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Digital Equity in the Time of COVID: Student Use of Technology for Equitable Outcomes

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DIGITAL EQUITY IN THE TIME OF COVID: STUDENT USE OF TECHNOLOGY FOR EQUITABLE OUTCOMES

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A report by the Metropolitan Educational Research Consortium (MERC)
Virginia Commonwealth University School of Education

ABOUT THIS REPORT

This issue brief is the third and final in a series published by the Metropolitan Educational Research Consortium (MERC) addressing digital equity in K-12 schools. It examines research regarding students' use of and outcomes related to technology. Research finds that inequities exist in use and outcomes for students based on gender, language, ability, race, SES and other sociocultural factors. Based on these inequities, theoretical and practical recommendations are discussed.

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A report by the Metropolitan Educational Research Consortium

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STUDENT USE OF TECHNOLOGY FOR EQUITABLE OUTCOMES

This is the third in a series of reports about digital equity in education. The initial report laid out a comprehensive framework for understanding and thinking through issues of digital equity in education that has utility for policymakers and researchers who are thinking about how to address these important issues in the long term, particularly post-pandemic. The framework focuses on what are often described as the three levels of the digital divide in education: access, use and outcomes. The second report focused on the issue of access, specifically to reliable high-speed internet and computing devices. In this report, we focus on equity issues around the use of technology and the outcomes associated with that use.

Introduction

In its 2017 National Educational Technology Plan update, the United States Department of Education observed that

> *A digital use divide continues to exist between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption.*[1]

Whereas the original digital divide was understood in terms of access and described in a binary system of what Selwyn (2004) called the "haves" and "have-nots," the second level divide focuses on how users make use of information and communication technology (ICT).[2] The framework for our reporting, as depicted in Figure 1, posits that a focus on digital equity in education causes us to think about the quantity and quality of uses of technology in the home, schools, and communities. Furthermore, we need to consider both academic and employment outcomes related to technology use. Cutting across both use and outcome concerns are demographic categories such as race, geography, sex, disability, and socioeconomic status (SES).

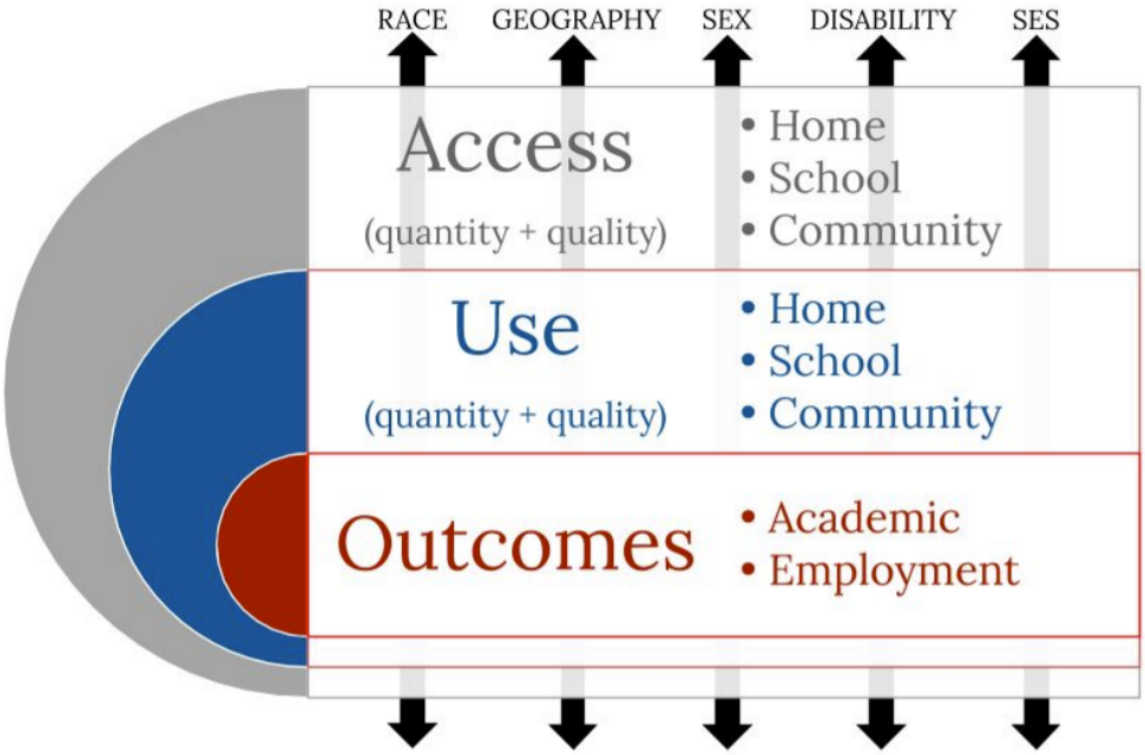
More generally, then, when looking at students' use of technology through an equity lens it is important to focus on ensuring that innovative technologies are being used with all students. Even in cases where students have access to the same technologies, instructors

[1] USDOE (2017, p. 7)
[2] Tichavakunda et al. (2018, p. 111)

may differentiate their use and approaches, sometimes in discriminatory ways. This can impact students' meaningful engagement with digital tools. The following questions guided this literature brief:

- How are factors of race, SES, primary language, ability, gender and culture related to digital inequities in technology use?
- What technology outcomes should we envision for our students?

