A Review of Studies Exploring Negative Effects of Digital Technology on Student Learning, Academic Performance, and Class Participation

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Abstract: *Thirty-two studies on using digital technology in the classroom to enhance learning were reviewed in this paper. It was concluded that although parents, educators, and school boards support and encourage students' use of cell phones, iPads, and computers in class for study-related purposes, numerous findings reveal that irresponsible use of these digital devices negatively impacts learning and students' performance in class. The common finding was that irresponsible use of digital devices, such as cell phones, iPhones, and computers in class distracts students and negatively impacts their learning, performance, and participation in class.*

Keywords: technology; education; digital distraction; negative effects; BYOD; technology in the classroom

Introduction

Inspired by current teaching trends, many North American schools have adopted Bring Your Own Device (BYOD) policies, allowing students to use personal devices like phones, iPads, and laptops in class. The Peel District School Board supports this, believing it prepares students for the future. Tools and learning platforms like Google Classroom enable quick access to information, creative learning, and collaboration.

Many who support this trend in education argue that the benefits of classroom technology outweigh the risks (Renwick, 2015). Research shows it enhances understanding and offers tailored instruction (Bouygues, 2019). Examples include Skype chats, digital portfolios, and blog writing. Additionally, technology improves education quality, fostering collaborative and creative learning while digital tools help teachers create engaging lessons and support distance learning, building learning communities and support networks (Raja & Nagasubramani, 2018). Despite the many benefits of digital technology, significant concerns persist regarding its misuse and the detrimental effects it can have on learning and development.

Project Purpose and Objectives

The purpose of this literature review, to examine the potential negative impacts of digital technology (specifically cell phones, iPads, and computers) on learning, students' cognitive/social development, and their learning environment, was inspired by the widespread use of digital devices in schools after the introduction of Bring Your Own Device (BYOD) policies. This study is conducted to build on previous findings by offering insights from three decades of research on negative effects of using technology in the classroom. It provides insights into *how* an ongoing use of digital devices in the classroom negatively affects learning, students' development, and the learning environment and *why* these findings are important. The findings this review reveals may benefit school leaders, policy makers, educators, parents, students, and anyone else who is interested in improving their teaching or learning practice.

Definitions of Terms

Peel District School Board (PDSB) defines technology as a number of resources including "computers, phones, cellular/mobile technology, servers, networks, Internet services, computer applications, data, email and collaboration tools, as well as third-party Internet services provided by the [the school] Board. Examples of third-party web services include E-Learning Ontario and online textbook providers." (PDSB, 2011, p. 2).

Research Question

According to secondary research resources over the past three decades, what range of negative effects has the introduction and ongoing use of digital devices (specifically cell phones, iPads, and computers) in the classroom by students had on their learning, academic performance, and participation.

Philosophical Perspective

The integration of technology in education is a multifaceted issue that can be analyzed through various theoretical lenses. Deweyan philosophers, social scientists, Kantian thinkers, constructivists, and care theorists all contribute valuable viewpoints to this discussion, highlighting how technology impacts learning, teaching methods, and student development. Deweyan philosophers view education as a lifelong, experiential process, advocating for the integration of digital technology in classrooms as a natural evolution driven by societal changes, where teachers guide and students actively participate in the learning process. Social scientists, however, see technology in classrooms as potentially problematic due to distractions and unsafe environments, recommending ethics education and monitored school-provided devices to mitigate misuse. Kantian philosophers recognize technology as a tool to improve education, though they stress the importance of its careful integration to avoid the negative impacts of multitasking. Constructivists support using digital technology to foster active engagement, imagination, and higher-order thinking, with educators monitoring and adjusting its use to achieve learning goals. In contrast, care theorists argue that excessive technology use in class negatively impacts social interaction and moral education, advocating for cooperative learning and minimizing digital distractions to enhance face-to-face interactions and overall student development.

