

# Everyschool.org's Research Summary on EdTech

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This summary serves as a science-based explanation behind Everyschool's mission to empower healthy, research-based educational technology in the classroom. EdTech research is mounting, and patterns have developed; those patterns, when looked at collectively, point to balance and caution when implementing technology in the classroom. The emerging patterns show the following:

- Teachers fuel learning better than technology
- There is little research and widespread bias to support technology in the classroom
- EdTech has not been proven to boost performance or test scores but has, in some cases, been linked to lowered test scores
- Screen time can compromise creativity
- Students retain more, focus better, and test higher when they read print
- Handwriting aids memory and deep learning
- Time limits matter
- Gamification is fraught with research-based red flags
- Screen addiction is real
- Too much screen time is linked to a myriad of mental and physical health concerns
- Young students are more susceptible to the negatives of too much or the wrong kinds of screen time
- Screens cause eye problems
- Access to cell phones during school hours is distracting and has been linked to lowered test scores
- Screen-based homework can be problematic
- Students with special needs may benefit uniquely from tech

If using a screen often comes at a price, then it's important to use them selectively, and only when they truly produce a unique outcome, develop a high-level skill, or support learning in helpful ways (see the Transformative and Supportive categories in The EdTech Triangle). Everyschool acknowledges that some schools might find it valuable to teach tech skills that prepare students for 21st century jobs; those skills might include advanced coding, robotics, website design, graphic design, or other truly Transformative tech types listed in The EdTech Triangle.

To better understand the above research patterns and see their bibliographical origins, please read on.

## **Teachers fuel learning better than technology.**

Despite the changing landscape in education, teachers remain the most effective influence on learning. While various methods of teacher-directed instruction are shown to produce above-average results (more than one year's growth during one year of school), typical uses of technology in the classroom, such as 1:1 laptop programs, web-based learning, gaming, and simulations, yield less positive results (less than one year's growth during one year of school).<sup>1,2,3</sup> Compared to face-to-face engagement, screens are an impoverished stimulation for a child's developing mind.<sup>4</sup> In fact, Andreas Schleicher, a veteran education analyst states, "In most of the highest-performing systems, technology is remarkably absent from classrooms."<sup>5</sup>

### **There is little research and widespread bias to support technology in the classroom**

Researchers are finding widespread biases in studies conducted by the tech companies who sell devices and other tech products to schools.<sup>6, 7</sup> When comparing replication studies done by an independent researcher to the research done by an app developer, the developer studies tended to post 80% higher academic gains.<sup>8</sup> In fact, “a report from the National Education Policy Center, a nonpartisan research group at the University of Colorado at Boulder, found the rapid adoption of the mostly proprietary technology in education to be rife with ‘questionable educational assumptions . . . self-interested advocacy by the technology industry, serious threats to student privacy, and a lack of research support.’”<sup>9</sup>

### **EdTech has not been proven to boost performance or test scores but has, in some cases, been linked to lowered test scores**

Providing students with laptops, tablets, and e-readers has a negative impact on test scores; in some cases, students score an entire grade level lower when using a device during all or almost all of their classes.<sup>3, 10</sup> Even Intel admits, “there are no longitudinal, randomized trials linking eLearning to positive learning outcomes.”<sup>7</sup> Research suggests that simply removing devices from the classroom is “equivalent to improving the quality of the teacher by more than a standard deviation.”<sup>11</sup> In fact, the increasingly popular 1:1 programs in schools have been shown to be one of the least effective methods of integrating technology.<sup>2</sup> From 2000 to 2012, reading performance declined among students who use the Internet at school.<sup>12</sup> And, overall, incorporating technology into the classroom has not shown any appreciable improvements in reading, math, or science outcomes.<sup>12, 13</sup>

### **Screen time can compromise creativity**

Creativity, defined as the “production of something original and useful,” requires “divergent thinking (generating many unique ideas) and then convergent thinking (combining those ideas into the best result).”<sup>14</sup> As a society, our creativity is in decline, and our youngest children (Kindergarten-6<sup>th</sup> grade) are experiencing the most serious decline.<sup>14</sup> Due to the engaging nature of screens and the pre-programmed limits of technological applications, students can become complacent, allowing technology to set the parameters, impeding on their own skills and curiosity.<sup>15</sup> After just one hour of screen time daily, children demonstrate lower rates of curiosity.<sup>16</sup> Even applications marketed to engage creativity often engage student’s fingertips more than their creative minds.<sup>15</sup> To foster true creativity—the number one leadership trait identified by 1500 CEOs<sup>17</sup>—we must allow for boredom, encourage role-play/fantasy worlds, tolerate unconventional answers, allow space with no artificial limits for students to produce their own ideas and work, and reduce screen time to allow for creative activities to fill that time.<sup>14, 18</sup> Ideally, teachers are focusing on intrinsic rewards (as opposed to extrinsic), delayed gratification, open-ended assignments, and intellectual risk-taking.<sup>18</sup>

