EAB

DISTRICT LEADERSHIP FORUM

The Impact of Education Technology Use on Elementary and Middle School Students

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Research Methodology and Purpose of this Report

Our research team spent twelve weeks reviewing literature on different types of education technology and comparing them to traditional learning methods, as well as studying how students' executive functions interact with these technologies. The goal of this report is to provide educators with research they can use to implement evidence-based practices regarding the use of education technology.

Education technology has increasingly found its way into schools, often as an alternative to traditional learning methods (e.g., students typing instead of handwriting notes in class). District leaders must consider their technological options carefully to ensure that students and teachers are best supported in meeting their district's strategic priorities and learning outcomes. **This report demonstrates that educators must balance best practices for teaching essential academic skills (e.g., reading, writing) with the need to expose students to fundamental digital competencies which are necessary for an increasingly technology-reliant world**.

If you have any questions about the research or methodology, please reach out to your dedicated advisor.

Leadership at a partner district approached AskEAB with the following questions:

1. How does education technology used in the classroom and for homework affect students of different ages?
2. What are high-impact uses of technology for students?
3. What is the developmental appropriateness of different technologies for various age cohorts (lower elementary, upper elementary, and middle school)?
4. How does technology interact with students' executive functions?
5. What is the appropriate amount of education technology use for students of different ages?

Executive Summary

Key Observations

Minimize student exposure to entertainment-based screen time in school and prevent excessive device-based homework assignments to protect students' sleep. While districts do not have control over students' screen use at home, they can minimize exposure to unhealthy screen use in the classroom and advise teachers to assign primarily screen-free homework. Institutions like the World Health Organization advise that children and adolescents spend no more than two hours per day using devices for entertainment purposes, and caution that screen use close to bedtime lowers the quality of students' sleep and can negatively impact achievement.

To improve students' abilities in core competencies like reading and writing, use traditional educational methods (e.g., handwriting) over digital alternatives (e.g., typing). Before students reach adequate mastery of education technology tools, they consistently perform worse academically when using technology to complete tasks. With a few exceptions, device-based reading and writing are not as beneficial to students as their traditional alternatives (e.g., reading on paper) and provide more opportunities for distraction.

Embed instruction on basic digital competencies into classrooms prior to introducing new technology to students. Districts must carefully consider whether students have been adequately prepared to navigate new digital platforms. Technology can enhance classroom learning when used well, but without proper preparation, can introduce barriers to learning instead. One barrier caused by inadequate instruction around technology use is executive dysfunction, which can cause students to fail to complete assignments for non-academic reasons.

Consider the varied effects of technology use on executive functions when integrating education technology into the classroom. Research finds that executive functions (EF) (e.g., inhibitory control, working memory) can significantly impact students' success in school and beyond. Educators should consider both which technology tools place undue stress on student EF (e.g., programs requiring students to remember multiple pieces of information simultaneously) while embedding EF skill development (which may include technology-based EF training) into school curricula.

1. Screen Time Use in Children and Adolescents

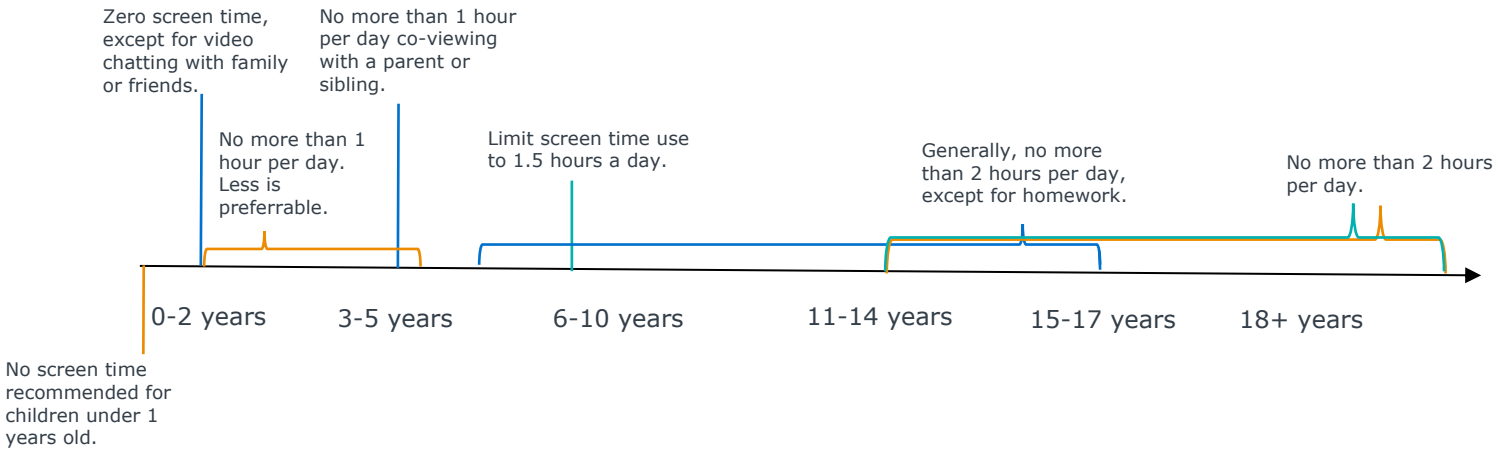
Youth Screen Time Surges Past Recommended Limits

Technology use by children has become an increasingly hot button issue, with researchers, educators, and other public figures making broad statements about how and for how long children should be interacting with screens. According to The Centers for Disease Control and Prevention (CDC)[1], in 2020, children eight to ten years old spent six hours per day using a screen for entertainment purposes (e.g., smart phones, tablets, television, video games, computers, and wearable technology). This amount increased further for older children, with 11- to 14-year-olds spending an average of nine hours on screens, followed by a slight drop in youth ages 15 to 18, who spend 7.5 hours using a device daily. Another recent study logged the screen time patterns of approximately 30,000 children aged three to 18 from January 2020 to March 2022 and found a significant surge in screen time worldwide, with a 52 percent increase in screen use among children since the onset of the COVID-19 pandemic[2].

These findings pose serious concerns for parents and educators, particularly when compared to recommendations from institutions of public health regarding screen time use. In 2019, the World Health Organization (WHO) recommended no more than one hour of screen time per day for children under five years old[3]. The American Academy of Pediatrics advises that children in the age range of 6-10 limit their total screen time to a maximum of 1.5 hours per day[4]. Both organizations emphasize that the overall recommended entertainment screen time for individuals, irrespective of age, should not exceed two hours daily. It is important to note that entertainment screen time does not include education technology use or devices used to complete homework. The diagram below serves as a visual representation of recommendations for entertainment screen time use in children by different guiding institutions.

