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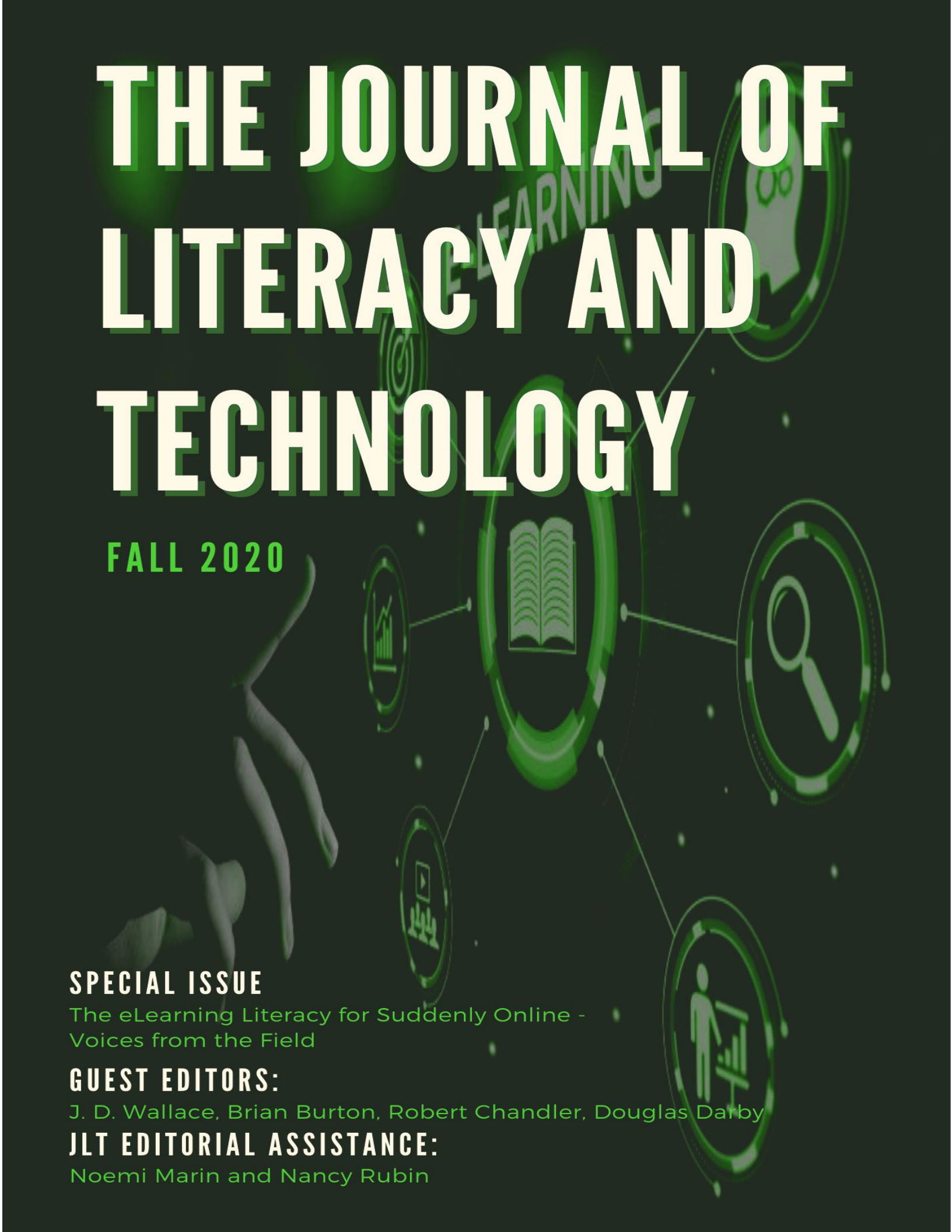

SPECIAL ISSUE

The eLearning Literacy for Suddenly Online - Voices from the Field

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Suddenly…Technologically Literate: The Need for A Capabilities Approach

Article Info

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Abstract

Technological literacy is integrated in various degrees in K-12 schools in the U.S. Technological literacy assesses how students understand technological concepts, adapt to technological change, and encourages them to participate in civic discussions about these changes. The sudden shift to online learning in the spring of 2020 highlights the importance of continuing these efforts. Early findings suggest that many students not only lacked access to computers and the Internet, they also lacked technological literacy skills to effectively navigate online courses. As schools move to more sustained levels of online learning, this paper argues for a capabilities approach to technological literacy that emphasizes individual development.