Literature Review

While most theorists and educators see technology as a powerful tool which can be used to enhance learning, multiple research findings suggests that learners often use technology for other than study-related purposes which negatively impacts learning. For some, the off-task use of technology is a sign of disrespect. Others argue that it can be attributed to "generational differences and cultural perceptions on acceptable social behaviours" (Neiterman & Zaza, 2019, p. 8). Many existing findings suggest that students who use their cell phones for entertainment rather than study purposes are those who are not engaged academically and/or socially (Berry & Westfall, 2015; Green, 2019). Other reveal that internal factors, such as students' ability to exercise self-control, play important role in students' ability to refrain from using technology for entertainment rather than for studying (Bolkan & Griffin, 2017). Students may engage in off-task technology use if they are bored and unmotivated in class (Bolkan & Griffin, 2017; Neiterman & Zaza, 2019).

For most researchers, the following two questions are of special interests: a) How responsibly do students use their cell phones in class; and b) How technological devices affect students' ability to learn and retain information? One study, that explores the effects of cell phone use on short-term retention of academic material, reveals that students with poorer academic performance are more likely to use their digital devices during lectures (Aaron & Lipton, 2017). The study also finds that students in classes with strict digital device policies score higher than those in classes with no restrictive digital device policies. For Kraushaar and Novak learning is a process that combines different activities including listening, viewing, responding to questions, and note taking and when students are distracted by their digital devices this process is disrupted which leads to poorer performance in class (Kraushaar & Novak, 2010). Their study reveals that students who are distracted by their laptops and other devices "have lower levels of academic performance as measured by homework, in-class quiz, project, exam, and final grade scores" (Kraushaar & Novak, 2010, p. 249).

Other studies link the use of digital devices in class to students' lack of focus (Raja & Nagasubramani, 2018). They find that sending text messages in class negatively impacts students' social skills. According to Raja and Nagasubramani, "being over-connected to the online world [results] in lack of focus and concentration in academics and to some extent, even in sports and extracurricular activities" (Raja & Nagasubramani, 2018, p. 35). These findings confirm that when students are not distracted by their cell phones they demonstrate higher ability to retain information and remain focused for longer periods of time. Similar findings reveal that irresponsible use of technology leads to cheating (Thomas & O'Bannon, 2013; Smale & Russo, 2021). Specifically, "technological developments like graphical calculators, high tech watches, mini cameras and similar equipment [are] great sources to cheat in exams" (Raja & Nagasubramani, 2018, p. 35). The use of digital devices in class is also found to lead to significant decrease in student comprehension linking the use of tablets in class to poorer performance among elementary school students (Bouygues, 2019). Finally, these findings reveal negative relationships between technology and learning by suggesting that the "more hours students [spend] daily on the computer, the lower their average [test] scores" are (Bouygues, 2019, p. 19).

Those who advocate against the use of cell phones, iPads, and computers in class, often argue that learners lose valuable skills by becoming dependent on technology. Some findings suggest that students who use cell phones and

computers in class to record material might lose their ability to remember information or handwrite their notes (Wilmer, 2017). Even Socrates suggested that writing tools affect people's ability to remember (Konnikova, 2012). One study that explores effects of computers on students' cognitive abilities, reveals that learners no longer try to remember information because they use computers to record it (Sparrow et al., 2011). Others find that integration of technology "compromises students' ability to learn, store and process information" (Neiterman & Zaza, 2019, p. 9). Modern learners often fail to critically analyze information or determine what is important. When they rely on cell phones, computers, and the internet to find and store information, they miss the opportunity to practice essential analytical skills (Wilmer, 2017). Multiple studies support these findings by reporting that people who self-report being heavy users of cell phones are less analytical and perform poorly on the knowledge measures and cognitive tests (Wilmer, 2017). Other findings support this by revealing that "adults and children learn symbols better if they write them by hand during learning than through other forms of practice, including visual, auditory, and even typing" (James, 2017, p. 503). Although typing notes may be more practical, convenient, and faster way of recording information, it negatively impacts students' ability to learn or develop valuable skills like handwriting.

