

Open Education Resources: Ensuring Inclusive Learning in Uncertain Times

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National Center on Accessible Educational Materials (2021). *Open education resources: Ensuring inclusive learning in uncertain times*. Wakefield, MA: National Center on Accessible Educational Materials.

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I. Overview

Open Educational Resources: “In the 2017 National Education Technology Plan, the U.S. Department of Education defines openly licensed educational resources as teaching, learning, and research resources that reside in the public domain or have been released under a license that permits their free use, reuse, modification, and sharing with others. Digital openly licensed resources can include complete online courses, modular digital textbooks as well as more granular resources such as images, videos, and assessment items.”¹

This document is an update to “Open Educational Resources: Designing for All Learners” by Andrew Hashey & Skip Stahl, published in 2014. Sections of that prior document have been edited, revised, and, in one or two cases, eliminated in order to more accurately reflect the current state of accessible Open Educational Resources, or OERs, in elementary, secondary, and postsecondary settings. In addition, given the precipitous shifts education necessitated by the COVID-19 pandemic, the authors recognize that both curricular and economic factors, among others, will likely impact OER adoption across the spectrum of schooling; to that end it is hoped that this updated overview proves helpful. This document is designed to provide an overview of accessible digital open educational resources (OERs) for elementary, secondary, and postsecondary education personnel involved in the selection, acquisition, and/or use of instructional materials.

Situated at the intersection of where the OER field meets accessibility issues, this paper details a variety of resources useful for evaluating and selecting appropriate and accessible OERs. Such resources can help decision-makers choose open educational resources that will be usable by the broadest range of learners present in their instructional settings. The Guide also outlines design challenges related to the creation of accessible OERs and points to useful approaches for creating OERs that are accessible for the widest possible range of users.

Bliss and Smith (2017) in their detailed history of OERs cite five activities the OER designation permits everyone to engage in, freely and in perpetuity, when using OERs. These are commonly referred to as the "5Rs", and are identified at [Opencontent.org](https://opencontent.org/):

1. Retain: Make, own, and control a copy of the resource (e.g., download and keep your own copy)
2. Revise: Edit, adapt, and modify your copy of the resource (e.g., translate into another language)

3. Remix: Combine your original or revised copy of the resource with other existing material to create something new (e.g., make a mashup)
4. Reuse: Use your original, revised, or remixed copy of the resource publicly (e.g., on a website, in a presentation, in a class)
5. Redistribute: Share copies of your original, revised, or remixed copy of the resource with others (e.g., post a copy online or give one to a friend)²

In contrast to earlier paper-based and commercial products, digital OERs created with these allowances can provide utility and impact in ways their original creators may never have imagined. Tracing growth from 1994 to the present, Bliss and Smith detail the extensive adoption of OER materials within national and international postsecondary settings, and the more recent, but growing application of OER and associated Open Educational Practices (OEPs) in elementary and secondary education.³

During the years since the original publication of this paper, OERs have emerged as key resources in all educational settings. As of 2020, 20 states have now signed on to the #GoOpen Initiative.⁴

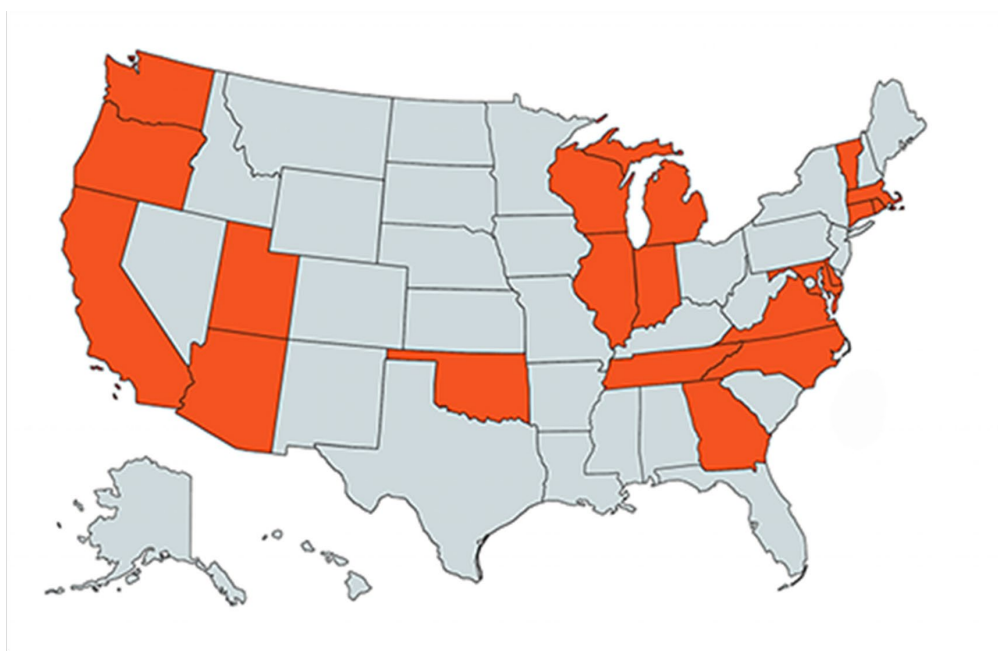


Figure 1: Map of U.S. States participating in the #GoOpen Initiative. Source: <https://tech.ed.gov/open/states>.

