THE EDTECH REPORT

Research to know right now
about technology in the classroom

by Everyschool.org

ABOUT THIS DOCUMENT

The EdTech Report isolates usable, evidence-based insights from the fields of EdTech, teaching and learning, child development, and psychology so that educators can embrace best practices with technology in the classroom.

When best practices with EdTech are embraced, students are better-positioned to thrive physically, emotionally, socially, and academically.

Specifically, this document:

1. **Isolates research patterns.** Every insight here represents a pattern taken from *many studies*, not just the ones cited.
2. **Condenses scholarly research.** What is often hard to boil down and access is now here in simple summary form.
3. **Offers clear insights.** Clarity makes way for usability and action in education spaces.

ABOUT EVERYSCHOOL.ORG

The EdTech Report is a resource created by Everyschool.org, an independent, research-based nonprofit whose mission is happier, healthier, smarter school communities through digital wellness. Everyschool.org created and maintains The EdTech Triangle, a research-based implementation model for technology in the classroom; as such, this document may act as a research-based explanation for that model.

HOW TO USE THIS DOCUMENT

The EdTech Report has been designed to be used by educators and decision makers to create District, school, or classroom technology philosophies, plans, and curricula.

Specifically, educators and decision makers might:

1. **Discuss the insights** listed here at board, curriculum, or other meetings.
2. **Use the insights** here as rationale for adopting a specific EdTech policy, plan, or implementation model (such as The EdTech Triangle).

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TEACHERS ARE UNIQUELY POWERFUL

Despite the changing landscape in education, teachers remain the most effective influence on learning. While various methods of teacher-directed instruction have been shown to produce above-average results (more than one year's growth during one year of school), typical uses of technology in the classroom–1:1 laptop/tablet programs, web-based learning, simulations, and gaming–yield less positive results (less than one year's growth during one year of school).[1,2,3] Technology is most powerful when in the hands of a teacher, or when used by students in concert with a teacher, rather than students working in isolation on their devices.[4] Compared to face-to-face engagement, screens are an impoverished stimulation for a child's developing mind.[5] In fact, Andreas Schleicher, a veteran education analyst, says that "In most of the highest-performing systems, technology is remarkably absent from classrooms."[6]

[1] Hattie, J. (2009) *Visible Learning A Synthesis of Over 800 Meta-Analyses Relating to Achievement.* New York, NY: Routledge

[2] Hattie, J. & Waack, S. (2018) Retrieved from https://visible-learning.org/backup-hattie-ranking-256-effects-2017/

[3] Bryant, J., Child, F., Dorn, E., & Hall, S. (2020) New global data reveal education technology's impact on learning.. Retrieved from https://www.mckinsey.com/industries/education/our-insights/new-global-data-reveal-education-technologys-impact-on-learning

[4] Bryant, J., Child, F., Dorn, E., & Hall, S. (2020) New global data reveal education technology's impact on learning.. Retrieved from https://www.mckinsey.com/industries/education/our-insights/new-global-data-reveal-education-technologys-impact-on-learning

[5] Ruder, D. (2019, June 19). Screen time and the brain. *Harvard Medical School.* Retrieved from https://hms.harvard.edu/news/screen-time-brain

[6] Ripley, A. (2010). Brilliance in a box. *Slate.* Retrieved from https://slate.com/news-and-politics/2010/10/what-do-the-best-classrooms-in-the-world-look-like.html

STUDENTS BENEFIT FROM TRANSFORMATIVE TECHNOLOGY

Over the last several decades, digital literacy has grown from simply the ability to use a word processing application to advanced technological skills that are ever-changing and often self-taught out of necessity.[7] Given the ever-evolving nature of technology, among the most important skills a student needs as they exit high school are critical thinking, collaboration, problem solving, digital literacy, and creativity.[8] When incorporating technology into the high school curriculum, educators must strike the fine balance to support and nurture the current state of adolescent brain development which seeks adventure, data, and connectedness,[9] with the need to provide students with an applicable skill set that will make graduates marketable to potential employers, vocational schools, or universities. Understanding complex applications not only provides students with an immediately marketable skill, but it also provides them with the experience of learning a complex skill, the foundation to build on that skill, and potentially transferable skills such as reasoning, creative thinking, mathematical modeling, special skills, and metacognition.[10,11] As job growth in STEM fields outpaces almost all other fields,[12] those positions are often the hardest to fill. The most fruitful implementation of technology in K-12 education is when opportunities are provided to high school students to gain exposure to–and perhaps even a mastery in–complex applications that produce a unique outcome or allow students to learn a high-level skill.