Figure 1. Digital Equity Model



Factors Related to Inequities in Technology Use and Outcomes

Research consistently shows that teachers sometimes view students' use of technology differently based on race, SES and other factors. For example, Rafalow (2018) found that

At a school with mostly wealthy and white youth, teachers communicate to children that skills from digital play represent valued capital for learning, whereas at schools with mostly minority and poor children, students learn that their digital skills are threatening or irrelevant to their education.[3]

In this section, we run the arrows in the framework through the issues of technology use and outcomes. In other words, we look at differences in technology use and outcomes by race, SES, sex, disability and other factors. Whereas the first report looked at access alone, in this report we examine use and outcomes together as they are hard to disentangle. That is, outcomes flow necessarily from use. For example, outcomes such as technology attitudes, technology course taking, technology career pursuits, etc. all logically follow from the ways that people engage with technology.

Race and SES

Studies focusing specifically on minority youth and ICT use indicate that racial and ethnic identities can have a profound influence on the ways students use ICT. A foundational study by Ito (2010) on students' use of technology outside of school demonstrated that a distinct youth culture influenced how teenagers used ICT. Tichavakunda and Tierney (2018) conducted a review of literature surrounding Black students' ICT use. The authors concluded that viewing Black students' activities through the lens of capital-enhancing and non-capital enhancing activities, as has often been done, tends to discount the online activities of Black youth. Instead, they recommended that applying a lens of cultural integrity[4] to Black students' digital endeavors would be helpful. Ahn (2011) suggested that educators and researchers should investigate youth participation in digital spaces, such as social media, in order to learn how cultural and social factors influence digital media participation. In a moment where virtual instruction is a growing reality due to the COVID-19 pandemic, social media platforms could be utilized to engage students in a meaningful way and reshape their relationship to technology in the classroom.

The non-profit organization Project Tomorrow has been conducting research on technology use in schools with parents, students and educators for over a decade. They reported that teachers in schools with high minority populations were 27% less likely to

[3] p. 1417
[4] Tierney (1999)

have students use “media creation tools” to demonstrate their learning compared to students in majority white schools.[5] Hohlfeld and colleagues (2017) reiterated the findings of earlier studies which found that teachers in low-SES schools were more likely to have students use technology to practice and reinforce skills, while students at high-SES schools were given more opportunities to use technology in ways which promote engagement and 21st century skills such as creating and conducting research. In a study by Warschauer and colleagues (2014), classroom observations showed that some teachers utilized laptops to engage students in a variety of writing activities. Based on students’ positive blog posts, interactive writing tasks such as blogging provided students a wider audience with which to communicate and boosted students’ enthusiasm for writing. However, teachers in lower-SES schools reported that it was difficult for students to benefit from school-provided laptops due to their lack of typing and literacy skills. Whether the lack of technology skills was actual or perceived, the result was that students in the low-SES schools did not have the same opportunities to engage with technology.

Inequities can also persist because, often, the most technology-rich environments are found in “advanced” or “gifted" classes such as advanced science, math or other STEM classes which tend to include fewer female students and students of color.[6] Reich (2019) put this rather succinctly, based on surveys and observations in classrooms across the country conducted during his doctoral research:

I routinely heard teachers say that when they designed new units that emphasized digital learning, they deployed them more commonly in their advanced track classes, where classroom management and content pacing were less daunting challenges. Since tracking closely correlates with race and income[7], this suggested that in practice, teachers devoted their ed-tech planning energy toward their already (comparably) affluent and advantaged students.[8]

However, these discrepancies are not inevitable. Darling-Hammond and colleagues (2014) detail several examples which show that when at-risk students are encouraged and allowed to engage meaningfully with technology they exhibit increased motivation and academic achievement. Similarly, Shapley and colleagues (2009) found that when compared to their control group peers, students from both economically advantaged and disadvantaged

[5] Project Tomorrow (2020, p. 5)
[6] Naff et al., (2020)
[7] Naff et al. (2021)
[8] Reich (2019, p. 32)

backgrounds who were enrolled in Technology Immersion[9] schools outperformed their peers on technology assessments. These same students also reported having more opportunities to work collaboratively in small groups with peers than students in the control group.

