Understanding the Role of Technology Interventions in the Classroom
Review Essay from MCCPTA Safe Technology Subcommittee
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For more information and queries, contact:
Lisa Cline, lisajeane@aol.com, Co-Chair MCCPTA Safe Technology Subcommittee
Dr. Assya Pascalev, apascal2003@gmail.com, Co-Chair MCCPTA Safe Technology Subcommittee
Dr. Sunil Dasgupta, sunildasgupta@hotmail.com, Chair, MCCPTA Health and Safety Committee

For nearly three decades, public educators, technology entrepreneurs, and corporate philanthropists in the United States have sought education reform through technology interventions and standardized testing.[1] Based on our survey of the research, we see a persistent disconnect between deductive expectations of technology interventions and self-reporting survey results, on the one hand, and available empirical evidence of actual student performance, on the other. Large public school systems such as MCPS face the enormous challenge of finding the right balance between continued optimism about the role of technology and the reality of the learning process. To do this right, we must explore the relative merits of digital and non-digital learning. We propose three steps toward this end.

First, determine age, subject-matter, and student appropriateness of digital content and technology interventions in the classroom. Some material is better delivered online while others using books—right now we do not know which materials are in fact better delivered digital and which are better delivered non-digitally. We also do not know how the digital-non-digital balance ought to shift with age. It is also the case that some students with IEPs need greater access to technology, which should be accommodated. Second, make a distinction between access to materials and learning. While making content available online for teachers, students, and parents is valuable, especially when the curriculum is continually updated, actually learning on screens is problematic as the literature review below shows. Third, develop mechanisms for regularly monitoring digital and screen-use by MCPS students, teachers, and parents so that the digital-non-digital balance may be adjusted over time.

The Johns Hopkins Report
In 2017, Montgomery County Public Schools (MCPS) commissioned The Johns Hopkins Institute of Education Policy (Johns Hopkins) to conduct a review of its Curriculum 2.0. John Hopkins reported its findings in March 2018. The central recommendation was that MCPS adopt *an externally-developed curriculum including software platforms* for the delivery of English Language Arts and Math content.[2] In April, MCPS opened a Request for Proposal (RFP) to solicit a new curriculum and this process is expected to be completed by December 2018.

The Johns Hopkins Report is a much-awaited investigation of the MCPS elementary and middle school curriculum in language arts and math. While the report addressed wide-ranging issues of alignment and appropriateness of materials and curriculum, based on the publicly-released Executive Summary, it did not address the relative differences in learning outcomes of digital/software platforms and non-digital tools such as books, which it has nevertheless recommended to MCPS.

Through the summer of 2018, MCPS curriculum review team members have made presentations to MCCPTA area meetings on the Johns Hopkins Report and the RFP process.

These presentations confirmed that neither the Johns Hopkins Study Report nor MCPS itself has systematically considered the relative merits of digital and non-digital learning. MCPS officials have emphasized the RFP required the new curriculum to use both digital and non-digital delivery; a purely digital or a purely non-digital curriculum would be rejected. This requirement means that curriculum with a 90-10 digital-non-digital balance would qualify for the RFP as would a curriculum that was 30-70 digital-non-digital. However, without systematic study of the relative merits of digital and non-digital curriculum, including age and subject-matter appropriateness, we do not know how to evaluate the different content mixes that will be offered by different vendors.

While MCPS officials said they would look into this issue now, it is important to develop a transparent and inclusive mechanism of assessment. The Executive Summary of the Johns Hopkins report describes the community input received by the study group as "survey data of the views of stakeholders." The nature and details of what information this survey data included is not shared. In contrast, the report notes that, "the research team conducted 52 focus groups and interviews at 20 MCPS elementary and middle schools with 324 educators – including both teachers and central staff – collecting 2,441 comments." The seeming exclusion of systematic community input from parents and, notably, teachers in a setting outside the school where they may be able to respond more freely exposes the study to deficiences stemming from inadequate stakeholder voices.

State law is pushing in the direction of more discovery on this issue as well. In 2018, the Maryland General Assembly passed HB1110 in, a bill which asks the Maryland State Department of Education (MSDE) to investigate the effectiveness and safety of technology interventions in classrooms across the state. HB1110 became law in April 2018.[3]

Does Technology Improve Learning Outcomes?