Doctor-Recommended Screen Time Use by Age

Via OSF HealthCare, the World Health Organization, and the American Academy of Pediatrics



1) Screen Time for Kids; How Much is Too Much? *OSF Healthcare*
2) Assessment of Changes in Child and Adolescent Screen Time During the COVID-19 Pandemic. A Systematic Review and Meta-analysis. *Jama Pediatrics*
3) Guidelines on Physical Activity, Sedentary Behaviour and Sleep for Children under 5 Years of Age. *World Health Organization*
4) Media and Children. *American Academy of Pediatrics*

The basis for these stringent recommendations is that research has overwhelmingly found that prolonged entertainment screen time use causes a multitude of negative developmental and behavioral effects. For example, research cited in EAB's literature review The Impacts of Screen Time on K-12 Students found connections between prolonged entertainment-based screen exposure and various physical and mental health issues in children, including obesity, depression, poorer social interactions, and anxiety. The literature review The Associations Between Screen Time and Mental Health in Adolescents from *BMC Psychology* found similar results, concluding that "excessive screen time in adolescents seems associated with mental health problems…Screen exposure time was most positively associated with problems in teens' mental well-being…and an increased risk of depression in girls."[5]

Teachers Can Influence Students' At-Home Screen Use by Limiting Online Homework

While these impacts are immensely concerning, the bulk of time students spend using devices for entertainment purposes occurs at home and is therefore mostly out of the control of educators. One key area where teachers can affect at-home screen use and some of its negative effects, however, is through the amount of online homework they assign.

Research from Harvard Medical School explored how adolescents and teens are struggling with a persistent lack of sleep due to the blue light emitting from their devices.[6] Not only do devices like cellphones emit light which interferes with the production of sleep hormones, young adults' still-developing self-control systems make it difficult for them to resist the instant gratification offered by most digital activities. This information is particularly important for educators, as insufficient sleep leads to poor academic outcomes in students.[7]

Given these findings, educators may have the most potential to positively influence students' at-home screen use by avoiding excessive amounts of homework which require digital devices and may interfere with students' sleep. According to the CDC, children aged six to twelve require nine to twelve hours of sleep per day, and adolescents aged 13 to 18 need eight to ten hours of sleep, with children needing an hour of screen-free time before bedtime to get good sleep.[8] This indicates that if teachers are assigning enough screen-based homework that students are not able to get to bed within an hour of the time needed to get a full night's sleep, the learning impacts of that homework are likely minimized or lost.

Educators Must Balance Evidence-Based Technology Use with Non-Technological Alternatives

The appropriate amount of screen-based education technology use in the classroom is a more complex question that has received increased public attention.[9] Although education technologies are sometimes effective in supporting student learning outcomes, these tools also present a new set of concerns when compared to their non-digital alternatives. For example, according to research cited in the article "The Effect of Cellphones on Attention and Learning: The Influences of Time, Distraction, and Nomophobia," one persistent issue with education technology is that simply

5) The associations between screen time and mental health in adolescents: a systematic review. *BMC Psychology*
6) Screen Time and the Brain. *Harvard Medical School*
7) Sleep and Health. *The Centers for Disease Control and Prevention*
8) Youth screen media habits and sleep: sleep-friendly screen-behavior recommendations for clinicians, educators, and parents. *Child and Adolescent Psychiatric Clinics of North America*
9) Screens Are Everywhere in Schools. Do They Actually Help Kids Learn? *The New York Times*

having access to cellphones negatively affects how well students paid attention and performed on tests.[10]

As there is a gap in the literature regarding the specific total amounts of time that educators should allocate to technology-based instruction during the school day, teachers must focus on balancing evidence-backed technology-based pedagogy with minimizing access to harmful forms of screen use. As schools and educators evaluate technology use in the classroom, the following sections of this report are intended to help identify and align instructional practices related to education technology with key learning goals.

10) The effect of cellphones on attention and learning: The influences of time, distraction, and nomophobia. *Computers in Human Behavior*

2. Framework to Evaluate Education Technology Use

This section will provide a framework for educators seeking to maximize the impact of how they interact with education technology in the classroom. This section focuses on identifying the behaviors of educators who use education technology effectively (which can also inform which technologies teachers choose to include in the classroom) as opposed to the following section, which focuses specifically on the impacts various education technology tools have on students.

Use a Framework to Characterize Effective Technology Use by Educators

The 2021 academic paper "Developing Instructional Technology Standards for Educators: A Design-based Research Study"[11] introduced a first-of-its-kind-framework designed to help educators embody effective use of education technology in classroom instruction. To originate the framework, researchers collected feedback from 2,429 K-12 teachers and school leaders through methods including focus groups, surveys, and interviews, with the goal of creating a unique set of educational technology standards for the classroom. The standards consist of seven roles for teachers to embody in their approach to classroom technology, each with a corresponding list of key indicators. For example, teachers can embody the "Designer" role by designing authentic, learner-driven activities and environments that recognize and accommodate learner variability. Success indicators for this role include a teacher's ability to:

Success Indicators for Teachers who are Education Technology "Designers"

1. Use technology to create, adapt and personalize learning experiences that foster independent learning and accommodate learner differences and needs.
2. Design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning.
3. Explore and apply instructional design principles to create innovative digital learning environments that engage and support learning.

Using this framework, educators can critically and comprehensively evaluate their classroom technology use and find areas for improvement and innovation. The authors recommend that school leaders give time to teachers to review and plan standards implementation and then go through a step-by-step approach when adopting new roles until they can be executed with fidelity.

See the full framework in the Appendix on **page 31**.

11) Developing instructional technology standards for educators: A design-based research study. *Computers and Education Open*

3. Impacts of Education Technology Interventions

This section will describe the impacts of different technological learning interventions and compare their impacts to those of their traditional alternatives where possible.

Computer-Assisted Learning Programs

CAL Programs Have Potential to Significantly Improve Student Learning

Computer-assisted learning (CAL) programs are software packages designed to develop specific skills in an educational environment. Section 4.1 (page 913) of the paper "Upgrading Education with Technology: Insights from Experimental Research," proposes that the key advantages of these tools are their ability to customize instruction down to the needs of the individual student, something which even the most skilled educators can struggle with.[12] By matching content to the user's level of academic preparedness, it allows students to "master relatively basic concepts before moving on to more advanced concepts, and to practice more in areas where they are struggling and less in areas in which they are already strong." This level of individualization saves instructional time and provides teachers with student-level data, updating them on learning progressions.

