Accessibility4Equity: Crippling technology-mediated compulsory education through sociotechnical praxis

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Abstract

During COVID-19, technology has frequently mediated schools' emergency remote learning. Tragically, many of those technologies, despite legal requirements to the contrary, are inaccessible to disabled youth—a pattern of oppression within compulsory education that predates the pandemic by almost two decades and is rooted in ableism. In this paper, I advance a new interdisciplinary framework—Accessibility4Equity (A4E)—that integrates existing single-discipline theories to explain the messy interactions among human and non-human actors engaged in learning that is equitable and accessible to disabled youth within the context of compulsory education. A4E asserts that equitable technology-mediated education is (1) constructed by educators and disabled people collaboratively crippling discourse and practice through sociotechnical praxis, (2) born technologically and pedagogically accessible; and (3) requires institutions to have the capacity to cultivate access intimacy and swiftly respond to individual needs. Hence, A4E is a framework that scholars and practitioners can use to begin the complex social change that is required to disrupt the unjust status quo and reimagine technology-mediated compulsory education as a place that values and is hospitable to disabled youth.
Practitioner notes

What is already known about this topic
• Technologies and instructional practices that oppress and exclude disabled youth are consistently used in compulsory education.
• Flexible pedagogical approaches make learning more accessible to disabled youth.
• The features and functionalities that make technology accessible to disabled adults are operationalised in the Web Content Accessibility Guidelines, which are incorporated into laws and policies around the world.
• Abled power shapes technology-mediated environments and disabled people’s access to them.

What this paper adds
• An interdisciplinary framework that explains the messy interactions among human and non-human actors engaged in equitable and accessible technology-mediated learning within the context of compulsory education.
• A framework, which is more valuable than the sum of its parts, for identifying and beginning to dismantle the systemic ableism that is embedded in technology-mediated compulsory education.
• Equitable technology-mediated education is (1) constructed by educators and disabled people collaboratively crippling discourse and practice through sociotechnical praxis, (2) born technologically and pedagogically accessible; and (3) requires institutions to have the capacity to cultivate access intimacy and swiftly respond to individual needs.

Implications for practice and policy
• To dismantle the systemic ableism embedded in technology-mediated learning environments, teachers and administrators must (1) pause to critically reflect on their beliefs and actions, (2) ally themselves with disabled youth and adults; and (3) act to ensure equitable access.
• Acting to ensure equitable access includes (1) examining and remediating existing learning environments, (2) proactively constructing born accessible learning environments moving forward; and (3) developing the capacity to cultivate access intimacy and swiftly respond to individual needs.

INTRODUCTION

During COVID-19, technology has frequently mediated schools' emergency remote learning. Tragically, a great deal of those technologies and instructional practices (eg, science lab simulations, standardised testing platforms, interactive picture books, and video games) have excluded disabled youth. I use the identity-first disability language convention because this convention aligns with my view of disability as a part of identity and a point of pride; a view that I have developed through my lived experience as a disabled person. Because they are designed exclusively for non-disabled learners—a persistent pattern of oppression
that predates the pandemic (National Federation of the Blind [NFB], 2020) when the constituent elements of the framework; Shaheen & Lohnes Watulak, 2019). Swan (2020) illuminated the oppression that Kai, a blind 7-year-old, has faced during emergency remote learning. Before the pandemic, Kai was able to do most of his schoolwork independently; but, the inaccessible technology-mediated remote learning environment stole his autonomy. Now, Kai has to rely on his sighted parents, who use technology in normative ways, to do his work because the technologies and instructional practices his school is using prohibit disabled ways of knowing and disabled forms of digital interaction. To change the unjust status quo, scholars and practitioners must collaborate with disabled people to better understand this oppression, which is rooted in ableism, and reimagine technology-mediated compulsory education as a place that values and is hospitable to disabled youth. Accessibility4Equity (A4E) provides a framework for engaging in that social change.

The technology access needs of disabled people—particularly adults—is not a new topic; in fact, it has been addressed in laws and policies around the world since the late-1990s. For example, Section 508 of the Rehabilitation Act of 1973 in the United States (US) (US Access Board, 2017), The Public Sector Bodies (Websites and Mobile Applications) Accessibility Regulations 2018 in the United Kingdom (UK) (Public Sector Bodies, 2018) and Article 9 of the United Nations’ (UN) Convention on the Rights of Persons with Disabilities internationally (UN, 2006). Moreover, scholars and practitioners in the fields of education, human-computer interaction (HCI) and disability studies have advanced theories and recommendations for practice born of two decades' worth of research (US Department of Education, 1996; Vanderheiden, 1988, 2000).