The central question here is how technology interventions improve learning outcomes. The promise of technology is widely held. As Thomas Friedman famously argued more than a decade ago, access to technology was making the World Flat, which implied that technology removed social and economic barriers to economic and social mobility. Teachers, schools, and society in general have largely accepted this promise. Legislators in California and Florida, two of the largest states in the U.S., have passed laws requiring digital textbooks.[4] Technology access has been pushed as an instrument of education equity.[5]

In the face of this technological optimism, actual empirical research on the impact of technology on learning in the classroom is actually sparse and sobering. Part of the problem appears to be the multicausal nature of the learning process, which makes it hard to disentangle the impact of technology from the quality of the curriculum and teachers, and the effects of a difficult home environment. The largest study to look at the problem is a multinational OECD (Organisation for Economic Cooperation and Development) report published in 2015. The OECD report correlates computer availability and use in classrooms a number of countries with performance on standardized testing to arrive at this stark observation:

> "In 2012, 96% of 15-year-old students in OECD countries reported that they have a computer at home, but only 72% reported that they use a desktop, laptop or tablet computer at school. Only 42% of students in Korea and 38% of students in Shanghai-China reported that they use computers at school – and Korea and Shanghai-China were among the top performers in the digital reading and computer-based mathematics tests in the OECD Programme for International Student Assessment (PISA) in 2012. By contrast, in countries

> where it is more common for students to use the Internet at school for schoolwork, students' performance in reading declined between 2000 and 2012, on average."[6]

In a 2017 review essay, University of Maryland researchers Patricia A. Alexander and Lauren M. Singer examine exisiting research since 1992 on the narrower question of reading comprehension differences between print and digital texts. They found that when reading texts longer than one page, the research showed better comprehension outcomes with print rather than with digital texts.[7] The research atrributes this to the disruptive effect of scrolling on screens. Their own research shows a paradox in the students self-reporting better comprehension with and clear preference for digital texts but performed better in actual tests of comprehension when using printed matter.[8]

The paradox between the technological optimism of advocates and the reality of contradictory and undiscernible results provided by empirical studies of technological interventions in education goes beyond students alone. A 2014 survey of 400 educators and administrators and 1,000 middle and high-school students sponsored by CompTIA, an IT trade association, found "75 percent of educators think that technology has a positive impact in the education process."[9] This finding stands in contrast to the studies such as the 2015 OECD report that do not support a positive correlation between technological intervention and learning outcomes. It is worth noting that 2015 OECD report, showed modest gains from technology interventions in some classrooms (with low to moderate use).

The prevalence and persistence of this paradox is puzzling. Potentially, two factors are at play in the MCPS deliberations over choosing its new curriculum. First, we believe there is significant industry pressure on the purchase and possibly continued maintenance of the curriculum contract. In this context, it is worth noting that Discovery Education, which has been at the center of the conflict of interest concerns, offers almost all-screen-based curriculum. Second, years of professional development extolling the importance of "innovation" in learning has predisposed teachers to viewing input as output, access as equity, and many teachers appear to be in a race to be cutting edge, often ignoring MCPS Technology Office's prohibitions on certain apps and programs.

While California and Florida are pressing forth on digital learning, the State of Maine, the first state to adopt a one-to-one laptop program, has discontinued the program after a decade of data showing no impact on learning outcomes.[10] Recent newspaper articles report that early leaders in the technology industry now insist on a no- or low-tech learning environment for their own children.[11] In higher education, professors are increasingly banning laptops from the classroom.[12]

Does Technology Reduce the Achievement Gap?

On equity, school-based technology was one hope for leveling the playing field for minorities and poor families. The actions of the California and Florida state legislatures reflect in part an intent to bring down the cost and improve access to curriculum. Technology firms have backed initiatives like the Khan Academy to deliver material where teachers are either unavailable or unable. In developing countries, access to education through handheld devices is believed to enable leapfrogging over absent infrastructure such as school buildings.

However, empirical evidence of success is hard to find. Arguments in favor of increased technology interventions for equity reasons, typically, mistake input for outcome or add variables so that the impact of technology becomes impossible to discern. Moreover, as the paradox of

expectations of learning among students and teachers show, there can be significant differences between self-reported survey results and actual performance.

A widely-cited 2014 Stanford study, for example, identified relatively lesser access to computers among poorer and minority students as the crux of the learning problem, thereby making access to computers the preferred solution.[13] One of the few empirical examples of success in the study comes from Talladega County, Alabama, which is described as "a district where 73 percent of students qualify for free or reduced-price lunch, dropout rates were high, and college-going was low" which, "over the course of just two years…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."[14]

On closer examination, rather than evaluating the impact of technology on learning, the report finds that increased teacher interaction is necessary to make technology interventions work. This raises the obvious question whether increased teacher interaction *without* the technology intervention might have had similar results. The study speaks to technology interventions without changes in teacher engagement here:

> "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. 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. 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."[15]

If anything, the conclusions suggest that technology without adequate one-on-one teaching can be counterproductive. The OECD's director of the Office of Education Research, Andreas Schleicher, stated that, "One of the most disappointing findings of the [2015] report is that the socioeconomic divide between students is not narrowed by technology, perhaps even amplified."[16]

What are the Dangers of Increased Screen and Computer Time?