The paper reports that some CAL programs are capable of significantly improving learning outcomes, particularly in math, and could replicate some aspects of in-person tutoring for both math and reading. One caveat to these findings is that several studies determined that to access the benefits of these technologies, teachers must supplement CAL with their own instructional expertise and with the existing classroom curriculum. In other words, the instruction delivered by the CAL programs needs to be effectively delivered in collaboration with the instruction delivered by the teacher (see the standards above to guide this process).

Consider How Integrating genAI with CALs May Impact Learning Potential

The integration of artificial intelligence (AI) into CALs is a potentially promising innovation that can help increase the degree to which software programs can adapt to each student's learning needs[13]. However, the novelty of AI means that there is a lack of research on its impact on student outcomes, contributing to uncertainties around adoption. These uncertainties include a lack of student motivation to use AI products, the failure of teachers to adjust instructional practices to account for new AI technologies, and the possibility that AI learning interventions could impede the development of core academic skills and executive functions. EAB's AI Playbook for District Leaders details critical actions every district should take to prepare for a future with AI, including how to draft AI guidance, build teacher AI literacy, and support AI experimentation.

Gamification in CALs Most Effective with Longer Games

A second behavioral strategy integrated into some CAL programs is gamified e-quizzes. According to the research paper, "The Role of Gamified E-Quizzes on Student Learning and Engagement: An Interactive Gamification Solution for a Formative

12) Upgrading Education with Technology: Insights from Experimental Research. *Journal of Economic Research*
13) Developing instructional technology standards for educators: A design-based research study. *Computers and Education Open*

Assessment System," gamified e-quizzes are as effective at evaluating students' learning performance as paper-based quizzes.[14] Implementing gamification (either via technology or other instructional methods) in the classroom can also promote learning, particularly for younger students and in STEM subjects. Additionally, gamified activities that carry on over longer periods of time create more positive outcomes, with games that continue for longer than a semester found to have more significant effects than those lasting less than a semester. Researchers theorize that the benefits of longer games are derived from the prolonged exposure to the game's mechanics, which allows students to focus more deeply on the learning content.[15]

Use What Works Clearinghouse to Find Effective Programs

Prior to implementing new CAL programs into the classroom, educators should ensure that the products and strategies they select are grounded in the research and have demonstrated effectiveness. A useful tool to conduct this evaluation is the intervention reports search tool from What Works Clearinghouse (WWC), a website developed by the Institute of Education Sciences to "ensure that states, districts, and schools can identify programs, practices, products, and policies that work across various populations." Using the intervention reports search tool, users can filter by categories such as topic, populations, grade level, and rurality to see the evidence base of different educational interventions. To characterize the strength of evidence, the WWC uses three levels (minimal, moderate, and strong) and considers factors like the number of studies supporting the recommended practices. They also consider whether the recommended practices were directly tested in the studies or tested in combination with other practices, consistently led to improved outcomes within and across studies, and if the studies capture a diverse range of students and contexts.

Reading on a Screen Compared to on Paper

Reading on Paper Superior to Reading on Screens for Deep Student Learning

A wealth of research finds that students read written texts more effectively on paper than on screens. A 2019 meta-analysis which assessed the topic specifically in the context of reading outcomes found that students performed better on assessments when they read course materials on paper versus on screens, even though students read at equivalent speeds in each medium.[16] Readers also tend to overestimate their understanding of the text when they read on screens, perhaps because of distractions which make it harder for readers to focus during on-screen reading. In contrast to these findings, other research found that students were able to grasp the main idea of passages of text at similar rates when reading on a screen versus on paper, although they were less capable of recalling specific details when reading digitally. These differences indicate that screen reading is suitable for overviewing topics, but paper reading is superior for close reading and assessment preparation.

14) The role of gamified e-quizzes on student learning and engagement: An interactive gamification solution for a formative assessment system. *Computers & Education*
15) Examining the effectiveness of gamification as a tool promoting teaching and learning in educational settings: a meta-analysis. *Frontiers in Psychology*
16) Reading from paper compared to screens: A systematic review and meta-analysis. *Journal of Research in Reading*

For additional insights and tools related to aligning early elementary school literacy instruction with the science of reading, see EAB's Narrowing the Third-Grade Reading Gap Resource Center.

Confirming these findings for older students, in a middle school reading comprehension test conducted by Norwegian researchers, student performance was much higher for those reading on paper compared to on a screen.[17] This insight was verified by eye-tracking technology which determined that the middle schoolers spent much more time rereading individual pieces of text when reading on screens, indicating a lack of initial understanding of the text. Middle schoolers were also found to be more capable of processing word meanings and the connections between words when reading on paper, according to a neurocognitive study of 59 students.[18]

Furthermore, screen reading's inferiority in developing reading comprehension in a school setting proved consistent for children aged between one and eight years.[19] For these younger children, however, the design of digital books (e.g., the inclusion of certain enhancements connecting the text to children's existing knowledge) and adult guidance during the reading process helps to improve screen reading outcomes. One area where digital books are more effective for students in early elementary school is in vocabulary development, especially when a digital dictionary is accessible to define infrequent words and expressions.

Expanding on this topic, a systematic literature review which observed students aged six to 18 years old discovered that students who test highly when reading on paper and students that are from households with more books and parental enjoyment of reading performed similarly no matter the medium.[20] On the other hand, those who performed more poorly on prior reading assessments struggled when asked to read on a tablet under time pressure. These results indicate that higher performing students are more adaptable to different reading conditions than lower performing students. Researchers were unable to come to a clear conclusion regarding the impacts of gender on-screen versus paper reading.

This section analyzes the differences between screen and paper as a reading medium and does not assess literacy intervention software. For more information on software-based learning interventions, see the computer-assisted learning section of this report (**page 10**).

Typing Compared to Handwriting

Handwriting More Effective for Students' Language and Writing Development than Typing

When districts consider their reading and writing instruction, with some exceptions, handwriting is far superior for teaching students the fundamentals of literacy. Despite how long handwriting has been a key aspect of modern education, the invention of

17) The smell of paper or the shine of a screen? Students' reading comprehension, text processing, and attitudes when reading on paper and screen. *Computers & Education*
18) Middle-schoolers' reading and lexical-semantic processing depth in response to digital and print media: An N400 study. *PLoS One*
19) A Comparison of Children's Reading on Paper Versus Screen: A Meta-Analysis. *Review of Educational Research*
20) Digital versus Paper Reading: A Systematic Literature Review on Contemporary Gaps According to Gender, Socioeconomic Status, and Rurality. *European Journal of Investigation in Health, Psychology and Education*

word processing technology has necessitated a reevaluation of the evidence supporting common instructional practices.