Enrollment in computer science (CS) courses is one indicator at the intersection of use and outcomes. At the elementary level, computer science coursework can generate interest and propel students into advanced CS coursework and even CS careers. The same can be said for CS coursework at the secondary level. Wang and Moghadam (2017) found that Black and Latinx high schoolers are underrepresented in CS from high school to career. In 2015, of the AP Computer Science A test-takers, 3.9% were Black, and 9.2% were Hispanic. Nine of the 49 states with at least one student who took the AP Computer Science A exam that year had no Black students participating. At the post-secondary level, only 11.4% of CS degrees were awarded to Black students and 8.5% awarded to Latinx students in 2012.[10]

Gender

The research on differences in usage based on gender is somewhat mixed. One study in 2010 involving nearly 5,000 Turkish students found no statistically significant differences in the amount of time girls spent on computers versus boys.[11] In contrast, another study, this one in 2014, regarding ICT use from 39 countries and gender, found that for almost all countries (35/39), girls' time using computers at home was statistically significantly less than boys' use.[12] In other places such as homes of friends and family and internet cafes, differences were statistically significant for 36 out of 39 countries.[13] There have been many studies regarding gender and usage and almost all have found differences between the ways in which girls and boys make use of technology. However, the existence of differences in itself does not necessarily point to inequities, as long as the promotion of technology and opportunities for use thereof is not biased toward boys and science as technology has historically been. It is important that schools continue to not only offer, but encourage and advocate for girls to make use of technology in emancipating ways.

Like enrollment in CS courses, technology attitudes are an important outcome to consider. For years, the prevailing view has been that girls and women hold more negative attitudes

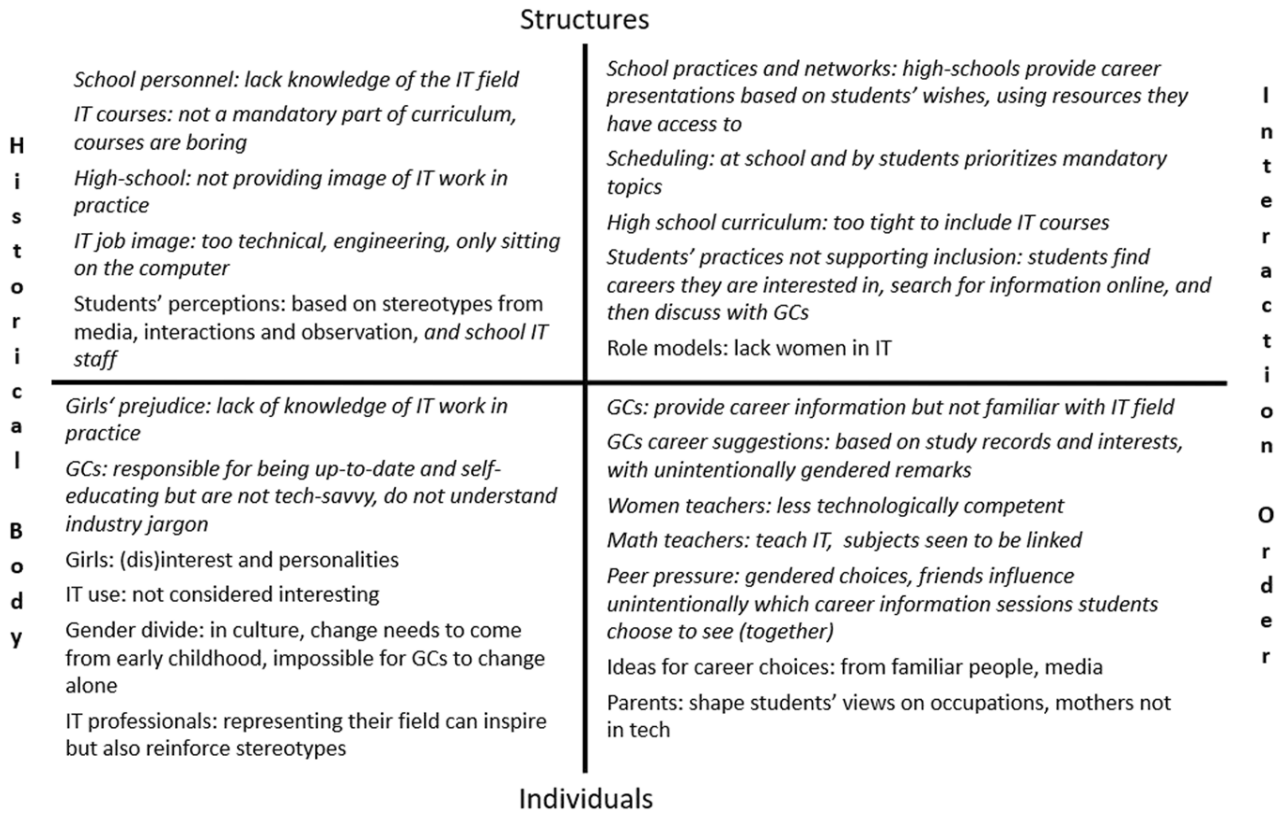
[9] The "technology immersion" schools in this study were part of The Technology Immersion Pilot (TIP), created by the Texas Legislature in 2003. An evaluation of the project was conducted by Shapley et al. (2009).
[10] Ericson et al. (2016); Wang and Moghadam (2017)
[11] Aypay (2010)
[12] Drabowicz (2014)
[13] Ibid.

