Engaged Teaching: Engaged Learning

An empirical study of teaching, learning, and student engagement across the K–12 community of Apple Distinguished Schools

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Table of Contents

Executive Summary

Student engagement is a critical, yet increasingly fragile, element of K–12 education—serving as a foundational driver of academic achievement, classroom behavior, social-emotional development, and more. Research consistently shows that engagement not only declines as students progress through grade levels but has also eroded over time—particularly in the aftermath of the COVID-19 pandemic. This decline poses significant challenges for learning outcomes, teacher satisfaction, and teacher retention.

Over the past two generations, K–12 classrooms worldwide have experienced unprecedented growth in access to educational technology. One-to-one computing programs, once experimental in the 1990s, are now common in schools around the world. This transformation accelerated during the COVID-19 pandemic, as educators and school leaders rapidly deployed digital tools to maintain continuity in instruction. Today, many schools continue to balance the opportunities and challenges posed by widespread technology use.

Educational technology offers a potential avenue for reversing engagement decline—but access alone is insufficient. While nearly all participating schools in this study provided one-to-one computing access, the strongest engagement benefits were observed in classrooms where technology was used purposefully to foster collaboration, creativity, and active learning.

Drawing on a large, international sample of 17,078 K–12 educators, this study examines how technology is integrated into classroom practice, how these practices vary by context, and how they relate to student engagement. All participants were drawn from schools in the Apple Distinguished Schools program, which has strict inclusion criteria—requiring participation in a one-to-one device program for at least two academic years and demonstrating integration of technology in creative, curriculum-driven ways.

Grounded in constructivist learning theories and informed by Ruben Puentedura's SAMR model, the analysis goes beyond measuring device access to explore the pedagogical intent behind technology use.

Key findings include:

- **Educational technology use is varied and context-dependent.** Even in schools with similar access, technology use differs across teacher backgrounds, grade levels, and subject areas, indicating the need to consider contextual and pedagogical factors.

- **Technology use is associated with deeper pedagogical practices.** Teachers reporting more frequent student technology use often used higher-level instructional strategies. This suggests that technology can serve as a vehicle for curriculum enhancement in a post-COVID K–12 landscape.

- **Student-centered technology use is linked to higher engagement and teacher satisfaction.** Classrooms where students actively used technology showed moderate positive correlations with student engagement ($r = .50$, $p < .001$). Among all practices measured, student collaboration—occurring on average in 57% of class time—had the strongest positive relationship with engagement. Engagement was also positively associated with teacher effectiveness ($\rho = .23$) and feelings of appreciation in their role ($\rho = .22$).

These findings reinforce that technology access alone does not determine learning outcomes or student engagement. To address declining student engagement, schools must focus on intentional integration—supporting educators in using technology to promote collaboration, inquiry, and active knowledge construction, positioning students as active participants and creators in their own learning.

Engaged Teaching: Engaged Learning

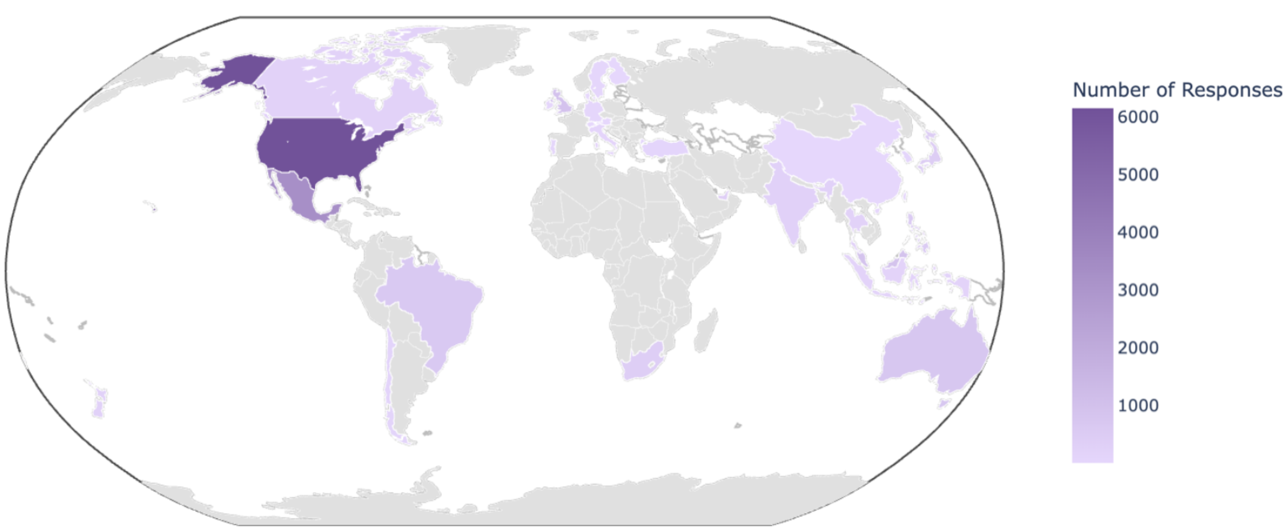
An empirical study of teaching, learning, and student engagement across the K–12 community of Apple Distinguished Schools

The *Engaged Teaching: Engaged Learning* research study examines technology access, classroom practices, teacher values, and student engagement among 17,078 K–12 teachers from 323 schools in 31 countries participating in the Apple Distinguished Schools program.

All participating schools provide one-to-one student technology access, yet educators use educational technology in markedly different ways across subjects, grade levels, and contexts. Classrooms with higher levels of student technology use more often use advanced pedagogical practices, especially those that involve active, hands-on learning. Analysis shows that students who use technology constructively (e.g., to create content) report higher levels of engagement across this global sample.

These findings reveal how technology access, classroom practices, teacher beliefs, and student engagement intersect. They emphasize the need for clear pedagogical intent, attention to context, and consistent opportunities for students to act as active participants in learning with technology.

Number of study participants by country



Contributors

This study was a collaboration between the Apple Distinguished Schools team and Reflective Educational Research. The study was funded by Apple Inc.

All data was collected voluntarily and anonymously by teachers who provided active consent to have their results analyzed and shared in a non-personally identifying manner. The principal investigator and lead author of the study was Dr. Damian Bebell. Kayla Burt served as lead Research Associate and second author. Christine Yang and Samuel Fiorillo supported this inquiry with systems and designs for reporting and dashboards, while Dr. Ruben Puentedura and Zhexun “Cinna” Xin provided additional analytic support.

The research was conducted independently of the sponsor and included the right to share results with participating schools and publish findings regardless of outcome. Both authors, as well as the research sponsor, have reviewed and approved this manuscript.

The authors would like to thank each teacher for their participation and voice. We are grateful to the Apple Distinguished School Community for their collaboration and support.

Background

> "My students were able to use tools from [their] iPad to help them develop their writing and comprehension skills. For example, a dyslexic student used the mic to have the iPad type what he wanted to write. Then, he could read and understand what was written. He felt more motivated in class, and I could see he was really developing his skills."
>
> - Middle School Language Arts Teacher from Brazil

Few modern educational reforms have been as far-reaching as the increased access to educational technology in K–12 classrooms worldwide. Over the past several decades, millions of classrooms have adopted computing devices for each student, marking one of the most ambitious educational initiatives in recent history (Bebell & O'Dwyer, 2010). One-to-one computing programs began as early as 1990 (Watters, 2015), but educators' integration of the internet and digital tools into daily teaching and learning is primarily a 21st-century phenomenon.

The COVID-19 pandemic unexpectedly shifted this trend, as the global K–12 community rapidly deployed educational technologies to support continuity in instruction. In the years since, many communities continue to navigate the opportunities and challenges that come with increased technology use in schools.

Given the breadth of technology use in K–12 settings, researchers have studied how one-to-one programs and other educational technologies influence teachers' instructional practices (Bebell & Burraston, 2014), shifts in pedagogy (Bebell & Kay, 2010), and classroom culture (Andrade Johnson, 2020). Researchers also examine how classroom technologies relate to student learning practices (Zheng et al., 2016), classroom engagement (Bebell & Burraston, 2014), and academic performance (Bebell & Pedulla, 2015; Kennedy et al., 2016; Stoneman, 2018). Understanding how technology influences learning also requires examining its connection to student engagement.

Student Engagement in Context

Student engagement remains one of the most critical yet complex educational outcomes (Trowler, 2010; Finn & Zimmer, 2012). Bond (2020) defines engagement as:

> "…the energy and effort that students employ within their learning community, observable via any number of behavioural, cognitive or affective indicators across a continuum. It is shaped by a range of structural and internal influences, including the complex interplay of relationships, learning activities and the learning environment" (p. 2).