However, disabled youth's access to technology-mediated compulsory education is a multifaceted issue that has not yet been adequately explored or theorised. Constrained by disciplinary boundaries, existing theories provide deep but siloed knowledge about singular aspects of disabled youth's access to technology-mediated compulsory education such as the technology, the learning, or the power structures. These single-discipline theories collectively provide essential components for theorising about disabled youth's access to technology-mediated compulsory education. But, to date, no one has reached across all of the disciplinary boundaries to integrate these theories into a framework that scholars and practitioners can use to analyse and begin to disrupt the unjust status quo. Therefore, in this paper, I advance a new interdisciplinary framework—A4E—that integrates existing theories to explain the messy interactions among humans, technologies, cultures and power structures engaged in equitable and accessible learning within the context of compulsory education.

EXISTING SINGLE-DISCIPLINE THEORIES OF ACCESS

To showcase the value that knowledge from each field offers about this issue and to begin to demonstrate that integrating the knowledge from existing theories provides a multifaceted understanding that is more valuable than the sum of its parts for facilitating crucial social change, in this section, I examine the facets of disabled youth's access to technology-mediated compulsory education that existing theories address and those facets that they neglect. Space constraints inhibit a detailed examination of the literature, for a complete review see Shaheen and Lohnes Watulak (2019).

Theories from education, particularly Universal Design for Learning (UDL), provide deep knowledge about how to simultaneously make learning accessible to disabled and non-disabled youth through a flexible pedagogical approach (Rose & Meyer, 2002); but do not address how to facilitate disabled youth's access to technology. Conversely, theories in HCI furnish detailed knowledge about how to create technologies that are accessible to
disabled adults by incorporating specific features and functionalities (Kirkpatrick et al., 2018; Vanderheiden, 2000). This knowledge has been operationalised in the Web Content Accessibility Guidelines (WCAG), a consensus standard developed by the World Wide Web Consortium that defines accessible technology through testable criteria (Kirkpatrick et al., 2018). But theories from HCI neglect the needs of disabled youth, the unique context of technology-mediated learning and the power structures that shape access.

The field of law and policy, which leverages WCAG (Mueller et al., 2018), has the same limitations as HCI, but brings essential insight into the topic through mandates (eg, Section 508 in the US, EN 301 549 V1.1.2 in Europe and The Public Sector Bodies Accessibility Regulations in the UK) as well as process-oriented codes of practice (eg, British Standard 8878 and International Organisation for Standards (ISO) 30071-1) that outline the steps an organisation can take to enact WCAG (British Standards Institute [BSI], 2010; ISO, 2019). Theories of access from disability studies are distinct from theories in the three other fields in that the theorising begins, rather than ends, with disability (Goodley et al., 2019). This approach is rooted in the field's heritage in the disability rights movement and its aim of challenging dominant conceptions of disability (Goodley et al., 2019; Kent, 2018). Theories from disability studies provide essential counter-hegemonic insight that exposes the underexamined assumptions, viewpoints and limitations of dominant theories of access. Four crucial constructs emerge from the subdisciplines of critical disability studies and disability studies in education:

1. inclusive education must be grounded in the notion that disability is socially constructed not an individual deficit;
2. access is a holistic construct that extends well beyond conformance with legal requirements and technical standards;
3. abled power shapes technology-mediated environments;
4. critical accessibility must be a shared project (Ellcessor, 2015; Foley & Ferri, 2012; Gabel, 2005; Goggin & Newel, 2003; Jaeger, 2012; Lewthwaite et al., 2018; Naraian, 2017). Additionally, the disability justice movement, which shares with disability studies both a counter-hegemonic approach and heritage in the disability rights movement, contributes the theory of access intimacy (Mingus, 2011), which adds depth and expansiveness to the holistic nature of access.