toward technology than boys and men. That view, though, is not well supported by the research. In an effort to get a bit more clarity on technology attitudes by gender, Cai and colleagues (2017) conducted a meta-analysis of studies on technology attitudes and gender. The analysis included 50 studies and the authors concluded that "...in general, males showed more favorable attitude [sic] toward technology use than females, especially on the dimensions of belief (e.g., believing in the societal usefulness of technology) and self-efficacy (e.g., self-confidence in one's ability to learn and use technology effectively)."[14] These findings come with a couple of caveats, though. First, despite the differences by gender, women's attitudes toward technology were still positive overall. Second, compared to previous meta-analyses of technology attitudes, the attitudinal gap was smaller in this study. Also, "...there was a noticeable reduction in gender gap with regard to self-efficacy, which is regarded as an important attitudinal dimension with implications for a person's choice, effort, and persistence."[15]

Perhaps as a result of the gender attitude gap, much like with students of color, there are significant gender gaps in enrollments in computer science classes, starting as early as elementary school. Wang & Moghadam (2017) report that only 21.9% of the AP Computer Science A test takers in 2015 were girls. Furthermore, in higher education, "...women comprise roughly 18% of CS degree earners, down from a peak of 37% in 1984."[16] Low participation in CS coursework in secondary and post-secondary schools yields low numbers of women in CS-related jobs in the workforce. Noting the low number of women in computing professions, Vainionpää et al. (2020) conducted a study to try to understand what causes inclusion/exclusion in this field. Through a literature review and interviews with high school students, they "...identified actors, societal and cultural factors – gendered environments, stereotypes and gender roles – and the contributions of lack of self-efficacy, experience, knowledge, interest and education."[17] This complex set of factors is depicted in the image below.[18]

[14] p. 9
[15] p. 9
[16] p. 615
[17] p. 859
[18] Girls in IT (emerald.com)

Figure 2. Factors Contributing to Gender Differences in Technology Use



English Language learners

English learners are one sub-group that also needs careful consideration in order to ensure equity.

> *...ELs also face a "second-level digital divide" (Hargittai, 2002), sometimes called a "digital use divide" (Warschauer, 2012), that is often invisible to teachers... While some students may be encouraged to use computers to execute complex intellectual tasks (e.g., participating in historical simulations or working on collaborative writing projects), ELs are often assigned to use computers for vocabulary drills, phonics practice, and other rote lessons (Valadéz & Durán, 2007; Warschauer, 2012). That is, while they may spend a lot of time working at the computer, they are nonetheless stuck on the wrong side of a digital divide, cut off from rich technology-based experiences.*[19]

[19] Altavilla (2020, p. 19)

Consequently, ELs should have opportunities not only to complete tasks in digital environments, but also to develop meaningful skills using digital tools. Likewise, teachers should evaluate whether a digital task could be better completed off-screen.

The virtual learning situation caused by the Covid-19 pandemic has offered some valuable lessons on students' learning with ICT that can inform our practice moving forward. For example, some teachers report observing that multilingual students have been, in fact, more willing to engage in text chat of virtual classrooms when compared to their oral participation during in-person instruction. When using digital communication and collaboration tools, teachers should consider facilitating small groups of three to five students of mixed English language proficiency, which are shown to lower anxiety and increase engagement among ELs when compared to situations where students work in pairs.[20] Although virtual learning environments can present challenges for all involved, they also provide additional tools that can enhance the instructional relationship between teachers and students. Another digital learning strategy which has been observed to work well with EL students is use of video. In the online learning environment many teachers have become more adept at making videos. Moving forward, teachers can make recordings of classes and concepts, and make those recordings available for students to review at their own pace. If videos are made available on YouTube, captions can be included or auto-generated, then viewers can choose to auto-translate the captions into a number of languages.[21]

Students with disabilities

Digital environments can be just as inaccessible to students with disabilities as physical spaces. The Individuals with Disabilities Education Act (IDEA) requires local and state educational agencies to provide instructional materials including those in digital formats for students with special needs. The use of these materials can create unintended barriers to participation and educational achievement when developers do not consider overall usability of electronic learning tools nor account for the assistive devices, hardware and software students may need to access digital content.[22]

Inaccessible technology which impedes learning is not just a problem in the US. Hersh & Mouroutsou (2019) found that this is a common problem in all 15 of the countries they studied:

[20] Satar & Özdener (2008)
[21] Wiltz (2019)
[22] Bowser & Zabala (2012)

> *...despite some progress in the use of ICT learning technologies to support the educational inclusion of disabled people, there is still a significant digital divide which affects their participation in education and restricts their future opportunities.*[23]