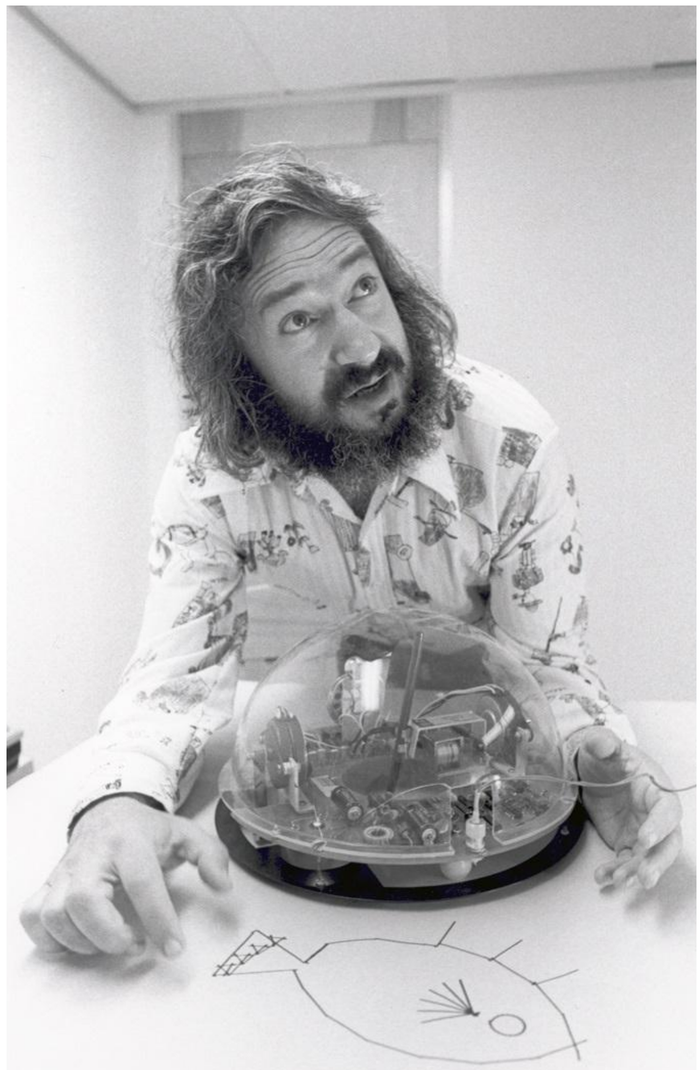
Engagement strongly indicates whether students view schoolwork as meaningful and motivating, and it often predicts broader academic success. Yet, recent research reveals two persistent challenges:

1. International assessments and longitudinal studies show that engagement declines steadily as students progress through school (von Davier et al., 2024).
2. Overall engagement has fallen across cohorts over time, with particularly sharp declines in the years following COVID-19 (Bălţătescu & Cernea-Radu, 2024; Gallup, 2024).

Theoretical Perspectives

To better understand the dynamic relationship between technology use and student learning, this study draws from many foundational ideas.

Jean Piaget (1936) first explored how learners actively make sense of the world through interaction and problem-solving, shaping influential theories about cognitive development. Building on these ideas, Seymour Papert (1980, 1992) extended such perspectives into the digital era, envisioning technology as a powerful medium for deeper, more meaningful learning. Papert argued that computers could expand students' cognitive opportunities, enabling them to actively construct knowledge and explore ideas in transformative ways.



While today's widespread access to technology fulfills part of Papert's vision, the fuller potential he described often remains unrealized in classrooms. To address this gap, scholars have proposed frameworks to understand the conditions that shape effective technology integration.

Image source: https://en.m.wikipedia.org/wiki/File:Seymour_Papert.jpg

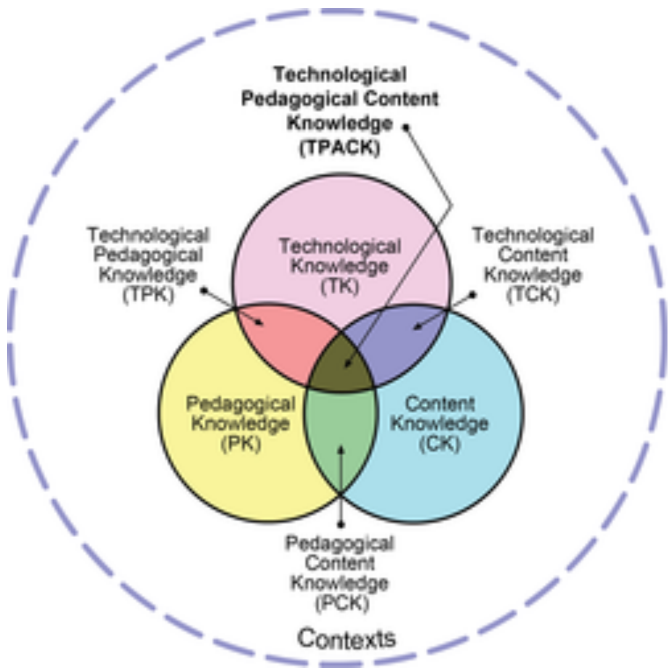


Image source: https://en.wikipedia.org/wiki/Technological_pedagogical_content_knowledge

The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) emphasizes that successful integration depends on the interplay of teachers' content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). This popular approach with educators similarly supports the current research by underscoring the central role of instructional intent and teacher expertise in determining how technology supports learning.

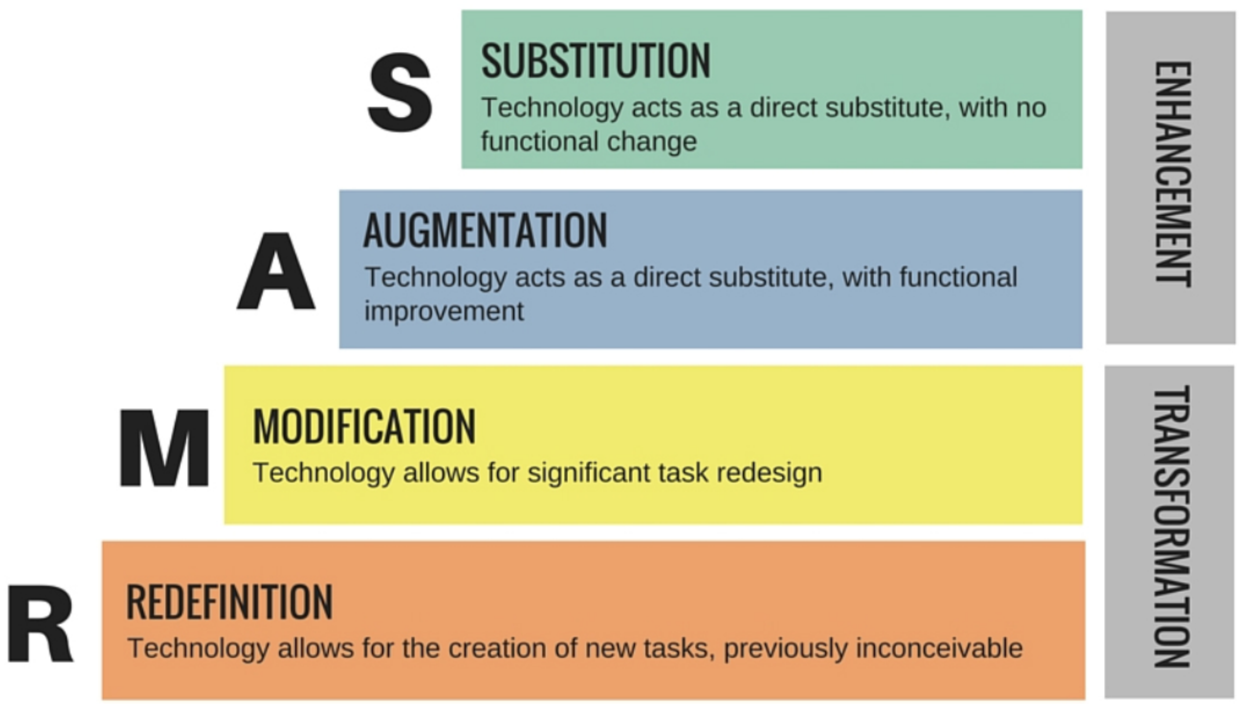
To more closely examine how technology can move beyond basic access toward transformative learning, this study primarily draws on Ruben Puentedura's (2009) SAMR model. Widely adopted in education, SAMR categorizes technology integration into four levels:

1. **Substitution** – Technology replaces a traditional tool or method without altering the core task. The learning outcome remains essentially the same, and the technology functions as a direct stand-in rather than a transformative element (e.g., typing an essay instead of handwriting it).

2. **Augmentation** – Technology still replaces a traditional method, but it introduces functional enhancements that improve efficiency, accessibility, or quality of output (e.g., typing an essay with built-in grammar tools or multimedia integration).

3. **Modification** – Technology enables a rethinking and redesign of the learning task itself. The activity evolves beyond its original form, allowing learners to engage in processes or produce outputs that would be difficult or impractical without digital tools (e.g., collaborative real-time editing of a shared document across locations).

4. **Redefinition** – Technology creates entirely new learning tasks and experiences. This level often involves immersive, collaborative, or creative opportunities (e.g., students engage in global collaborative research projects).



The SAMR model acknowledges that teachers' pedagogical *intent* is a critical component for the design, implementation, and evaluation of any new resource. In this study, the SAMR model provides a lens to understand how technology use varies across classrooms and how these practices may relate to student engagement. For this reason, we consider the specific and unique components of teacher and student technology use rather than a single, generic dimension.

Methodology

Survey-based research remains a foundational tool across educational technology scholarship and is particularly useful for capturing a wide variety of practices and beliefs at scale. As one component of the larger research and policy discourse, well-designed surveys provide critical, empirical insight into instructional practices and teachers' valuable perspectives, helping researchers and school leaders move beyond anecdotal evidence.

Building off prior research, a new teacher survey was developed to capture teacher background, technology access, and a wide range of classroom practices, attitudes, and beliefs (Bebell et al., 2010; LEGO, 2025). The resulting online survey included Likert scale, frequency scale, and open response question types.

Beginning in late 2021, Apple Distinguished Schools were invited to participate in the study. Schools that responded received further information and a link to the online teacher survey, which most respondents completed in under 15 minutes.

All data was collected voluntarily and anonymously by K–12 classroom teachers who provided active consent to have their results analyzed and shared.

Each participating school received access to their own school results and study-wide findings through customized data dashboards and PDF reports. The 323 participating schools were the initial audience for fostering more empirical self-reflection on technology, teaching, and learning within and across the Apple Distinguished Schools community. However, with no shared intervention or educational connections beyond Apple Distinguished School status, the variations across school and classroom settings provide a rich opportunity for comparison of practices. The cumulative, collective value across thousands of classrooms (all with notable educational technology programs) provides a rich, teacher-voiced perspective on evolving classroom practices across the globe.