Researchers warn that we cannot count on technology to improve poor teaching or student engagement. Some findings reveal that substituting audio for paper books, or 3D software for pen and paper, does not equal enhanced instruction or successful learning (Ilin, 2020). In other words, providing students with access to digital devices does not automatically improve learning (Renwick, 2015). Such practices may be more convenient and less costly, but not necessarily more effective. For example, one study reports that "The 3D aspect of the software helped the students understand the spatial dimension. Compared to pen and paper this is true, but the same 3D effect can be achieved with simple physical objects. Plastic geometrical objects that could be taken apart, measured, and put back together would be a more cost-effective, interactive, and hands-on experience that would match or surpass the technological tool." (Ilin, 2020, p. 110). It can be concluded that "there is no compelling proof that the substitution technology for traditional methods is necessary" and makes students learn more effectively (Ilin, 2020, p. 111).

Method and Procedures

For this project I conducted a metasynthesis described by Erwin, Brotherson, and Summers as an "intentional approach to synthesizing and interpreting data across qualitative studies" (Erwin et al., 2011, p. 191). I carefully reviewed and analyzed examples of qualitative research studies, peer-reviewed articles, and books in the disciplines of education, human development, psychology, philosophy, and communication. In doing so, I followed the process of conducting qualitative meta-synthesis as described by Erwin, Brotherson, and Summers in their study of 2011 (Erwin et. al., 2011). The research process involved searching of electronic databases including ERIC and Nipissing University electronic library database. Descriptors employed in the searches included digital classroom, technology, BYOD, and effects of digital technology on learning.

The initial search in Education Resources Information Center (ERIC) for keywords "technology in classroom negative effects" generated 20,156 results. I selected only the peer reviewed journals and the search produced 8,447 findings. I then limited my search to studies published since 2004 which produced 8,336 results. To keep my findings relevant to the topic I added "cell phones" to my search criteria which produced 856 findings. I then browsed through research reports and journal articles and selected those that meet the following criteria:
1. The range of negative effects cell phones in the classroom have on student learning, cognitive/social development, and the learning environment.
2. The range of negative effects iPads in the classroom have on student learning, cognitive/social development, and the learning environment.
3. The range of negative effects computers in the classroom have on student learning, cognitive/social development, and the learning environment.

I applied the same search criteria when navigating through Nipissing University Library. Using the same keywords, I searched for research reports and peer reviewed articles until I found the ones that met my search criteria and provided me with relevant information. I decided not to limit my search to student grades or subjects because I wanted to learn about how technology impacts different learners and classes. I created a list of selected articles and proceeded with collecting, reading, and analyzing data.

To organize the information which I gathered from the selected readings, I also referred to Braun and Clarke's Thematic Analysis paper which describes the thematic analysis as a "method for systematically identifying,

organizing, and offering insight into patterns of meaning (themes) across a data set" (Braun & Clarke, 2012, p. 57). Then I began organizing the found information using the six-phase approach to thematic analysis described by Braun and Clarke as the following:

- Phase 1: Familiarizing Yourself with the Data.
- Phase 2: Generating Initial Codes.
- Phase 3: Searching for Themes.
- Phase 4: Reviewing Potential Themes.
- Phase 5: Defining and Naming Themes.
- Phase 6: Producing the Report.

Selection of Study Materials

I began by creating a list of all articles that best met my search criteria. Then I numbered each article. I conducted screening by carefully reviewing each of the selected articles and making notes of my findings. I created a code list specific to my research question. I divided my codes in two sections: a) categories, which I numbered *1, 2,* and *3*; and b) negative effects, to which I assigned letters *a, b,* and *c* (see the list below).