One area of reading and writing instruction that teachers must evaluate is how handwriting impacts language development in comparison to typing and which medium is appropriate for different tasks. In a study published in *Trends in Neuroscience and Education,* preliterate five-year-olds were instructed to either print, type, or trace a series of letters and shapes and then were shown these letters and shapes again while undergoing MRI scans.[21] Results of the scans found that the motor cortex of the brain was activated the most for children who printed the letters. This research indicates that at a neurological level, handwriting has the strongest impact on teaching children the essential visual symbol recognition necessary for literacy.[22]

These findings were consistent with the results of two classroom experiments where kindergarteners were tested for letter recognition, naming, writing performance, and word reading after being trained either using pen and paper or typing on a computer keyboard.[23,24] One relevant caveat to this body of research is that typing can be as effective as handwriting in teaching visual symbol recognition in certain environments, such as when students had not received any prior literacy instruction.[25]

Regarding the impact of typing versus handwriting on students' writing development, the findings of two meta-analyses found that the ability to handwrite smoothly in K-12 students contributes to writing quality, writing fluency, the quality of the substance of writing, writing consistency, and greater legibility.[26,27] Additionally, contradicting the idea that handwriting and typing require substantively different skillsets, students' writing fluency in each of the mediums is significantly related, particularly in writing speed. Unsurprisingly, the studies found that students are able type faster than they can handwrite. Some studies do outline the advantages of word processing software for elementary students besides writing speed.[28] For example, the tools present in word processing software, like spelling and grammar checkers, and the ability to delete or edit text, can motivate reluctant students to write and improve their writing quality.

Lastly, research suggests that handwriting class notes is more effective than typing them. This finding is well established for college-age students, according to a meta-analysis that reviewed 24 separate studies across 21 articles.[29] This research found that students who handwrote and reviewed handwritten notes during class received higher course grades, although note-taking volume was higher for typed notes. While the ideal note-taking medium is less studied in younger students, a classroom experiment of ten- to eleven-year-old boys established that students' conceptual understanding of the material taught in their biology and history classes was much higher one week later when they handwrote class notes versus typed them on a laptop.[30]

21) The effects of handwriting experience on functional brain development in pre-literate children. *Trends in Neuroscience and Education*
22) The Importance of Handwriting Experience on the Development of the Literate Brain. *Current Directions in Psychological Science*
23) Handwriting or Typewriting? The Influence of Pen- or Keyboard-Based Writing Training on Reading and Writing Performance in Preschool Children. *Advances in Cognitive Psychology*
24) The influence of writing practice on letter recognition in preschool children: A comparison between handwriting and typing. *Acta Psychologica*
25) Does learning to write and type make a difference in letter recognition and discrimination in primary school children?. *Journal of Cognitive Psychology*
26) A Comprehensive Meta-analysis of Handwriting Instruction. *Educational Psychology Review*
27) The roles of handwriting and keyboarding in writing: a meta-analytic review. *Reading and Writing*
28) The Impact of Technology on Students' Writing Performances in Elementary Classrooms: A Meta-Analysis. *Computer and Education Open*
29) Typed Versus Handwritten Lecture Notes and College Student Achievement: A Meta-Analysis. *Educational Psychology Review*
30) Taking Class Notes by Hand Compared to Typing: Effects on Children's Recall and Understanding. *Journal of Research in Childhood Education*

Continue to Include Keyboarding Instruction as a Life Skill for Students

Despite the benefits of handwriting both in English language arts instruction and note-taking for children at a variety of developmental levels, keyboarding remains an important life and career skill for many students. The Common Core State Standards for English Language Arts & Literacy recommends starting keyboarding instruction in third grade and continuing until sixth grade. The standards suggest that students in the third grade should be able to "produce and publish" writing with the guidance and support of adults and gradually gain independence until they have the ability to type a minimum of three pages in a single sitting in the sixth grade.

In addition to the Common Core Standards, some states have released keyboarding standards of their own. For instance, the New York State Education Department published keyboarding guidance in 2017 as part of their NYS Next Generation English Language Arts Learning Standards that recommends students should begin to explore keyboards as early as possible (PreK), and continue practicing until they can demonstrate proficient keyboarding speed and accuracy by the end of their secondary education.

Additional Resources

EAB's Student-Centered Classroom Design and Technology demonstrates how to balance the advantages of handwriting against the advantages of technological integration in classrooms. For example, pages five through eight suggest organizing classrooms into learning zones or distinct stations that support varied pedagogical strategies. This strategy helps build student familiarity with typing while simultaneously creating space for the importance of handwriting.

Paper- Versus Computer- Based Testing

Students Fare Worse on Computer-Based Tests, Especially Students with Limited Tech Access

Studies over the past two decades have primarily drawn the same conclusion: students, in the aggregate, do better when tested on paper versus on a computer.[31] Overall, research indicates that students' unfamiliarity with the test-taking technology, not just test content, can lead to poor performance on standardized exams. These findings remain consistent across several states, with Illinois, Rhode Island, Maryland, Massachusetts, and South Carolina all documenting lower scores for computer-based testing (CBT) compared to paper-based testing (PBT) on The Partnership for Assessment of Readiness for College and Careers (PARCC) and the National Assessment of Educational Progress (NAEP).

31) Comparing Paper and Computer Testing: 7 Key Research Studies. *EducationWeek*

In South Carolina, researchers found that "students who took the test online performed as if they'd had five fewer months of academic preparation in math and 11 fewer months of preparation in English than their peers who took the test on paper."

Despite this emerging consensus, the effects of CBT are not universal amongst all demographics. Studies have frequently found that students who have greater familiarity with technology, through computer use and access both inside and outside the classroom, tend to do better in CBT compared to less technologically savvy students.[32,33] Researchers theorize that as a result of these students' comfort with keyboarding technology, they can focus more on the quality of their writing over the mechanics of word processing, particularly in ELA tests.[34,35] It is important to note that this difference in technological skill and access, and therefore CBT performance, disproportionally impacts students from low-income households, English Language Learners, students with disabilities[36], girls, people of color, and students attending schools in poor neighborhoods[37].

