Status of Online Learning Programs in K–12: Implications for Teachers

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NEA Research, a department in the National Education Association's Center for Great Public Schools, prepared this Research Brief in response to a 2017 Representative Assembly New Business Item (No. 135), which charges that–

> *NEA will investigate and produce a research analysis of computer-based programs, often wrongly promoted as "personalized" or "competency-based" learning programs that use learning analytics to simply customize standardized learning and replace human educators with digital training and tracking systems.*

Background

Since the introduction of computers into public schools during the late 1970s, there has been a significant increase in the number of computers in classrooms, in access to the internet, and in the frequency of teacher and student use of computers in the classroom. Between 1999 and 2012, the number of computers in education buildings grew by 71 percent. In 2008, 100 percent of public schools had one or more instructional computers with internet access, 97 percent of teachers had one or more computers in their classroom, and 93 percent of classroom computers had internet access.[1]

The increase in computer devices and connectivity in schools is the result of several coinciding developments: infrastructure improvements (*e.g.,* broadband connectivity, access to Wi-Fi, and distance learning), lower price points for devices designed for schools, and increased development of digital content. These investments continue, as evidenced by a 2018 announcement by the private sector (especially Verizon and Amazon) planning expenditures in technology, teacher training, and internet connectivity in K–12 schools.[2]

The drive toward expansion and use of technology in education is motivated by a set of broad educational policy goals shared by many education community stakeholders. The belief is that new technologies in online learning will promote student engagement, boost achievement, narrow the equity gap, support effective teaching, and enhance teacher productivity.[3]

As the number of devices has increased and innovations in digital content and learning platforms have evolved, the policy trend at the district level is to provide every student with her or his own laptop or tablet computer in an effort to encourage personalization. The expectation is that a personalized learning environment (facilitated by the 1:1 ratio) will increase student technology use, promote project-based instruction, and result in better relationships between students and teachers.[4] Data on the number of districts that have achieved the 1:1 ratio is not currently available. However, a 2017 *EdTech* article reported that more than 50 percent of teachers now have a 1:1 student to device ratio in their classrooms.[5]

NEA Policy

The NEA Policy Statement on Digital Learning (see below) seeks to strike a balance between the need for technology in the classroom and the importance of teacher and classroom peer interaction in the learning process. The NEA policy supports the use of digital learning, particularly when schools use blended models that combine online learning with purposeful interaction with teachers and classroom peers. However, NEA stands in opposition to approaches that rely exclusively on delivery of online instruction without face-to-face interactions among teachers and peers.

This Research Brief presents an overview of online learning in K–12 public school systems focusing on its impacts on student outcomes and the role of teachers. (The phrases *online learning* and *computer-based learning* appear synonymously in this Research Brief and encompass any digital device through which educational content is transmitted to and received by learners.)

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Online Learning *(Personalized Learning and Blended Learning)*

Teachers have been using computers for instructive and administrative purpose since the advent of personal computers in the 1980s.[6] However, in recent decades innovations in educational technology have transformed online learning. The key features of the recent technology innovations include–

- ✔ Diversity in the types of digital devices (computers, tablets, smartphones) that can be used to access content and to communicate with peers, teachers, and learning communities.
- ✔ Digitized and rich instructional resources, such as interactive electronic books with videos and multimedia features that can be regularly updated.[7]
- ✔ Learning platforms that integrate various types of software applications to accomplish specific instructional (and non-instructional) goals for example, digital content, student data (performance and demographics), and learning management systems.[8]

These innovations in technology have facilitated development of personalized learning and blended learning approaches to instruction. A personalized learning instructional environment enables teachers to tailor instruction to each individual student, thereby focusing on a "student's academic strengths and weaknesses, interests and motivations, learning style, preferences, and optimal pace of learning."[9] Instruction is customized for a single student by loading into the learning platform school-sponsored text, videos, and lessons for students to engage at their own pace, both at school or at home. This allows teachers to "spend more time with each student, because a proportion of students could be occupied at any one time with computer-aided instruction."[10]