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The sudden shift to online learning that many U.S. K-12 schools faced in the spring of 2020 presented itself with challenges and opportunities. Some educators characterized this new reality as "crisis teaching" in which, as Gross (2020) writes, "our classes, our curriculum are not the most important part of anyone's life right now" (para. 2). This pivot to online learning had practical advantages, including a stopgap measure to keep students engaged in the learning process and to fulfill school requirements. However, this shift amplified many educational inequities that already existed, such as lack of reliable access to the Internet, lack of access to computers to complete school work, lack of technological literacy skills to effectively navigate online classes, and lack of parental involvement as parents struggled to balance working from home and home schooling their kids. Teachers reported widespread absenteeism particularly among high schoolers with less access to computers and the Internet. At the same time, several benefits (intended and unintended) emerged. Online learning improved outcomes for some students who struggled to pay attention in face-to-face (FTF) classrooms because it minimized distractions like disruptive classmates, since teachers have the power to mute students' microphones. Additionally, introverts who were not comfortable participating in the FTF classroom had multiple opportunities to participate in the online classroom, such as through discussion boards, chats, and emojis. And, the integration of videos and multimedia content appealed to different kinds of learners (Harris, 2020).

COVID-19 necessitates that some forms of online learning will continue to be part of educational offerings into fall 2020 and beyond. Moving forward, there is rich opportunity to articulate and refine the kinds of literacies that students will need to manage this new context. Technological literacy will be a crucial component of students' success. This article first provides an overview of technological literacy and its relevance to online learning. Next, it offers an expansion of current conceptualizations of technological literacy that integrates the notion of capabilities, preparing to adapt to technological change and participate in larger conversations and debates about technological innovation and development.

What is Technological Literacy?

Technological literacy first emerged as a concept in the 1980s when there was growing awareness that the U.S. was falling behind other nations in terms of preparing a science, technology, engineering, and mathematics (STEM) workforce. The 1983 report *A Nation at Risk: The Imperative for Educational Reform* outlined a number of suggestions for how to reform U.S. education, especially in terms of increasing math and computer science skills (National Commission on Excellence in Education, 1983). This report led to several organizations creating more robust curriculum for technology and engineering education. The concept of technological literacy emerged as part of this initiative. In addition to acquiring specific skills, educators argued that students should also develop technological literacy, where they could understand how technology works, as well as how technologies shape society and how society shapes technological development. As Loveland, Hoepfl, and Barbato (2020) write,

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> the goal is to develop individuals who have a broad, conceptual understanding of technology and its place in society, enabling them to be active participants in the technological world and careful creators and users of technology. All technological systems are embedded within social and environmental contexts and all have, or will have, both intended and unintended consequences. Many of our current global problems were created by our technological choices. This increases the need for technologically literate citizens who participate in decision-making. (p. vii)

This framing of technological literacy led to several organizations developing standards for technological literacy. While these standards have shifted over time, the lasting element is that students should be able to adapt to technological change as well as be prepared to engage in broader conversations about the mutual shaping of society and technology. Technological innovation involves costs and benefits related to choices made in their adoption. Additionally, advocates of technological literacy urge that while citizens are dependent on technology, they remain largely ignorant of technological concepts leading to a citizenry that is not engaged with decisions that shape technological development.

Technological literacy is measured by the capacity students have to understand the broader technological world, rather than having a narrow expertise of a small part of it. For example, a technologically literate student would understand the limitations of viewing a website on a smartphone versus a laptop. The information is presented differently and thus context is important. Another component of technological literacy is to understand the different affordances that are allowed by different platforms and different technologies (Shaw, 2017). Technological literacy is continuously developed through practice-based learning in the face of constant mutual reconfigurations of technology and practice.

As technology is increasingly integrated across the curriculum, there is concern that teachers over-emphasize technological competency and skill acquisition, rather than literacy. While skill acquisition is important, technologies continues to evolve and, as Pearson and Young (2002) argue, technological competence does not guarantee literacy. As they point out, civil engineers may be very skilled in understanding how structures and materials respond to heavy loads, yet may have little understanding of how the buildings they design affect society. In this way, as Winner (1999) states, artifacts have politics. Technologies can change the exercise of power and experience of citizenship. Technologies are not isolated tools freely adopted and discarded at will, but systems of understanding embedded within people's lives that can reconfigure social order. Winner uses the example of the overpasses on Long Island, New York, which are unusually low. As he points out, Robert Moses, who designed many of the roads, parks, and bridges in New York, deliberately specified that these overpasses be low hanging so that buses could not travel on the parkways, reflecting his class and racial prejudice. Poor people and people of color, who rely on public transportation, would be dissuaded from traveling to Long Island.