Researchers find that the negative effects of CBT compared to PBT are mostly consistent across grades. For more details on grade level findings, see the table below:

Grade-Levels Findings Show CBT Has Negative Impacts on Test Scores for Many Students

Grade	Finding	Exam
Third Grade	"We find substantial online test penalties for third grade students – taking PARCC for the first time – in both 2015 and 2016." [38]	PARCC
Third Grade	"Results suggest that average scores and standard errors are quite similar across [computer] and paper tests. Although the differences were still quite small (less than a half a scale score point), 3rd graders tended to show slightly larger differences. This study provides evidence that scores are comparable across [Oregon's computer] and paper delivery modes." [39]	The Oregon Department of Education's (ODE) Technology-Enhanced Student Assessment (TESA)
Fourth Grade	"While high-performing fourth graders are able to fully display their writing abilities on the computer, low- and middle-performing fourth-graders may not be able to—based on an analysis of 15 tasks common to the 2010 pilot writing assessment on paper and the 2012 pilot writing assessment on the computer that aimed to minimize the effects of confounding variables, such as task difficulty and accessibility." [40]	NAEP
Eighth Grade	"Results showed that the computer-based mathematics test was significantly harder statistically than the [equivalent] paper-based test. In addition,	NAEP

32) Pencils Down? Computerized Testing and Student Achievement. *Education Finance and Policy*
33) Comparing Paper and Computer Testing: 7 Key Research Studies. *EducationWeek*
34) *Ibid*
35) Pencils Down? Computerized Testing and Student Achievement. *Education Finance and Policy*
36) Is the pen mightier than the keyboard? The effect of online testing on measured student achievement. *Economics of Education Review*
37) Comparing Paper and Computer Testing: 7 Key Research Studies. *EducationWeek*
38) Is the pen mightier than the keyboard? The effect of online testing on measured student achievement. *Economics of Education Review*
39) Comparability of Student Scores Obtained from Paper and Computer Administrations. *Office of Assessment and Information Services Oregon Department of Education*
40) Performance of fourth-grade students in the 2012 NAEP computer-based writing pilot assessment. *U.S. Department of Education*

	computer facility predicted online mathematics test performance after controlling for performance on a paper-based mathematics test, suggesting that degree of familiarity with computers may matter when taking a computer-based mathematics test in NAEP."[41]	

Finally, one point of controversy is whether students' CBT scores catch up after they build test-taking skills over several years of online testing. One study, for example, found that the disparate impacts between students in CBT and PBT continue even after the students gain experience with CBT.[42] A second study, where students experienced the whiplash effect (i.e., going from pencil to computer - or vice versa - more than once), determined that the differences between the CBT and PBT testers fade out quickly under these conditions.[43] These findings demonstrate that school-level investment in digital accessibility and digital skill instruction in the early grades, particularly for testing environments, can potentially reduce some of the performance differences between CBT and PBT.

How schools can prepare their students for online tests

A 2016 paper by Wendy Gelbart from the University of Nevada at Las Vegas offers some tips for helping prepare students for the transition to computer-based testing, which we excerpt directly from this article below. Despite CBT's potential negative impacts on student test scores, taking steps to prepare students for CBT is critical given the inevitability that students will continue to encounter CBT in their educational and professional careers.

- **Take practice tests on the computer.** Allow students to take practice tests that look like the end-of-year tests. This is especially crucial for students who need accommodations, like text-to-speech or adjusting font size, so they don't have to spend time on testing day figuring out how to access the tools they need.
- **Practice using technology in the classroom.** Students do best when their testing environment is like their normal learning environment. Integrate technology into the classroom on a regular basis.
- **Keep advocating for better tests.** If high-stakes testing remains a lynchpin of education, they need to capture student learning. Teachers know better than anyone what design elements might hold their students back from showing what they truly know, and test designers should seek their feedback.

Digital Creativity Tools

Balance Use of Digital and Traditional Creativity Tools for Students

Developing children's creativity represents an important goal for many educators. Research shows that creative thinking is associated with important skills like divergent thinking and problem-solving as well as promoting positive emotional

41) Does it Matter if I Take My Mathematics Test on Computer? A Second Empirical Study of Mode Effects in NAEP. *Journal of Technology, Learning, and Assessment*
42) Pencils Down? Computerized Testing and Student Achievement. *Education Finance and Policy*
43) Is the pen mightier than the keyboard? The effect of online testing on measured student achievement. *Economics of Education Review*

development and better emotional understanding in children.[44] Creativity as a student skill has also garnered increasing attention for its importance in preparing students for the future, particularly in the context of career and technical education. For example, the resource Design Principles for Middle Grades CTE from Advance CTE and the Association for Career and Technical Education notes that creativity is a key skill necessary for employability.

Background on Creativity as a 21st Century Skill

The final section of EAB's Student Success Milestones report highlights the 21st Century Learning (P21) framework, an SEL framework which has a strong focus on critical thinking and cognitive flexibility. Though the P21 framework began with 18 skills, educational leaders reduced the framework into four essential skills: critical thinking, communication, collaboration, and creativity. **Pages 15-17** of the EAB report detail how profiled districts use this framework to develop assessments of students' critical thinking and creativity.

School-based experimentation with various creative tools may come in the form of traditional artistic methods, such as pottery or painting, or through the use of digital creativity tools like iMovie or Photoshop. A systematic review of the use of emerging technologies to promote creativity in education found that the learning outcomes of these tools are primarily dependent on the functionality of the tools.[45] For instance, internet-enabled collaboration (e.g., through online courses or some social media platforms) was shown to "inspire students to generate new ideas positively" and "broaden students' horizons and engage students in the learning process that promotes creativity." Additionally, design tools like Adobe suite, Microsoft PowerPoint, and 3D building programs allow students to execute their creative ideas through digital design features. One caveat to these benefits is that navigating the features in these complex design tools requires additional cognition and mental effort. These are factors which are less applicable to creative expression through traditional artistic mediums like pencil and paper.

Regarding the balance between both digital and traditional artistic mediums in a pedagogical context, some educators say that the use of emerging technologies is essential to fostering creativity, which they define as "the act of producing new ideas, approaches, or actions."[46] These educators claim that new tools help push the frontiers of artistic expression forward and that it is essential for students to gain experience with new forms of meaning-making to make sense of a changing world. Other educators believe that being "pro-tech" by explicitly assigning technology-based creative assignments is harmful, as it encourages the mechanical completion of work and limits self-expression.[47]

Offering a middle ground, a final perspective expressed in a comparative study of the efficacy of traditional art techniques versus digital art techniques is that instructors should integrate a variety of different methodologies and mediums into classroom learning.[48] Curricula that include art-making should be flexible enough to "support the integration of digital tools and resources in art education while preserving the

44) Children's developing reflections on and understanding of creativity. *Cognitive Development*
45) Using emerging technologies to promote creativity in education: A systematic review. *International Journal of Educational Research Open*
46) Creativity, Technology, Art, and Pedagogical Practices. *Art Education*
47) Creativity in Digital Art Education Teaching Practices. *Art Education*
48) A Comparative Study of Traditional Art Techniques versus Digital Art Techniques in the Context of College Visual Art Education. *American Journal of Arts, Social and Humanity Studies*

essential foundations of traditional techniques" to foster creativity among students with diverse learning styles and interests. Ultimately, it is up to the discretion of educators and district leaders to determine when to meet learning objectives through traditional creative mediums and when to apply digital technologies to students' creative experiences.