There is little doubt that the introduction of smartboards and Google Chromebooks in school have marked a dramatic shift in content delivery in classrooms. In 2012, Florida state legislature reflected this shift when it passed a law requiring 50 percent of all classroom instruction to be digital by 2015.[17] A 2016 Children and Screen Time advisory report from the Office of Education for Santa Clara County, CA, similarly highlights the importance of technology in enhancing learning opportunities.[18]

Neither Florida nor Santa Clara County are known to have conducted audits of their claims about the impact of technology, but a 2016 study reported in the *Journal of Pediatric Health* reported strong correlation between screen time and sleep health.[19] Research on screen time is problematic because the making of control and experimental groups of human child subjects would violate most research board reviews.[20] Still, the medical research community has decided that there is sufficient cause to take notice.

The American Academy of Pediatrics recommends that “parents and caregivers develop a family media plan that takes into account the health, education and entertainment needs of each child as well as the whole family…proactively think about their children’s media use and talk with children about it, because too much media use can mean that children don’t have enough time during the day to play, study, talk, or sleep.”[21] Furthermore, Common Sense Media, an organization devoted to balance in screen time, reports that 59 percent of parents say their kids are “addicted” to their screens, while 66 percent say their kids spend too much time on screens.[22]

The use of medical authority in this debate presents contradictions. The Santa Clara screen time advisory references an American Academy of Ophthalmology report stating, "there is no convincing scientific evidence that computer video display terminals (VDTs) are harmful to the eyes," but the reference to the assertion links to the Health Physics Society Journal, which thereafter does not identify a source from the American Academy of Ophthalmology. Meanwhile, the American Academy of Ophthalmology website displays the organization’s recommendation to limit screen time to prevent eye strain and damage. In short, the Santa Clara advisory from 2016 does not factor in the American Academy of Opthalmology’s warnings, but the organization is cited as a source.

Finally, student screen and internet usage has raised questions about privacy. A number of states and school districts are cracking down on child privacy laws. Baltimore County Public Schools has taken extra steps to ensure privacy of student data[23] and the state of Texas is considered a pioneer of child privacy laws and efforts with the passage of HB2087, which provides strong privacy protections for student data within Texas public schools.[24] MCPS itself has been trying to lock-down servers and examine its custodial responsibilities with respect to student data, but this remains an early work in progress. Anecdotally, parent reports to the MCCPTA Safe Technology Subcommittee suggest a race among teachers to introduce more technology, some of which may violate the Children’s Online Privacy and Protection Act (COPPA) and are not vetted by the MCPS Technology Office. This leaves the MCPS CTO and team to play catch-up with actual practice inside schools.

Finding the Balance

HB-1110 instructed the Maryland State Department of Education to evaluate the effectiveness and safety of technology interventions in classrooms across the state. The Johns Hopkins study did not anticipate this coming state requirement and seemingly did not address the issue of digital learning effectiveness.

Based on the study and other official MCPS reporting of the study, we do not know how much time Montgomery County school students spend on the computer at school or at home. Further, we do not understand what the impact of technology interventions has been on learning outcomes in MCPS classrooms. Specifically, what ages or what subject matter benefit most from screen-based learning and where screens can be detrimental. The study does not provide evidence of learning measures to determine where we stand on these questions. Nevertheless, it recommends externally-developed digital platforms for delivery of the new curriculum despite current research calling into question the effectiveness of curriculum significantly delivered via screens.

It would be worthwhile to draw a distinction between how MCPS (and other adults, including parents) access the new curriculum and how students access and learn the material. Online access can be a big convenience, especially when the curriculum needs to be continually updated and more resources are added and printed text books are expensive and many are

outdated before they make it to the shelf. However, actual on-screen learning outcomes or how screens might distract students is a different analytical problem as the literature review above demonstrates. Separating access and learning challenges would help us develop and adjust the right balance between digital and non-digital content.

Finally, there is a strong argument to be made for regular monitoring of digital use within MCPS by teachers, students, and parents. We do not even know how much time students of various ages spend on screens. Anecdotally that teachers in middle and high schools direct students to use apps that are not approved by MCPS Central Technology Office. Equally, we know that even elementary school children are sometimes able to access inappropriate content when they use their own devices on school property, including the school bus. A straightforward correlational analysis of student login duration (probably available within MCPS) and test scores, for example, can be a starting point. Over time, the analysis should reveal how we should adjust the digital-non-digital balance. We can further improve our understanding of challenges with periodic survey of teachers, students, and parents.

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