Using Technology to Support At-Risk Students' Learning

SEPTEMBER 2014

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ALLIANCE FOR EXCELLENT EDUCATION

For many years, educators and policymakers looking for strategies to close the achievement gap and improve student learning have sought solutions involving new uses of technology, especially for students placed at-risk. Unfortunately, the results of technology initiatives have been mixed. Often, the introduction of technology into classrooms has failed to meet the grand expectations proponents anticipated. The educational landscape is replete with stories and studies about how at-risk students were unable to benefit from particular innovations seeking to use computers for teaching.

There are, however, successes among these efforts, and they reveal some common approaches to technology use. Based on a review of more than seventy recent studies,[1] this brief describes these approaches, particularly as they apply to high school students who have been at risk of failing courses and exit examinations or dropping out due to a range of personal factors (such as pregnancy, necessary employment, mobility, and homelessness) and academic factors (special education needs, credit deficiencies, and lack of supports for learning English). The brief then outlines policy strategies that could expand the uses of technology for at-risk high school youth.

HIGH SCHOOL STUDENTS AT RISK

The introduction of the No Child Left Behind Act in 2001 brought increased attention to the achievement gap that has long existed in the United States between low-income and more advantaged students, between students of color—especially African American, Latino, Native American, and Pacific Islander students—and white students, between new English learners and native speakers of English, and between students with and without disabilities. At the high school level, these achievement differences are often also associated with attainment differences, in the form of very different rates of graduation and college attendance for individual groups of students. For example, nearly half of Hispanics, African Americans, and Native Americans do not graduate on time with their classmates. Sadly, this is not unusual: more than one million U.S. high school students drop out each year, an average of one student every twenty-nine seconds.[2]

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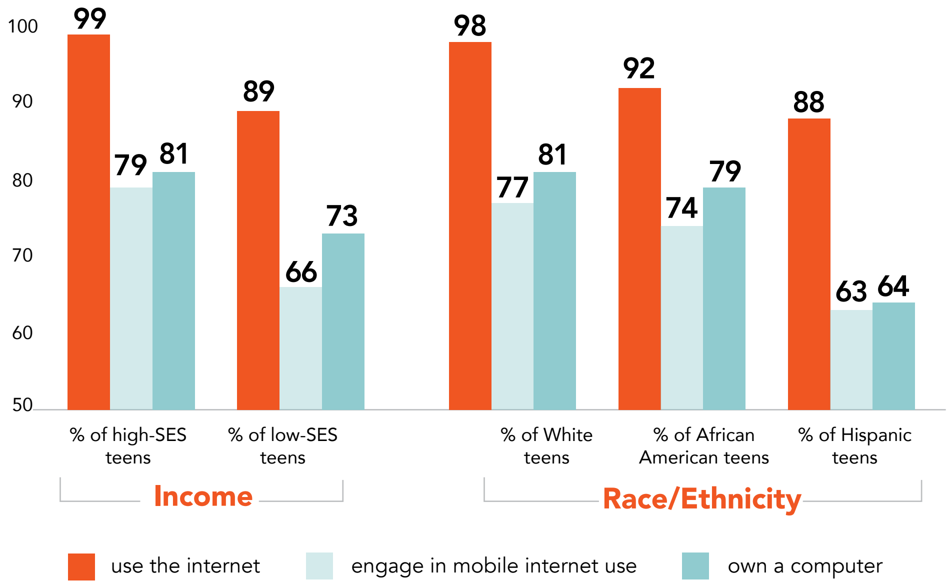
FIGURE 1: Technology Access in 2012
by Student Income and Race/Ethnicty: Percentage of Teens Who …