In recent years, thousands of letters have been sent to schools from the Office of Civil Rights of the USDOE and several lawsuits have been filed over inaccessible websites, which has brought greater attention to accessibility of digital spaces for people with disabilities.[24] While not a new issue, the current state of remote learning due to the pandemic may have brought renewed visibility to the barriers faced by students with disabilities who are trying to learn from home. Some of the confusion may come from a misunderstanding of the difference between assistive or adaptive technology and technology accessibility.[25] Shaheen and Lohnes Watulak (2019) suggest that combining the ideas of Universal Design for Learning (UDL) and accessible technology could offer some promise to bridge the gap, as UDL and accessible technology both focus on making technology more accessible for all students. In a topical issue brief addressing teaching SWD during remote learning, the US DOE, Office of Special Education Programs advises that educators "should consider accessibility across two domains when planning and delivering virtual instruction for SWD: infrastructure-level access and student-level access."[26] The report also suggests using both synchronous and asynchronous methods, as well as "specific practices for specially designing instruction (SDI), universal design for learning (UDL), positive behavioral interventions and supports (PBIS), virtual explicit instruction, and self- regulation."[27] This recommendation seems similar to that of Shaheen and Lohnes Watulak mentioned above, as these methods are each applicable to all students. Therefore, it may be the case that digital equity regarding how students make use of technology for learning can be achieved in much the same way that instructional equity can be achieved and that educators and policymakers may need to recognize and work toward this goal.

Fortunately, there are supports for parents and teachers using digital content to instruct students with special needs. The National Center on Accessible Instructional Materials (NCAIM) offers technical assistance and interactive tools and The National Instructional Materials Access Center (NIMAC) offers a library of electronic source files that meet national accessibility standards for families, educators and publishers.

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[23] p. 3341
[24] Shaheen & Lohnes Watulak (2019)
[25] For more information on assistive technology versus accessible technology see Shaheen & Lohnes Watulak (2019, p. 189)
[26] US DOE (2020, p. 2)
[27] US DOE (2020, p. 2)

Family and cultural factors

Through work in digital environments, students enhance their capital by participating in behaviors that help them gain skills that benefit their education and employment options. Unfortunately, these same digital media activities may buttress existing inequalities and allow elite youth to maintain their privileged cultural, social and financial positions.[28] Bourdieu's (1986) theory of reproduction and cultural capital purports that cultural knowledge and skills are passed down through social class, learned implicitly and are inherited by students "because of their class, racial, and gender identities."[29] Therefore, children from affluent families may learn different manners and skills than working-class children and benefit from capital-enhancing digital practices that allow them to stay in power and obtain material benefits.[30]

Parent guidance of their children's ICT use is an essential aspect of modern parenting practices. Parents tap their knowledge of ICT to mediate children's use and demonstrate their digital cultural capital as they assist their children in meeting school and social expectations. Yuen and colleagues (2018) suggest that strategically deploying digital skills to help their children meet society's standards for evaluation can be conceptualized as parental ICT competence.[31]

Parents' educational/SES background and parental ICT competence are indicators of cultural capital and linked to ICT-related child-rearing practices. These factors are significant for student development and can impact digital (in)equity among students. Yuen and colleagues found that the cultural capital pertinent to education is complex and involves ICT experiences children encounter in both home and school environments. In their study of students from Hong Kong, the researchers found almost no differences in participants' basic ICT skills (e.g. playing games, watching videos, socializing online, etc.) but did note that students "did not capitalize equally on these skills to enhance their development."[32] Parents from lower social classes did not have the cultural capital to regulate and guide their children's use of ICT. They also could not effectively meet teachers' requests for participation, thus reproducing digital inequity in the younger generation. The rapidly changing technological trends also present a challenge for researchers studying the use of specific ICT and their impact on social, cultural and financial capital.[33]

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[28] DiMaggio & Hargittai (2001); Hargittai & Hinnant (2008)
[29] Tierney & Jun (2001) p. 210
[30] Tichavakunda, et al. (2018)
[31] Yuen et al. (2018)
[32] Yuen et al. (2018, p. 612)
[33] Tichavakunda, et al. (2018)

Family factors pose a complex problem for addressing issues within the second digital divide. They can both exacerbate the gap by providing additional resources to students who are already performing at high levels with ICT, as well as create additional barriers to students who might otherwise be excelling with in-class ICT instruction but do not have a supportive environment for technology use at home. In our growing technological world, having the tools and resources, as well as the knowledge to employ technology for themselves and with their children is increasingly seen as a dominant form of capital. Parents who don't engage in the many aspects of technology or adopt technology for themselves are often perceived as lacking and unable to fully participate in their child's education.[34] In addition, Warschauer et al. (2010) shared that

> *Many low-income or immigrant youth will have few friends or relatives who are sophisticated users of digital media. Conditions in the household (and neighborhood) such as relatively few computers, lesser degrees of broadband Internet access, fewer people with a college education, and fewer English speakers are likely to shape the kinds of experience youth have with digital media.*[35]

While parents generally recgonize the importance of computer use for educational purposes, they also often worry about children spending too much time in front of computers. For example, Lei and Zhao (2008) found that while over 70% of parents thought that laptops for education were important, 38.7% of parents also felt that "their children spent too much time on the laptops."[36] In a similar study by Keane and Keane (2018) parents overwhelmingly viewed computers as an important learning tool (92%), but only 64% reported feeling that technology would result in better academic outcomes.