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Technological Literacy and Learning

While many educators advocate technological literacy in technology-focused classes, such as engineering, the integration of technology in many aspects of life and the recognition of the skills necessary for 21st century learning have necessitated that technological literacy be embedded across the curriculum. Working and learning in the 21st century requires technological literacy, especially practices such as collaboration, communication, problem solving, and lifelong learning, which many of these learning technologies enable. This shift is reflected in the International Society for Technology Education (ISTE) standards for technological literacy. ISTE standards evolved from "learning to use technology" (1998) to "using technology to learn" (2007) to "transformative learning with technology" (2016). Some examples of transformative learning with technology include assistive technologies for students with different learning needs (such as deaf and hard-of-hearing students and visually impaired students), the Google Suite for Education, which allows students the ability to interact and communicate through a number of different applications, mobile tablets that increase accessibility for coding, and social media technologies that allow students and teachers to connect with information on a global level (Fingal, 2019).

Williams (2009) illustrates how technological literacy can lead to transformative learning when he writes,

> the goal of all effective pedagogies is to be transformative; to transform pre-existing attitudes and practice to accommodate new experiences and knowledge in working toward, in this case, a form of technological multiliteracy which essentially results in the felt need to participate in the democratization of technology and the design of personal and social futures. (p. 250)

In this sense, democratization of technology empowers students to see themselves as tech savvy, able to understand and adapt to technological change, and to use technologies to solve social problems. One way that technological literacy can be integrated in the curriculum is for teachers to help students understand and evaluate different technologies to develop solutions to problems and achieve goals. One example of an organization that is doing this well is Technovation (www. technovation.org), a global nonprofit that helps girls develop mobile apps to address real-world problems, such as poverty, illiteracy, and the climate crisis.

Despite the potential of technological literacy to transform pedagogy, there is little information on how teachers are integrating technological literacy in the classroom. What is available shows that teachers (and teacher training) tend to over-emphasize competence at the expense of literacy (Uerz, Volman, & Kral, 2017). This problem has been persistent since, as Young et al. (2002) write,

> there is a lack of reliable information about what people know and believe about technology, as well as about the cognitive steps that people use in constructing new knowledge about technology. These gaps have made it difficult for curriculum developers to design teaching strategies and for policymakers to enact programs to foster technological literacy. (p. 78)

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Indeed, one of the challenges of increasing technological literacy in the classroom is that students are often passive consumers of technology, rather than active producers of content. This gap becomes especially illuminated in looking at underserved students, who too often are encouraged to use educational technologies for drill-and-practice activities and remediation (Zielezinski, 2016).

Instead, Davies (2011) proposes a framework for evaluating technological literacy that includes three levels: awareness (what can technology do?), praxis (how do you complete a specific task with it?), and phronesis (why are you using this technology to accomplish a specific task?). Since the early 2000s, there has been a mandate to integrate educational technology into classrooms while also increasing students' technological literacy. Davies points out that too often, "technology" is viewed as just computers and software. Instead, educational technology refers to any tool that can help students accomplish learning goals. As he writes, "technology literate people know what the technology is capable of, they are able to use the technology proficiently, and they make intelligent decisions about which technology to use and when to use it" (p. 47). Technological literacy, then, is not about mastering the Microsoft office suite, but instead about selecting different tools to accomplish different tasks. To achieve this, teachers would expose students to a variety of tools to allow them to pick and choose which ones would be appropriate given the specific task.

Technological literacy starts with the kinds of technological concepts children develop through experience. Mawson (2013) found that through creative activities, like play and simulation, children had a good gasp of technological concepts. She recommends that teachers allow children greater input into and control of technological tasks set for them. This could lead to more in-depth technological knowledge and practice, such as collaborative problem-solving and peer tutoring. Teachers would play the role of helping students clarify ideas and reflect on the process and outcome. Additionally, teachers could help them understand the broader social and environmental issues involved in their design process.