Of the available theories, those from disability studies are the most interdisciplinary; scholars have used the disability studies approach to reconceptualise access discourse and practice in fields such as HCI (Ellcessor, 2015; Jaeger, 2012; Lewthwaite, 2014; Lewthwaite et al., 2018), instructional technology (Foley & Ferri, 2012; Kent et al., 2018) and education (Gabel, 2005; Naraian, 2017). However, none of the disability studies theories (1) integrate concepts from all four fields nor (2) address all of the human and non-human actors engaged in equitable and accessible technology-mediated compulsory education. Disability studies theories pertaining to compulsory education neglect in-depth discussions of technology and theories pertaining to technology in education focus on the tertiary education context. Moreover, scholars have called for more critical examinations of technology in various contexts using a disability studies approach (Goggin, 2018; Kent et al., 2018; Lewthwaite et al., 2018).

In sum, these four fields contribute essential knowledge for comprehensive theorising about disabled youth's access to technology-mediated compulsory education. The field of education offers deep knowledge about facilitating learning for diverse youth in the unique context of compulsory education. HCI provides extensive detail about how to create accessible technology. The field of law and policy explicates technology accessibility mandates around the world. Finally, disability studies problematises the conceptions of access from the other fields, clarifies that the goal of access theorising is to reimagine environments as hospitable to disabled people not to normalise disabled people so they fit into existing environments and furnishes more expansive conceptions of access.

To date, no one has suggested integrating the knowledge from these four fields nor demonstrated how to integrate all of the knowledge to construct an interdisciplinary understanding
of disabled youth's access to technology-mediated compulsory education. Therefore, in this paper, I take up the task of breaking down all of the disciplinary boundaries and integrating the deep knowledge of existing theories to construct a heretofore unavailable understanding of technology-mediated compulsory education that is equitable and accessible to disabled youth. The resulting framework, A4E, is more valuable than the sum of its parts for facilitating crucial social change within compulsory education because unlike existing theories, which narrowly focus on one facet of the issue (eg, technology, learning, or power structures), the A4E framework addresses all facets of the issue and explains the messy interactions among all of the human and non-human actors.

AN INTERDISCIPLINARY FRAMEWORK OF ACCESS

To construct A4E, I used an interdisciplinary disability studies approach and viewed the available literature through the lens of two theoretical frameworks: the political relational model of disability (Kafer, 2013) and the social shaping view of technology (MacKenzie & Wajcman, 1999). Six assumptions arising from these theoretical frameworks informed the development of A4E.

First, disability does not reside in individuals but in the relationship among humans, built and digital architectures, cultural norms and power structures (Kafer, 2013). Therefore, the ‘problem’ is not certain bodies or minds, the ‘problem’ is built and digital environments and the cultural patterns that perpetuate the oppression of those minds and bodies. Second, disability is not a monolithic experience; it is heavily influenced by one’s intersectional identities and the privilege or oppression that accompany those identities (Kafer, 2013; Meekosha & Shuttleworth, 2009).

Third, technologies are shaped by continual negotiations among human actors and the environmental context in which they emerge and are implemented (MacKenzie & Wajcman, 1999). Consequently, technologies are value-laden tools with encoded biases that humans create and use to solve political problems and, in so doing, frequently create new problems and reify long-standing forms of oppression (O’Neil, 2016). Fourth, issues of access to technology cannot be solved by merely fixing the technology because the problem is both human and technological (MacKenzie & Wajcman, 1999).

Fifth, access is pluralistic, relational and context-dependent. That is, access is not a state of an individual that once acquired exists across time and space but access is multidimensional, including physical, intellectual, social and cultural components (Goodley, 2013; Jaeger, 2012; Kafer, 2013; Mingus, 2011). Finally, disabled ways of knowing and being are equivalent to non-disabled ways of knowing and being (Kafer, 2013).

The name of the framework, A4E, emphasises three key characteristics of the complex work. First, the term ‘accessibility’ is used to connect the framework to the language of accessibility and the disability cultures that developed that language (Elcessor, 2015). Second, the phrase ‘for equity’ reveals the goal of the framework, equity for disabled youth in technology-mediated compulsory education. Third, the use of the numeral four symbolises the integration of theories from four fields.