Categories:

1. Range of negative effects the use of cell phones in the classroom has on student learning, performance, and/or participation in class
2. Range of negative effects the use of iPads in the classroom has on student learning, performance, and/or participation in class
3. Range of negative effects the use of computers in the classroom has on student learning, performance, and/or participation in class

Negative Effects:

(a) Distraction: affecting students' ability to remain focused and stay on task
(b) Purpose: used for other than study-related purposes such as text messaging, e-mailing, accessing social media
(c) Performance: negatively impacts student's ability to retain information and/or student's academic achievement

Findings:

Aaron & Lipton (2018): 1a, 1b, 1c
Berry & Westfall (2015): 1a, 1b, 1c
Bolkan & Griffin (2017). 1b
Bouygues (2019): 2c, 3c
Fried (2008): 3a, 3b, 3c
Green (2019): 1a, 1b
Kaminske, Brown, Aylward, & Haller, M. (2022): 1a
Beland & Murphy (2016): 1a, 1b, 1c
Wilmer, Sherman, & Chein (2017): 1a, 1b, 1c
Sparrow, Liu, & Wegner (2011): 3c
Duncan, Hoekstra, & Wilcox (2012): 3c
Ophir, Nass, Wagner, & Posner (2009): 3a
Thomas, & O'Bannon (2013): 1a
Salcines-Talledo, Gonzalez-Fernandez, Diaz-Herrera, & Area-Moreira (2022): 1a
Neiterman & Zaza (2019).: 1a, 1b, 3a

Results

As the findings suggest, 9 out of 15 studies report that students' use of cell phones in classroom has a range of negative affects on students' learning, performance, and/or participation in class (Aaron & Lipton, 2018; Berry & Westfall, 2015; Green, 2019; Kaminske et al., 2022; Beland & Murphy, 2016; Wilmer et al., 2017; Thomas & O'Bannon, 2013; Salcines-Talledo et al., 2022; Neiterman & Zaza, 2019). According to these findings, cell phones distract students and affect their ability to remain focused and stay on task.

Seven out of 15 studies report that students use their cell phones in class for other than study-related purposes such as text-messaging, e-mailing, or accessing social media which affects their learning, performance, and participation in class (Aaron & Lipton, 2018; Berry & Westfall, 2015; Bolkan & Griffin, 2017; Green, 2019; Beland & Murphy, 2016; Wilmer et al., 2017; Neiterman & Zaza, 2019).

Four out of 15 studies report that students' use of cell phones in class negatively affects their academic performance, including their ability to retain information (Aaron & Lipton, 2018; Berry & Westfall, 2015; Beland & Murphy, 2016; Wilmer et al., 2017). One study reports that irresponsible use of technological devices leads to poorer performance and lower academic achievement (Bolkan & Griffin, 2017). Another reveals that "the positive effects that technology can bring to the classroom cannot outweigh the temptation to use personal technological devices for purposes unrelated to class." (Neiterman & Zaza, 2019, p. 1).

Only 1 of 15 studies reports that students' use of iPads in classroom negatively affects their academic performance (Bouygues, 2019). However, the researchers who conducted this study report that they cannot establish a cause-and-effect relationship between computers, tablets, and other digital devices which cause drop in students' academic scores. This is because "it is possible that the fraction of students who report using these devices at a high frequency are students with the greatest learning needs" (Bouygues, 2019, p. 25).

Six out of 15 studies report that students' use of computers in classroom has negative effects on students' learning, performance, and participation in class (Fried, 2008; Ophir et al., 2009; Neiterman & Zaza, 2019; Bouygues, 2019; Sparrow et al., 2011; Duncan et al., 2012). Four out of these studies find that computers distract students and negatively affect their ability to remain focused and stay on task (Bouygues, 2019; Fried, 2008; Sparrow et al., 2011; Duncan et al., 2012). 1 out of 15 studies reveals that when students use their computers for other than study-related purposes, the quality of their academic performance drops (Fried, 2008). One study reports that when students have access to their computers they are less likely to memorize information (Sparrow et al., 2011).