AI in Art

One point of contention between the above perspectives on digital creativity tools is the use of AI in art. Some artists emphasize the viability of AI algorithmic tools to challenge traditional notions of art education and prepare students for the blurring of boundaries between the digital and material worlds. Conversely, the National Art Education Association's position statement on AI, while noting that AI may have beneficial creative uses, argues that AI algorithms promote a "diluted understanding of the creative process, stifling students' ability to develop their artistic voices and practice the skill of ideation."

Learning Management Systems

LMS Use May Disproportionately Benefit Students Already Engaged in Class

Learning Management System (LMS) is an umbrella term used to describe a software platform used to facilitate and centralize classroom administrative functions. These tasks include file storage, course preparation, hosting educational content and resources, delivering and tracking student activities, administering assessment activities, and accumulating and presenting grades.[49] LMS' have become ubiquitous tools in school districts across the country, with Canvas, Google Classroom, Schoology/PowerSchool Learning, and Moodle representing 85 percent of the LMS market share in North America as of 2022.[50]

EAB's report LMS Selection and Implementation describes the process that profiled districts underwent to select the LMS most appropriate for their needs and offers key insights to ensure effective LMS implementation.

While most tools provided by these systems are administrator- and teacher- facing, a systematic literature review published in the *International Journal of Emerging Technologies in Learning* which focused on student use of LMS' found that college students used these platforms primarily to register for classes, access learning materials, participate in discussion forums, and complete assessments.[51] Additionally, students' satisfaction with their LMS was high, provided that the information uploaded by instructors and administrators was useful and up-to-date.

49) Selecting a Learning Management System: Advice from an Academic Perspective. *Educause Review*
50) Update on the K-12 LMS Historical Market. *listedtech*
51) The Analysis of Learning Management System towards Students' Cognitive Learning Outcome: A Systematic Literature Review. *Emerging Technologies in Learning*

Regarding impacts on student outcomes, researchers also found that students who only used their LMS prior to assessments had lower satisfaction with the software than those who used it every day. This indicates that LMS' may disproportionately benefit students who are already likely to be engaged in class. The previous study's finding is supported by a working paper which examined 59 schools in 15 school districts and determined that "higher levels of student [LMS] usage is associated with larger [GPA] effects and students whose teachers use the system more frequently also experience larger gains in GPA."[52] The paper also found that when parents were nudged via mailer and phone call to check their children's grades and assignments in the LMS, students' GPAs improved slightly by .1 points.

One advantage of LMS' that drove student satisfaction was that they allowed students to work on assignments anytime and anywhere, according to the literature review referenced above. Secondly, in a flipped classroom environment where students are provided the necessary information prior to attending class, LMS' were identified as motivating college students to learn. Other findings from the systematic literature review's assessment of LMS' are improved learning outcomes, enhanced thinking and innovation skills, a positive impact on e-learning engagement, and the development of self-study skills. While these results are encouraging, an important caveat is that much of the impacts listed above were found in overseas postsecondary students in online or hybrid classrooms. K-12 students remain an understudied population in terms of LMS use.

Assign Paper-Based Homework Where Possible, with Digital Assignments as a Complement

One student-facing aspect of LMS' that may be of interest to K-12 educators is whether students turn in assignments at higher rates through an LMS compared to in-person. Some educators have raised concerns that younger students specifically may have difficulty accessing and navigating online platforms, which causes them to fail to obtain and submit work.[53] According to a presentation from a teaching fellow at the Harvard Graduate School of Education, while online assignments may save paper, students' average homework completion rate at one middle school the author observed was about three percent higher when given paper handouts.[54] With that being said, 55.1 percent of the students still preferred online homework despite the difference in submission rates.

Students who turned in homework more frequently online reported that they found it easier to organize their work digitally than on paper, whereas students who preferred paper assignments reported that they appreciated the physical reminder. The difference in submission rates is consistent across research, with a second study observing "a significant decrease in student return rates of homework when digital submission was utilized instead of traditional submission … Overall, submission rates show a 13.55 percent decrease," at one middle school and one high school in central Illinois.[55] Given these findings, educators should prioritize using paper homework assignments, with online submission serving as a complement rather than a substitution.

52) Technology Adoption in Education: Usage, Spillovers and Student Achievement. *CESifo Working Paper Series No. 6101*
53) EAB Interviews and Analysis
54) Online vs. Paper Homework: How Medium Affects Completion Rate. *Harvard Teacher Fellows*
55) Homework Completion: Perceptions and Comparisons of 6th-12th Grade Students Using Traditional and Digital Submission. *Proceedings of Teaching and Education Conferences*

This section highlights key findings on the impacts of additional education technologies on which literature is still emerging. Specifically, this section addresses one-to-one device programs, virtual reality (VR) and augmented reality (AR) tools, and interactive whiteboards.

Impacts of One-to-One Device Programs on Student Achievement Remain Mixed

One-to-one programs, where the school assigns a personal device to each student, are one way in which many students encounter education technology. The 2024 study "Technology in the Classroom: Personal Computers and Learning Outcomes in Primary School" compared the implementation of one-to-one programs between 2009 and 2016 to fourth through sixth grade standardized test performance in mathematics and language.[56] The researchers "f[ound] no evidence suggesting that 1:1 technology, in comparison to more limited computer use, have an impact on average performance in language and mathematics." Despite this result, the paper also notes that "1:1 technology may have benefits that are not captured by our outcome variables; above all, students' computer skills are likely to be enhanced, and we cannot rule out that there is important age heterogeneity in such impacts." These outcomes are consistent with the findings of this literature review of technology access, which determined that while K-12 access programs are effective at increasing students' computer usage and digital skills, their impact on academic achievement is more mixed, with larger positive effects for postsecondary students.[57]

Consider the Effects of VR and AR Tools on Accessibility

Virtual reality (VR) and augmented reality (AR) tools are technologies that integrate the user fully or partially, respectively, into digital worlds and user interfaces. The 2022 study "Ten Years of Augmented Reality in Education: A Meta-Analysis of (Quasi-) Experimental Studies" assessed AR use in the classroom and found that students who were instructed using AR had better learning outcomes than those who received conventional instruction, particularly when the subject area required visualization and collaboration.[58] Additionally, VR technology can be used to increase accessibility for students with disabilities, according to a study published in 2023.[59] For example, students with neurodevelopmental disorders can "navigate" more easily in a virtual world to develop communication abilities. Virtual reality can also be particularly helpful for children who have physical problems that affect their ability to move, allowing them to visit places that would otherwise be inaccessible. However, while virtual reality can make experiences more accessible for some students with disabilities, it can also be inaccessible or even dangerous for other students, including those with epilepsy, claustrophobia, photosensitivity, or certain forms of autism.