Blended learning is presented in the advocacy literature as a way to scale personalized learning. There is no single definition of blended learning, as various stakeholders have advanced their own definitions of the approach. However, the NEA Policy Statement on Digital Learning captures its key elements–

> *"Blended and/or hybrid learning is an integrated instructional approach in which a student learns, at least in part, at a supervised physical location away from home and through online delivery where the student has control over at least some aspects of the time and place of accessing the curriculum."*[11]

Within this overall framework, there are differences in modes of delivery identified by specialists as "blended learning approaches." Teachers are engaged, but there is differentiation in the degree of teacher involvement (online only, face-to-face, part of the time), in scheduling, and in the degree of student control (self-pacing).[12]

Unfortunately, data are not available as to the scale of implementation of individualized and blended learning approaches within the public school sector. Anecdotal evidence, however, suggests high levels of favorability among classroom teachers. While personalized learning is at times presented as different from blended learning, in practice it is often merely one component of a blended learning approach. In an online review of studies focusing on the public sector, there are no instances identified in which students worked in isolation from teachers. Teachers create and expand opportunities for personalized learning by controlling factors such as when instruction is delivered and where and how students complete different components of a learning experience.

State of the Research

Assertions regarding the educational value of technology in general and of blended learning in particular have been examined in a number of studies. Researchers have focused on different aspects of online learning and its effects by focusing on software application, learning conditions (individualized *vs.* blended models), and online courses (credit recovery or competency-based programs). Within each line of inquiry, there are only a limited number of studies to review; fewer, some claim, meet the standards of rigor preferred in the field. Nonetheless, there are published studies, evaluations, and thought pieces that present the results of findings regarding educational technology and student outcomes. Selected findings about outcomes are summarized below, focusing on educational technology generally and personalized learning and blended learning more specifically. (This summary does *not* include studies of online courses, virtual schools, and blended schools, or studies of effects in higher education and outside K–12.)[13]

Personalized Learning. The National Bureau of Economic Research recently published a working paper reviewing the results of experimental studies on the effectiveness of technology-based approaches in education.[14] The Bureau focused both on promising general uses of technology in education and specifically on access to technology, computer-assisted learning (CAL), behavioral interventions, and online courses. Their findings

regarding the effects of access to technology and CAL were the most relevant to this Research Brief. Studies about the impact of access to technology at the K–12 level yielded mixed results, and Bureau researchers concluded that access to a computer *per se* has limited impact on student learning. (Studies of this question had only a small number of schools, all at high school level.)

Studies focusing on CAL examined software programs designed to help students improve or practice particular skills, such as math and reading. (Presumably, teachers were involved in selecting software programs, but studies of this question did not provide information regarding the role of teachers.) The Bureau's review of studies of this question found no effects cited in eight studies and a negative effect cited in one. However, Bureau researchers found positive effects cited in 20 of the 29 studies they reviewed. Fifteen of the 20 studies examined the effects of software programs on improving learning in mathematics. Despite mixed results, Bureau researchers concluded that, taken together, their overall findings show much promise for improving learning outcomes, particularly in mathematics.[15]

Researchers also reviewed impact studies of "personalized learning" that used specific CAL platforms. These programs are described as having an "… ability to harness emerging artificial intelligence and machine learning techniques to model the cognitive processes of students and offer content accordingly." Specific programs included in the review were ASSIST, Cognitive Tutor, and SimCalc. All of these learning platforms/programs focused on mathematics with variation by grade levels, coverage of the curricula, and time spent on the computer (*vs.* class time). Researchers reported strong improvements in math scores for 7th and 8th graders using SimCalc, no effects for Cognitive Tutor in year one and small effects for year two, and improved math scores for those students using ASSIST. Two reading programs were included in the review, FastForWord, which targets students with reading challenges, and a reading comprehension program for middle school students, Intelligent Tutoring for the Structure Strategy (ITSS). Evaluators reported weak and insignificant results for the first program and significant positive results for ITSS.[16]