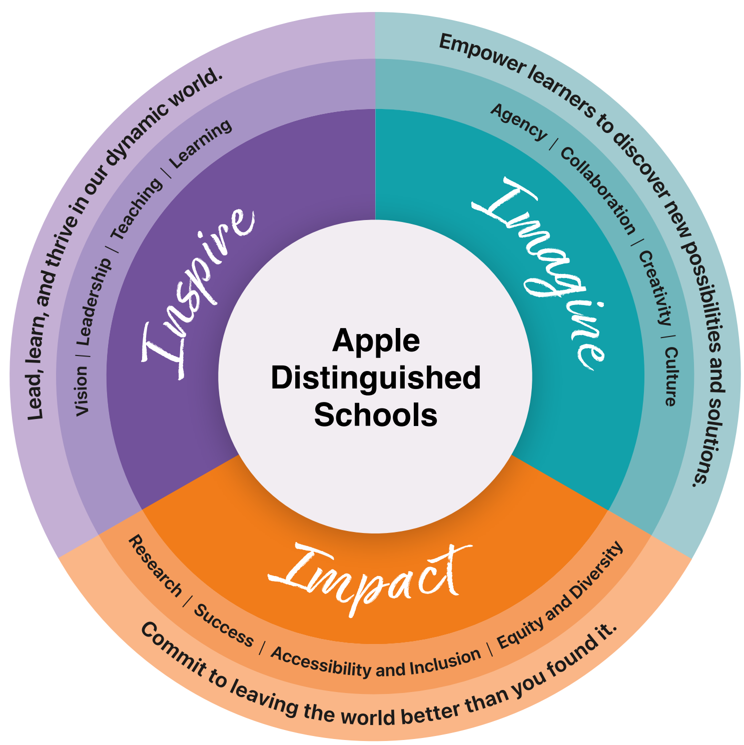
Apple Distinguished Schools Program

The Apple Distinguished Schools program is a voluntary program of over 1,000 K–12 public and private schools in over 40 countries. Participating schools vary dramatically, but are alike in adopting Apple technology to foster creativity, collaboration, and personalized learning (Apple Distinguished Schools, 2025).

The current criteria for program inclusion includes:

1. Schools must participate in a one-to-one device program for at least two academic years.
2. Educators integrate technology creatively and meaningfully into their curriculum.
3. In regions where it is available, at least 75% of teachers hold Apple Teacher distinction.
4. Each school demonstrates continuous improvement and positive student outcomes.

It is important to note that this study is not intended as a representative analysis of all schools globally. Rather, it focuses on the self-selected population of Apple Distinguished Schools. Without a shared curriculum, intervention, or other shared characteristics beyond their one-to-one device programs and Apple Distinguished Schools affiliation, this analysis aims primarily to describe and compare teaching and learning conditions among respondents.



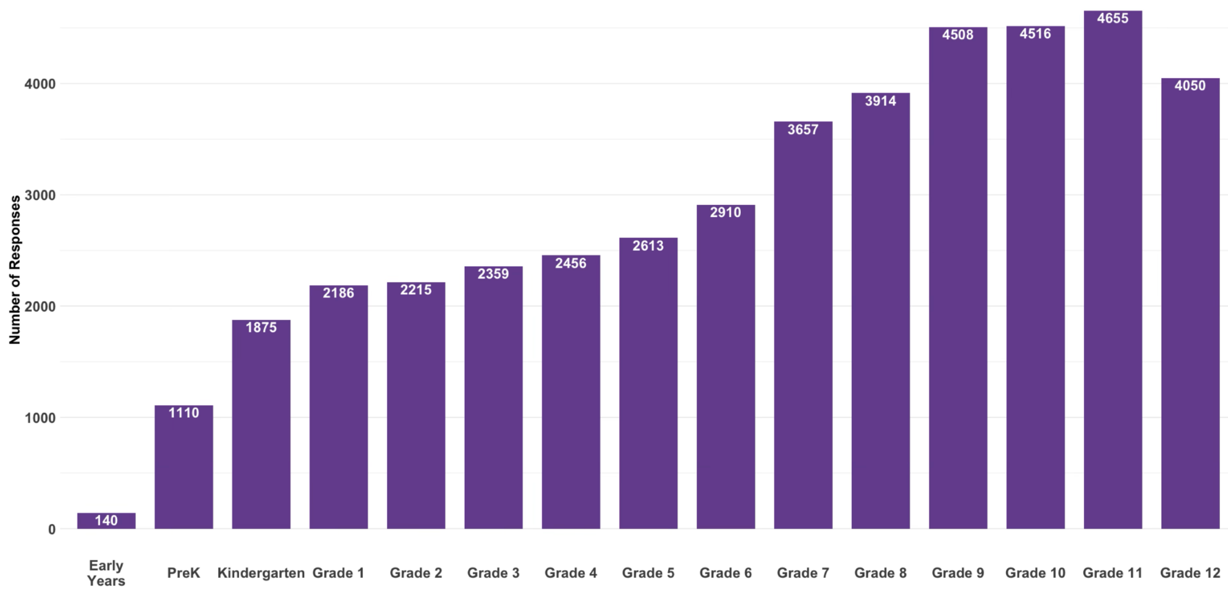
Results

17,078	323	31
Teachers	Schools	Countries

About the Teacher Respondents

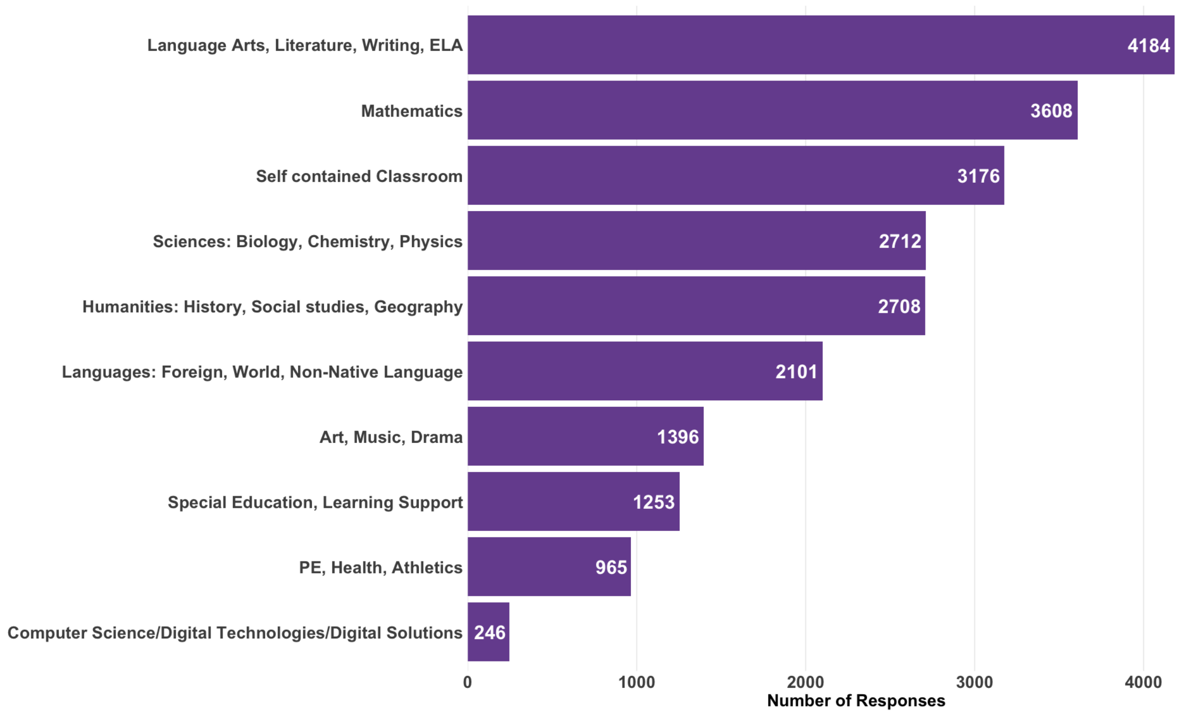
A total of 17,078 classroom teachers participated in the Apple Distinguished School snapshot study across 323 schools in 31 countries (36% of responses were from the United States) and six continents. Before exploring their practices and beliefs, it is useful to briefly summarize the participating teachers—many of whom serve multiple grade levels or subject specialties—to provide context for this unique global sample.

Global teacher responses by grade



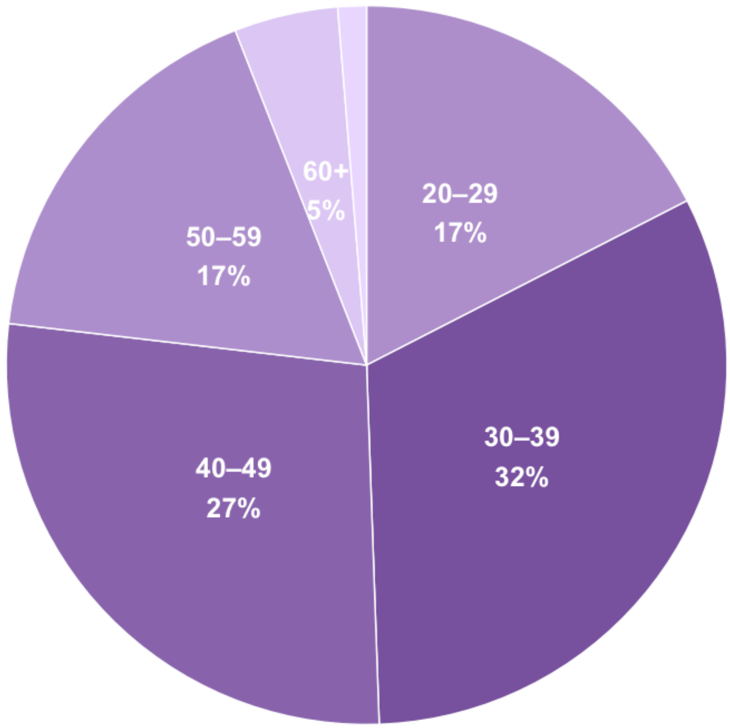
In total, 2,640 teachers served students in the youngest settings (Early Years, PreK, or Kindergarten), 6,390 teachers served elementary grades (1–5), 6,116 served middle school grades (6–8), and 7,085 served high school grades (9–12). More specifically, participants served a broad range of grade levels and subject specialties across the Apple Distinguished Schools community.