Interactive Whiteboards Offer High Teacher Satisfaction but Mixed Evidence on Impacts on Student Achievement

Interactive whiteboards (IWBs) are large interactive display tools that allow for annotations and serve as a technological alternative to the traditional dry-erase board or chalkboard. IWBs are perceived positively in the classroom and can have strong

56) Technology in the classroom: Personal computers and learning outcomes in primary school. *Economics of Education Review*
57) Upgrading Education with Technology: Insights from Experimental Research. *Journal of Economic Literature*
58) Ten years of augmented reality in education: A meta-analysis of (quasi-) experimental studies to investigate the impact. *Computers & Education*
59) Exploring the Opportunity to Use Virtual Reality for the Education of Children with Disabilities. *children*

motivational effects if imbedded into teaching and learning. While the research on whether IWBs impact student achievement is mixed, this technology has the largest positive impact with teachers already comfortable with tools like projectors.[60] A critical review of the positive research consensus on IWBs claims that while teachers report high levels of satisfaction with the flexibility and versatility of the tool, there is little evidence they impact learning outcomes.[61] Additionally, some teachers run into practical issues with IWBs like low visibility in sunny rooms and difficulties locating an ideal height for the board. Overall, school leaders weighing the pros and cons of IWB acquisition should determine whether the student and teacher enthusiasm for the product is worth the high technology costs and diligent implementation processes.

60) The Effects of Interactive Whiteboards (IWBs) on Student Performance and Learning: A Literature Review. *Journal of Educational Technology Systems*
61) Interactive whiteboards: boon or bandwagon? A critical review of the literature. *Journal of Computer Assisted Learning*

4. Executive Functioning

Executive Functions are Critical to Students' Long-Term Success in School and Life

Sometimes referred to as the "CEO" of the brain, executive functions (EFs) are the cognitive processes that control purposeful, goal-directed behaviors. These processes govern and monitor the brain's mental organization to ensure that it operates efficiently.[62] Examples of the neurological tasks included in the executive functions are the following:[63]

- **Goal Maintenance** is the ability to persevere through difficult and frustrating tasks.
- **Inhibitory Control** is the ability to resist first instincts and impulsiveness.
- **Shifting** is the ability to consciously redirect attention from one thought to another.
- **Working Memory** is the ability to temporarily store and manipulate information in one's mind.

These cognitive processes are often split into two categories, commonly referred to as "hot" and "cold" EFs. Hot EFs include behavioral regulation and are engaged during periods of strong emotion or social situations. On the other hand, cold EFs are needed for more rational and abstract processes, like metacognition, self-control, and other logical actions.[64,65] The importance of EFs in children's development cannot be understated. Researchers have found that different aspects of EFs, including self-control and self-regulation, are positively associated with academic, social, and behavioral outcomes in school, and can predict the health, wealth, employment status, and criminality of adults.[66]

Studies show that EF develops rapidly during childhood, with progress likely stabilizing around early adulthood or late adolescence (ages 18-20).[67] While not all EF skills develop at the same pace, one idea consistent in the research is that the more rudimentary cognitive abilities develop first, followed by the more complex behaviors that build upon those early developmental skills. According to the report "Executive Function: Implications for Education," different EF abilities reach a mature state of development at the end of three age milestones: middle childhood (cognitive flexibility), adolescence (inhibitory control and decision-making), and early adulthood (goal-setting and problem-solving).[68]

Other research has shown that regarding inhibition, there is a period of dramatic change between ages three and five, a less dramatic change from ages five to eight, and the least amount of change after age eight.[69] Despite these general patterns of development, it is important to note that EF development is highly specific to the individual and different for each skill. Unfortunately, research on EF does not connect

62) The Clinician's Guide to Geriatric Forensic Evaluations. *Academic Press*
63) Executive Functions in Social Context: Implications for Conceptualizing, Measuring, and Supporting Developmental Trajectories. *Annual Review of Developmental Psychology*
64) Ibid
65) Evaluation and Treatment of Neuropsychologically Compromised Children. *Academic Press*
66) Executive Functions in Social Context: Implications for Conceptualizing, Measuring, and Supporting Developmental Trajectories. *Annual Review of Developmental Psychology*
67) A canonical trajectory of executive function maturation from adolescence to adulthood. *Nature Communications*
68) Executive Function: Implications for Education. *U.S. Department of Education*
69) A Developmental Perspective on Executive Function. *Child Development*

these skills explicitly to tasks students would be completing in school, like turning in homework or essay writing, because EF is primarily researched in a laboratory setting or through behavioral questionnaires, not in classroom-based research.

Reading Rockets offers the following strategies to help children with EF difficulties turn in their homework:

1) Develop templates of repetitive procedures

2) Provide accommodations (e.g. online submission)

3) Teach the use of tricks and technology that help compensate for organizational weaknesses.

Consider Which Technology Uses Strain Students' EF Skills Most

Regarding the application of EF concepts to classroom education technology, the Kennedy Krieger Institute, a healthcare organization dedicated to improving the lives of children with disabilities, offers a series of insights on the topic.[70] First, the institute explains that educators can structure the learning environment to accommodate students with different levels of EF. In terms of education technology use, asking students to use unfamiliar devices, software, or websites can cause executive dysfunction (a mismatch between EF demands and the skills of the individual), which can manifest in behaviors such as impulsivity, distractibility, and difficulty with complex task completion and transitioning between activities. The use of technology to complete schoolwork can also be more taxing than analog alternatives because it requires navigation of the technology itself in addition to the educational aspect of the assignment. Furthermore, when using personal devices in the classroom, students and teachers both reported that students were more likely to become distracted, struggle with initiating and completing tasks, unsuccessfully multitask, and be unable to problem-solve when technology did not work as expected.

Rather than taking an overly narrow focus on restricting students' in-classroom technology use, educators can consider which of the technology tools students are expected to use regularly are placing an undue burden on students' executive function. To this end, we share three questions below that the Kennedy Krieger Institute recommends educators consider when incorporating technology into curriculums to mitigate executive dysfunction in students of all ages:[71]

70) Executive Function and Online Learning. *Kennedy Krieger Institute*
71) Ibid

Questions to Evaluate Technologies' Potential Effects on Student EF

1. Is my instructional design/tool/learning management system (LMS) overly demanding on my students' inhibitory control? (i.e., do they have to focus on stopping/pausing impulses to engage in the task?)
2. Is my instructional design/tool/LMS overly demanding on my students' working memory? (i.e., do they have to keep multiple pieces of information in mind as they manipulate the information to complete the task?)
3. Is my instructional design/tool/LMS overly demanding on my students' flexible thinking? (i.e., do they have to focus on coming up with multiple ways to approach a task or problem, and do they need to independently troubleshoot their technology?)