Rand Corporation also conducted a study of personalized learning as implemented in 62 schools across multiple grades levels and subjects. Although they presented the instructional intervention as personalized learning, it was also an example of blended learning since teachers were involved in the delivery of math and science instruction. Schools used a variety of approaches in implementing personalized learning; specifically, learner profiles, personal learning paths, competency based progression, and flexible learning environments. Rand researchers found that students attending the treatment schools made gains in mathematics and reading over a two-year period relative to comparable schools. However, a review by the National Education Policy Center questioned the relevance to policy and practices for public schools, given that 90 percent of the schools in study were charter schools selected into a competitive funding program.[17]

Given the decision by many school districts to provide 1:1 computing, researchers have looked at the impact of these initiatives and have found mixed results. Studies of 1:1 initiatives in Maine and Texas found no evidence of increase in achievement and satisfaction; researchers concluded that increased use of the device alone did not enhance learning.[18] However, a 2010 study reported positive results when schools implemented 1:1 computing along with more training and immersion; researchers reported that 7th grade students saw significant gains in English language arts on the state assessment compared with schools that had not provided 1:1 computing.[19] Similarly, researchers at North Carolina State's Institute for Educational Innovation found an increase in student motivation and engagement with the use of laptops. They also found positive effects on students' test scores and collaboration skills and in more directed self-learning.[20] Finally, a Michigan State University College of Education researcher found that 1:1 computing had a statistically significant positive impact on student language arts, writing, math, and science achievement scores.[21]

Studies that measured non-cognitive outcomes, such as student engagement, have also reported positive results. In a study of computer-assisted instruction (CAI) in Texas, researchers found no statistically significant increase in math achievement for students using CAI, but they did note that CAI students were significantly more engaged throughout the intervention period than was the comparison group.[22]

Blended Learning. In a study published by the U.S. Department of Education in 2010, researchers noted that between 1994 and 2006 there were no rigorous studies comparing learning effectiveness between online and face-to-face instruction for K–12 students.[23] Since that 2010 study, more studies have been published, but the growing volume of work still remains limited.

The Institute for Education Sciences has produced a report that analyzes 17 studies of online blended learning programs. Thirteen of those studies showed positive results, two showed no effect at all, and one showed a negative effect. Those that reported positive results were mostly mathematics programs (algebra and geometry). The exception was studies that reported results for *Read 180,* a reading comprehension program, and *Time to Know,* a blended learning and elementary reading

program. However, only seven studies used any rigorous analytical system to measure then determine true success. As a result, Institute researchers concluded that, while in general their findings do not support the drawing of conclusions for effectiveness as a whole, the findings specific to programs showing evidence of positively influencing student achievement might inform educators' decision-making about blended learning.[24]

A few of the small case studies have compared the effectiveness of blended learning (also called flipped learning) to traditional instruction. Researchers reported positive impacts of blended learning conditions on student engagement and student-teacher interaction, positive attitudes towards mathematics, and improved classroom discussion. However, they reported mixed or no positive results for student learning outcomes.[25]

To summarize, the overall assessment of the effects of educational technology is that the results are mixed. Positive outcomes are mostly in mathematics, but the improvements have not been at scale, whether via use of personalized platforms or blended leaning approaches. Given the evolving nature of this area, researchers will no doubt revisit this issue as programs are replicated across the country.

Change in Teachers' Role

A central focus of this brief is to unearth information about online programs that use student analytics and other routines that can potentially replace or diminish the role of teachers. An online search of this topic resulted in few empirical studies that examined this question. However, a number of non-academic publications have explored the issue.[26] The range of commentary is diverse and divergent. Some analysts concluded that online programs are not likely to replace the role and function of teachers. The testimonies below represent the essence of their arguments–

> *"Humans are social animals and there is something about the human connection between students and teaches that matters a lot…there are things that computers will never be able to do as good as human teachers."[27] (Research scientist)*

> *"Computers cannot create a culture of excellence and push students to meet high expectations…technology is a tool not a silver bullet."[28] (Reform advocate)*

> *"The teacher's personality and enthusiasm is important. Videos are nice, but it's not the same. I get so much from working with a teacher who really cares about us and the subject they are teaching."[29] (Student)*