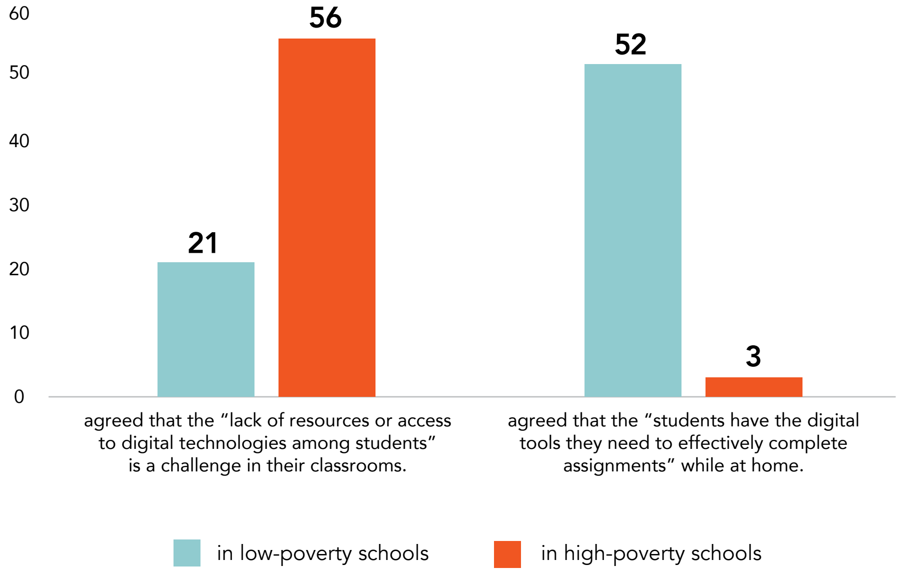


M. Madden et al., "Teens and Technology 2013," Pew Research Center, 2013, http://www.atlantycalab.com/untangiblelibrary/wp-content/untangible/130315%20-%20PIP_TeensandTechnology2013.pdf (accessed January 31, 2014).

Low-income students and students of color comprise an ever-larger share of the U.S. student population. More than sixteen million students now live below the poverty line,[3] and an additional eight million qualify for free or reduced-price lunch.[4] Children in poverty now make up nearly half of our public school students. The nation's 23.8 million minority students also comprise nearly half of the school population, and many of them are underserved by their school systems. Studies show that on nearly every indicator of educational access—school funding, qualified teachers, high-quality curriculum, books, materials, and computers—low-income students and students of color have less access than white and affluent students.[5]

In the area of technology access, there are disparities in ownership and internet access across socioeconomic groups. According to a recent survey, both low-income teens and young people of color are noticeably less likely to own computers and use the internet than high-income or white teens.[6] (See Figure 1.) For example, only 64 percent of Hispanic teens owned a computer in 2012, compared to 81 percent of white teens. The study reported that the kinds and quality of devices and the extent of broadband access also differed across more and less wealthy households and communities. As a result of these factors, teachers in high-poverty schools were strikingly more likely to say that the "lack of resources or access to digital technologies among students" was a challenge in their classrooms (56 percent vs. 21 percent).

FIGURE 2: Effects of Disparities in Technology Access on Classroom Instruction (2012): Percentage of Teachers Who …



Source: Purcell et al., 2013

Only 3 percent of teachers in high-poverty schools agreed that "students have the digital tools they need to effectively complete assignments while at home," compared to 52 percent of teachers in more affluent schools.[7] (See Figure 2.)

One important aspect of this problem is that more than 70 percent of public K–12 schools do not have sufficient broadband to allow most of their students to engage in digital learning activities at the same time. A recent report notes that "the reality is that many schools and libraries are attempting to serve hundreds, and sometimes thousands, of users with the same amount of bandwidth typically used by a single household."[8] Meanwhile, 30 percent of households do not have high-speed broadband, and many more lack the necessary speeds to access and use modern digital learning tools. Slow connection rates are concentrated in nonwhite and low-income households and communities.