It is worth noting that I intentionally avoided using the term universal to name the framework. As other scholars have argued, universal theories of access broaden the focus of access work from disabled people to the larger populous and in doing so push aside and obscure disabled people and their needs (Elcessor, 2015; Knoll, 2009; Voithofer & Foley, 2007). Moreover, using the value add to the majority to justify essential access for the minority is antithetical and is a false promise in the instances when disabled people’s access needs do not add obvious value for non-disabled people (eg, Braille and sign languages).
Consequently, the term *universal* is not part of the name because the A4E framework centres disabled youth in this essential access work.

**An overview of A4E**

Figure 1 illustrates the relationship between the constituent elements of the framework. The A4E figure features four nested concentric circles, which create a small centre circle surrounded by three rings. Below the nested circles, an arrow, labelled *equity*, represents continual movement to increase equity without suggesting an endpoint at which the work concludes. Process-oriented theories of access, such as ISO 30071-1 from the field of law and policy and disability studies theories that position accessibility as complex and expansive work informed the overall structure of the framework (ISO, 2019; Jaeger, 2012; Kafer, 2013; Kelly et al., 2007; Lewthwaite, 2014; Mingus, 2011).

The centre circle, labelled *disabled youth*, denotes the centring of disabled youth and the dashed outer ring, labelled *compulsory education*, locates this endeavour in the deep-rooted institution of compulsory education. The centring of disabled youth and the positioning of the work within compulsory education is critical given the relational and context-dependent nature of access, an idea that arises from the fields of disability studies and education (Ellcessor, 2015; Goodley, 2013; Jaeger, 2012; Kafer, 2013; Selwyn, 2011) and the unique lived experiences of disabled youth, which are different from those of disabled adults who have previously been the focus of most access work, including WCAG. For example, disabled youth are often still learning the assistive technology skills that disabled adults have mastered.

Moving out from the centre circle, the inner ring draws on other theories to delineate three key elements of the complex endeavour of constructing equitable technology-mediated learning environments—*born accessible*, *individualised*, and *cripped*. The three elements are represented as congruent segments of the inner ring.

Consistent with Jaeger’s (2012) Information World’s theory, born accessible learning environments ensure disabled youth have physical, intellectual and social access to learning. The framework argues that physical access is achieved by leveraging WCAG and legal requirements for accessibility (eg, Section 508, EN 301 549 V1.1.2 and Public Sector Bodies, 2018). Intellectual and social access, the framework asserts, is accomplished through the flexible pedagogical approach of UDL (Rose & Meyer, 2002).

The second element in the inner ring, *cripped*, incorporates the critical examination of abled power and privilege and the ways in which technology-mediated compulsory education reproduces that power; an approach to access work that arises from disability studies (Ellcessor, 2015; Goggin & Newel, 2003; Kafer, 2013; Lewthwaite, 2014). Moreover, this element positions disabled people as leaders and collaborators in access work, an idea rooted in the disability rights movement (Davis, 2013).

In harmony with scholars from disability studies, the third element in the inner ring, *individualised*, acknowledges that disability is intersectional, access is not a fixed state and learning is an interdependent activity in which individuals employ human and non-human supports (Knoll, 2009; Lewthwaite, 2014; Meekosha & Shuttleworth, 2009; Naraian, 2017). In the process of constructing born accessible learning environments, educators make powerful decisions about which supports will be inherent (eg, teachers, print books) to the environment and which will be auxiliary (eg, assistive technology, interpreters). Consequently, no learning environment is universally accessible. That reality, however, must not be the rationale for excluding some youth due to lack of ‘fit’. Rather, the individualised element of A4E asserts that educators’ work must include cultivating access intimacy—that elusive, hard to
FIGURE 1 The centre circle is labelled disabled youth. Moving out from the centre circle, the inner ring is divided into three congruent segments. The first segment, born accessible, reads WCAG, legal requirements, and UDL. The second segment, individualised, reads access intimacy and swiftly responsive. The third segment, crippled, reads disability-led, transformative work, examining abled power. The medial ring features the labels reflection and action positioned across the ring from one another with two-way arrows connecting them. The dashed outer ring is labelled compulsory education.

describe feeling when someone else ‘gets’ your access needs (Mingus, 2011, n.p.)—and swiftly responding to the individual needs of disabled youth.