Additionally, class, cultural and ethnic factors can also affect parent perceptions about a child's use of technology. Studies focusing on the perspectives of Latinx immigrant parents regarding their children's use of technology revealed some common worries, including safety concerns about children having access to the internet, concern over being held responsible for devices which were broken or stolen and even worries that the devices would be used to identify and target undocumented family members.[37] These parent perceptions need to be taken into account and addressed by schools and policymakers if equity is to be ensured for all students expected to use devices for learning at home. Providing families with information about how to monitor students' computer use, setting time limits for screen time, making parents aware of filters and protective measures installed on devices and even offering informational sessions regarding expectations for

[34] Hollingworth, et al. (2011)
[35] p. 188
[36] p. 116
[37] Katz & Gonzalez (2016); Nogueron-Liu, (2017); Tripp (2011)

students' use of technology for academic purposes may help alleviate parent concerns and lead to more effective practices at home.

In addition to having concerns, parents often report that while they have the technological hardware necessary for ICT use in the home, they do not have the skills or background necessary to supervise their own children in learning with technology. This may be especially true during the COVID-19 pandemic. Results from a Los Angeles Unified School District survey conducted in May of 2020 reported that only 48% of parents felt "very confident" about having the devices, access and technical skill to help their child with remote learning.[38] This lack of skills impacts students, specifically in remote learning models, because students may not have the necessary support to access learning content and activities, even if the necessary devices and bandwidth are provided.

[38] Speak Up (2020)

ENVISIONING POSITIVE OUTCOMES OF TECHNOLOGY USE FOR ALL STUDENTS

Having documented the disparities that exist in technology use and outcomes, the rest of this report is dedicated to envisioning a brighter, more equitable future. The goal of digital inclusion should be to empower students and educators to reach their goals through the use of digital technologies in both academic and personal pursuits. However, too often, technical access to a tool or effective use of the tools available precede and override any discussion of desired outcomes for said access and use. However, "if mere use of digital technologies is conflated with actual understanding of how the technologies work and what they imply, educational initiatives run the risk of pursuing narrowly technical goals that will not tend to empower learners."[39] In this section, we will propose an approach to envisioning outcomes that empowers learners to build upon their own background knowledge and personal strengths. This will allow them to build digital agency and have the confidence to pursue both academic and personal aspirations. First, we envision this future on a more conceptual level. Then, we outline some more practical steps that can be taken in order to better approach digital equity in education.

Towards Digital Equity in Education: A Conceptual Perspective

The primary goal of this issue brief is to provide an overview of the literature regarding digital equity with respect to use and outcomes and provide recommendations for moving toward digital equity based on these findings. However, the considerations around digital equity are guided by some key conceptual and theoretical perspectives, which provide essential understandings which are interwoven throughout this work. The next few sections will address these ideas.

Begin with a sociocritical Lens

Before work toward digital inclusion can begin, practitioners must first recognize that educational technology exists within already defined social spaces and relational interactions. Technology is a social phenomena; therefore work in digital equity must consider all of the socio-cultural factors that impact students' experiences with technology both in and out of school. Much of the research regarding educational technology begins from either an instrumentalist or determinist approach.[40] In contrast to these approaches, Collin and Brotcorne (2019) advocate for using a sociocritical approach to digital (in)equity

[39] Collin & Brotcorne (2019, p. 176)
[40] Ibid.

which recognizes that technology is not neutral or innately beneficial for education. The authors suggest that a sociocritical approach "enables digital (in)equity issues to be linked to broader academic and social inequities, both at the design and implementation stages and in teachers' and learners' use of the technology, while also making it possible to propose fairer alternatives, to ensure that digital technology contributes to school equity efforts."[41]

Over the last few years, the Digital Equity Laboratory, a research workshop in New York City, has explored the various ways in which structural digital inequities are intertwined with other dynamics of historical and societal inequities. Their findings highlight issues such as the risks associated with online privacy, especially for communities of color and also the potential for these same communities to be left out of the 2020 census counts due to reliance on digital methods of collecting census data. This research reiterates how unequal social practices around digital equity can have real consequences.

Through applied research and leadership in digital equity, the DEL has worked toward overturning the systemic inequities around issues of access and use of technology. It also provides career opportunities and practical leadership in order to build collective agency and self-determination for digital justice. As evidenced by the work of the DEL, the first step in envisioning digital inclusion and positive outcomes for all stakeholders is to recognize the inherent inequalities that exist within the relational use and access of digital technologies. Only then can true equity (not just equality or basic access) for educational technology begin to be achieved.