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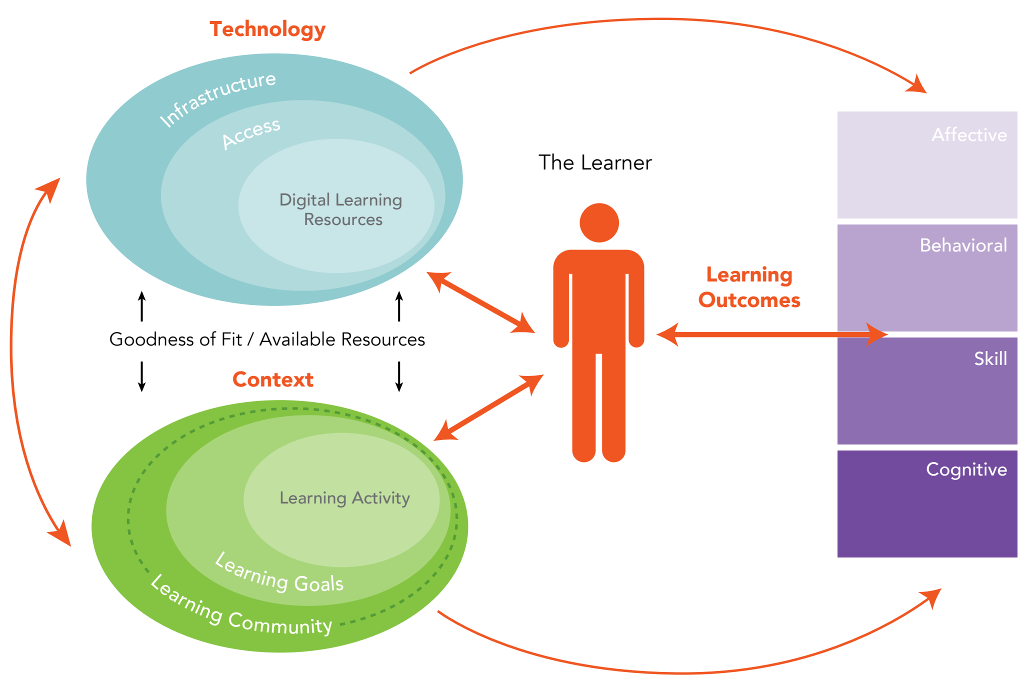
These differences mirror the disparities in other learning resources – dollars, teachers, and instructional services – experienced by students in different schools. For at-risk students, they add the additional disadvantage of reducing their readiness to engage in the primary means of information access and transfer in a technologically based society and economy. The good news is that research shows that if at-risk students gain ready access to appropriate technology used in thoughtful ways, they can make substantial gains in learning and technological readiness.

LEARNING IN A TECHNOLOGY-ENHANCED ENVIRONMENT

When we think about learners using technology, there are many different factors to consider. Whether we are talking about retirees using Massive Open Online Courses (MOOCs) or ninth graders using simulations to learn algebra I, many characteristics of the environment affect what we call a *digital learning ecosystem*, as shown in Figure 3 below.

FIGURE 3: Digital Learning Ecosystem



First, different ***learning outcomes*** are possible, ranging from affective (for example, student interest and motivation) and behavioral (for example, engagement with learning) to specific objectives that are skills based, cognitive, or both. Important ***aspects of the technology*** make a difference for these outcomes, including the technology *infrastructure*, such as bandwidth, servers, storage, and data hosting. *Access* is a function of the amount and kind of hardware used in the learning environment, as well as the way in which it is used. In schools, common models for access include one-to-one devices, stationary computer labs, mobile computer labs, and bring your own device (BYOD) programs. At home, models for access include the ownership or sharing of computers, tablets, and smartphones, as well as connection to the internet. Youth may also have access to technology in the community beyond home or school. Infrastructure and access are closely related, and each provides a set of enabling circumstances surrounding the appropriation of technology for learning. *Digital learning resources* are the materials—software and human resources—that structure the learning opportunity for the student.

Finally, the *learning context* includes the *learning community* (that is, *who* the student learns with, online and in person), the *goals* of the community, and the *nature of the learning activities*. Figure 4 shows the aspects of the learning context at each of these levels as they commonly appear in the research literature.

The technology and learning contexts interact with the characteristics of the learner. Together, these shape the learner's experience and the outcomes associated with their use of digital resources.

This ecosystem is much more complex than the binary conceptions of technology use that were common at the end of the twentieth century. The early years of research on the digital divide often only reported whether students had or didn't have access to computers, offering little information about the details of use. Even now, it is common for researchers to attend to some but not all aspects of the digital learning ecosystem presented here. It is these details, however, that ultimately make the difference in technology use outcomes. In this review, to the extent possible, we identify patterns of effective use by attending to the contexts, materials, and strategies that surrounded and supported students' efforts.