Use Evidence-Based Interventions and Embedded Curricula to Mitigate Executive Dysfunction

One way to get ahead of executive dysfunction in students is to incorporate interventions proven to aid EF development into the classroom. Despite the aforementioned potential negative effects of technology on students' EF, research on children between four and twelve years old finds that surprisingly, computerized EF training is the most effective intervention to improve students' EF skills.[72] The evidence-based programs observed in the study feature games that train EF abilities like working memory by becoming progressively more difficult as students practice. As a result of this training, students were found to have improved in EF and in math six months later.

Additional interventions shown to be effective were aerobic exercise and mindfulness practice. The study also highlighted two essential components of effective EF curriculums: 1) they do not expect young children to sit still for long, as such expectations are not developmentally appropriate, increase teacher-student tensions, and lead some children to dread school and/or to be wrongly labeled as having ADHD, and 2) the programs tend to reduce stress in the classroom; cultivate joy, pride, and self-confidence; and foster social bonding; all of which support efforts to improve EFs and academic achievement. Finally, school districts can prioritize building students' EF skills by integrating EF development into their core curricula (see examples below).

72) Interventions Shown to Aid Executive Function Development in Children 4 to 12 Years Old. *Science*

Examples of District EF Curricula

- Evansville Vanderburgh School Corporation (IN) developed the GAIN (Growth in Academics through Innovation and Neuroeducation) program to support healthy whole student development with the goal for students to graduate high school with the cognitive, academic, executive functioning and employability skills needed to be successful.
- Dearborn Academy (MA) is a state-sponsored special needs school for elementary, middle, and high school students. They offer instruction through the SMARTS Executive Function Curriculum, which is intended to teach students crucial learning skills. Throughout a student's time at the school, students learn individualized strategies that help them with EF skills such as notetaking, studying, project planning, breaking down complex directions, and more.
- Lawrence School (OH) is a special education school for elementary, middle, and high school students. Teachers weave executive function coaching into their instructional approach in all classrooms at every grade level. The entire school day is organized to help students build these skills—from visual cues to consistent routines to metacognitive language. Every faculty member is trained to provide direct instruction, frequent reassurance, and consistent feedback.
- Landmark School (MA) presented webinars on EF for elementary, middle, and high school families. Recordings of the presentation as well as the slide decks used are available on their website.

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Appendix

Framework from "Developing Instructional Technology Standards for Educators: A Design-based Research Study"

Standard	Indicator
1. Learners Teachers are professionals who are committed to improving their practice through professional learning, monitoring research and proven approaches, and learning from and with others.	a. Embrace continuous learning of how to transform learning with technology, set goals for professional growth and reflect on practice, and apply evolving pedagogical strategies that leverage technology.
	b. Keep abreast of emerging learning science research and collaborate with colleagues and experts to explore how to apply proven approaches with students and within the learning process and environments.
	c. Model with colleagues and students social learning through the use or creation of online personal and professional learning networks.
2. Leader Teachers are professionals who transform learning with technology through their contributions to a shared vision, advocacy, and expertise.	a. Engage as teacher-leaders in school or district-wide efforts to shape, advance and accelerate a shared vision of empowered learning with technology.
	b. Advocate for equitable access and reducing the digital opportunity gap with colleagues, administrators, parents, and the community.
	c. Engage as teacher-leaders to inform technology purchase and adoption decisions by identifying, evaluating, and curating digital tools, applications, and resources.
3. Citizen Teachers are professionals who exercise and model the digital rights, responsibilities, and opportunities of living in an inter-connected, digital world.	a. Exhibit for colleagues and students ethical and legal practice with digital tools and resources, and model positive, socially responsible behavior in interactions online.
	b. Model for students and empower them to manage personal data, protect privacy and manage digital identity
	c. Understand the implications of data collection on student privacy and advocate for the awareness and protection of student and learning analytics data.
	d. Engage with families to bolster students' educational goals and reduce barriers to digital access, and proactively communicate with families in ways that exhibit cultural competency.
4. Collaborator Teachers prioritize collaboration to improve practice by learning and sharing resources, ideas and problem-solve.	a. Establish dedicated time to collaborate with colleagues to plan and share ideas for using technology to create authentic learning experiences.
	b. Collaborate and co-learn with students to explore and experiment with digital tools and resources that support learning, and to diagnose and troubleshoot technology issues.

	c. Use collaborative tools to engage virtually with experts, teams, and students, locally and globally, to expand students' authentic, real-world learning experiences.
5. Designer Teachers build a robust toolkit of skills to design learning activities and environments that support students achieving the 2016 ISTE Standards for Students.	a. Redesign learning activities around pedagogies that leverage the available technology, digital environments, tools, and resources to maximize an authentic, active, learner-driven process that aligns with content area standards.
	b. Design learning experiences that use technology to accommodate learner variability, personalize learning, and engender student choice, self-direction, and goal setting.
	c. Keep current with effective instructional design practices for a variety of digital learning environments—including online, blended, mobile—and curate digital educational resources and tools to enhance student engagement and learning.
	d. Create a variety of learning environments that use effective teaching strategies and leverage digital tools and resources to manage and support the learning process.
6. Facilitator Teachers evolve their role to become a facilitator of learning who empowers students and apply the 2016 ISTE Standards for Students in their practice.	a. Adopt role as classroom facilitator to promote a culture of student agency where students establish their own learning goals, reflect on learning, and assume responsibility for learning outcomes.
	b. Implement strategies that address learner variability and provide opportunities for personalized learning, student choice and individualized pacing.
	c. Become adept in applying effective learning strategies and managing the learning process in a variety of classroom configurations and digital environments, including online and emerging virtual environments.
	d. Promote exemplary research skills to find and critically evaluate data and information and support students in curating resources for their intellectual pursuits.
	e. Model and support students in the use of digital tools or applications to deploy a deliberate design process for creating or innovating solutions.
	f. Engage students in formulating and solving problems that leverage computing power and rely on algorithmic thinking, representing data, and modeling to test solutions.
	g. Cultivate creative student expression in choosing and using digital tools, platforms, and resources to communicate or publish original works.
7. Analyst Teachers understand and use data to inform their instruction and support students to achieve their learning goals.	a. Design a variety of formative and summative assessments that capitalize on technology to provide immediate feedback to students, offer alternatives that empower students' choice in demonstrating their learning, and include competency-based approaches that allow personalized pacing.

	b. Access, analyze and use quantitative and qualitative data to effectively respond to student needs and instruction.
	c. Understand student assessment input and output and use that information to facilitate ongoing engagement with students and parents to help guide student progress.