Continuing out from the centre of the circle, the medial ring features two elements, reflection and action, positioned across the ring from one another with two-way arrows connecting them. This ring emphasises that the work of accessibility, delineated in the inner ring, is not...
Accessibility is praxis—a dialectical relationship between critical reflection on abled power and the ways it is reproduced by schools and educators and action to create learning environments that value and are hospitable to disabled youth. Action unmoored from critical reflection cannot dismantle the oppression of disabled youth in technology-mediated learning environments (Lewthwaite, 2014).

A4E’s propositions

Building on the knowledge across the four fields, A4E makes 3 interrelated propositions about technology-mediated learning environments that are equitable to disabled youth. These propositions lead to implications for practice, policy and research, which will be explored in the following sections.

Proposition 1
Equity for Disabled Youth Requires a Crippling of Technology-Mediated Education.

To disrupt systemic ableism, the A4E framework crips the discourse and practice surrounding technology-mediated compulsory education in four ways. First, A4E calls into question the compulsory abledness of technology-mediated pedagogy and demands that educators (ie, teachers and administrators) critically examine abled power and privilege and the ways in which their institutions reproduce that power. That work should be integrated with critical examinations of other power structures (eg, race, class, citizenship, gender, sexuality). Second, A4E centres the needs of disabled youth. Non-disabled youth may also benefit from this work, but their needs are not the focus nor the impetus. Third, the framework positions accessibility as transformative work conducted in collaboration with disabled youth and adults, as opposed to charity work done on behalf of disabled people. Placing a token disabled person on a rubber-stamping advisory board is not collaborating, it is a practice of objectification and is incongruent with A4E. Finally, the framework asserts that access work should be disability-led whenever possible.

Proposition 2
Equitable Technology-Mediated Learning Environments are Constructed Through the Sociotechnical Praxis of A4E.

Technology alone is insufficient to dismantle the oppression that is embedded in technology-mediated compulsory education. Adopting and implementing an accessible instructional technology, such as an accessible learning management system, will not eradicate the oppression of disabled youth in technology-mediated education broadly nor in the confined space of the learning management system. Just as humans can turn an accessible building into an inaccessible one by obstructing ramps, humans can embed inaccessible content (eg, videos without closed captions and video description) and oppressive pedagogy (eg, permitting only one means of demonstrating competency) into an accessible digital platform.

The oppression that disabled youth face is sociotechnical, a collaboration between humans and technologies. Therefore, educators have to engage in the sociotechnical praxis of A4E to construct technology-mediated learning environments that value and are hospitable to disabled youth. This praxis consists of deep reflection and action that continually evolves through the dialectical relationship between the two forms of labour (Freire, 1996). That is, as individuals and institutions reflect on the ableist nature of the status quo in technology-mediated education, they begin to intentionally reshape their beliefs, cultures, practices and technologies towards valuing and being hospitable to disabled youth. Moreover, when the ideological work of examining abled power and privilege and the concrete action of making
technology and pedagogy accessible become part of educators’ daily work the reflection and action inform each other and facilitate the construction of technology-mediated learning environments that are increasingly equitable for disabled youth. A4E is not a destination at which institutions or individuals will ever arrive, because access work is always in a state of becoming; it is never perfect nor complete (Kelly et al., 2007; Naraian, 2021). Therefore, the sociotechnical praxis of A4E must endure to ensure equity for disabled youth.

**Proposition 3**
Equitable learning environments are both born accessible and individualised.

To be equitable, technology-mediated learning environments must be born physically, intellectually and socially accessible to disabled youth. In other words, disabled youth must be able to reach, understand and use the information and knowledge shared and constructed therein (Jaeger, 2012). Born accessible technology-mediated learning environments only utilise technologies that conform to accessibility standards (ie, WCAG 2.1) and flexible UDL-aligned pedagogy. Equitable technology-mediated learning environments must also be individualised because disability is an individual intersectional experience. To construct individualised learning environments, educators must cultivate access intimacy (Mingus, 2011) with disabled youth by:

- Interrogating decisions about whether learning supports are inherent or auxiliary in a learning environment;
- Vigilantly identifying instances where the environment fails to provide the supports an individual needs to learn;
- Swiftly implementing missing supports;
- Creating spaces where disabled youth feel safe making access requests; and
- Abolishing requirements for disabled youth to justify their access needs for them to be granted.