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[7] Christian, A. (2022). Why 'digital literacy' is now a workplace non-negotiable. Retrieved from https://www.bbc.com/worklife/article/20220923-why-digital-literacy-is-now-a-workplace-non-negotiable

[8] English, D., Cushing, E., Therriault, S., & Rasmussen, J. (2017). College and career readiness begins with a well-rounded education: Opportunities under the Every Student Succeeds Act. Retrieved from https://ccrscenter.org/sites/default/files/AskCCRS_Well-Rounded_Education.pdf

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[11] Scherer, R., Siddiq, F., & Sanchez Viveros, B. (2019). The cognitive benefits of learning computer programming: A meta-analysis of transfer effects. *Journal of Educational Psychology, 111* (5). Retrieved from https://www.gwern.net/docs/psychology/2019-scherer.pdf

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BIAS AND LACK OF RESEARCH FROM EDTECH COMPANIES

Researchers are finding widespread biases in studies conducted by the tech companies who sell devices and other tech products to schools.[13,14] 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.[15] 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.'"[16]

[13] Miles, M. (2018, February 6) Tech companies are buying their own education research. That's a problem. *Education Week*. Retrieved from https://www.edweek.org/ew/articles/2018/02/07/tech-companiesare-buying-their-own-education.html

[14] Gabriel, T., & Richtel, M. (2011, October 8). Inflating the software report card. *The New York Times.* Retrieved from https://www.nytimes.com/2011/10/09/technology/a-classroom-software-boom-but-mixedresults-despite-the-hype.html

[15] Barshay, J. (2019, March 18). The dark side of education research: Widespread bias. *The Hechinger Report.* Retrieved from https://hechingerreport.org/the-dark-side-of-education-research-widespreadbias/

[16] Morris, B. & Hobbs, T. (2019, September 3). Schools pushed for tech in every classroom. Now Parents are pushing back. *The Wall Street Journal.* Retrieved from https://www.wsj.com/articles/in-a-schooldistrict-where-technology-rules-grades-fall-parents-ask-why-11567523719

EDTECH AND TEST SCORES

Providing students with laptops, tablets, and e-readers has been shown to have 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.[17,18] Even Intel admits that "there are no longitudinal, randomized trials linking eLearning to positive learning outcomes."[19] Research suggests that simply removing devices from the classroom is "equivalent to improving the quality of the teacher by more than a standard deviation."[20] In fact, the increasingly popular 1:1 programs in schools have been shown to be one of the least effective methods of integrating technology.[21] From 2000 to 2012, reading performance declined among students who use the Internet at school.[22] And, overall, incorporating technology into the classroom has not shown any appreciable improvements in reading, math, or science outcomes.[23]

[17] Mourshed, M., Krawitz, M., & Dorn, E. (2017) How to improve student educational outcomes: New insights from data analytics. Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/social%20sector/our%20insights/how%20to%20improve%20student%20educational%20outcomes/how-to-improve-student-educational-outcomes-new-insights-from-data-analytics.ashx

[18] Barshay, J. (2019, June 10). Research shows lower test scores for fourth graders who use tablets in schools. The Hechinger Report. Retrieved from https://hechingerreport.org/research-shows-lowertest-scores-for-fourth-graders-who-use-tablets-in-schools/

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[20] Carter, S., Greenberg, K., & Walker, M. (2016, May 1). The impact of computer usage on academic performance: Evidence from a randomized trial at the United States Military Academy. Retrieved from http://seii.mit.edu/research/study/the-impact-of-computer-usage-on-academic-performance-evidencefrom-a-randomized-trial-at-the-united-states-military-academy/

[21] Visible Learning. (n.d.) Retrieved from https://reader.mediawiremobile.com/Corwin/issues/204141/ viewer?page=5

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[23] Wilson, E. (2019, April 24). Ed-Tech utopia is over. Education Next. Retrieved from https://www.educationnext.org/ed-tech-utopia-is-over-personalized-learning

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)."[24] As a society, our creativity is in decline, and our youngest children (Kindergarten-6th grade) are experiencing the most serious decline.[25] 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.[26] After just one hour of screen time daily, children demonstrate lower rates of curiosity.[27] Even applications marketed to engage creativity often engage student's fingertips more than their creative minds.[28] To foster true creativity— the number one leadership trait identified by 1500 CEOs17— we must allow for boredom, encourage role-play/fantasy worlds, tolerate unconventional answers, allow space free from artificial limits for students to produce their own ideas and work, and reduce screen time to allow for creative activities to fill that time. [29] Ideally, teachers are focusing on intrinsic rewards (as opposed to extrinsic), delayed gratification, open-ended assignments, and intellectual risk-taking.[30]

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[24] Bronson, P., & Merryman, A. (2010, July 10). The creativity crisis. Newsweek. Retrieved from https://www.newsweek.com/creativity-crisis-74665