Technological literacy is especially important for promoting diversity in the sources of innovation. There is a persistent racial and gender gap in STEM and research has shown that girls and students of color are uninterested in the ways in which technology is taught, opting out of these courses. For example, based on his findings of gender biases in technology classrooms in Rhode Island high schools, Walach (2015) recommended that these programs needed to appeal more to girls' interests, through offering training in areas such as medical technology and biotechnology, as well as using design problems that help solve pressing social problems, like the need for sustainable technologies. Hasse (2017) found that educational technologies created new inequalities in the classroom. In her classroom observations, she found that teachers relied on tech-savvy boys to help them overcome technological barriers in the classroom at the expense of including other engaged students. In this way, technology was emphasized over content, reinforcing gendered stereotypes of who gets to be tech-savvy.

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In order to address some of the limitations of how technological literacy is framed, some scholars argue for a "critical technological literacy" that, as Petrina (2000) advocates, would focus on addressing power and dominance that perpetuate inequalities in the built world. A critical technological literacy is a "renegotiation of power from the state and economic control of technology education toward a power for ecology, justice, labour, and the public" (p. 182). A critical approach emphasizes the mutual shaping of society and technology, which interrogates how people design, deploy, and appropriate technologies. To illustrate these concerns, Bijker (2010) uses the example of introducing robots into an industrial workplace. Robots can increase an organization's productivity, but this process also redefines what "work" is in that setting. The same can be said about education. What counts as "learning" now is quite different with the diffusion of educational technologies.

McGuire (2019) shows how a critical technological literacy would include a consideration of e-waste, or the impact of disposing outdated electronic technologies that are toxic and often shipped to the global south. In another example, Freeman, Park, and Middleton (2019) examined how a rural community dealt with interrupted internet access due to a lack of a stable infrastructure. The community applied their own critical technological literacy by figuring out how to create a wireless network that was more reliable and affordable for residents.

Emejulu and McGregor (2019) argue that technological literacy can lead to what they call "radical digital citizenship" which "problematizes dominant ideas about technologies and rethink citizens' relations with technology to advance the common good" (p. 132). Radical digital citizenship first includes a critical analysis of the social, political, economic, and environmental consequences of technologies in everyday life which then leads citizens to "collectively deliberate and take action to build alternative and emancipatory technologies and technological practices" (p. 131).

Technological Literacy and Online Learning

How might technological literacy be integrated in online learning? As schools adopt new online learning platforms, such as Microsoft Teams, and require assignments with a range of evolving and changing digital applications, it becomes essential that teachers assess student readiness to participate fully. Technological literacy calls for teachers to assess students' ability to adapt to new technologies and understand how to select technologies to achieve their goals. Students should develop a general understanding of the development of the tools they are using as well as some of the discussion about their use. For example, the frequency of Zoom-bombs, in which hackers broadcast racist, misogynistic, and homophobic content in online meetings, revealed the importance of using this platform securely. Technological literacy is also a strategy for helping students succeed in online learning. Teachers could, for example, teach students about the different components of their laptops, tablets, or mobile phones as well as the mechanisms by which these devices connect to the Internet. They could discuss the history and development of these systems so that

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students are not just passive consumers of technology completing homework tasks, but instead understand these developments and be prepared to adapt as new devices emerge.

Moving out of the suddenly online context, teachers can ask themselves why technology is important, what is its purpose, does it increase access to learning, and will it transform learning? They can engage students in these discussions and talk with them about some of the most important issues facing our world that are impacted by technological decision-making, such as the importance of protecting private information, the ways in which technologies reflect power structures, and the impact of technological innovation on the environment.

Much of what was seen in the suddenly online context was overly deterministic: technology would stand in for the FTF component. As Trust (2018a) writes, "when used effectively, technology can redefine and transform learning. However, far too often, technology acts as a substitute for another tool, serves as a classroom management tool, or is used because it is required by the school (e.g. learning management systems)" (p. 54).

One of the challenges of online learning is the widespread adoption of learning management systems that may not allow for these practices to emerge. As Godwin-Jones (2012) writes, learning management systems (LMS) "embed pedagogical and cultural values which raise questions about learning design, instructional choice, and computer literacy" (p. 4). He goes on to argue that the "closed, self-contained system uses cognitive-behavioral learning, with emphasis on information presentation and measurable performance assessment" (p. 4). Many LMS platforms emphasize transmission of knowledge, emphasis on individualism, and linear forms of communication. This approach to online learning contributes little to the kinds of technological literacy students will need in their work lives.