By joining this coordinated effort, these states have agreed to:

- Adopt/Implement a statewide technology strategy that includes the use of openly licensed resources as a central component

- Develop and maintain a statewide repository solution for openly licensed resources
- Participate in a community of practice with other #GoOpen states and districts to share learning resources and professional development resources
- Create a webpage to share the commitment to #GoOpen and document the state’s progress.⁵

A stronger emphasis on the accessibility of OERs is an important emerging trend. For example, in 2020, the Fund for the Improvement of Postsecondary Education program at the US Department of Education funded an Open Textbooks Pilot program to demonstrate cost savings in high-enrolment courses.⁶ In addition to this economic expectation, OERs developed with this funding must also attend to and document accessibility:

All digital content developed under this grant program must incorporate the principles of universal design (www.cast.org/udl/) to ensure that they are accessible to individuals with disabilities. The content and courses must be in full compliance with the Americans with Disabilities Act, Section 504 of the Rehabilitation Act of 1973, as amended, and the Web Content Accessibility Guidelines 2.0, Level AA (www.w3.org/TR/WCAG/).⁷

OERs hold the potential to democratize avenues to learning where barriers have long stood. However, in order for students with disabilities, to achieve equal benefit from OER-based learning opportunities, accessibility issues must be addressed. The extent to which curriculum materials are appropriate for, and usable by, students with sensory, physical, learning, and cognitive disabilities is both a civil right and an educational mandate. Ensuring that curriculum resources are usable by every student is increasingly important as schools, colleges and universities expand their use of digital learning resources. While many solutions exist for transforming inaccessible print-based instructional materials into more accessible digital formats, retrofitting digital resources for accessibility may present far more technical challenges. As a consequence, acquiring or creating digital versions that are accessible from the outset becomes a key consideration.

The extent to which curriculum materials are appropriate to and usable by students with sensory, physical, learning, and cognitive disabilities is both a civil right and an educational mandate.

Further, accessibility features designed for learners with disabilities offer enhanced flexibility for culturally and linguistically diverse students, and simply provide more alternatives for all potential learners.

Addressing Precipitous Change

In order for this vision to become a reality, OERs ideally must align with an educational institution's curriculum, instructional philosophy, and established practices. As a consequence of COVID-19, for example, each of these components in every school and university in the country was disrupted. According to a study by McKinsey & Company, a management consultancy, the period of contagion, self-isolation, and economic uncertainty profoundly changed the behavior of the nation's consumers and shifted digital solutions from an optional asset to a primary necessity.⁸ A McKinsey survey noted that "Digital adoption rates...covered decades in days, with e-commerce deliveries increasing in the initial 8 weeks of the pandemic what took previously 10 years to achieve, telemedicine increasing tenfold in 15 days, remote working soaring twentyfold in 3 months, and online entertainment service Disney+ achieving in 5 months what took Netflix 7 years to do, and 250M Chinese students switched to online learning in 2 weeks."⁹

The shift to remote instruction has been crisis-driven and abrupt, forcing all of the nation's K-12 systems into online learning, most with little expertise or capacity.¹⁰ [Burbio's K-12 School Opening Tracker](#) offers a regularly updated national map of virtual and face-to-face learning in US K-12 settings that graphically details the scope of the pandemic's impact.

IN-Person Index
(0=Virtual;100=Traditional)