Emergent Themes

Distraction as a Call for Action. Some findings suggest that the mere presence of cell phones can distract students and affect their learning (Wilmer, 2017). Others see this distraction as an opportunity for educators to improve engagement, arguing that irresponsible phone use of digital devices in class reflects an instructor's failure to engage students (Green, 2019). Multitasking with cell phones during class negatively affects learning, information retention, and academic performance (Fried, 2008; Wilmer, 2017; Beland & Murphy, 2016). Research shows students often turn to their phones when course materials are disengaging, highlighting the importance of engaging teaching practices (Green, 2019). These findings align with constructivist and Deweyan views that digital technology can enhance learning if: a) Both educators and students use technology responsibly for educational purposes. b) Educators utilize technology to make lessons engaging. c) Students use technology solely to understand new material.

Different Devices have Different Effects on Student Performance and Learning. Studies suggest that digital devices like cell phones, iPhones, and computers affect learning and student performance differently. Bouygues reports that fourth graders in Arizona using tablets frequently scored 26 points lower than those who never used them, though this does not establish a cause-and-effect relationship due to various limitations (Bouygues, 2019). However, the study found a clear association between tablet use and poorer performance among elementary students. While some studies highlight the positive impact of technology on learning, others note that highly multipurpose devices like cell phones can be distracting and reduce productivity (Beland & Murphy, 2016). Thus, educators should weigh the pros and cons of using digital devices in classrooms to determine their overall benefit.

The Impact of Technology is Different for Everyone. Studies report a close link between cell phone use and students' ability to self-regulate and focus on learning (Wilmer, 2019). Wilmer's review shows that smartphone addiction reduces the ability to achieve flow and self-regulate (Wilmer, 2019). Beland and Murphy found that banning cell phones in classrooms led to a 6.41% improvement in test scores, with the most significant impact on disadvantaged and underachieving students. Students in the lowest achievement quintile improved by 14.23% of a standard deviation, while top achievers were unaffected (Beland & Murphy, 2016). This suggests low-achieving students have lower self-control and are more distracted by mobile devices, while higher achievers remain unaffected by phone policies.

Cell Phone as a Shared Responsibility: Teachers' and Students' Perceptions of Cell Phone Use in Class. Studies indicate that students often overestimate their multitasking abilities (Duncan, 2012). Chronic media multitaskers have poor cognitive control and find it difficult to filter out irrelevant information (Ophir et al., 2009). According to one study, only 25% of pre-service teachers supported cell phone use in classrooms, although many believe it can enhance learning and motivation (Thomas and O'Bannon 2013). Recent research reveals that students' attitudes toward cell phone use in class have remained largely unchanged, while teachers have become more accepting of it (Stachowski et al., 2020). However, the study reports that students now advocate for stricter consequences for policy violations compared to earlier recommendations (Stachowski et al., 2020). This suggests that both students and educators share responsibility in regulating digital technology use in the classroom.

Discussion

The study prompts several questions about the role of technology in education. For instance, it raises the question of whether teacher training impacts student performance and their use of technology in the classroom. Additionally, there is a need to explore who is responsible for students' irresponsible use of digital technology.

Multiple studies suggest that educators may contribute to students' irresponsible use of technology and low academic achievement (Neiterman & Zaza, 2019; Noddings, 2015; Green, 2019). Boredom often leads to irresponsible tech use and lower achievement (Bolkan & Griffin, 2017). Engaging lessons are crucial, but responsibility should be shared between students and teachers (Noddings, 2015; Neiterman & Zaza, 2019). Noddings argues educators can't expect desired learning outcomes without motivating students (Noddings, 2015). Green suggests distracted cell phone use should prompt teaching adjustments, not just restrictions on devices (Green, 2019). Students must be involved in setting learning goals and view technology as a learning tool, echoing Dewey's educational philosophy (Noddings, 2015). Both educators and students need to share enthusiasm for learning to effectively integrate technology in education (Neiterman & Zaza, 2019).