Individual disabled youth might require analog supports, such as hardcopy tactile graphics or human supports, an assistant or interpreter. The timing of individualised supports is essential; forcing disabled youth to wait hours, days, or weeks for these essential supports is not equity, it is oppression. Moreover, these individualised supports are not a replacement for an alternative to born accessible learning environments. Individualised supports are an essential component of A4E that works in tandem with born accessible environments and the crippling of technology-mediated teaching and learning to ensure equity for disabled youth. It would be incongruent with A4E for an educational institution to implement a technology that was not physically accessible to disabled youth (ie, does not conform with WCAG) and then provide the accommodation of a human assistant as a way to circumvent the inaccessible technology.

In sum, the sociotechnical praxis of A4E disrupts the systemic ableism embedded in technology-mediated compulsory education by (1) crippling discourse and practice; and (2) constructing learning environments that are both born accessible and individualised so that disabled youth have equitable access to learning.

**DISCUSSION**

During the COVID-19 pandemic, a great deal of compulsory education is occurring remotely and is mediated by some form of technology. The ramifications of this digital turn are likely to continue unfolding beyond the pandemic. The A4E framework offers important insight for practitioners about how to ensure disabled youth have equitable access to learning.
A4E reminds educators that disabled youth are entitled to equitable access to technology-mediated compulsory education. In the abrupt transition to remote learning and digital environments, disabled youths’ access to technology-mediated learning environments has often been overlooked (Mitchell, 2020; NFB, 2020; Peterson, 2020; Swan, 2020). A4E rejects the practice of privileging the needs of abled youth—especially during a crisis—and demands that the needs of disabled youth be centred in the construction of technology-mediated learning environments during COVID-19 and beyond. The implications of A4E for practitioners during ordinary and extraordinary times are threefold, educators (i.e., teachers and administrators) must: (1) pause to critically reflect on their beliefs and actions, (2) ally themselves with disabled youth and adults and (3) act to ensure equitable access.

Critically reflect

One of the key propositions of the A4E framework is that access work is continual sociotechnical praxis. That is, the work is both human and technological and it requires both reflection and action. During a crisis, the focus is on the action. But the A4E framework compels educators to acknowledge that the action of implementing accessible technologies and flexible pedagogical approaches, while essential, is not sufficient to dismantle the oppression that disabled youth face in technology-mediated environments. Educators at all levels must set aside time to engage in the ideological work of critically examining abled power and reflecting on how they are complicit in reproducing that power. To do the ideological work, educators should ask themselves questions such as:

• How will I enact my values in constructing this technology-mediated environment;
• How will this environment actively make space for disabled ways of knowing and being so that disabled youth feel safe and free to learn;
• How will this environment intentionally promote disabled youth and acknowledge their genius;
• In what ways do the norms in this environment afford and prohibit disabled youth’s engagement; and
• How am I disrupting the compulsory abledness that the instructional technology industry perpetuates?

This ideological work is foundational to A4E. Before one can ally themselves with disabled people or engage deeply in action, one must first turn a critical lens on their practice. Those who approach the disabled community to develop relationships without first engaging in this ideological work are liable to do so wearing a hero’s cape and expecting disabled people to rejoice in their arrival—an approach that, in addition to being counterproductive, will cause harm.

Ally with disabled people

A4E positions access work as transformative work carried out in collaboration with disabled people; it is political work aimed at disrupting oppression and amplifying the thoughts of disabled youth. The first step in engaging in this type of work is to affirm that the goal is not to save disabled youth or to help them overcome their disability—because disability is not something that needs to be overcome and disabled youth do not need heroes. Disabled youth need allies who will push for social change with them and their disabled elders.
The second step is to recognise that disabled youth and adults are the access experts; it is to them that educators should turn for guidance and leadership. That does not mean that disabled youth and adults should do all of the work or that abled people are not responsible for educating themselves. It means that educators need to recognise and value the wisdom and skills that disabled youth and adults have developed by inhabiting an ableist world—wisdom and skills abled people do not possess.

The third step is to develop deep meaningful relationships with disabled youth and adults and intentionally engage them as critical friends and leaders in the work. One effective way to engage disabled adults is to hire them to fill positions across your institution. If there are not any disabled employees at your institution or disabled community members who are interested in engaging in the work, first ask yourself why those people do not exist in your space or why they are not interested in engaging. Then, hire disabled accessibility consultants to provide the essential expertise. As for the youth, students who are old enough to work can also be hired as consultants and students of any age can be compensated for their expertise through academic merit. It is unjust to expect disabled people to give away their specialised knowledge and skills.