Global teacher responses by subject area



In addition to information on grade level and subject area, the survey also captured demographic variables, including teachers' age and years of teaching experience. The following figures summarize these characteristics for the study-wide sample.

Global teacher responses by teacher's age



Global teacher responses by years of teaching experience

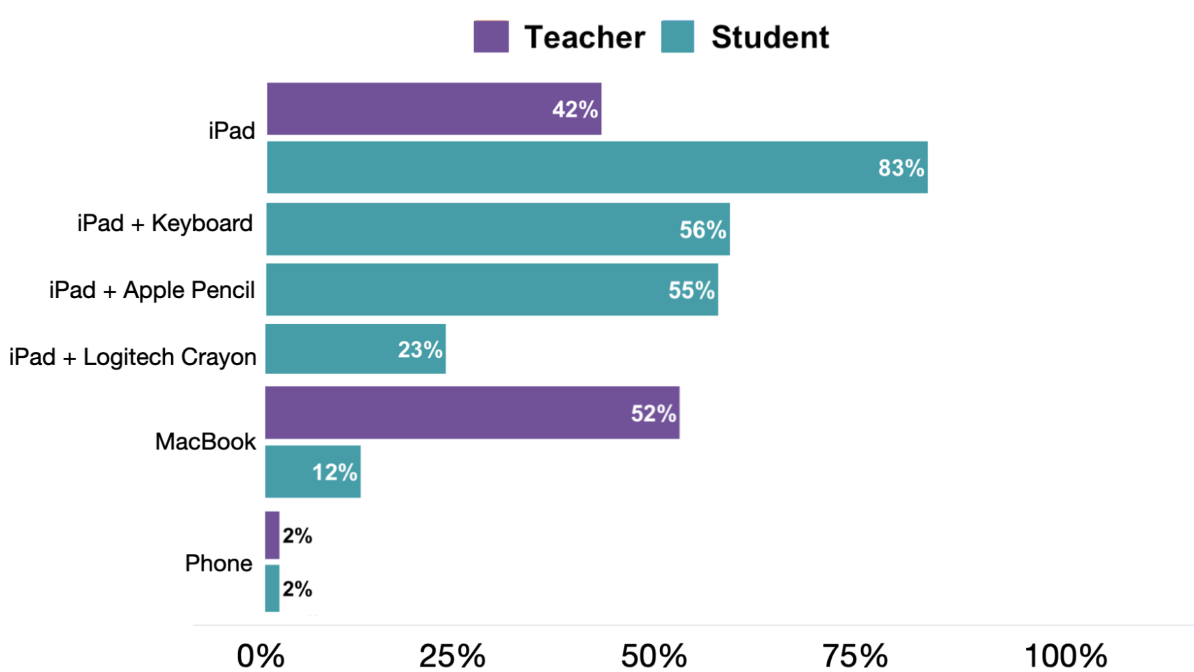
Years of Teaching Experience	Number of Respondents
0–5	3198
6–10	3807
11–15	2795
16–20	2581
21–25	1898
26–30	1162
31–35	580
36–40	389

Technology Access and Conditions

Many studies have documented the trends and types of educational technology tools used by students and teachers in school. In this inquiry, all schools equipped students with one-to-one Apple technologies. As such, the difference between Apple and non-Apple products, or differences between shared access and one-to-one student access, cannot be directly explored. However, across all 323 school settings, the study can illuminate variations across teacher and student devices.

Across the 2024 results, 42% of teachers reported using iPad as their primary tool, compared with 83% of their students. Additionally, the survey captured whether students in iPad settings had additional access to Logitech Crayons (23%), Apple Pencils (55%), or external keyboards (56%).

Most frequently used student and teacher devices for in-class learning (2024)



Among the many instructional approaches reported, student collaboration emerged as a particularly noteworthy practice. On average, teachers indicated that students worked collaboratively in pairs or groups 57% of the time. It is noteworthy that student collaboration in class, as measured by the survey, demonstrated the strongest relationship with student engagement of all measured practices—showing a positive statistically significant correlation ($r = .50$, $p < .001$). This suggests that even moderate increases in collaborative learning time may be associated with meaningful gains in student engagement.

The graph below illustrates variation in reported collaboration frequency across grade levels, providing further insight into how differences across settings may lend themselves more readily to collaborative practices.

Frequency of student collaboration in class across grades (2024)

Grade	Mean
Early Years	47.6%
Pre-K	48.1%
Kindergarten	51.3%
Grade 1	57.3%
Grade 2	58.8%
Grade 3	57.8%
Grade 4	59.3%
Grade 5	60.7%
Grade 6	61.1%
Grade 7	58.6%
Grade 8	55.4%
Grade 9	54.5%
Grade 10	53.5%
Grade 11	53.4%
Grade 12	51.1%

Student Collaboration Frequency

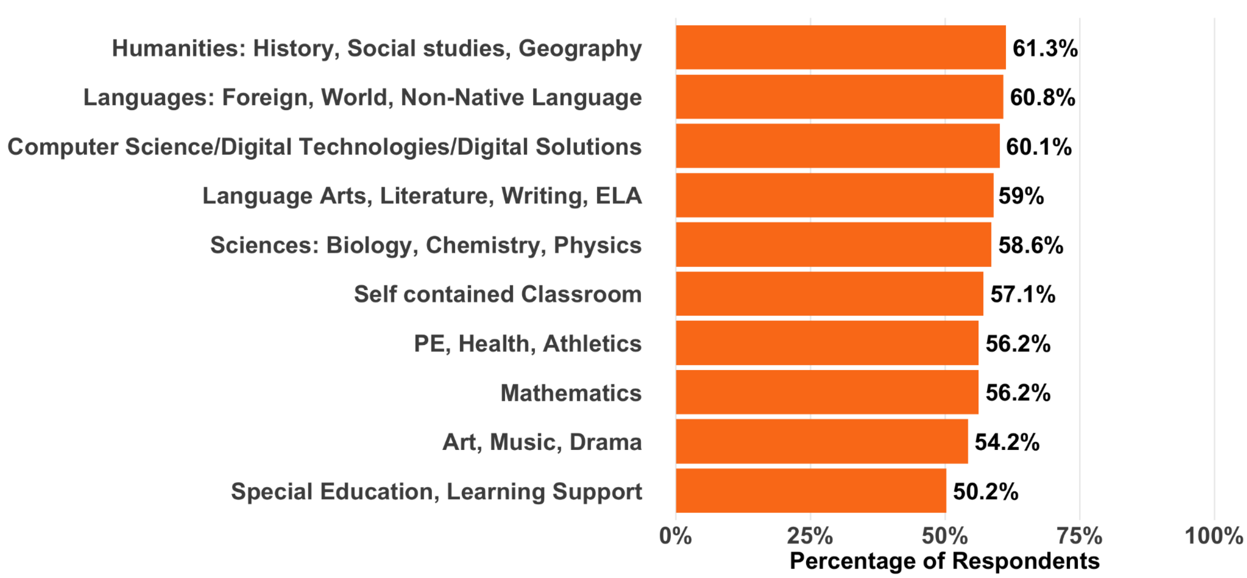
61.1% Vs. **51.1%**

Grade 6 — Grade 12

When examined by grade level for 2024, student collaboration frequency increased steadily from Early Years (47.6%) through Grade 6 (61.1%) before declining through the secondary grades, averaging 51.1% in Grade 12. This pattern aligns with a substantial body of research showing that student engagement—and opportunities for peer collaboration—also tend to peak in middle grades before declining in later schooling years.

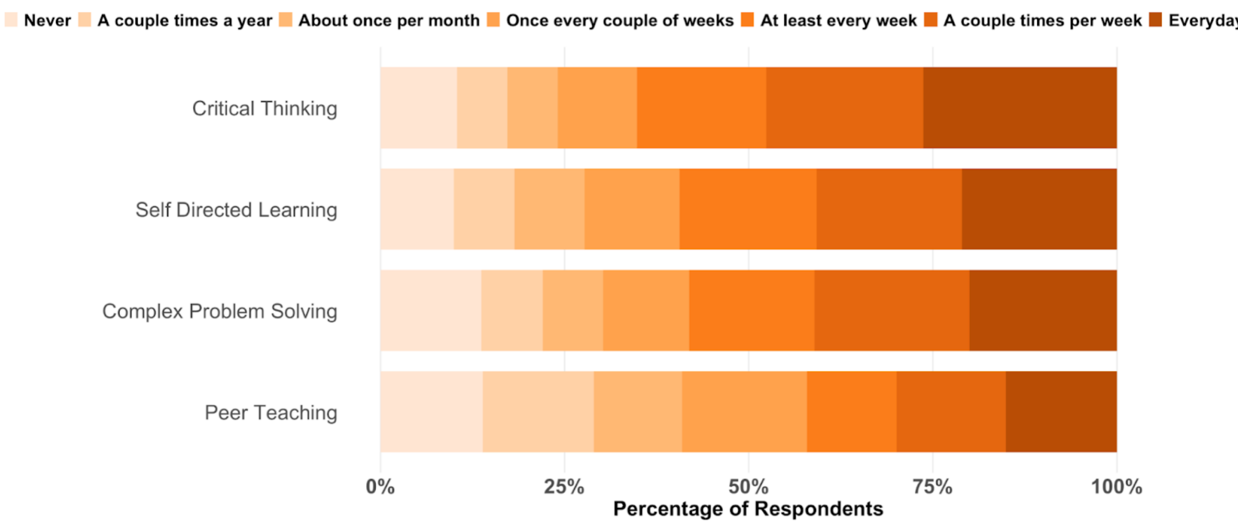
The figure below illustrates how frequently students collaborate across different subject areas, offering insight into which disciplines may more readily support collaborative approaches.