### **Students retain more, focus better, and test higher when they read print**

Reading comprehension is significantly greater when students read in print as opposed to digitally.<sup>19</sup> Students who read in print are more likely to engage in deep reading and concentrated reading, while those reading digitally spent more time scanning, key-word spotting, and browsing.<sup>20</sup> Compared to paper, screens are not able to recreate the tactile experience that people need to connect with written material in a satisfying way.<sup>21</sup> Students reading on a screen rely on “remembering” more than “knowing,” while students who read in print more often “know” the answer (indicating a deeper level of learning and retention).<sup>21</sup> Although the idea of hyperlinks in electronic textbooks may seem appealing, in reality, hypertext is distracting, decreases sustained attention, and promotes more fragmented reading.<sup>20</sup> Children who read on-screen are nearly twice less likely to be above-average readers, and they are three times less likely to enjoy reading.<sup>22</sup>

## **Handwriting aids memory and deep learning**

Laptop notetakers performed worse than longhand notetakers when recalling factual content and demonstrating conceptual understanding.<sup>23</sup> Printing and cursive writing utilize different brain functions than keyboarding, and producing letters, stroke by stroke, improves our ability to process information.<sup>24, 25</sup> Even when device usage is limited to just note-taking, shallower processing of the material may occur, leading to diminished learning.<sup>23</sup> By writing, we process material more deeply, and the act of handwriting “engages the thinking part of the mind.”<sup>26</sup>

## **Time limits matter**

Despite reassurances from tech companies that educational screen time “doesn’t count” in the same way recreational screen time does, screen time itself— the sedentary, isolating act of being on a screen— has deleterious effects. Numerous studies have demonstrated structural and functional changes in the brain related to screen time including brain atrophy, reduced cortical thickness, and damage to the frontal lobe.<sup>27</sup> Massive brain changes are occurring throughout childhood, but specifically in infancy and adolescence.<sup>28</sup> During this vital time of development, our brains rapidly prune skills we aren’t using and strengthen the ones we do use.<sup>28</sup> We are often told to balance screen time with physical activity, but the actual amount of time spent on a screen, regardless of physical activity, does affect physical and mental health.<sup>29</sup> In fact, the recommendation of no more than 2 hours of technology a day for school aged children is supported by research.<sup>29</sup>

## **Gamification is fraught with research-based red flags**

The research on educational games, which most often includes points-based or achievement-based play, shows mixed outcomes.<sup>30</sup> Some research shows positive effects,<sup>31</sup> while other studies show the learning gains they offer are shallow or short-lived.<sup>32, 33</sup> Still other studies show that, compared to a control group, students using gamified curriculum exhibit less motivation, satisfaction, and empowerment, as well as scored lower in final exams.<sup>34</sup> In all, their total educational benefits are mostly inconclusive.<sup>30,35</sup> What’s more, as every educational game is different and studies are lacking, it’s not often possible for teachers to know which games to offer and which to avoid.<sup>30</sup> What we can say is that educational games mostly isolate students from face-to-face interactions and are often similar to their entertainment-based counterparts, which have been developed to lure us in with “hijacking techniques” and “compulsion loops,”<sup>36</sup> leading to concerns of addiction and overstimulation. Given all these factors, educational games have been placed in the Restrictive category within The EdTech Triangle, and are recommended to be used only sparingly.

## **Screens use can become habitual**

Screens are exciting and compelling, making it difficult for healthier hobbies, interests, or learning methods to compete.<sup>37</sup> Engagement is often cited as a primary reason for choosing tech in the classroom; however, that idea has been criticized, given that “keeping children engaged requires an environment of constant novelty, which cannot be sustained.”<sup>38</sup> Repeated behaviors (reaching for a device during downtime, filling a moment of boredom with an educational game, or engaging with a device over connecting to a peer) can become biologically compelled habits, making it more difficult for students to turn off screens as they become older.<sup>39</sup>

## **Too much screen time has been linked to a myriad of mental and physical health concerns**

The effects of screen time on well-being are established. The more time children and adolescents spend looking at a screen, the lower their psychological well-being.<sup>16</sup> Adolescents who spend more time on non-screen activities (sports, social interaction, print

media) are less likely to report depressive symptoms.<sup>40</sup> In fact, “all screen activities are linked to less happiness, and all non-screen activities are linked to more happiness.”<sup>41</sup>

In regards to tech use, the list of mental health concerns is long (and not just in the context of excessive use). Many deleterious effects appear after just one to two hours of tech time per day.<sup>16, 41, 29</sup> Concerns include:

Sleep disruption<sup>42</sup>

Depression<sup>41, 16</sup>

Anxiety<sup>16</sup>

Loneliness<sup>41</sup>

Social problems<sup>15</sup>

Less curiosity<sup>16</sup>

Difficulty making friends<sup>16</sup>

Difficulty staying calm<sup>16</sup>

Increased arguing with caregivers<sup>16</sup>

Decreased ability to complete tasks<sup>16</sup>

Decrease in empathy<sup>43</sup>

Reduced attention span<sup>16</sup>

Difficulty regulating emotion<sup>16</sup>

Obesity<sup>15,44</sup>

Impaired fine motor skills<sup>44</sup>

Lower cardiovascular fitness<sup>44</sup>

Some of these effects may be due to the screen itself, but likely many arise as a result of what the screen replaces, including interaction with caring adults and face-to-face connections with peers.<sup>15, 41</sup> When parents and teachers band together to promote healthy life habits, we produce a healthier generation of students.