[25] Bronson, P., & Merryman, A. (2010, July 10). The creativity crisis. Newsweek. Retrieved from https://www.newsweek.com/creativity-crisis-74665

[26] Linn, S., Almon, J., & Levin, D. (2012, October 1). Facing the screen dilemma: Young children, technology and early education. Retrieved from https://commercialfreechildhood.org/sites/default/files/ facingthescreendilemma.pdf

[27] Twenge, J. M., & Campbell, W. K. (2018, October 18). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. Preventive Medicine Reports, 12, 271-283. doi: 10.1016/j.pmedr.2018.10.003

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PRINT IS POWERFUL

Reading comprehension is significantly greater when students read in print as opposed to digitally.[31] Students who read printed texts are more likely to engage in deep reading and concentrated reading, while those who read digitally spend more time scanning, key-word spotting, and browsing.[32] Compared to paper, screens are not able to recreate the tactile experience that people need to connect with written material in a satisfying way.[33] 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).[34] Although the idea of hyperlinks in electronic textbooks may seem appealing, in reality, hypertext is distracting, decreases sustained attention, and promotes more fragmented reading.[35] 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.[36]

[31] Mangen, A., Walgermo, B., & Bronnick, K. (2013, January 5). Reading Linear Texts on Paper Versus Computer Screen: Effects on Reading Comprehension. International Journal of Educational Research, 58, 61-68. Retrieved from https://www.sciencedirect.com/science/article/pii/ S0883035512001127?via%3Dihub

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[33] Jabr, F. (2013). The reading brain in the digital age: The science of paper versus screens. Scientific American. Retrieved from https://www.scientificamerican.com/article/reading-paper-screens/

[34] Jabr, F. (2013). The reading brain in the digital age: The science of paper versus screens. Scientific American. Retrieved from https://www.scientificamerican.com/article/reading-paper-screens/

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HANDWRITING AIDS MEMORY AND DEEP LEARNING

Laptop notetakers performed worse than longhand notetakers when recalling factual content and demonstrating conceptual understanding.[37] Printing and cursive writing utilize different brain functions than keyboarding, and producing letters, stroke by stroke, improves our ability to process information. [38,39] Even when device usage is limited to just note-taking, shallower processing of the material may occur, leading to diminished learning.[40] By writing, we process material more deeply, and the act of handwriting "engages the thinking part of the mind."[41]

[37] Mueller, P. A., & Oppenheimer, D. M. (2014, April 23). The pen is mightier than the keyboard. Psychological Science, 25(6), 1159-1168. doi: 10.1177/0956797614524581

[38] Bach, D. (2014, December 23). UW Prof: Handwriting engages the mind. Retrieved from https://www.washington.edu/news/blog/uw-prof-handwriting-engages-the-mind/

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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 often 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.[42] Massive brain changes are occurring throughout childhood, but specifically in infancy and adolescence.[43] During this vital time of development, our brains rapidly prune skills we aren't using and strengthen the ones we do use.[44] 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.[45] In fact, the recommendation of no more than 2 hours of technology a day for school aged children is supported by research.[46]

[42] Dunckley, V. (2014, February 27). Gray matters: Too much screen time damages the brain. *Psychology Today.* Retrieved from https://www.psychologytoday.com/us/blog/mental-wealth/201402/ gray-matters-too-much-screen-time-damages-the-brain

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[44] Page, A., Cooper, A., Griew, P., & Jago, R. (2010, October 11). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-1017. doi: 10.1542/peds.2010-1154

[45] Page, A., Cooper, A., Griew, P., & Jago, R. (2010, October 11). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-1017. doi: 10.1542/peds.2010-1154

[46] Page, A., Cooper, A., Griew, P., & Jago, R. (2010, October 11). Children's screen viewing is related to psychological difficulties irrespective of physical activity. *Pediatrics, 126*(5), e1011-1017. doi: 10.1542/peds.2010-1154

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.[47] Some research shows positive effects, [48] while other studies show the learning gains they offer are shallow or short-lived.[49,50] 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.[51] In all, their total educational benefits are mostly inconclusive.[52] 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.[53] 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,"[54] leading to concerns of compulsive habits 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.