Disabled employees, disabled youth and disabled community members engaged in the work will identify inaccessibility and ableism that is baked into your institution's technology-mediated learning environments—factors that abled educators have overlooked. Disabled people will also have novel ideas about how to structure learning environments that are equitable and accessible to disabled youth. Moreover, if disabled people are meaningfully engaged and their knowledge and viewpoints are valued in future work, inaccessibility and ableism can be addressed before the oppression becomes inherent in the learning environment.

Act to ensure equitable access

With the foundational work of critical reflection underway, educators can begin to act. The action required to ensure disabled youth have equitable access to technology-mediated learning environments involves three substantial activities: (1) examining and remediating existing learning environments; (2) proactively constructing born accessible learning environments moving forward; and (3) developing the capacity to cultivate access intimacy and swiftly respond to individual needs.

Examining and remediating existing learning environments

Examining and remediating the existing technology-mediated learning environments to be accessible to disabled youth necessitates a two-part process, which will require the involvement of technology staff, administrators, teachers and accessibility experts. First, teams must determine if the key platforms that they currently use (eg, learning management systems, video conferencing apps, etc) at a minimum comply with WCAG 2.1. The technical standards, while imperfect, facilitate physical access—opening the door for many disabled people to reach the learning environment. To determine conformance with WCAG 2.1, teams should:

1. Review the Accessibility Conformance Reports (sometimes called Voluntary Product Accessibility Templates) for the platforms they use; and
2. Have an accessibility expert, preferably a disabled person, test the platforms using automated tools and manual testing.
Second, teams must examine the pedagogical approaches that are used to determine the extent to which those approaches align with UDL. Specifically, are those pedagogical approaches flexible? Do they provide multiple means of representation, action and expression and engagement (Rose & Meyer, 2002)? To remediate inaccessible technologies or pedagogical approaches that are identified during the evaluation, educators should look to the literature on technology accessibility and UDL (see Crossland et al., 2017; Meyer et al., 2014; Shaheen, 2019).

Constructing born accessible learning environments

Moving forward, to construct born accessible technology-mediated learning environments that centre disabled youth, educators should intentionally utilise technologies and pedagogical approaches that are accessible. Instead of constructing technology-mediated environments by chasing the latest instructional technology trend, educators should approach the work with a critical lens—assuming that digital tools and pedagogical approaches that are not explicitly promoted as accessible to disabled people likely are not accessible and recognising that some tools and approaches that are promoted as accessible will fall short. Incorporating accessibility into the procurement process, to ensure new technologies conform with WCAG 2.1 at a minimum, is an essential component of this work (see Lazar et al., 2015; Shaheen, 2019; Shaheen & Lohnes Watulak, 2019). Another essential component involves providing ongoing professional development for teachers and instructional designers about UDL so that they can develop UDL-aligned pedagogical approaches that are suitable across the curriculum and various technology-mediated contexts.

Developing capacity to individualise

The A4E framework asserts that equitable technology-mediated learning environments must be individualised, which requires cultivating access intimacy and swiftly responding to individual needs. Therefore, the final action that educators, especially administrators, must take is to develop both the infrastructural and pedagogical capacity to cultivate access intimacy and swiftly respond to individual disabled youth's needs. From an infrastructure standpoint, sufficient human and financial resources must be available to swiftly meet the foreseeable but dynamic needs of individual disabled youth. Moreover, administrators should interrogate and, wherever possible, abolish bureaucratic structures that require disabled youth to labour through administrative procedures to justify their need for learning supports, just because those supports are different from the supports their peers require.