Figure 4: The Learning Context

Learning Community

- Factors within **school/local communities**.
  For example:
  - Approach to learning
  - Pedagogical values
  - Norms and culture
  - Parent involvement
- Factors within **classroom community**.
  For example:
  - Grade level
  - Teacher experience level
  - Classroom management strategies

Learning Goals

- Objectives for using technology:
  - Mastery of basic skills
  - Promote higher-order skills
  - Remediation of skills
  - Promote technological literacies
  - Promote skill development
  - Influence learner behavior
  - To make or build something
  - Exploration of interests
  - Pursuit of friendships

Learning Activity

- Academic subject(s) or other content area
- Interaction model(s)
  - Content consumption
  - Content creation
  - Content sharing
  - Interactive simulation/games

EFFECTIVE TECHNOLOGY USE FOR AT-RISK HIGH SCHOOL STUDENTS

The common caricature of computer-based instruction has been one in which the computer "takes over" for the teacher, presenting information to students, who absorb it, work on practice problems, and provide answers to factual questions posed by the computer until they demonstrate "learning" and move on to the next batch of information. And indeed, early versions of computer-based instruction (CBI) were structured much like electronic workbooks, moving students through a transmission curriculum in a fairly passive manner. Often programs have been geared toward improving student performance on minimum-competency tests, like high school graduation exams, that cover similar material in a similar format.

Results from these efforts have been largely disappointing. In some cases, students demonstrated improved outcomes on tests of similar information tested in a similar format; in most, they performed about the same as students taught by teachers during the same time period.[9] One recent study, for example, used rigorous methods of random assignment to evaluate the impact of a variety of math and reading software products across 132 schools in 33 school districts, with a sample of more than 9,400 students, and found no significant difference on student test scores in classrooms using the software as compared to classrooms not using the software.[10] Another large study using random assignment methods to evaluate the effectiveness of students' exposure to a phonics-based computer program also found no effect in terms of gains on reading comprehension tests.[11]

However, other approaches have been more productive. Research has indicated three important variables for success with at-risk students who are learning new skills:

- interactive learning;
- use of technology to explore and create rather than to "drill and kill"; and
- the right blend of teachers and technology.

INTERACTIVE LEARNING

One literature review summarized succinctly the typical uses and effects of technology in relation to different learner populations, noting that "the drill and practice activities favored in low-SES schools tend to be ineffective, whereas the uses of technology disproportionately used in high-SES schools achieve positive results."[12]

An analysis of data from the National Assessment of Educational Progress (NAEP) illustrates this point:[13]

> [T]he use of simulations/applications in eighth grade and games in the fourth grade positively affected test scores, whereas drill and practice at the eighth grade negatively affected the scores. In science, games … , word processing … , simulations … , and data analysis … all positively affected test scores. And in eighth grade reading, use of computers for writing

activities positively affected test scores, but use of computers for grammar/punctuation or for reading activities (which usually involve drill or tutorials) negatively affected test scores.[14]

All of these more interactive strategies produce greater success than the use of computers for programmed instruction. Unlike "computerized workbooks" that march students through material they learn through rote or algorithm, interactive CBI systems can diagnose students' levels of understanding and customize the material they engage with, offer a more interactive set of instructional activities, and provide feedback to students, as well as more detailed information about student progress. Programs like these, with teachers supplementing instruction to explain concepts and coordinate student discussion, have been found in several studies to be successful in helping low-achieving students pass state competency tests[15] and master complex new material.[16]

One of the benefits of well-designed interactive programs is that they can allow students to see and explore concepts from different angles using a variety of representations.