Much has been written about effective and ineffective online teaching and learning practices. Best practices in online learning include the importance of creating community, having teachers that are engaged and have social presence, and designing an intuitive online space so that students are not confused about where to access the information (Means, Bakia, & Murphy, 2014). One of the strengths of online learning is the ability to engage students in multimodal forms of communication to deliver content so that students with different learning styles can interact in the ways that are most useful to them.

Teaching online changes what is meant by teaching and learning and changes the way people think about learning. As Hamilton (2016) writes, educational technologies come into being in relation to conflicting ideas about what education is. Much of the discourse about online learning is that it is an inadequate substitute for face-to-face learning, but a necessary one to keep children and teachers safe during the pandemic. However, this dichotomous framing of face-to-face versus online learning limits possibilities to harness the potential of learning technologies. Applying a social shaping approach to educational technology calls for looking beyond the function of certain technologies, to interrogate what values allowed for these technologies to come into being as well as

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what is at stake for different groups (institutions, teachers, students).

One of the critiques of the use of technology in education is that "users of technology are not disembodied as some researchers assume, rather they experience constraints that make some practices more likely and make other practices less likely" (Costa, Hammond, & Younie, 2019, p. 395). They warn that technology use is often seen as a binary (digital natives vs. digital immigrants; adopters vs. resisters, deep learners vs. surface learners). Instead, technology use is based on circumstances and can be inconsistent. One of the benefits of online learning is that it can appeal to different types of learners, engaging multiple modes of learning, such as visual and audio learning. Learners can go back and engage with material multiple times (unlike in a physical classroom) and they may not be distracted by other students in the classroom.

Moving into the Fall, many school districts are planning for synchronous instruction through videoconferencing software. However, benefits of online learning are that there are multiple ways in which students can engage with content. There are a number of instructional technologies that can encourage collaboration and communication, as mentioned in the previous section. Utilizing these technologies can increase interactivity and engagement. This is quite different than simulating what happens in a face-to-face classroom.

At the same time, there have been lots of lessons learned from those who have been teaching online longer during this time, especially from educators who have been doing this in China. Some of these suggestions include governmental support for technological integration, reinforcing students' existing knowledge base rather than teaching new content, reducing online class time and encouraging "off-screen" activities, frequently communicating with parents, and acknowledging the social and emotional needs of students, teachers, and families (Ning & Corcoran, 2020).

A Capabilities Approach to Technological Literacy

The examples presented above show some of the limitations of how technological literacy is applied in practice, but also the potential of technological literacy for leading to a more just society. Moving forward from a "suddenly online" context to a more sustained integration of online learning, there is a need to refocus efforts to increase technological literacy, especially as they contribute to capabilities, or the freedoms individuals have to pursue their own potential.

A capabilities approach offers a framework for assessing and evaluating inequality, moving away from a measure of one's material resources to an evaluation of what one can actually do with these resources (Sen, 1999). A capabilities approach reflects what Robeyns (2006) identifies as a "sociological turn" in economics because it integrates social theories and can be useful for critiquing social norms and practices that contribute to inequality. Central to a capabilities approach are the concepts of functionings and capabilities. *Functionings* refer to one's state of well-being, such as being well-nourished or literate. *Capabilities* are the freedoms one has to realize these functionings. Traditional economic measures of poverty, for example, assume that equality in income will lead to

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the same equality in well-being and freedom. Yet, different social and physical characteristics, such as age, sex, education, and culture, impact an individual's ability to achieve their own potential. Take for example the differences between an able-bodied worker and a disabled worker. They may receive the same income, yet they may have quite different abilities to translate this income into well-being.

Capabilities include "positive freedoms," which Gould (1988) writes include "capacity for choice and its exercise, absence of constraining conditions, and the availability of means" (p. 40). Thus, in order to ensure that people have equality of capabilities, it is important to address the constraining conditions, such as discrimination, illiteracy, and poverty, that create barriers to equality. In other words, a capabilities approach leads to an examination of freedoms in terms of what people can *do* rather than what they can *buy* (Saito, 2003).

One of the critiques of the capabilities approach is that it can be difficult to apply in practice (Robeyns, 2006). There is disagreement on whether to assess functionings, capabilities, or both, as well as deciding which capabilities are most necessary to measure. That said, a capabilities approach has been used to assess human development in specific countries, who is considered poor in developing countries, poverty and well-being in advanced economies, and gender inequality (Robeyns, 2006).