Frequency of student collaboration in class across subjects (2024)

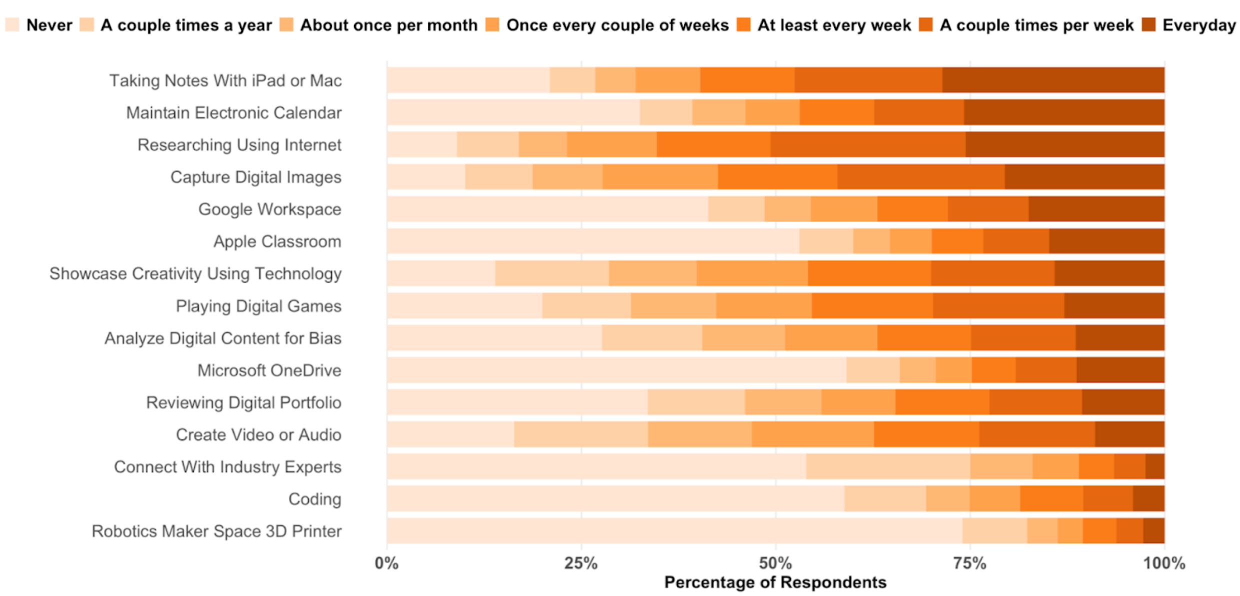


The following stacked bar charts present the frequency of instructional practices reported in the 2024 survey. Among non-technology practices, critical thinking and self-directed learning were the most frequently observed across all classroom settings. Additionally, teachers estimated widespread and frequent student use of educational technology. The most common technology practices were using an iPad or MacBook to take notes, maintaining an electronic calendar, and research using the internet. Activities requiring more infrastructure and planning such as coding, using robotics, maker spaces, and 3D printers, or connecting with industry experts occurred less frequently.

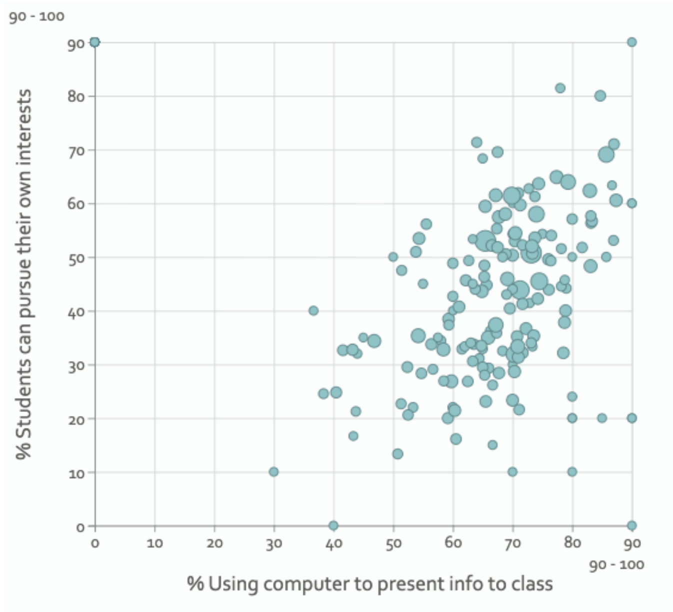
Average frequency of students' non-technology practices in the classroom (2024)



Average frequency of students' technology practices in the classroom (2024)

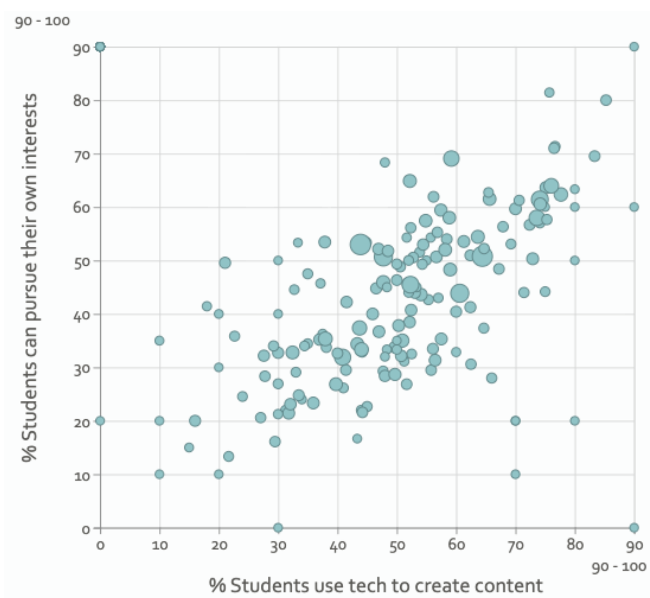


Teacher use of technology to present information to class



r = .33

Student use of technology to create content



r = .59

While technology access and classroom practices provide the backbone of the classroom experience, they do not operate in isolation. Teachers' underlying beliefs about technology's value, its impact on learning, and their own capacity to integrate it meaningfully all play a pivotal role in shaping what occurs in classrooms. The next section explores how teachers perceive educational technology, its potential, challenges, and its influence on teaching, learning, and student engagement.

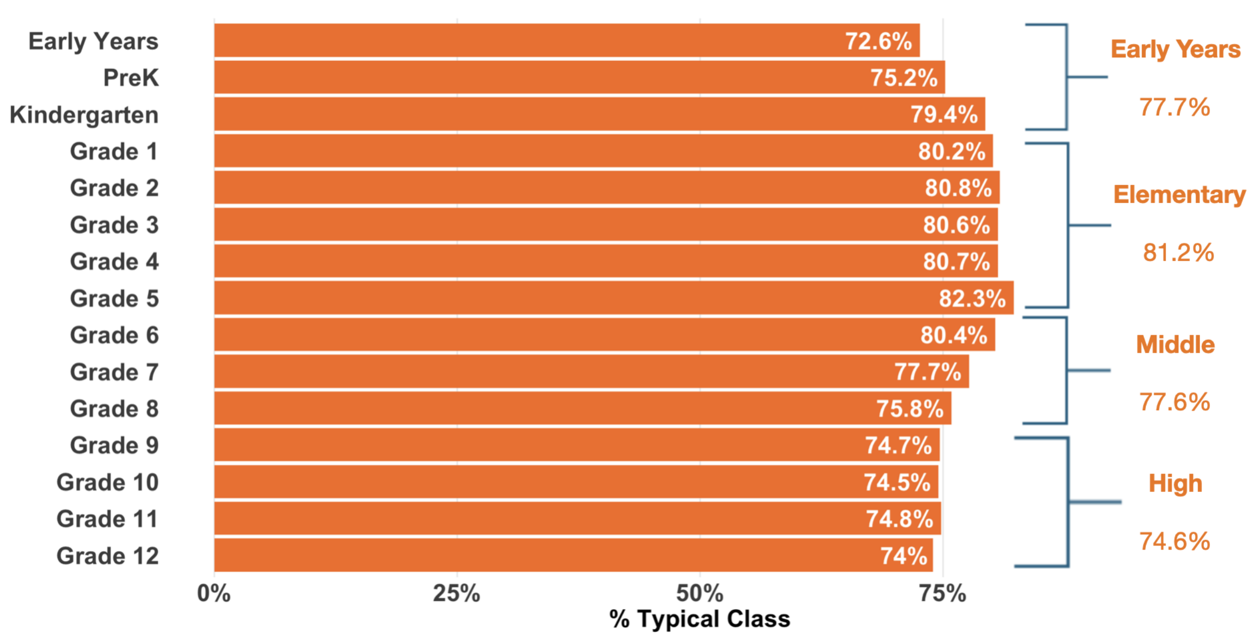
To explore this, teachers across settings were asked to estimate the percentage of time in a "typical" class that students were actively engaged. As a near-universal educational goal across grade levels and subjects, engagement rates were generally high: teachers across the three survey administrations reported that students were actively engaged for an average of 78% of class time. The following tables and figures examine how these engagement levels varied across the study sample.

78%

of class time, students were reported as actively engaged

Consistent with prior research, engagement patterns varied by grade level. When all other factors were held constant, engagement tended to peak in the upper elementary grades before declining through middle and high school. Smaller differences were observed across subject areas, reflecting the interplay of curricular and pedagogical factors. Teachers of more traditional academic subjects (e.g., languages, mathematics, humanities) reported the lowest engagement rates, while self-contained classrooms—more common in younger grades—tended to report higher engagement.