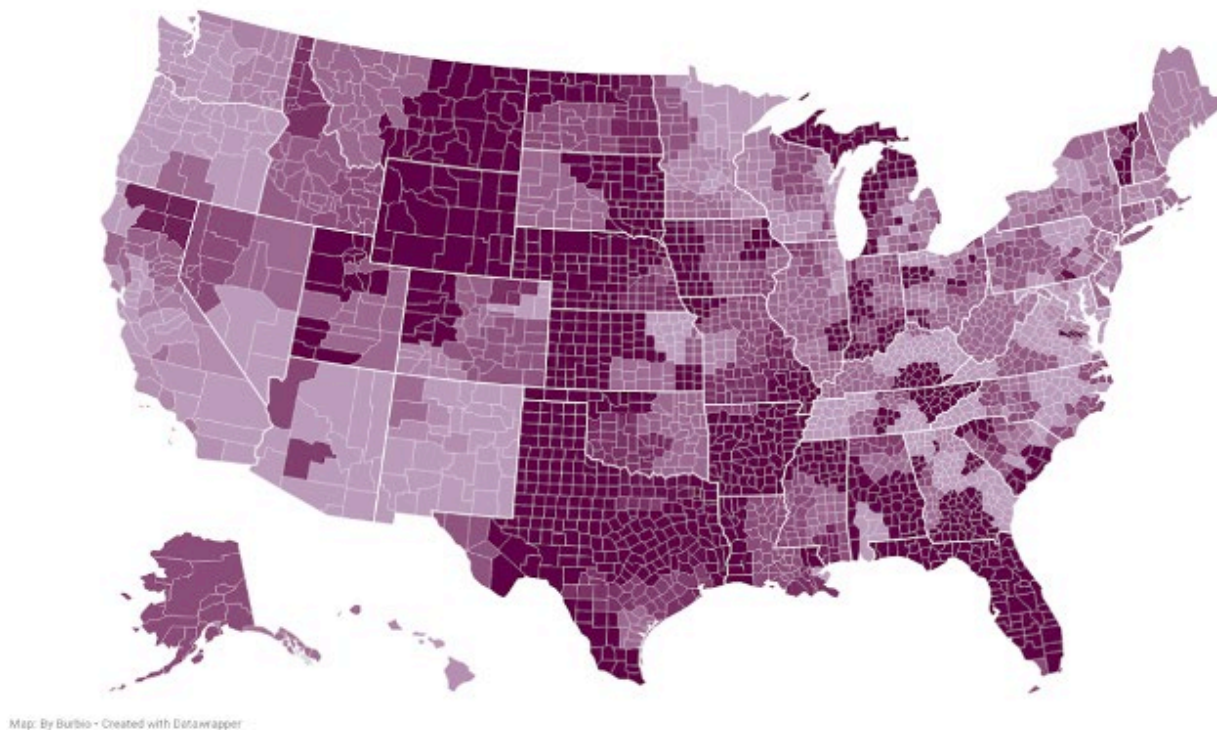


Figure 2: Burbio's K-12 School Opening Tracker. Source: Burbio (<https://cai.burbio.com/school-opening-tracker/>).

While postsecondary sites weathered the initial transition to remote learning better than K-12 schools, numerous courses of study were forced into remote practices ill-suited to many discipline-specific outcomes.

If this disruption was short-lived, in-person schooling could be quickly re-established and the process of education would return to established practices. Rapid resolution appears to be increasingly elusive, however, and most schools are moving to incorporate remote, digital learning as a core feature, rather than as an adjunct offering. Simultaneously, budgets—municipal and educational—are facing record projected shortfalls, all of which leading decision makers to re-evaluate expenditures. As a result of these factors, the cost savings that have been touted as an inherent feature of OERs have significantly increased appeal.

II. The Increasing Adoption of Open Educational Resources (OERs)

The rapid worldwide growth of OERs can be attributed to a multitude of factors. Chief among these is the notion rooted in the United Nations' Human Rights Declaration (Article 26) that all people have the right to a free education at elementary levels.¹¹ As referenced earlier, 20 States in the United States have joined the #GoOpen Initiative.

Research and reporting on OER usage continue to underscore numerous potential benefits of OERs for all learners, including those with disabilities. These include expanded access to learning resources, cost savings, and flexibility in content development—among other advantages (synthesized in Table 1 below).

Table 1. Advantages of Digital Open Educational Resources for Learners with Disabilities

Context	Opportunities
Permissions	An open license removes legal barriers to customization, creating opportunities for more flexible learning environments and practices
Curation	Educators can curate materials from a diverse range of contributors, including those with disabilities
Adaptation & Dissemination	Materials adapted to increase accessibility can be shared widely
Cost Reduction	An Open license removes upfront costs for both students and instructors
File Formats	Digital OER can be replicated, transformed, and shared in file formats that may be better designed from the outset to be interoperable with assistive technologies. ¹⁰

Cost Savings

The issue of cost continues to be a main consideration in the adoption of educational resources, and therefore a boon for OER adoption and use. A 2017 curriculum adoption survey of 584 school districts indicated that districts serving high poverty students adopted OER at a rate more than double districts with low rates of student poverty: 22% to 10% respectively.¹¹ Districts with a high percentage of students in poverty also reported that the cost of instructional materials was either a critical or very important factor in their decision-making compared to districts with a lower percentage of students in poverty. The potential cost savings of OER adoption was earlier detailed in a study of

middle and high school students in 2012.¹² In this study only two of 20 teachers chose to provide OERs (science textbooks) in a digital format with the remainder utilizing a full print or print-on-demand approach, which increased the cost of OER deployment. Nevertheless, the authors reported that the cost of a single commercial textbook was amortized to \$11.43/year during a seven-year cycle of use compared to \$5.14/year for the OERs selected.