Provide for cultural integrity

Overturning systemic inequities is a necessary first step in pursuing digital inclusion. However, for students facing a digital divide, affirming their culture and how that culture impacts their use of technology is also meaningful. Scholars have recognized the importance of building upon students' culture for positive educational outcomes.[42] Building upon that research, Jocson affirms that integrating culture into digital pedagogy can aid students in learning new digital literacies.[43] Similarly, Haddix and Sealey-Ruiz (2012) recognize that increased digital literacy can reverse deficit mindsets and empower urban youth, specifically adolescent males of color, to embrace their culture through digital technologies.[44] As Tichavakunda and Tierney (2018) observed, "cultural integrity does not

[41] Ibid, p. 177
[42] Freire (1998); Ladson-Billings (1995); Morrison et al. (2008)
[43] Jocson (2012)
[44] Haddix & Sealey-Ruiz (2012)

suggest that culture is a substitute for digital skills or academic outcomes. Yet for students at the margins, affirming their culture is critical for meaningful engagement."[45]

Build upon existing strengths

Tichavakunda and Tierney take an assets-based perspective toward both the culture and digital skills of Black youth. Rather than focusing on the racial digital divide, they argue that scholars and educators should highlight and build upon the students' existing strengths in digital literacy. Through a systematic review of literature, the authors found that very few studies focused on how Black students' use of digital tools outside of school could be beneficial for their educational pursuits. Of the studies that did focus on Black youths' use of technology, uses where Black youth excel, such as gaming and social media, were often discounted as non-capital enhancing activities. Tichavakunda and Tierney asserted that, "by studying the digital practices of diverse users with educational outcomes in mind, we may better learn how to cultivate and build on their skills."[46] Positive outcomes for students must build upon culture and the existing ICT strengths in order to achieve digital agency.

Digital agency as a goal

Digital agency, as defined by Passey and colleagues (2018), is "the individual's ability to control and adapt to a digital world"[47] through digital competence, digital confidence and digital accountability. As such, students need to develop the skills, self-confidence, and social responsibility to interact effectively using technology, the internet, and social media to process, create, and share information. Envisioning digital agency as the outcome of digital inclusion highlights the need to provide for digital equity at both Level One and Level Two of the digital divide. As Hohlfeld and colleagues (2017) suggested, "if Low-SES students do not have equal opportunities to create digital artifacts, then it goes without saying that they are less likely to have the ICT skills needed for empowering their own digital activities and creations (Level Three)".[48] In order to achieve Level Three (empowerment of students), educators must consider how they can promote equity of use and provide equitable access for students in order to realize the outcomes of cultural, personal, and digital agency.

Finally, "in the interests of social cohesion and individual well-being, policy makers need to ensure that policies are in place to equip citizens with the tools (cultural capital rather than hardware and access alone) that allow them to interact with confidence and competence

[45] Tichavakunda & Tierney (2018, p. 117)
[46] Tichavakunda & Tierney (2018, p. 119)
[47] p. 426
[48] Hohlfeld et al. (2017, p. 150)

with new technological tools and systems."[49] Building upon students' cultural and personal strengths can lead to collective empowerment and individual agency within an increasingly digital world.

Towards Digital Equity in Education: A Practical Perspective

Technology is not a replacement for effective teaching, but rather a tool to be used in the classroom for deeper and more personalized learning opportunities. In order to build upon students' strengths and culture and establish lifelong digital agency, educators must consider how ICT is used both within schools and in personal contexts. This implies moving students from passive use of technology as consumers to active use of a variety of ICT skills as producers and creators of content. As Dolan (2016) asserts,

> *...culturally and linguistically diverse students, low-income students, and students with disabilities deserve the same opportunity to use technology in ways that are productive and inclusive and that allow for their diverse perspectives to be heard, and fostered to leverage their potential as producers of technology.*[50]

With this goal in mind, and thinking of Hohlfeld's third level of digital divide "empowering students"[51] the following are a few areas that schools should address as they work toward digital equity.

Ensuring equitable curriculum

To begin with, educators must consider how ICT tools can be meaningfully integrated into classroom instruction. Sometimes, existing curriculum can be used in new and creative ways to engage students in critical thinking and communication.[52] Moving forward, schools need to evaluate their curriculum to identify where the most technology-rich environments are found and ensure that these are not just available, but are also used by all students and teachers. Evaluating where the technology is found and who is benefitting from it is important to ensuring equity.

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[49] Passey et al. (2018, p. 427)
[50] Dolan (2016, p. 32)
[51] Hohlfeld (2017)
[52] Ritzhaupt (2013)

Developing digital literacy and digital citizenship

One of the central purposes of education is preparing another generation of citizens to participate in our democratic society. In order for students to productively use technology, they will need to develop digital literacy skills that allow them to work collaboratively, ethically and safely to access technology and utilize it to demonstrate their own learning. Although prevalent, the idea of today's students as "digital natives"[53] does not negate the need for them to be instructed in digital literacy skills in order to make sure they are employing technology in ways that benefit and emancipate them. It is imperative that teachers use technology to prepare students for full citizenship in an inter-connected, media-infused society. This idea of citizenship, often termed digital citizenship, can be defined as "the continuously developing norms of appropriate, responsible, and empowered technology use."[54] From cyberbullying to plagiarism, students must learn effective ways to behave online as well as in person.

Using technology to differentiate learning

Another important aspect of digital access for students is the ability to differentiate content, curriculum, and continued education for all learners. Students can use technology to explore personal interests and deepen their understanding of certain content. Various tools[55] can be used to assess and communicate with different types of learners. Finally, technology has the potential to meet the needs of all students, including students with disabilities, EL students, and gifted students by providing opportunities for differentiation at all levels.

