019
>
> [redacted]

The data you request is available from the Office of Public Instruction (OSPI). Please see link from within the Data & Reporting section of that agency's website:

https://washingtonstatereportcard.ospi.k12.wa.us/

As shown in this example,

https://washingtonstatereportcard.ospi.k12.wa.us/ReportCard/ViewScho[redacted]

you can search by school and academic year. The percentage of students from each school that met state standards for each test is downloadable from the site. You can also call OSPI at 360 725 6000 for more detailed assistance.

I am not certain what you mean by "raw test scores." If you are requesting de-identified student level data (e.g., one row per student with columns for school name, ELA scale score, math scale score) , your request may be deemed a research request rather than a public records request.

My understanding is that research requests are approved at the discretion of the agency. T[redacted] would not approve a research request at this time for student-level data.

I will close your request at this time. Please advise if I can be of further assistance.

Best regards,

[redacted]

Public Records Officer

[redacted]

Appendix C

Permission to Modify and Adapt a Validated Survey

RE: PERMISSION TO ADOPT YOUR RESEARCH SURVEY INSTRUMENT

[redacted]

Mon 8/9/2021 11:35 AM

To: Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>

Please be cautious

This email originated from outside of ACE organization

You are welcome to use or modify the survey as you need. I do not have reliability or validity scores.

[redacted]

From: Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>
Sent: Sunday, August 8, 2021 9:52 PM
To [redacted]
Subject: PERMISSION TO ADOPT YOUR RESEARCH SURVEY INSTRUMENT
Importance: High

PERMISSION TO ADOPT YOUR RESEARCH SURVEY INSTRUMENT

Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>

Sun 8/8/2021 10:51 PM

To: [redacted]>

AMERICAN COLLEGE of EDUCATION

Doctoral Research Permission Letter

My name is Abimbola Akintounde and I am a doctoral candidate at American College of Education (ACE) writing to request permission to use your existing survey accessed from this link https://files.eric.ed.gov/fulltext/EJ847358.pdf

This information will be used for my dissertation research related to the **Causal-Comparative Study of High School Cell Phone Policies and Students' Test Performance.** The purpose of the quantitative causal comparative study will be to examine if there is a significant difference in the learning achievement attained at high schools with prohibitive cell phone use policies versus high schools with permissive cell phone use policies.

Please, do you have the reliability and validity score for the survey instrument?

Looking forward to your assistance. Please, feel free to contact me or my dissertation chair with any questions regarding this research.
Principal Investigator: **Abimbola Akintounde**
E-mail: **Abimbola.Akintounde4229@my.ace.edu**
[redacted]
Dissertation Chair: **Dr. Deborah VanOurerk**
E-mail: [redacted]
Thank you for your attention to this issue and prompt response. I appreciate your time and consideration of my request.

Sincerely,
Abimbola Akintounde
EdD Candidate - Curriculum and Instruction
American College of Education

We cannot expect improvements in student outcomes if we do not initiate intentional modifications to our instructional practices (Weber, 2016).

Appendix D

IRB MR Approval of Adjustments to Doctoral Dissertation Proposal

RE: MR Review of Slight Modifications to Sample Size and Data Analysis Reported

ACE IRB [redacted]

Thu 2/17/2022 5:18 PM

To: [redacted]

Hello Abimbola,

The updated proposal is approved. I will document the changes in the IRB records. Best wishes on the next steps of your dissertation.

[redacted]

Chair, Institutional Review Board
American College of Education
101 W Ohio, Suite 1200, Indianapolis, IN 46204
Email: irb@ace.edu
ace.edu

AMERICAN COLLEGE of EDUCATION

From [redacted]

Subject: Re: MR Review of Slight Modifications to Sample Size and Data Analysis Reported

Please, find attached my modifications to the chapters 1-3, reflecting the accentuated adjustments to the FRLP eligibility threshold, correlation of the inclusion criteria with the dependent variable and the increase in the target population from 64 to 65 high schools. Thanks again.

Abimbola

From [redacted]

Subject: RE: MR Review of Slight Modifications to Sample Size and Data Analysis Reported

Hello Abimbola,

Adjusting the inclusion criteria changes the target population for your study. I see that you have noted this in chapter 4, however, we want to make sure to note that in chapter 3 as well. The IRB will need to review this once you have attained approval of the MR, so could you please send me chapters 1-3 so that I can verify that these changes were made there also? Thanks!

From: Abimbola Akintounde <abimbola.akintounde4229@my.ace.edu>
Sent: Tuesday, February 15, 2022 3:44 PM
To: ACE IRB [redacted]
[redacted]
Subject: MR Review of Slight Modifications to Sample Size and Data Analysis Reported
Importance: High

Good Afternoon,

Please, find attached my application for an MR for the two adjustments proposed to my research, which are as follows:

- Include a correlation of the strict inclusionary criteria for purposely selected schools in the data analysis section. The approved proposal only included descriptive statistics for reporting the selection criteria. The inclusion criteria were only defined to purposely select schools with similarities. These are not the explanatory/independent variable for the study, therefore, all RQ and hypotheses would remain intact as proposed.
-
- One of the inclusion criteria was adjusted from less than 25% on Free and Reduced Lunch to less than 40% of students on Free and Reduced Lunch, which is the Federal benchmark for delineating low-income schools and Title 1 status.

Thanks for your consideration.

Sincerely,
Abimbola Akintounde
EdD Candidate - Curriculum and Instruction
American College of Education

We cannot expect improvements in student outcomes if we do not initiate intentional modifications to our instructional practices (Weber, 2016).