In the postsecondary space, one OER textbook provider, OpenStax, reported use of their curated OER by 48% of colleges surveyed and approximately 2.2 million students.¹³ Another survey analysis using this aggregated data estimated that, on average, postsecondary students enrolled in courses using OER saved \$116.94.¹⁴

Given the projected and significant economic impact of COVID-19 on both municipal and institutional budgets, one can assume that immediate and projected cost considerations will be a greater factor in emerging curriculum materials acquisitions in both K-12 and postsecondary decision-making.^{15,16}

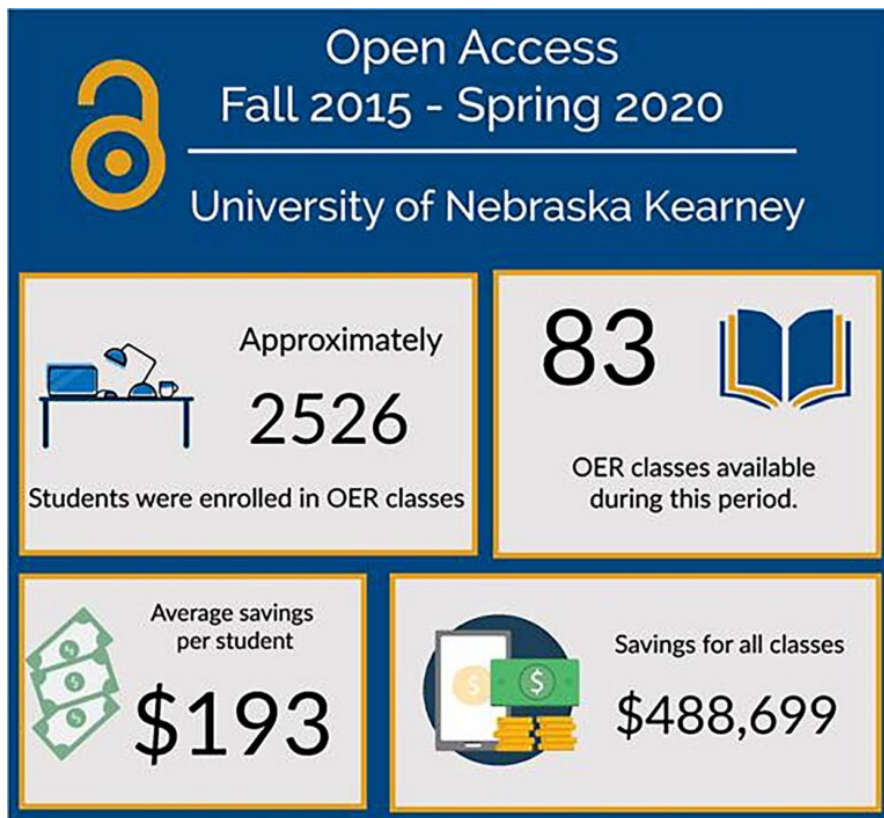


Figure 3: The adoption of an OER program at the University of Nebraska Kearny saved each student an average of \$193 in textbook costs. Source: University of Nebraska Kearney (<https://guides.library.unk.edu/open-educational-resources>).

Flexibility is a Key Factor in an Upheaval

With nearly every school thrust into emergency remote learning, society's evolving reliance on digital access exploded overnight, revealing significant discrepancies between those having, and comfortable with, internet appliances and access, and those without. Schools that had previously initiated remote online or "blended" options fared better than those that hadn't, but the crisis has been felt by all involved. Schools that could quickly inject flexibility into all four aspects of their curricula—goals, materials, methods, and assessments—have been able to reconstitute a semblance of continuing, if altered, education and opportunity.¹⁷

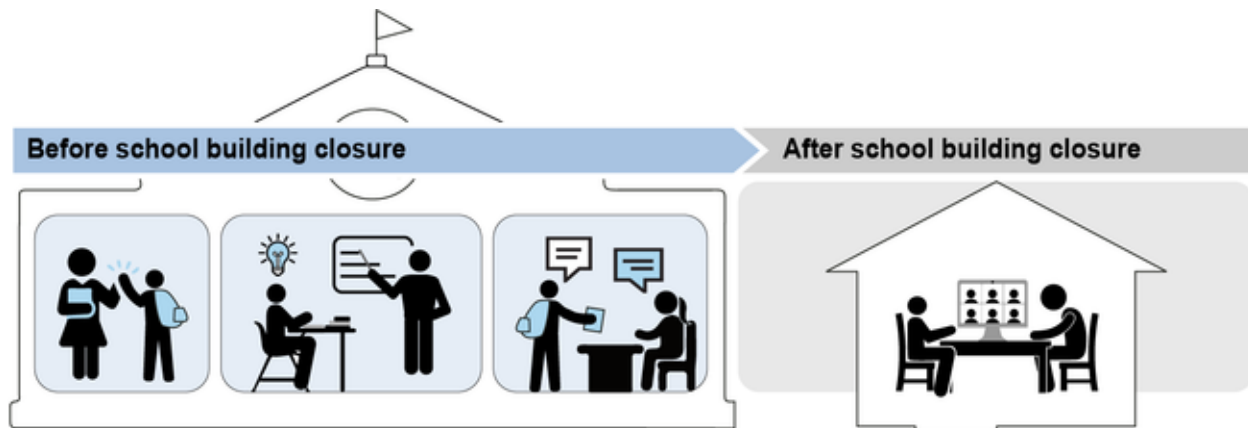
During this period of extended uncertainty, the availability of flexible, inclusive learning materials, especially free or low-cost digital ones that can be accessed from anywhere, has increasingly been viewed as a logical necessity.¹⁸ Although the gap between learners who are connected and those who are not has been gradually narrowing, the COVID-19 crisis revealed these discrepancies in stark contrast. Furthermore, students with disabilities and in poverty or in under-resourced learning settings have experienced even more debilitating limitations.¹⁹ These populations disproportionately struggled with lack of devices suitable to remote learning, lacking internet access and education personnel unfamiliar with teaching online.²⁰

This reality underscores the sense of urgency with which accessibility must be considered across all technology contexts and compounds the need to ensure that OERs—designed to benefit historically under-served groups of learners such as individuals with disabilities—are designed with all learners in mind. The flexibility of OER, then, can be viewed as a true equalizer only when these resources are fully accessible—both in the sense of users possessing internet-enabled devices and connectivity, as well as being usable by the full range of learners, including those with disabilities.