Nonetheless, districts *have* attempted to gain cost savings by replacing teachers with online programs. For example, a school district in Colorado replaced three foreign language teachers with online instruction. Other examples include a high school in Maine purchasing the software program Rosetta Stone to serve as foreign language teacher and a school district in Georgia hiring 10 virtual teachers to fill vacant positions.[30] Despite these reports, there is insufficient information about the extent to which districts are substituting technology for labor. There are isolated examples of such actions, but no evidence of large-scale efforts to replace teachers. Moreover, for the decision maker, it may not prove the most desirable option. One district administrator who decided to use these programs noted that, "computers couldn't compare to having a living breathing teacher in the classroom with the student."[31]

Other observers have pointed to a possible "replacement" of teachers by technology in specific areas such as scoring of student assessments. This is not a new development in the field of assessment. High-speed scanners can score responses to multiple choice and short essay questions, but trained personnel, many of whom are teachers, continue to score extended response items.[32]

Adaptive personalized learning software is presented as likely to accelerate the trend towards the teaching of certain skills by computer-based programs. Analysts contend that the new online learning platforms are capable of "teaching" certain parts of the curriculum, such as basic skills or tasks that can be reduced to routine. In this context, the online learning software delivers the basic skills component of the curricula, which would allow a shift in the role of teachers to "enablers," "facilitators," and motivators of learners. This is probable, as computers already perform these functions. However, this is an augmented role rather than a shift, as noted by one teacher–

> *"Technology is not as good at giving robust feedback on a project where you're moving to much higher levels of Bloom's taxonomy. …it's not that great leading a Socratic discussion among students to reach higher levels of understanding. It's not as good as a teacher being able to understand the emotion of a student and try a different approach in the moment to reach that student in a deep, one to one way."[33]*

Finally, another possible scenario depicts a shift to functions that computers cannot execute, such as: expert thinking, complex communications, and solutions to new problems. An example of this is the "expert teacher in technology" function in which

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teachers in special assignments curate open-source educational resources for other teachers to use. One teacher noted that she sees her role shifting from a communicator of knowledge to a designer of engaging, high quality learning experiences for her students. However, it appears that few if any districts have moved in this direction.[34]

The work and ideas cited here are mostly conjecture and predictive in nature and need further exploration. Attempts have been made in districts to replace teachers with online learning programs, but instances of this are uncommon. None of the "replacements" has occurred at scale. Creative thinkers have put forth a vision of how technology might change the role and function of teachers; however, no definitive conclusion can be drawn because there is insufficient empirical work on which to substantiate assertions about the effects of online leaning on teachers' employment status. Moreover, even in the case of online programs that use student analytics, it is unclear that in all instances teachers are absent from planning or delivery of instruction. On the contrary, teachers use the information to plan instruction, provide feedback, and create additional tasks for their students. Thus, near term, the issue is not teacher replacement but a modification of current roles to accommodate the opportunities that new technology offers.

Summary

There has been a significant increase in the availability of digital tools (mainly laptops) in public school systems in the country. Federal level support, increased investments from private industry, and reduced technology price points for the education sector have all contributed to increases in availability. At the same time, however, innovations in educational technology promise to change how teachers deliver instruction and give students greater control over their learning.

The new technologies also raise concerns about a change in the role of teachers and potential replacement of teachers. While technology can be programmed to perform repetitive routines used to deliver basic skills training, this does not diminish the role of teachers. Machines cannot perform higher order functions, nor can they replace the personal interaction that is so crucial to the teaching and learning process. Certain low-level tasks currently performed by teachers might possibly be assumed by new technologies, but, overall, technology does not at this point pose a serious threat to the teaching profession.

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All links are current as of June 20, 2018.

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8. Some characteristics of learning platforms include:

   - ✔ They support multiple customers, databases, and web services.
   - ✔ They are designed for the learner so that they are central actors in the system design.
   - ✔ They support connections between learners and customization of content based learner needs.
   - ✔ They have built in analytics based on amalgamation of learner data across courses, across institutions.
   - ✔ They allow for discovery of instructional content, user-generated content, and of other learners.

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24014|6.2018|ck

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