From a pedagogical standpoint, educators should examine how resources in the nondigital world could be implemented to further support disabled youth. For example, how could one leverage non-digital resources to support an adventitiously disabled student who has not yet mastered the assistive technology they need to navigate the accessible digital interfaces the school is using for remote or online learning? Or consider a blind student taking spatially intense subjects like science and math; they will need figures rendered in either a paper tactile graphic or a 3D object because the technology for representing spatial information in a digital tactile format is still rudimentary and difficult to acquire in 2021. How will the school swiftly provide those analog resources?
Social change is complicated

To move forward and start crucial social change, A4E enjoins educators to (1) pause to critically reflect, (2) ally themselves with disabled youth and adults; and (3) act to ensure equitable access. Social change is messy and complicated; educators who take up this work are likely to confront challenges and resistance. Galvanising people around a new endeavour that does not have a finite list of action steps or a definitive endpoint will take time and require institutional knowledge and interpersonal skill. The work of A4E requires a complete reversal of course from a model of forcing disabled youth to fit into an inflexible learning environment to a proactive model of always centring disabled youth when designing learning. That paradigm shift means that inaccessible technologies and pedagogical practices that educators might feel are beneficial for abled youth have to be reimagined, redesigned, or replaced. Some educators will have a difficult time embracing that work. To them, it may feel unfair to deny dozens of abled youth opportunities for the benefit of a ‘small number’ of disabled youth.

One approach for softening the task is to articulate all of the ways that abled youth will benefit from accessible learning. While that seems at first blush to be a win-win message, the subtext of that pitch is that access work is only worth doing if it benefits the abled majority—a message that reinforces the ableist ideas that underpin the unjust status quo that necessitates this work. An alternative approach, which is aligned with the propositions of A4E, is to engage in a dialogue about ways to meet the same learning goals using alternative technologies or pedagogical approaches that ensure disabled youth have equitable access. Research, I (2019) conducted with compulsory schools in the US indicated that these questions and challenges are likely to also arise during the procurement of new technologies, particularly when there are no products on the market that have the desired capabilities and are accessible. While this work is not simple nor straightforward, educators in the US who have begun the work reported it was worth the effort (Shaheen, 2019).

CONCLUSION

In this paper, I advanced a new interdisciplinary framework—A4E—that, unlike existing theories, fully addresses the issue of disabled youth’s access to technology-mediated compulsory education by explaining the messy interactions among human and non-human actors engaged in equitable and accessible learning within the context of compulsory education. A4E asserts that equitable technology-mediated education is (1) constructed by educators and disabled people collaboratively criping technology-mediated compulsory education through sociotechnical praxis, (2) born technologically and pedagogically accessible; and (3) requires the infrastructural and pedagogical capacity to cultivate access intimacy and swiftly respond to individual needs. Ergo, A4E is a framework for embarking on a long and complex journey for crucial social change.

Constructing a framework is just the beginning of the work required to dismantle the oppression that disabled youth face during ordinary and extraordinary times. As I outlined in the discussion section, moving forward there is a great deal of work for practitioners to do in collaboration with disabled youth and adults. The burden of the work, however, must not rest solely on practitioners. Lohnes Watulak and I (2019) previously pointed out the dearth of literature pertaining to technology accessibility in compulsory education; this dearth of theoretical and empirical knowledge necessitates substantial work from researchers. Disabled youth need scholarly allies who will work with them and their disabled elders to push back on the systemic oppression they face in compulsory education today. I encourage scholars across the academy to take up this interdisciplinary topic and help construct the urgently
needed knowledge. Just as the work in the schools must be done in collaboration with disabled youth and adults, so, too, must the research.

The lack of knowledge about technology accessibility and the needs of disabled youth in technology-mediated environments has perpetuated the oppression that disabled youth face during ordinary times, and it has amplified the oppression that disabled youth face during the extraordinary time of COVID-19. If practitioners and scholars begin to centre disabled youth in the technology-mediated educational work they do, ally themselves with disabled youth and adults, and critically reflect on abled power and its reproduction within education, collectively we can begin to change the status quo and move towards technology-mediated compulsory education that is equitable for disabled youth. It is technologically, pedagogically and ideologically possible to construct technology-mediated learning environments that are equitable to disabled youth and incorporate emerging instructional technologies.

The only just path forward is to collaboratively reimagine technology-mediated compulsory education as a place that values and is hospitable to disabled youth and A4E is a framework that scholars and practitioners can use to embark on that social change.

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CONFLICTS OF INTEREST
I have no conflicts of interest to disclose.

DATA AVAILABILITY STATEMENT
The data discussed herein are available in the scholarly literature, which can be accessed through most university libraries.

ETHICS STATEMENT
Given this is a theoretical paper and no human subjects research was conducted, IRB approval was not required.

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