III. Making Good on the Promise of OERs: Reaching All Learners

Dominant perspectives on open educational resources maintain that while OERs are intended for use by all, a primary utility lies in facilitating access for those who benefit least from current conditions.²¹ In addition, OER design, development and distribution can facilitate innovative solutions to educational challenges in ways that may not be possible, or be difficult, within commercial enterprise.²²

The current public health crisis precipitated by COVID-19 has significantly increased the need to address learner variability in targeted and innovative ways. A recent report to Congress from the Government Accountability Office (GAO) highlights the diminished opportunities for students with disabilities in particular as K-12 schools all transitioned to remote learning:²³



Source: GAO analysis of interviews. | GAO-21-43

Figure 4: The shift to remote learning meant that opportunities for personalized support were reduced as learning moved to virtual environments. Source: US Government Accountability Office (<https://www.gao.gov/products/gao-21-43>)

In response to the remote learning imposed by COVID-19, GAO guidance related to OER use has quickly emerged. One set of recommendations is aligned to the United Nations Educational, Scientific and Cultural Organization (UNESCO) OER guidelines in five areas:

1. Building capacity of stakeholders to create access, use, adapt and redistribute OER
2. Developing supportive policies
3. Encouraging inclusive and equitable quality OER
4. Nurturing the creation of sustainability models for OER
5. Facilitating international cooperation.²⁴

These recommendations, which support the widespread adoption of OER, also note that these “Open” instructional materials and media need to exist within the context of Open Educational Practices (OEP).²⁵

Open Educational Practices are defined as instructional approaches that can only occur within the context of the “Five Rs” referenced previously: Retain, Reuse, Revise, Remix

and Redistribute. Combining OER (materials) with OEP (approaches) leads to innovative solutions, and “permissions” both the instructors who select these resources and their students who use them to create, re-create, enhance and further distribute these assets.²⁶ To that end, both OER and the OEP that incorporate them have the potential to facilitate inclusive education. How are they doing?

A recent (2020) literature review of 31 published papers exploring both OER and OEP in the context of accessibility and the inclusion of learners with disabilities applied four attributes—perceivable, operable, understandable, and robust—from the Web Content Accessibility Guidelines (WCAG 2.0) as an analytical framework.²⁷ To guide their inquiry the authors created a table correlating WCAG 2.0 attributes to guidelines related to OER functionality:

Table 2 Description of the WCAG 2.0 Attribute and Guidelines applied to OER

WCAG Attribute	WCAG Attribute Description	OER Guidelines	OER Guidelines Description
Perceivable	The content and interfaces of OER can be perceived by users.	Text Alternatives	Provide a variety of forms that people need for non-textual content, such as large print, Braille, and so on.
		Time-based Media	Provide access to time-based media.
		Adaptable	Ensure that all OER are available in some way to all users
		Distinguishable	Make the default presentation easy to perceive by people with disabilities.
Operable	OER, including the content and interface, must be operable for users.	Keyboard Accessible	Make all functionalities achievable by using the keyboard.

WCAG Attribute	WCAG Attribute Description	OER Guidelines	OER Guidelines Description
		Enough Time	Provide enough time for users to use OER.
		Optically neutral	Do not design OER in a way that might trigger seizures.
		Navigable	Support navigation and retrieval functions.
Understandable	OER, including the content and interface, must be understandable by users.	Readable	Make OER text readable and understandable.
		Predictable	Make OER contents display and operate predictably.
		Input Assistance	Provide more assistance to avoid and correct mistakes.
Robust	OER must be robust enough that it can be accessed by a variety of types of user agents, including assistive technologies.	Compatible	Increase compatibility with the current and future user agents, especially assistive technologies: i.e., screen reader or Braille display devices

Of the publications reviewed, only two emphasized authoring tools designed to create accessible OER, leading the authors to note: “This might explain the limited number of fully accessible OER.” A recent scan of OER authoring tools that either emphasize or incorporate accessibility features identified three notable resources: [Pressbooks](#), [MERLOT Content Builder](#), and [Open Author](#) from OER Commons, which includes a built-in accessibility checker developed in collaboration with the [Center on Inclusive Software for Learning](#).