One of the benefits of well-designed interactive programs is that they can allow students to see and explore concepts from different angles using a variety of representations. For example, one study of at-risk high school students in Texas found that they learned significantly more using an interactive instructional environment to study quadratic functions than those in a control group who studied the same concepts via traditional lecture, note taking, and drill and practice. In this experiment, students spent fifty-five minutes per day working through six lessons that followed the cycle of "engage, explore, explain, and elaborate." Through this cycle, students used simulations that allowed them to manipulate information on interactive graphs and tables. They followed an exploration and were prompted to explain and elaborate on certain phenomena observed. They also engaged in dialogue with other students about their findings. The authors concluded that "results are deeply embedded in the core of the learning process and the necessity to create an environment that involves all students in high level thinking skills and to promote problem solving versus a more drill-practice approach."[17]

Another study found significant gains in mathematics achievement for students using video-based instruction modules with annotations to help them identify important elements in a problem and interact with 3-D digital models before applying their understanding by building a product in the digital environment.[18] This example illustrates how the program worked:

> The eight-minute video problem in Fraction of the Cost was developed locally and stars three middle school students who decide to build a skateboard ramp. To answer the subproblems in the video, students needed to calculate percent of money in a savings account and sales tax on a purchase. They also had to read a tape measure, convert feet to inches, decipher building plans, construct a table of materials, compute mixed fractions, estimate and compute combinations, and calculate total cost of building the ramp. Several learning tools on the CD-ROM helped students understand concepts in the overall problem. For example, one module showed a three-dimensional ramp that students could rotate to see all sides. The 2 x 4s (i.e., dimension lumber) used in building the ramp were color-coded to enable students to see more clearly which lengths corresponded to which parts of the schematic drawing. In another module, students could build the ramp by dragging lengths of 2 x 4s out of a stack of lumber and attaching them in the correct way.[19]

This approach can, of course, carry into all content areas. In science, for example, students learn new concepts by exploring them with simulations, watching videos, and constructing content of their own to represent their thinking about the subject. Through the use of technology, students see content in many forms as it comes alive with maps, videos, hyperlinks to definitions, additional content, and more.[20] These examples illustrate how interactive technology can be used to enhance student achievement by providing multiple means and methods for learners to grasp traditionally difficult concepts.

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TECHNOLOGY TO EXPLORE AND CREATE

Other research finds that students learn more when they use technology to create new content themselves, rather than just being the recipients of content designed by others. A number of studies have found that students demonstrate stronger engagement, self-efficacy, attitudes toward school, and skill development when they are engaged in content creation projects.[21] Among other examples, this can include engaging in multimedia content creation to communicate ideas about the material they are studying by creating reports, graphic representations of data they have researched or developed, websites, PowerPoint presentations, video production, digital storytelling, and other means.[22]

In one of the many studies illustrating the effective use of technology as an interactive tool for both practicing skills and creating new content, several ninth-grade English classrooms with large numbers of at-risk students—including many who had previously failed English and were predicted to fail the state ninth-grade reading test—ultimately outperformed other higher-tracked classes in their school on the state tests. These other classes included both on-level and Advanced Placement sections that studied the same material without technology supports. In the technology-rich classroom developed for the classes of at-risk students, the teacher used one-to-one availability of computers with wireless connections to the internet to engage students in "word processing, spreadsheet, database, web page production and presentation software in a variety of contexts." According to the researchers,

> [t]his flexibility provided an environment that was fun and exciting for the students. Students produced research-based websites in place of research papers, and they discussed points of literature in blogs, instead of traditional handwritten journals. All of this closely resembled the world of today's teenagers that includes instant messaging, email and web-based gaming.
>
> The teacher used the laptops often and planned a special unit of concentrated use at least once each six-week grading period. For example, prior to a unit of study she would ask the students to use the laptops for discovery exercises such as web quests or museum tours. She also required the students to use advanced organizer software on the laptops to map out a paper before they began to write … An assignment concerning the Holocaust exemplifies the kind of research-based websites produced by the students. The teacher introduced the unit of study with discussion and lecture. The topics covered historical aspects and relevant current issues that tie to examples of genocide in the world today. Next, the teacher provided the students with pertinent information on citation style and writing tips. The classes then spent several days in the library accessing the Internet and books that they could use as a foundation for their research. The

> teacher then asked the school's instructional technology specialist to visit the classroom and establish web space and folders for the students on the school's server. The teacher spent the next few days teaching the students how to use webpage construction software and troubleshooting their efforts. The students were required to have a home page, three sub-pages and a reference page; each of these pages was required to be linked to each other. They were required to have at least two pictures and no more than four per page. Each student was required to plan their website in a storyboard format, and the project was graded using a predetermined rubric.