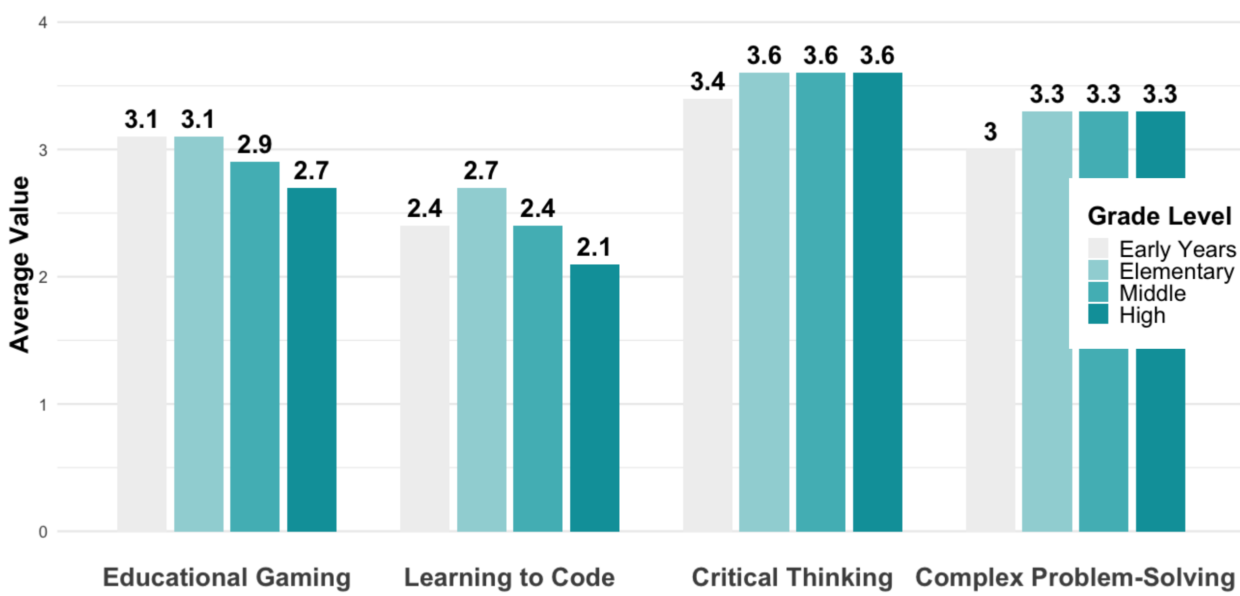
Average frequency of student engagement by grade (2024)



Like the differences observed across instructional practice, closer analysis of teacher beliefs demonstrates notable differences in how teachers value certain instructional strategies. For more specialized practices such as educational gaming and coding, teachers' valuations tended to decline as grade level increases.

In contrast, more widely endorsed practices like critical thinking and complex problem-solving exhibited consistent positive valuations across nearly all Apple Distinguished School teachers. To illustrate the relationship between teacher beliefs and their setting, we examine four teacher beliefs across school levels: educational gaming, learning to code, critical thinking, and complex problem-solving.

Study-wide teacher valuation towards common pedagogies and classroom condition by school level (2024)



Student Engagement

Conditions

> "Using iMovie, students compiled text, illustrations, and audio into a cohesive digital story. They learn to edit and enhance their projects with transitions. animations, and special effects, such as using a green screen. Having students work on this type of product helps them become really engaged in their learning experience."
>
> - Elementary multi-subject teacher from Mexico

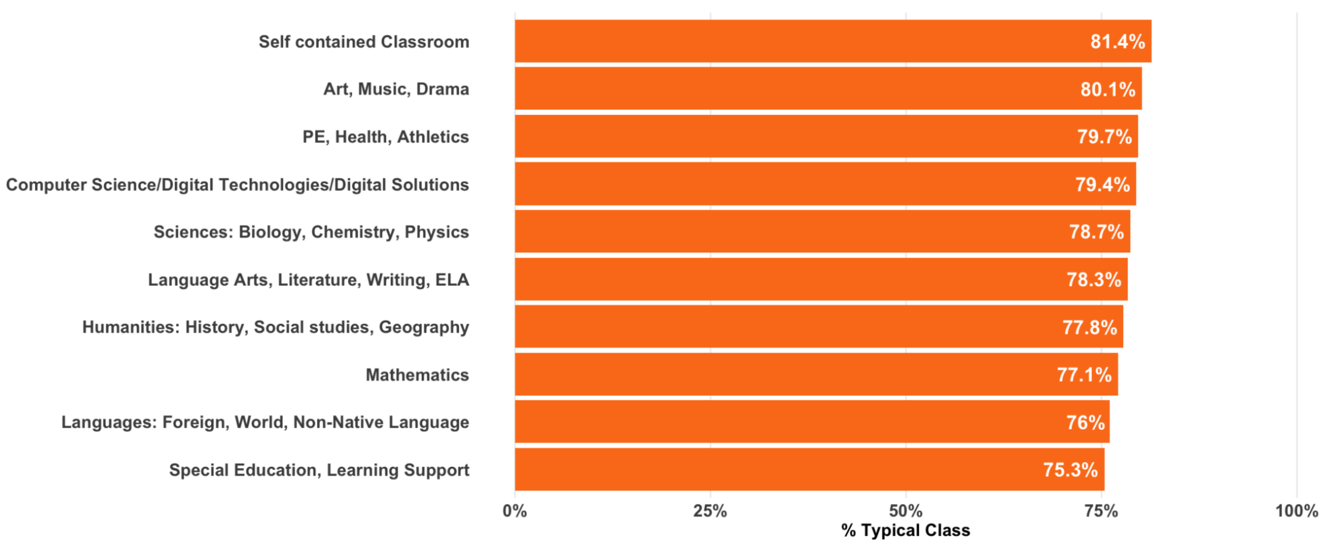
Student engagement is a multifaceted concept with many typologies, definitions, and models. Yet, it remains a universal component of learning related to many personal and academic outcomes. Today, two student engagement trends challenge educators and policy makers. First, comparative research studies consistently show global engagement levels decreasing as students maturate (von Davier et al., 2024). In other words, children around the world report less engagement in school as they progressed through their respective educational systems. A second disturbing trend suggests engagement levels have also been decreasing over time, particularly since the COVID-19 pandemic (Bălţătescu & Cernea-Radu, 2024; Gallup, 2024).

Despite these challenges, research shows that student engagement is a malleable trait impacted by classroom and school practices, including the use of educational technology (Li & Xue, 2023). However, such impacts were closely associated with teacher and classroom variables, as well as program fidelity (Bebell & O'Dwyer, 2010; Fisher, 1989; Hiebert et al., 1989).

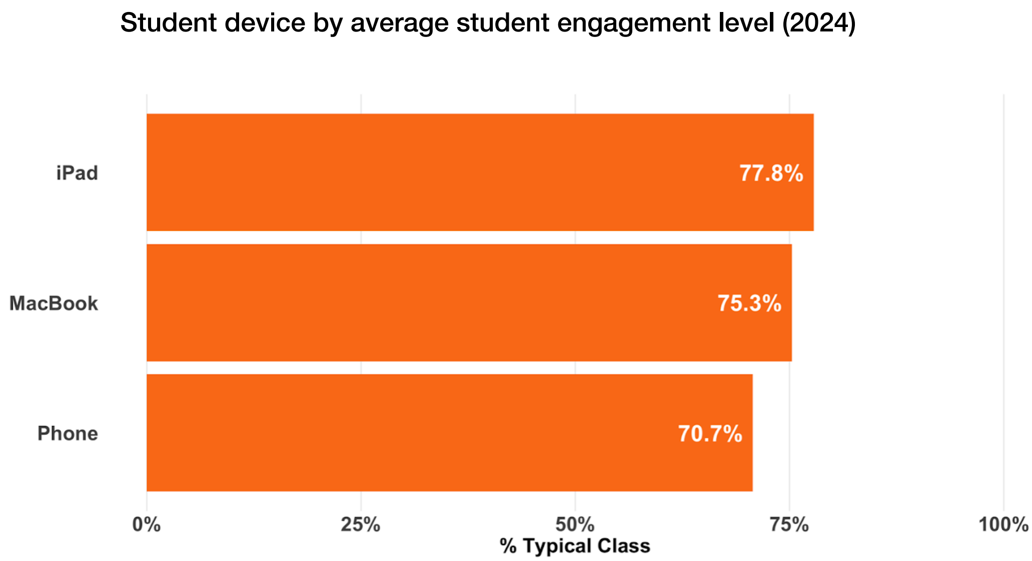
In the post-COVID-19 educational landscape, researchers and educators are working to reconcile a stark contrast: while students are deeply engaged with personal technology outside of school, classroom-based engagement continues to decline. As schools invest in educational technology, it is critical to understand whether—and how—these tools and related practices are fostering deeper engagement and meaningful learning outcomes.