One additional finding noted that the majority of surveyed papers employed a functional approach to measuring OER accessibility, and that no inquiry utilized learning analytics or student data to confirm or deny findings in the context of academic achievement. Consequently, while OER could be determined to be usable or not usable by a student with physical, sensory, or cognitive challenges, any associated achievement impact remained elusive.²⁸ Broadening the use of learning analytics has potential to sharpen OER creators' understanding of users' experience with their resources, and with the outcomes associated with their use.

IV Addressing Learner Variability

Universal Design for Learning (UDL) is predicated on a concept of learner variability that has emerged from neuroscience research. A recent article detailing the research basis for UDL identifies:

...three general dimensions of systematic variability that exist in every learner at every age: differences in terms of the way they represent information, differences in the way that they engage with media and material, and differences in the way they can act and demonstrate what they know.²⁹

The core principles of UDL—multiple means of engagement, action and expression, and the representation of information—and the associated [UDL Guidelines](#), strategies, and checkpoints for those designing and delivering educational environments acknowledge this triad of variability.³⁰ Instructional materials designed and implemented while attending to a UDL framework offer flexibility sufficient to personalize a learning opportunity for each student.

Practical strategies for incorporating UDL into postsecondary OER materials and practices exist at [UDL On Campus, Tacoma Community College](#); [Global UDL Classroom](#), and [UNESCO](#), among others. As mentioned earlier, the accessibility expectations inherent in a UDL approach are also required as a part of the US Department of Education's "Open Textbooks Pilot Program"³¹ For elementary and secondary education, the #GoOpen Initiative sponsored by the US Department of Education's Office of Educational Technology (OET) and the Council of Chief State School Officers (CCSSO) has incorporated UDL for both its policies and practices.³²

V. Efficacy-Based Research

Determining the extent to which any educational resource elicits its intended result is of great importance. Given that adaptive reuse is a central characteristic of OERs, the evolving nature of any given OER renders difficult any long-term attempt to evaluate the

degree to which it advances important educational outcomes. Much has written about the challenges inherent to efficacy-based research on OERs,³³ and this challenge holds true for OER implementation in both the K-12 and postsecondary settings.

K-12—Since the original publication of this paper, research into the efficacy of OERs has expanded considerably. As noted previously, the systematic or even schoolwide use of OER in K-12 settings continues to be limited but growing. An analysis of K-12 OER research 2012-2017 found the focus of the majority of those inquiries to be theoretical & philosophical as opposed to outcome-based.³⁴ A large-scale comparative analysis of elementary students (grades 3, 4, and 5) mathematics achievement found no outcome differences between those using OER versus commercial resources.³⁵ Other studies have suggested positive outcomes for struggling students who use OERs for math practice; specifically, students' logins, video views, and practice questions answered, were positively associated with their later performance on assessments.³⁶ This limited data suggests the use of OER is associated with outcomes comparable to, or better than, those connected to the use of commercial resources.

Postsecondary—Research and analyses of OER adoption and outcomes in postsecondary settings have predominated, but inquiries related to OER use in K-12 schools is growing. A review of 16 efficacy and 20 postsecondary student perception studies suggests both equal or greater academic outcomes coupled with significant cost savings.³⁷ Another meta-analysis of research studies aimed at determining the impact of OER use on postsecondary student academic outcomes and withdrawal rates. This study found no measurable difference for academic achievement between OER and commercial textbook use but did note a significantly lower rate of course withdrawals among students in courses using OERs.³⁸

Efficacy inquiries related to OERs have tended to focus on comparing the cost, quality, editorial exactness, and standards alignment of OERs to their commercial counterparts, with the default assumption being that commercial curriculum products meet the preferred criteria in those categories. This positioning may be a false dichotomy with respect to academic achievement since little learning media-centric research has met the What Works Clearing House (WWC) research standards, so there is little validated research documenting the validity of instructional materials. As some inquiries have noted, cost and politics often dictate elementary and secondary textbook selection more than any associated academic outcomes.³⁹ Combining comparatively equal educational achievement benefits with significant cost savings to K-12 states and districts and to individuals engaged in postsecondary learning, a strong case is made for the democratizing impact of OER for learners across the educational landscape.

VI. Identifying and Selecting Accessible OERs

Considerations

Statutory Expectations for Accessibility

Ensuring that learning materials are usable by every student, or available in alternate formats that provide an essentially equivalent ease of both use and opportunity is a concept inherent in education, civil rights, and copyright law. Equal access to educational opportunities is embedded in federal civil rights and education laws, including the Rehabilitation Act of 1973, the American with Disabilities Act in 1990, the Individuals with Disabilities Education Act (IDEA) of 2005, and the Every Student Succeeds Act (ESSA) of 2015. Universal Design for Learning, with its essential accessibility expectations, is included in the Higher Education Opportunity Act (2008), the ESSA (2015), and in every National Education Technology Plan for the past decade.