The students, who had previously encountered behavioral problems and high rates of failure on the state test, were highly motivated. The researcher and the teacher attributed this to the use of technology, which engaged them in projects in which they had high levels of agency and also gave them opportunities to practice material that they would later encounter on the state test. When she was asked what it was about the use of technology that improved the students' achievement, the teacher responded,

> It gives them an atmosphere of active learning. They are involved in their learning at all times, they make their own learning decisions, and they buy into [the classroom] … With the assistance of technology I am able to differentiate my instruction to meet the needs of individual students; they know that and want to be a part of that kind of atmosphere.[23]

One key to content creation projects is the use of scaffolding to guide the students through a series of increasingly more complex activities that build on one another. Scaffolds may include "visuals, such as storyboards or graphic images, to stimulate imagination, aid in retention of valuable information, and explore strategies for expressing prior knowledge in a written format."[24] Motivation and self-esteem are further enhanced when the content creation tasks are culturally relevant, accessible, and take into account students' interests.[25]

Another example of how skills can be developed through such tasks comes from a study that involved fifty-five Latino adolescents in a number of shorter content creation projects.[26] In this study, students attended sixteen two-hour weekly sessions. Within these sessions, each student had a computer and engaged in original content creation activities in which important skills were embedded. In one lesson, for example, students were asked to create materials for a business they envisioned themselves starting, such as a restaurant. They used a program such as Excel to track expenses, Print Shop to advertise to potential employees, and FrontPage to mock up a website for their business. This project also illustrated how, by creating student agency within the learning activity, and providing opportunities to apply skills in concrete ways, students can be motivated and gain a wide range of skills.

THE RIGHT BLEND OF TECHNOLOGY AND TEACHERS

As the above examples suggest, significant gains in achievement and engagement can occur for underserved students in learning environments characterized by computer use that engages students in interactive learning that offers multiple representations of ideas and real-time digital feedback, as well as opportunities to apply learning as they create content.

One-to-One Access

It is important to note that in all of the examples of successful outcomes, students had access to ***one-to-one computing opportunities*** with adequate hardware and bandwidth to support their work. One-to-one access refers to environments where there is one device available for each student. Researchers have found that one-to-one availability is particularly important for lower-income students' ability to gain fluency in using the technology for a range of learning purposes, since they are less likely to have these opportunities at home. For example, in one study that examined the implementation of a one-to-one laptop program in three economically different schools in California, lower-income youth demonstrated significantly higher gains in mathematics relative to the higher-income students, and teachers were most likely to say they found the laptops to be useful for learning by "at-risk" youth.[27]

When students were given one-to-one laptop access as well as access to the internet at school, they made use of this opportunity at least several times a week, for purposes ranging from seeking background knowledge, facilitating "just in time" learning, and supporting research projects. In addition to the work the students were doing in math, the researchers noted that one-to-one laptop implementation increased students' likelihood to engage in the writing process, practice in-depth research skills, and develop multimedia skills through "interpretation and production of knowledge."[28]

Teacher and Peer Engagement

Along with the ready availability of technology, it is equally important to have the ready availability of ***teacher supports*** and ***other students' input***, thoughtfully used. Results are strongest when the uses of technology discussed above are combined with opportunities for strategic teacher support and social interactions among students.

When students were given one-to-one laptop access as well as access to the internet at school, they made use of this opportunity at least several times a week.

In a study comparing blended and online learning outcomes, 1,943 Korean students, of whom 915 were identified as underprivileged, took online courses using Flash- and video-based learning resources.[29] Students progressed through learning sessions by completing online tasks individually, receiving real-time digital feedback, and engaging in group discussions. One group of students experienced online learning supported by a homeroom teacher (blended condition), and the other group engaged in self-study without the help of any teachers (fully online condition).

> Learners who worked with teachers alongside their online experience were much more likely to say that they developed an interest in the subject and increased their academic standing.