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https://doi.org/10.1016/j.compedu.2014.08.019

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SCREENS USE CAN BECOME HABITUAL

Screens are exciting and compelling, making it difficult for healthier hobbies, interests, or learning methods to compete.[55] 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."[56] 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.[57]

[55] Lieber, C. (2018, August 8). Tech companies use "persuasive design" to get us hooked. Psychologists say it's unethical. *Vox.* Retrieved from https://www.vox.com/2018/8/8/17664580/ persuasive-technology-psychology

[56] Richtel, M. (2011, September 3). Technology in schools faces questions on value. *New York Times.* Retrieved from https://www.nytimes.com/2011/09/04/technology/technology-in-schools-faces-questionson-value.html

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SCREEN TIME HAS BEEN LINKED TO A MYRIAD OF 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.[58] Adolescents who spend more time on non-screen activities (sports, social interaction, print media) are less likely to report depressive symptoms.[59] In fact, "all screen activities are linked to less happiness, and all non-screen activities are linked to more happiness."[60] In regards to tech use, the list of mental health concerns is long (and not just in the context of excessive use). Many deleterious outcomes appear after just one to two hours of tech time per day. Concerns include sleep disruption, depression,[61] anxiety, loneliness, less curiosity, and difficulty making friends; other issues include difficulty staying calm, increased arguing with caregivers, and decreased ability to complete tasks and maintain focus.[62] More issues are decreased empathy,[63] obesity, impaired fine motor skills, and lower cardiovascular fitness.[64] Some of these outcomes may be due to the screen itself, but likely many arise as a result of what screens replace, including interactions with caring adults and face-to-face connections with peers.[65] When parents and teachers band together to promote healthy life habits, we produce a healthier generation of students.

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[58] Twenge, J. M., & Campbell, W. K. (2018, October 18). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, *12*, 271-283. doi: 10.1016/j.pmedr.2018.10.003

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[63] Empathy: College students don't have as much as they used to. (2010, May 27). Retrieved from https://news.umich.edu/empathy-college-students-don-t-have-as-much-as-they-used-to/

[64] Holland, K. (2018, March 7). Too much technology: Children growing up with weak hands, fingers. *Healthline.* Retrieved from https://www.healthline.com/health-news/too-much-technology-children-withweak-hands

[65] Linn, S., Almon, J., & Levin, D. (2012, October 1). Facing the screen dilemma: Young children, technology and early education. Retrieved from https://commercialfreechildhood.org/sites/default/files/ facingthescreendilemma.pdf

YOUNG STUDENTS AND SCREENS

Experiential learning, in which students are physically active in creative and self-initiated play, is necessary for healthy development in preschoolers and kindergartners.[66] 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. On the other hand, creative and hands-on play has been linked to problem solving skills and creativity. [67] Research has shown that fast-paced media, especially in younger children, is linked to impaired executive function and lower ability to delay gratification.[68] The recent uptick in reduced fine motor skills in young children may be related to an increase in screen time exposure as well.[69] More than anything, devices in the classroom often displace other activities known to be more beneficial to the health and development of young students.[70] In summary, "healthy neural branching of the developing brain depends on close personal relationships with caring adults and on hands-on experiences in the real world."[71]

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[66] Linn, S., Almon, J., & Levin, D. (2012, October 1). Facing the screen dilemma: Young children, technology and early education. Retrieved from https://commercialfreechildhood.org/sites/default/files/ facingthescreendilemma.pdf

[67] Linn, S., Almon, J., & Levin, D. (2012, October 1). Facing the screen dilemma: Young children, technology and early education. Retrieved from https://commercialfreechildhood.org/sites/default/files/ facingthescreendilemma.pdf

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SCREENS AND EYE PROBLEMS

Screens can cause eyestrain, headaches, and blurred vision; the effect can exhaust our mental and physical resources and make information recall more difficult.[72] The number of cases of nearsightedness now qualifies as an epidemic, with a rapid increase starting in 2007 when the smartphone was introduced.[73] The consequence of nearsightedness isn't just glasses— it also increases the risks of major eye disorders like retinal tearing, glaucoma, and cataracts. When tablets are used in classrooms with fluorescent lighting, the "effect is multiplied tenfold."[74] Using a computer seven hours a week or more triples the risk for nearsightedness.[75] 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.[76]

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CELL PHONES IN SCHOOLS CAN UNDERMINE LEARNING

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.[77] Divided attention, even for brief distractions, can affect long-term retention of material.[78] Access to a personal device makes multitasking more likely to occur, and the research is clear on the negative effects of multitasking on performance.[79,80] 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.[81] 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).

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SCREEN-BASED HOMEWORK RAISES CONCERNS

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.[82] Students intend to complete homework, and yet the distractions on a device are overwhelming.[83] 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.[84] Eliminating what is likely the greatest distraction— digital devices— will allow students to concentrate fully (one of the strongest predictors of future success) and more deeply understand new concepts.[85] Teachers can help parents reduce overall screen time by assigning screen-based homework only when it is truly necessary.

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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.[86,87] Studies show that assistive technology should be used with caution and not totally replace teacher-assisted lessons, though.[88] 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."[89] Taken collectively, technology for students with special needs can often be transformative, but isn't always.[90] Everyschool believes each special needs child should receive individual evaluations often and within the context of the teachers and experts available and the scope of their Individual Education Program (IEP).

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