Of recent note, in 2020 the United States Department of Education published an updated interpretation related to the Individuals with Disabilities Education Act of 2005 (IDEA), noting that, for the purposes of ensuring that inclusive and appropriate learning materials are made available to every elementary and secondary student who needs them, the term “Print Instructional Materials” includes digital instructional materials.⁴⁰ This interpretation acknowledged the increased prevalence of digital materials in K-12 schools and that those materials also need to conform to accessibility expectations. These protections also extend to the copyright domain. In 2019, Section 121 of the Copyright Act was amended to broaden access to literary and musical works by eligible individuals who required “accessible formats” in order to meet the use and opportunity expectations.

In addition to federal statutory requirements, most states have accessibility mandates built into their instructional materials acquisition laws and regulations. Specific state-by-state accessibility information is available from the State Educational Technology Directors Association’s (SETDA) [Digital Instructional Materials Acquisition Policies for States \(DMAPS\)](#) online database and, for K-12 requirements specifically, from the interactive map provided by [3playmedia](#). In the absence of any information to the contrary, federal and state accessibility requirements and mandates designed to address commercial instructional materials should be assumed to apply to OERs as well.

OER Formats

OERs are created in many digital formats. In the context of this overview, open source apps and standalone games should be considered inaccessible unless stated otherwise. Alternatively, games developed according to the [Game Accessibility Guidelines](#) have been created with inclusivity in mind and may come accompanied by a checklist detailing the accessibility features offered.⁴¹ Mobile apps are extensive, and while guidance exists for designing apps for use by individuals with varying sensory, physical and cognitive capabilities, there are few “user friendly” utilities for checking app accessibility.^{42, 43} Apple Computer’s [Human Interface Guidelines](#) and [Accessibility on iOS](#), and Google’s [Build More Accessible Apps](#) and [Make Your App Accessible](#) offer detailed assistance for creating accessible applications but require technical expertise to take advantage of these resources.

In the majority of K-12 and postsecondary settings, OERs augment, replicate or replace more “traditional” curriculum resources: leveled readers, textbooks, novels and stories, white papers, news articles, trade publications, etc. Word documents, PDFs, webpages (HTML) and EPUBs tend to be the most common formats of digital OERs used in educational settings. Below we highlight key accessibility resources that help users render materials in these formats usable by all.

Microsoft Word documents: Microsoft Office has a built in “Accessibility Checker” for use in all Office applications. In Word it can be found under the “Review” tab

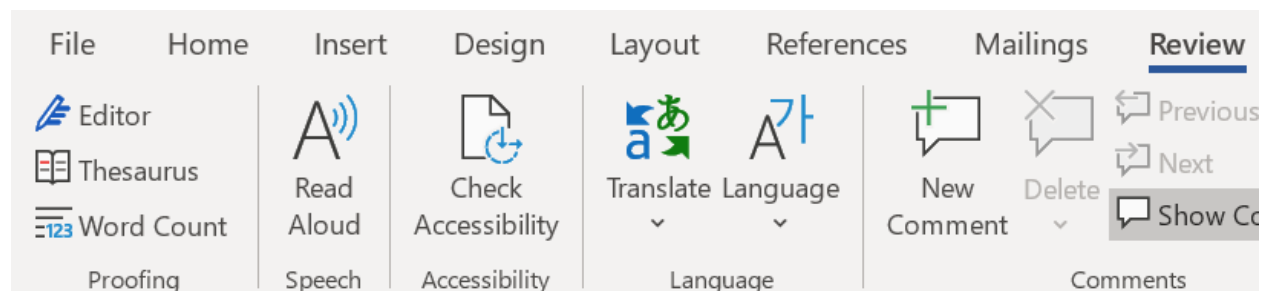


Figure 5: Microsoft Word includes an Accessibility Checker in the Ribbon. Source: Screenshot by author.

Scanning a Word-based OER using the Checker is a straightforward process, and corrective guidance is built in as well. Ensuring that Word documents are accessible from the outset is especially important since many learning resources originally developed in Word end up being exported to other formats: PDF, EPUB; even HTML. Accessible Word documents result in more accessible transformations.

GSuite (Google Docs, Slide, Sheets, etc.): As a ubiquitous productivity and instructional tool in many K-12 and postsecondary settings, curriculum resources developed in GSuite/Google Classroom can be scanned for accessibility using a third-party commercial product, [Grackle Suite](#). The Grackle accessibility checking utilities are available for 30 day use at no charge. For more detail on the accessibility features of Google Classroom, download a PDF of its [Voluntary Product Accessibility Template \(VPAT\)](#).

Adobe PDF documents: While the commercially-available Adobe Acrobat Pro has an internal checker and retrofitting wizard for determining, and, if necessary, improving, the accessibility of PDF documents, the free Adobe Acrobat Reader DC offers some supports that can bypass common accessibility challenges in poorly designed documents.⁴⁴ The [PAC 3 Accessibility Checker](#) from Access-for-all is a free utility for assessing PDF document structure and compliance with a PDF/UA (Universal Accessibility) set of protocols. PAC 3 generates a summary report detailing a document's conformance (or lack thereof) with a variety of checkpoints. PAC 3 can provide information to help determine the degree to which a PDF resource might be usable by students with disabilities.