The researchers found that "teacher assistance seems to be mandatory for the online learning of underprivileged students."[30] In this study, students illustrated high levels of satisfaction and learned more in the blended learning condition because of the real-time support and encouragement they received from their teachers. When students were asked to select the area where they experienced the most personal development, there were several advantages for those who experienced the blended context. Learners who worked with teachers alongside their online experience were much more likely to say that they developed an interest in the subject and increased their academic standing, while learners who did all of their work online were much more likely to say that they experienced no change in their learning. Additionally, students reported satisfaction associated with opportunities for interactions among learners.[31]

In a U.S. study examining the use of computer-based instruction in an alternative school that students attended after they had failed out of or been expelled from a traditional high school, teachers used technology to support student success in ways ranging from computer-based content instruction (through the Plato program) to computer use for student research and development of content. In that context, students reported that they would choose to use Plato for subjects where they wanted to add to their skills, see visualizations of the content, and demonstrate mastery (to pass out of a class), but not for those subjects they perceived as difficult to learn via computer. Students noted that the availability of teacher support for learning challenging concepts and for helping them overcome moments of confusion when they were working through ideas on the computer was critical. Students and their teachers also noted that it was important to have variety in their learning choices, including contexts in which the computers were used to write autobiographies and short stories, to create multimedia PowerPoint projects, and to allow them to learn through inquiry and personal expression.

A Systemic Approach

A similar strategy with strong results has been used in the traditional schools in Talladega County, Alabama, a district where 73 percent of students qualify for free or reduced-price lunch, dropout rates were high, and college-going was low. Beginning with Winterboro High School, the leadership team redesigned the entire school program, focusing on increasing student engagement through active, project-based learning; integrating technology tools to support instruction; and training teachers to make necessary pedagogical shifts. A case study of the initiative notes that

> [i]n the PBL model, students are constantly creating, practicing, and exploring as they work to complete assignments and lessons that require blogging, participating in online forums and chats, or doing in-depth research projects that require the development of analytical and media awareness skills. Other lessons have students developing and editing wikis, recording podcasts and vodcasts, developing multi-media presentations, designing and producing publications, and creating complex animations; this diverse array of activities has been developed in order to keep students engaged and stimulated with an interactive educational process while teaching them meaningful content and skill sets that they will be able to apply in the real world.[32]

Over the course of just two years, this systemic approach led to an increase in graduation rates from 63 percent to 87 percent and a climb in college acceptance rates from 33 percent to 78 percent. During the same period, the high school had significant decreases in suspensions, alternative school referrals, and dropout rates, preventing failures that had previously routinely occurred.

What About the"Flipped" Classroom?

One form of instruction offering a novel blend of teachers, peers, and technology is the "flipped" classroom. Typically, this term refers to arrangements in which technology tools are used outside of class to provide students with the information that might normally occur during direct instruction in the classroom (for example, offering video-based lectures, reading, and quizzes that students are expected to complete at home), while class time is used for discussion and collaborative, problem-based inquiry. While currently much discussed, this approach has been tried primarily in higher education settings. It is not yet widely used in K–12 education, and there has been little research about its effects with different populations of students. One recent literature review noted that

> (m)ost studies conducted to date explore student perceptions and use single-group study designs. Reports of student perceptions of the flipped classroom are somewhat mixed, but are generally positive overall. Students tend to

> prefer in-person lectures to video lectures, but prefer interactive classroom activities over lectures. Anecdotal evidence suggests that student learning is improved for the flipped compared to traditional classroom. However, there is very little work investigating student learning outcomes objectively.[33]

The studies that do exist suggest that college students in flipped classrooms are generally more likely to watch video lectures at home than to complete text-based reading, and that they learn more from interactive video lectures than other video lectures or in-person lectures. We might guess that high school students who are motivated and supported to do work at home might respond similarly. It is unknown, however, whether at-risk students would find the space and time to engage in these out-of-school activities.

A large body of research has found that well-designed collaborative, problem-based learning tasks are successful tools for students to acquire inquiry skills and other process skills. However, they must be thoughtfully connected to structured information sources that can inform the problem-solving process at optimal times if they are also to have a positive effect on building knowledge.[34] While more research is needed, these findings suggest some of the conditions that might need to be present if this new approach to using technology is to be successful in high schools.