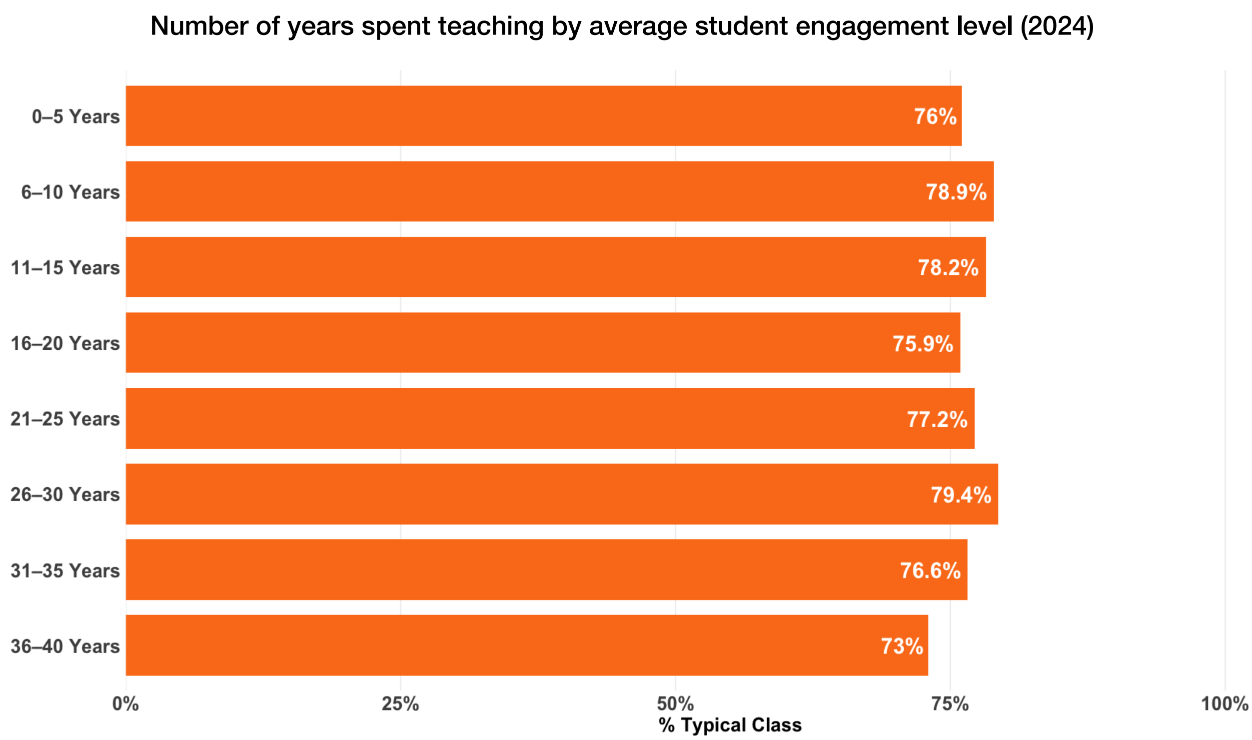
Across the entire sample, smaller differences in student engagement were observed across teachers' subject area, suggesting the many curricular and pedagogical factors related to engagement. Overall, teachers serving some of the most traditional academic subjects (e.g., languages, mathematics, and humanities) often observed the lowest rates of student engagement. However, it is important to note that self-contained classrooms often serve younger students, an important factor influencing classroom engagement.

Average frequency of student engagement by subject (2024)



The relationship observed between student device type and engagement is confounded by the fact that MacBook programs were more frequently deployed in upper grade levels (where engagement is traditionally lower). As such, the study-wide difference between student devices largely disappeared (and even reversed) when grade levels were held constant, suggesting that the overall difference in study-wide patterns of engagement are similar, on average, across the iPad and Mac settings. Additionally, there was less overall student engagement observed in those small numbers of settings where students used phones as their primary educational device in the classroom.





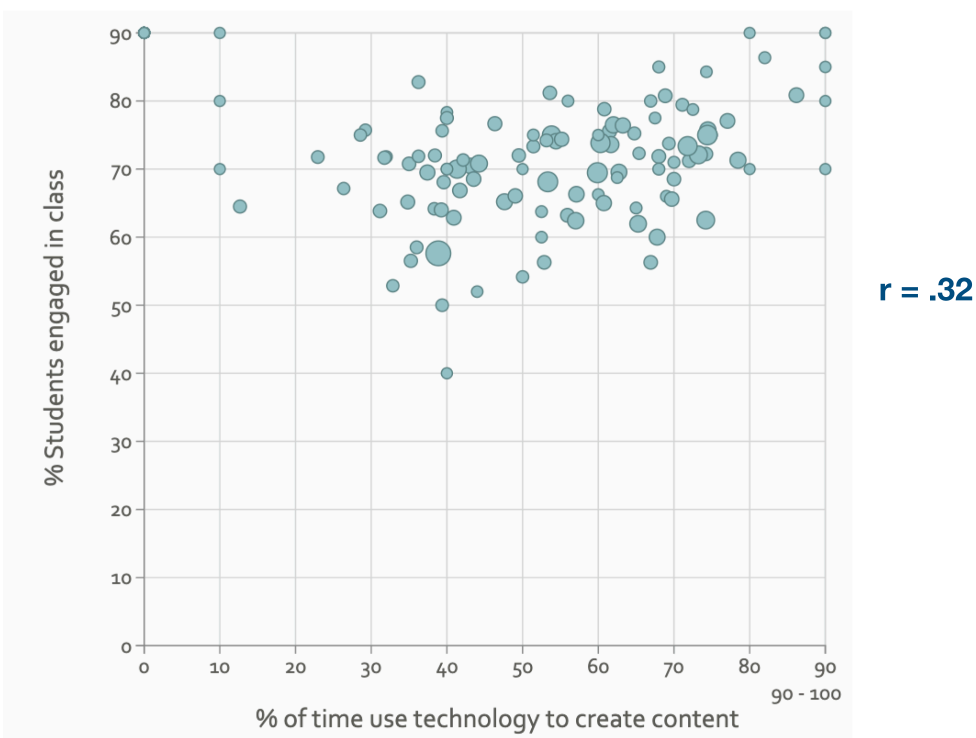
Student engagement levels showed relatively little variation across teachers' years of experience, though the lowest averages were reported by those at both ends of the spectrum—early-career (0–5 years) and late-career (36+ years) educators. There was essentially no difference in the estimated percentage of engaged class time for U.S. teachers and non-U.S. teachers (77.3%).

Impacts

> "Due to problems with children researching, I created individual videos for people they might meet in a Greek Agora or a Mayan marketplace. The children really engaged with these audio-visual stimuli and were able to feed back so much more about how these people lived in the past."
>
> - Elementary multi-subject teacher from the UK

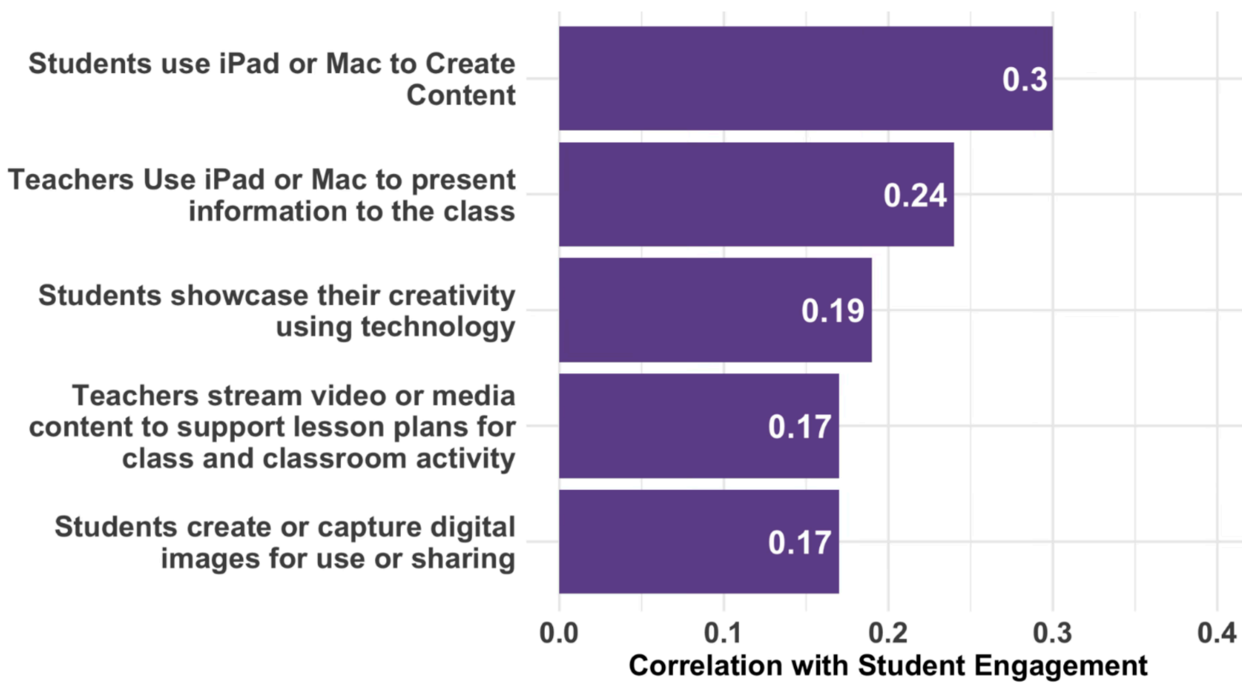
Exploring the variation across responding teachers, it is possible to show how the differences in classroom practices relate to teacher or student outcomes. For example, the relationship between the frequency of using a computer to present information to the class (from 0–100% of class time) was positively related (r = .3, p < .001) to teachers' perception of student engagement. Generally speaking, those teachers who more frequently used technology for presenting information were somewhat more likely to report higher levels of student engagement.

Student use of technology to create content



Looking across reported classroom conditions, including educational technology practices, across the 2024 responses showed the strongest relationships with engagement was observed for students' use of iPad or MacBook to create content ($\rho = .30$). Other practices demonstrated smaller but still meaningful relationships. For example, teacher use of iPad or Mac to present information correlated positively at $\rho = .24$ with student engagement.

Relationship between technology practices and student engagement



Study-wide, not all technology practices were found to have significant relationships to student engagement. For example, while the results suggested that student note-taking with technology was among the most commonly reported daily classroom activities, its relationship with student engagement was notably weak ($\rho = .05$). This relationship suggests an important distinction between the most routine instructional practices and those "deeper" classroom practices more closely associated with increased student engagement levels.

Significance

Although simple, this descriptive study offers several valuable insights for future research and practice.

01 First, findings confirm the varied and multi-dimensional use of educational technology in K–12 classrooms. Differences across teacher backgrounds, grade levels, and subject areas suggest that educators employ technology autonomously to support different instructional goals. Even in schools with comparable access, the ways, purposes, and frequency of technology use vary considerably. This complexity underscores the need for research that accounts for contextual and pedagogical nuances, as emphasized by TPACK (Mishra & Koehler, 2006) and pedagogical intent, as reflected by SAMR (Puentedura, 2009).