Studies show mixed reports on the impact of teacher training and classroom technology use. Bouygues argues that teacher training on classroom technology integration does not significantly impact the relationship between technology use and student achievement. Bouygues found that students whose teachers had received training did not perform significantly better than their peers, suggesting that teacher training on technology integration alone does not have a clear positive effect on student performance (Bouygues, 2019). According to this study, the students with trained teachers did not outperform peers using devices frequently, suggesting training has no clear positive effect on performance. On the contrary, Ilin emphasizes the importance of teachers evaluating technology tools to meet learning goals, supporting the need for training (Ilin, 2020). Others argue that teachers need specific training to integrate technology effectively, as it requires understanding pedagogy and adapting to classroom contexts (Thomas & O'Bannon, 2013; Koehler & Mishra, 2009). Successful integration involves creatively structuring technology use to support learning goals and addressing students' needs and prior knowledge (Koehler & Mishra, 2009).

Suggestions for regulating the use of technological devices in classroom

Banning technology from classrooms is impractical because some students, including those with disabilities, rely on digital devices for learning (University of Waterloo, n.d.; Thomas & O'Bannon, 2013). Instead of banning, regulation is recommended. Canadian courts and researchers support regulating technology use, advocating clear policies and specific guidelines for device use (Bouygues, 2019; Smale & Russo, 2021). Effective regulation involves assessing the necessity of technology for learning, carefully analyzing its benefits, and setting clear, enforceable policies (Ilin, 2020; Bouygues, 2019). Studies suggest that moderate use of technology, with strict regulations, enhances academic performance (Bouygues, 2019). Educators should also be trained to manage technology use effectively and engage students in setting and adhering to technology policies (Neiterman & Zaza, 2019; Berry & Westfall, 2015).

Limitations

Some limitations of this review include measuring the quality of qualitative research and synthesizing information without sacrificing the relevance or integrity of individuals who conducted the original research. Other limitations, as reported by the studies reviewed in this paper, include findings based on small samples which may lead to incorrect results (Duncan et al., 2012; Thomas & O'Bannon, 2013). Others point to possible inaccuracies of their reports due to self-reported information (Wilmer, 2017). For example, one extensive review of multiple studies, reports that "majority of studies in this field employ self-report questionnaires that provide" limited findings (Wilmer, 2017, p. 2). Similarly, Bouygues's study, which analyzed NAEP and PISA reports that rely on self-reported data obtained from student surveys, reports that results may be unreliable since participants may not have offered accurate responses. One study suggests that students' perceptions of using digital devices in class may have been difficult to interpret (Green, 2019). For example, it points that students do not necessarily perceive their cell phones as distractions, but use them as learning tools, especially to record and write information (Green, 2019). The survey conducted as part of this study did not offer students a space to define what forms of composing they do on their cell phones. In other words, the participants did not specify what type of writing they performed using their cell phones. Hence, it is unclear if students used their cell phones for texting or social media, which can also be interpreted as acts of writing (Green, 2019).

Conclusion

This study explores various negative impacts of digital technology—particularly cell phones, iPads, and computers—on students' learning, performance, and classroom participation. A significant 60% of the studies reviewed indicate that students' use of cell phones negatively affects their academic performance and achievement. These digital devices are frequently identified as sources of distraction, which affects students' ability to focus and engage actively in class activities. Each study analyzed confirms that irresponsible use of digital technology detrimentally influences students' learning experiences, academic performance, and overall classroom participation. These findings emphasize the necessity for school boards and educators to develop and enforce policies that regulate digital device usage within educational settings. It is important for both educators and students to understand the implications of technology use in the classroom and to foster responsible usage practices to maximize learning.

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