POLICY IMPLICATIONS

Researchers have begun to amass some useful knowledge about the successful use of technology to support students who are often placed at-risk of school failure, to help them strengthen their understanding, close skill gaps, and recoup prior experiences of failure. This research has found that using computers as replacements for teachers in traditional drill-and-practice exercises has not produced greater success for such students, but that more interactive, proactive, and teacher-supported uses have helped students make strong strides in achievement.

These findings suggest a number of implications for policymakers and educators at the federal, state, and local levels. We offer the following recommendations:

1. **Technology access policies should aim for one-to-one computer access.** At-risk students benefit from opportunities to learn that include one-to-one access to devices. One-to-one access refers to environments where there is one device available for each student in the learning environment. Studies finding positive impacts on student learning typically describe opportunities to learn where there is at least one device per student, and the devices are readily available for multiple uses by the student throughout the school day.
2. **Technology access policies should ensure that speedy internet connections are available to prevent user issues when implementing digital learning.** Digital learning often requires internet access, and this need is growing with the proliferation of audio and

video resources hosted on the web. Reliable access to speedy internet allows teachers and students to support learning in real time. However, many schools, especially in lower-income communities, have poor bandwidth and problems with connectivity. Students who experience challenges in learning can become especially frustrated if they are stalled by inability to access the content they are trying to use or find. In studies using technology for learning, at-risk students participating in blended and online courses recommended faster internet connections as an important factor for improvement.[35]

3. As schools, districts, and states plan the ways they will purchase materials and use technology, they should consider that **at-risk students benefit most from technology that is designed to promote high levels of interactivity and engagement with data and information in multiple forms**. Substantial research illustrates that activities supporting many kinds of interactions between learners and the material—including different visualizations of concepts; multiple ways of seeing, hearing, and learning about them; and opportunities to be active in manipulating data, expressing ideas, and other aspects of the learning process—were essential to support learning by lower-achieving and other at-risk students.

4. **Curriculum and instructional plans should enable students to use technology to create content as well as to learn material.** Research illustrates that when students have opportunities to create their own content using technology (for example, conducting research to make decisions or draw conclusions from evidence, finding and manipulating data, developing reports, creating websites, designing PowerPoint presentations, and creating spreadsheets), they become more motivated and develop stronger skills. Classrooms should include technology uses that increase student agency and higher-order skills as well as those that guide students through the learning of specific content.

5. **Policymakers and educators should plan for blended learning environments, characterized by significant levels of teacher support and opportunities for interactions among students, as companions to technology use.** Blended learning occurs when the instructional environment combines digital learning and face-to-face interactive learning. The most productive contexts are those that combine structured learning of information with collaborative discussions and project-based activities that allow students to use the information to solve meaningful problems or create their own products, both individually and collectively.

All of these recommendations must rest on a base of adequate supports for teacher learning about how to use the technologies and pedagogies that are recommended. In addition, such initiatives must include the technical assistance that educators need to manage the hardware, software, and connectivity that make technology infusion possible.

When coupled with project-based learning strategies and effective support for teachers, a systemic approach to digital learning has shown great potential to facilitate shifts in school culture and strengthen students' twenty-first-century skills. Many districts have utilized Project 24 (www.plan4progress.org), a comprehensive digital learning framework offered free to all school districts, as the backbone for such implementation. This framework helps districts plan before they buy, developing a concrete vision of student-centered, technology-infused learning, like the strategies used with noteworthy success in Talladega, Alabama, described above.

With a strategic policy approach that supports the most effective technology uses, many more students who are currently at risk can be enabled to learn effectively, graduate from high school, and be successfully launched on a pathway to a productive future.

ACKNOWLEDGMENTS

This report was written by Linda Darling-Hammond, EdD; Molly B. Zielezinski, EdD; and Shelley Goldman; with support from policy associates at the Alliance for Excellent Education.

The **Alliance for Excellent Education** is a Washington, DC–based national policy and advocacy organization dedicated to ensuring that all students, particularly those traditionally underserved, graduate from high school ready for success in college, work, and citizenship. www.all4ed.org

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ENDNOTES

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