02 Second, results suggest a continued, positive relationship between technology use and deeper pedagogical practices. Typically, teachers reporting more frequent student technology use also reported the use of deeper, more advanced instructional strategies. Although not causal, the strong association for rich pedagogy and one-to-one student computing first suggested at the dawn of the computer age continues to manifest in a post-COVID K–12 landscape. Pedagogically rich teaching and learning can occur in any classroom setting, but current results suggest that technology is a frequent vehicle for teachers' enhancement of their curriculum/lesson.

03 Third, the study finds a moderate positive relationship between classroom technology use and student engagement—particularly when students are the active users. Student engagement also correlated significantly with teachers' sense of effectiveness ($\rho = .23$) and feeling appreciated ($\rho = .22$), while showing a negative association with their intention to leave the profession. These findings suggest that classroom practices impact both student engagement and teacher satisfaction. Given declining engagement with age, it is crucial to identify teaching conditions that foster engagement. The study also highlights the need to differentiate educational from personal technology use, especially amid rising concerns about screen time.

Implications and Limitations

This report begins the exploration of a rich dataset amplifying the voice and practices across a diverse, global sample of teachers. While current findings serve to highlight universal trends globally, future analyses focused within subject, grade level, location, and other classroom/teacher characteristics will continue to yield meaningful insights.

As with any large-scale survey research, it is important to acknowledge the study's limitations to appropriately contextualize the results. While the data provide meaningful insights into the relationship between technology, classroom practices, and student engagement, several factors may influence how these results should be interpreted.

1. **Sample-Specific Scope** – While the study draws from a large and diverse international sample, the findings are not generalizable to all schools globally, nor to all schools within the Apple Distinguished Schools network.
2. **Teacher-Reported Engagement** – This study investigates student engagement solely through the voices of teachers. Although teacher insights are valuable, this report does not capture student, leader, or parent experiences.
3. **Descriptive and Correlational Nature** – The study employs descriptive and correlational methods. As a result, the research cannot infer causality, only patterns and associations within the data.

Despite these limitations, we believe that any school or community can benefit from research-informed reflection activities, including self-study like action research. For current or future Apple Distinguished Schools, new and ongoing opportunities for collaborative, participatory research resumes in November 2025.

References/Resources

Andrade Johnson, M. D. S. (2020). Digital equity: 1:1 technology and associated pedagogy. In R. Papa (Ed.), Handbook on promoting social justice in education (pp. 1609-1639). Springer. https://doi.org/10.1007/978-3-030-14625-2_142

Apple Classrooms. (n.d.). *Apple Classrooms of Tomorrow*. Retrieved July 25, 2025, from http://www.appleclassrooms.com/apple-classrooms-of-tomorrow/

Apple Distinguished Schools (2025). *Apple Distinguished Schools: Program overview*.

Bălţătescu, S., & Cernea-Radu, A. E. (2024). Age-related variations in school satisfaction: The mediating role of school engagement. *Hungarian Educational Research Journal, 15*(1), 67-87. https://doi.org/10.1556/063.2024.00302.

Bebell, D., & Pedulla, J. (2015). A Quantitative Investigation into the Impacts of 1:1 iPads on Early Learner's ELA and Math Achievement. *Journal of Information Technology Education: Innovations in Practice, 14,* 191- 215. https://doi.org/10.28945/2175

Bebell, D., & Burraston, J. (2014). Procedures and examples for examining a wide range of student outcomes from 1:1 student computing settings. *Revista de Curriculum y Formacion del Profesorado, 18*(3), 137-160.

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire Wireless Learning Initiative. *The Journal of Technology, Learning and Assessment, 9*(2), 1-60.

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *The Journal of Technology, Learning, and Assessment, 9*(1), 1-16.

Bebell, D., O'Dwyer, L., Russell, M., & Hoffman, T. (2010). Concerns, considerations and new ideas for data collection and research in educational technology studies. *Journal of Research on Technology in Education, 43*(1), 29-52. https://doi.org/10.1080/15391523.2010.10782560

Blundell, C., Mukherjee, M., & Nykvist, S. (2022). A scoping review of the application of the SAMR model in research. *Computers and Education Open, 3*(100093), 1-12. https://doi.org/10.1016/j.caeo.2022.100093

Bond, M. (2020). Facilitating student engagement through the flipped learning approach in K-12: A systematic review. *Computers & Education, 151*,103819. https://doi.org/10.1016/j.compedu.2020.103819

European Commission. (2013). *Survey of schools: ICT in education – Benchmarking access, use and attitudes to technology in Europe's schools: Final report*. Publications Office of the European Union. https://data.europa.eu/doi/10.2759/94499

European Commission. (2019). *2nd survey of schools: ICT in education. Objective 1: Benchmark progress in ICT in schools. Executive summary*. Publications Office of the European Union.

Finn, J. D., & Zimmer, K. S. (2012). Student engagement: What is it? Why does it matter? In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement (pp. 97–131)*. Springer. https://doi.org/10.1007/978-1-4614-2018-7_5

Fisher, C. W. (1989). *The influence of high computer access on student empowerment* (ACOT Report No. 1). Advanced Technology Group, Apple Computer, Inc.

Froud, K., Levinson, L., Maddox, C., & Smith, P. (2024). Middle-schoolers' reading and lexical-semantic processing depth in response to digital and print media: An N400 study. *PLOS ONE, 19*(5), e0290807. https://doi.org/10.1371/journal.pone.0290807

Gallup. (2024). *Walton family foundation–gallup voices of gen z study: Year 2 annual survey report*. Gallup, Inc. https://nextgeninsights.waltonfamilyfoundation.org/resources/2024-voices-of-gen-z-study/

Hamilton, E. R., Rosenberg, J. M., & Akcaoglu, M. (2016). The substitution augmentation modification redefinition (SAMR) model: A critical review and suggestions for its use. *TechTrends, 60*(5), 433-441. https://doi.org/10.1007/s11528-016-0091-y

Hiebert, E. H., Quellmalz, E. S., & Vogel, P. (1989). *A research-based writing program for students with high access to computers* (ACOT Report No. 2). Advanced Technology Group, Apple Computer, Inc.

Jargon, J. (2024). *The battle to ban screens from school now includes chromebooks and tablets*. Wall Street Journal. https://www.wsj.com/tech/personal-tech/the-parents-opting-their-kids-out-of-screens-at-school-12b216e0?reflink=desktopwebshare_permalink

Kennedy, C., Rhoads, C., & Leu, D. J. (2016). Online research and learning in science: A one-to-one laptop comparison in two states using performance-based assessments. *Computers & Education, 100*, 141–161. https://doi.org/10.1016/j.compedu.2016.05.003

Korbey, H. (2023, June 27). *How to teach kids who flip between book and Screen*. MIT Technology Review. https://www.technologyreview.com/2023/04/19/1071282/digital-world-reshaping-childrens-education-reading/

Li, J., & Xue, E. (2023). Dynamic interaction between student learning behaviour and learning environment: Meta-analysis of student engagement and its influencing factors. *Behavioral Sciences, 13*(1), 59. https://doi.org/10.3390/bs13010059

LEGO Education. (2024). State of classroom engagement report: How global insights from 6,000-plus administrators, teachers, parents, and students reveal strategies to build more engaged classrooms. LEGO. https://education.lego.com/en-us/classroom-engagement-report/

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for integrating technology in teacher knowledge. *Teachers College Record*, *108*(6), 1017–1054.

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. Basic Books, Inc.

Papert, S. (1992). *The Children's Machine: Rethinking School in the Age of the Computer*. New York: Basic Books, Inc.

Piaget, J. (1936). *The origins of intelligence in the child*. Routledge & Kegan Paul.

Puentedura, R. R. (2009). As we may teach: Educational technology, from theory into practice. Apple.

Schmidt, M., McDonald, J. K., & Moore, S. (2025). The research we don't need will persist until we dismantle the systems that sustain it. *Journal of Computing in Higher Education, 37*(2), 507–542. https://doi.org/10.1007/s12528-025-09446-4

Stoneman, D. (2018). (dissertation). A quantitative Inquiry into the Effectiveness of One-to-One Mobile Computer Access for Students. Retrieved 2025, from https://www.proquest.com/docview/2051185823.

Trowler, V. (2010). *Student engagement literature review*. The Higher Education Academy. https://www.advance-he.ac.uk/knowledge-hub/student-engagement-literature-review

von Davier, M., Kennedy, A., Reynolds, K., Fishbein, B., Khorramdel, L., Aldrich, C., Bookbinder, A., Bezirhan, U., & Yin, L. (2024). *TIMSS 2023 International Results in Mathematics and Science*. Boston College, TIMSS & PIRLS International Study Center. https://doi.org/10.6017/lse.tpisc.timss.rs6460

Watters, A. (2015, February 12). 25 years ago: The first one-to-one laptop program. *Hack Education*. https://hackeducation.com/2015/02/12/first-one-to-one-laptop-program

Yang, D., Cai, Z., Wang, C., & others. (2023). Not all engaged students are alike: Patterns of engagement and burnout among elementary students using a person-centered approach. *BMC Psychology, 11*, 38. https://doi.org/10.1186/s40359-023-01071-z

Yanguas, M. L. (2020). Technology and educational choices: Evidence from a one-laptop-per-child program. *Economics of Education Review*, *76*, 101984. https://doi.org/10.1016/j.econedurev.2020.101984

Zheng, B., Warschauer, M., Lin, C.-H., & Chang, C. (2016). Learning in one-to-one laptop environments: A meta-analysis and research synthesis. *Review of Educational Research, 86*(4), 1052–1084. https://doi.org/10.3102/0034654316628645