Continued staff development

According to the Consortium for School Networking (CoSN), professional development was the second most reported challenge by district instructional technology leaders in 2017, 2018 and 2019.[56] Downes and Bishop (2015) found that several factors related to curriculum were key to developing and sustaining technology integration. Key factors included utilizing technology to enhance the curriculum which was relevant, purposeful and engaging for students as well as teachers. Another major factor was allowing for proper staff development and time for teachers to learn and incorporate technology which supported their curricular goals. In other words, technology was most effective and engaging when it was used thoughtfully and purposefully to support and extend the curriculum. One way to facilitate this type of integration is through sustained professional

[53] Prensky (2001)
[54] digitalcitizenship.net
[55] ASCD (2011)
[56] CoSN (2019)

development for teachers as technology evolves and changes. However, staff development must be equitable. It is important to ensure that staff development in the area of technology is not concentrated among teachers who teach technology-based courses or advanced courses which are mostly attended by White, Asian and high-SES students. Also, ensuring that special education teachers and EL teachers are able to participate in technology PD related specifically to their population could prove beneficial. Incorporating technology more intentionally throughout teacher preparation programs would likely improve the landscape for future educators as well.

While it is evident that students are using technology in ever-increasing ways in their personal lives, it seems that schools may have trouble keeping pace. One way to alleviate this may be to focus on integrating technology in culturally relevant ways while also involving parents and families in the process. Providing access not just to devices and high-speed internet, but also to the skills students need to utilize technology for ways which empower them needs to be a priority for schools moving forward, even looking past the pandemic. Unfortunately, many of the solutions to these challenges, such as continuing professional development, integrating technology into the core curriculum and building students' digital literacy skills are not things that can be quickly implemented. However, examining our practices through a lens of equity is a worthy beginning.

Enrichment opportunities

Finally, schools could partner with community organizations and businesses to offer extracurricular enrichment programs and training to students, families, and community members.[57] The benefits of community and after school programs that allow students to engage in digital technologies and STEM activities outside of schools have been widely recognized.[58] Additionally, some schools offer after-school programs to accelerate students' technological knowledge without having those skills tied to a specific curriculum.[59]

Conclusion

ICT literacy is an essential 21st century skill for success in both professional and academic settings. Today's classroom teachers provide more opportunities for students to use word processing, graphic design and other ICT as part of the educational program. Students are expected to demonstrate understanding and use of ICT resources in assignments and these expectations will continue to increase even beyond the COVID-19 pandemic. However, as

[57] Ritzhaupt et al. (2013)
[58] Barton & Tan (2018); Ito (2010); Ryoo & Barton (2019); Sheridan et al. (2014)
[59] Ritzhaupt et al. (2013)

research finds that a digital divide still exists based on gender, ethnicity, and SES,[60] addressing the outcomes of digital inequity, the third level of the digital divide, is partly dependent on the quality of instruction provided in the schools.[61] The inequity that exists in the third level of the digital divide places students at risk in the competitive global workforce where technology skills are essential for success.

While it is widely recognized that students in today's 21st century world need to develop skills and competencies with technology in order to be successful in school and beyond, the ways in which technology is incorporated into instruction vary vastly across states and districts. For example, New Computer Science standards were issued for Virginia public schools in 2017 with the expectation that schools would begin incorporating them into instruction in the Fall of 2019. The standards are not specifically tested on any state standardized tests and are not included as a graduation requirement in the Virginia Standards of Accreditation. However, "teachers are expected to integrate Computer Science standards into core discipline instruction where appropriate."[62] This leaves implementation decisions up to individual districts, building administrators and classroom teachers, which could contribute to inequities for students. This problem is not only relative to Virginia, but persists across the United States as well.

Another issue is that staffing for teaching technology and STEM can vary widely across districts, with higher-resourced districts having more technology resources and more positions dedicated to teaching technology and STEM than districts with fewer resources. Technology and STEM skills are often not specifically included in state assessments. The expectation, especially at the elementary level, is that classroom teachers will integrate technology into the core content. This can lead to inequities, as the research shows that teachers use technology in a variety of ways, including for classroom administration, communicating with parents and students, personal productivity, and instruction.[63] How effectively teachers integrate technology into instruction depends on a variety of factors, including available resources, teachers' experience and comfort with technology, and students' perceived ICT and digital literacy skill level, and technology support for teachers.

Unfortunately, the result of all of these factors is that technology tends to be used in different ways with different students across buildings, often inequitably. Access to technology, and especially integration of technology in ways which support higher order thinking has also been shown to be stratified within schools. Even in cases where students might have access to the same technologies, instructors may differentiate their use and

[60] Ibid.
[61] Hohlfeld et al. (2017)
[62] Virginia Department of Education (2020, October, p. 2)
[63] Hohlfeld et al. (2017)

approaches, sometimes in discriminatory ways, which can impact students' meaningful engagement with digital tools. As we work toward digital equity it is important to keep in mind the ultimate goals of empowering students and helping them to develop digital agency that will allow them to utilize technology to reach their own personal, academic and career pursuits.

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What can we learn together?