### **Young students are more susceptible to the negatives of too much or the wrong kinds of screen time**

Experiential learning, in which students are physically active in creative and self-initiated play, is necessary for healthy development in preschoolers and kindergartners.<sup>15</sup> Despite the popular view that children will be “left behind” if they are not exposed to digital devices from an early age, there is no research to support that this is true.<sup>15</sup> On the other hand, creative and hands-on play has been linked to problem solving skills and creativity.<sup>15</sup> Research has shown that fast-paced media, especially in younger children, is linked to impaired executive function and lower ability to delay gratification.<sup>45</sup> The recent uptick in reduced fine motor skills in young children may be related to an increase in screen time exposure.<sup>44, 46</sup> More than anything, devices in the classroom take away from a multitude of other activities known to be more beneficial to their health and development.<sup>47</sup> In summary, “healthy neural branching of the developing brain depends on close personal relationship with caring adults and on hands-on experiences in the real world.”<sup>47</sup>

### **Screens cause eye problems**

Screens cause eyestrain, headaches, and blurred vision; the effect can exhaust our mental and physical resources and make information recall more difficult.<sup>21</sup> The number of cases of nearsightedness now qualifies as an epidemic, with a rapid increase starting in 2007 when the smartphone was introduced.<sup>48</sup> The consequence of nearsightedness isn’t just glasses—it also increases the risks of major eye disorders like retinal tearing, glaucoma, and cataracts.<sup>48</sup> When tablets are used in classrooms with fluorescent lighting, the “effect is multiplied tenfold.”<sup>48</sup> Using a computer seven hours a week or more triples the risk for nearsightedness.<sup>49</sup> Prolonged use of tablets increases the negative effects, and one of the

best protective factors— exposure to daylight— isn't always given the priority it deserves during the day. Increasing outdoor time during the school day contributes to a notable reduction in the risk of nearsightedness.<sup>50</sup>

### **Access to cell phones during school hours is distracting and has been linked to lowered test scores**

Allowing personal devices in the classroom can lead to decreased attention and retention of material. Students who are allowed personal devices in the classroom perform significantly worse on exams compared to students without a personal device.<sup>51</sup> Divided attention, even for brief distractions, can affect long-term retention of material.<sup>51</sup> Access to a personal device makes multitasking more likely to occur, and the research is clear on the negative effects of multitasking on performance.<sup>52, 53</sup> Banning cell phones significantly increases student performance, even more so among the lowest-performing students, making a school-wide cell phone ban one of the simplest ways to reduce educational inequality.<sup>54</sup>

Aside from the academic concerns, one of the greatest costs of allowing cell phones in school is a student's ability to isolate, disengage from face-to-face connections, and participate in recreational online activities (including accessing age-inappropriate content and social media).

### **Screen-based homework can be problematic**

The data supporting the negative effects of too much recreational screen time is vast. However, parents are finding it difficult to limit recreational technology at home when their children are assigned digital homework.<sup>9</sup> Students intend to complete homework, and yet the distractions on a device are overwhelming.<sup>55</sup> Most students report high levels of distraction and small amounts of actual time spent on homework. In fact, only 3% of the time teens spend on a device is actually creating content, and the majority is passive consumption and communication.<sup>55</sup> Eliminating what is likely the greatest distraction— digital devices— will allow students to concentrate fully (one of the strongest predictor of future success) and more deeply understand new concepts.<sup>56</sup> Teachers can help parents reduce overall screen time by assigning screen-based homework only when it is truly necessary.

### **Students with special needs may benefit uniquely from tech**

Just as there are no two children alike, there are no two children with special needs that respond exactly the same way to the same interventions. The complexity of a unique child's situation makes it impossible to make blanket statements on the use of technology for children with special needs. There are many cases in which technology can be truly transformative for this population. There is also good reason to be diligent in exploring non-tech options, but there are instances in which the tech option opens a world for a child who might not otherwise be able to access a portion of their education.<sup>57, 58</sup> Studies show that assistive technology should be used with caution and not totally replace teacher-assisted lessons, though.<sup>59</sup> In all, "people may look at assistive technology as a tool that leads students with disabilities to succeed, while others believe assistive technology makes them dependent and students with disabilities will not be able to do the tasks on their own."<sup>57, 60</sup> Taken collectively, technology for students with special needs can often be transformative, but isn't always.<sup>61</sup> EverySchool believes each special needs child should receive individual evaluations often within the context of the teachers and experts available and the scope of their Individual Education Program (IEP).

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