Technological literacy can increase one's capabilities, offering a means to access information, adapt to technological change, and allow people to use communication channels to draw attention to diverse stories and perspectives. Technological literacy increases individuals' capacities to make decisions in complex situations. As Fourez (1997) writes, "understanding the spread of disease during epidemics, deep-freezing, the structures of computer software, the way to transmit a fax, or the freezing of diesel fuel, makes it possible for us to negotiate reasonable and rational decisions when faced with a series of problems" (p. 905). Fourez's description is especially relevant as students, teachers, and policymakers continue to understand the spread of COVID-19.

Technological literacy is not only about understanding how technologies works, but also about being able to speak about technologies to others. The shift to online learning has led to discussions about how to help students overcome cognitive deficits, such as how to master software applications and be engaged in video conferencing sessions. Instead, pedagogical approaches that increase technological literacy allow students to achieve a "level of interaction with scientific practices" (Fourez, 1997, p. 911). Technological literacy encourages students to make informed choices about which technologies to use for different purposes and prepares them to participate in broader conversations about technology policy issues in the digital age, such as network neutrality, privacy and surveillance, and censorship on social media. In this way, technological literacy encourages civic engagement through a critical look at the ways in which technology influences society and the way society influences technological development. Technological literacy is especially relevant when addressing Americans' lack of knowledge on digital topics such as

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cybersecurity, browsing, and social media ownership (Vogels & Anderson, 2019).

Technological literacy is crucial as citizens' lives become "datafied" through artificial intelligence and machine learning. Data is becoming a core element of cultural, social, political, and economic life and students need to understand these dynamics. Carmi and Yates (2020) argue that the increased use of artificial intelligence and machine learning in decision-making about processes related to citizens' lives, as can be seen in arenas such as healthcare and policing, or even Netflix, call for curriculum that increases data literacy.

The "suddenly online" context revealed the importance of bridging the digital divide, which continues to be determined by race and class. One in three African Americans and Hispanics still don't have access to computers at home. And, 35% of Black households and 29% of Hispanic households do not have broadband (Simama, 2020). Even in urban areas where broadband is available, the cost can be too expensive for families. These realities are what led to schools creating mobile hotspots for students, even before COVID-19.

However, access to the same technologies does not necessarily ensure equality of opportunity. This becomes evident in looking at the persistent under-representation of women and minorities in STEM fields. When women do enter STEM fields, they may receive income equal to their male counterparts, yet they may not have the same freedom to achieve as men because of discrimination and lack of maternity leave policies. These issues became especially salient in stories from female game designers who have reported a toxic work culture that includes sexual harassment and not being taken seriously, causing them to leave their jobs (Caddy, 2020).

A capabilities approach to technological literacy enables freedoms for youth to pursue interests that they value. A capabilities approach to technological literacy might, for example, make it possible for students to develop mobile apps that fulfill social or economic needs in their community. This necessitates rethinking structural barriers in place in education, such as filtering information from certain websites in schools and re-evaluating acceptable use policies. While there are good reasons why schools develop these policies, it may have the unintended effect of limiting youth's capabilities. For example, Vickery and Shaw (2014) discovered that black and Latino students' participation in after-school digital media clubs helped them to develop digital literacy. Yet, school policies blocked their access to social media and video sharing sites, limiting their ability to share their work, expand their social networks, and increase their social capital. Policies that restrict material considered inappropriate or uneducational denies students access to what they consider useful and even educational spaces, including social network sites and video games. As a result, Watkins (2018) identified that these students lived on the "digital edge" of formal education limiting their ability to fully benefit from the affordances of these technologies.

What Next?

The situation brought on by suddenly online learning offers a unique opportunity to reimagine how to integrate technological literacy across the curriculum. Technological literacy is especially

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important because the current moment not only revealed the inequities that persist in technology use and access, but also the importance of citizens participating in engaged dialogue about technological development and policies.

According to ISTE, very few states (only 17 out of 50) have updated their standards to the 2016 standards, which better articulate how to use technology for transformative learning. ISTE provides much guidance, but there also needs to be a cultural shift in how the ways in which students are taught not only how to use technology, but also how to become active participants in technological design and decision-making. In this way, technological literacy can empower students not only to be critical consumers of technology, but also producers and innovators.

This more refined focus on what technological literacy adds to individual development can help contribute to a more just and equal society. This is especially important for non-dominant groups who have been left out of these decisions, but who are most often impacted by these decisions. Educational inequities continue to affect students along race/ethnicity and class lines. Technological literacy is one way to not only bring attention to this inequality but empower students to see themselves as change agents.

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