Web Pages (HTML): the degree to which a web resource was designed with inclusivity in mind can be determined using the [WebAIM Web Accessibility Evaluation Tool](#), WAVE. This free utility measures web resources against the international Web Content Accessibility Guidelines (WCAG). WAVE is available as a toolbar add-on to Chrome and Firefox browsers and both a summary and detailed report and is a quick way of determining the extent to which a web-based learning resource might present barriers to students with sensory, physical or cognitive disabilities. Links to [additional Web accessibility evaluation tools](#) are available from the World Wide Web Consortium (W3C).

EPUB: EPUB is the file format of choice for commercial ebooks, increasingly prevalent in postsecondary settings, with currently less of an impact in K-12 schools. The free [ACE by DAISY Accessibility Checking Tool](#) compares EPUB publications to the EPUB Accessibility Specification and generates a helpful report. In addition, IMS Global Learning Consortium has published a list of [Accessibility Key Principles for Digital eText Materials \(EPUB\)](#) to offer guidance to postsecondary stakeholders interested in establishing effective practices for ensuring Accessible Educational Materials. While focused on EPUB as the target format, these principles also apply to other formats as well. Additionally, documents created in Microsoft Word can be exported as EPUB using the [WordToEPUB utility](#). Exporting a Word document in the EPUB format can significantly enhance its accessibility.

Interoperability

As of this writing, digital learning resources are deployed throughout K-12 and postsecondary settings via a Learning or Content Management System (LMS/CMS) like Seesaw, PowerSchool, Google, Classroom, Schoology, Brightspace, Canvas, Blackboard, and others. The coordination, centralized management, data collection and consistent navigation of these systems is both immensely appealing and economic. Nearly all of them provide mechanisms for educators, schools, districts and institutions to contribute learning resources, including open-source materials.

Many LMS/CMS systems combine structural rigidity (to enhance consistency) with considerable educator and student flexibility. Rigidity occurs when the system requires that any content added at the “local” level (e.g., not provided by the LMS/CMS vendor) conform to the system’s student data tracking protocols, i.e., single sign-on, student use, achievement tracking, etc. Prior to acquiring any OER content, particularly in K-12 settings, it would be important to know if the district/region/state requires this level of conformance. If not required, OERs may still be used, but since the majority of them do not offer student data tracking capabilities, outcomes associated with their use will not be machine reportable.

Academic Standards

The widespread national adoption of the Common Core State Standards (CCSS) in elementary and secondary education has provided OER initiatives with a set of grade-aligned academic achievement targets, and an increased interest in the use of OERs.⁴⁵ OER Commons, a national repository of curated OERs, has created the “[Common Core Hub](#)” as a means of categorizing open resources that align to the English Language Arts and Mathematics CCSS. Similarly, the [EngageNY Common Core Library](#) and [UnboundED](#) have generated, curated, and catalogued extensive ELA and Math K-12 OER collections that are CCSS-aligned, and address the shift to the Next Generation Learning Standards for English Language Arts and Math. Eastern Michigan University maintains a more expansive list of [Curriculum Resources for PK-12](#). For K-12 math and science materials, OER Commons curates a [collection](#) specifically aligned to the Next Generation Science Standards (NGSS), as does [OpenSciEd](#), [cK-12](#), and a suite of materials and multimedia resources from the [NROC Project](#).

VII. Addressing OER Design Challenges

A growing body of media and materials depicted as “educational” and rated by crowdsourcing mechanisms as standards-aligned has raised questions among industry experts, education researchers, and other stakeholders about the validity of these

appraisals. In other words, in contrast to commercial publishers who often employ content and pedagogical experts to direct the creation and evaluation of their educational products, many OERs are evaluated and disseminated based on peer- or user-reviews. Six concerns regarding the quality of OERs were identified in a March 2013 report from the Software & Information Industry Association (SIIA), and continue to be timely for both OER design and evaluation:

Metadata. Inclusion of appropriate metadata allows content to be found by user search, to be portable across platforms, to be efficiently stored and retrieved from databases, and enables automated analytics tools to determine which resources are most effective.

Accessibility/Universal Design. Additional resources may also be needed to make the content fully accessible to students with disabilities.

Standards/Course Alignment. This includes alignment to local, state, and/or national standards as well as to various types of assessments.

Check for Bias. Content needs to be editorially reviewed to ensure that it is free of bias and is fair in its treatment of religion, ethnicity, race, and sexual orientation.

Assessments. Formative, interim, and summative assessment items and scoring rubrics may be included to support core curricula.

Multiple Versions. Resource development should take into account the work and cost of ensuring that a particular resource displays properly on a wide variety of devices and technologies and provides backward compatibility.

The details highlighted by SIIA were expanded upon in 2018 by the promotion of [the CARE Framework \(Contribute, Attribute, Release, Empower\)](#) as a structure for guiding OER creation, enhancement and maintenance. A core commitment embedded in this approach is to address the diversity of learners, including making OERs accessible to those with disabilities, from the outset.

As for the expanding use of OERs in both K-12 and postsecondary settings, MDR, a market-related division of Dun and Bradstreet, noted in a [2018 report](#) that five years after the SIIA publication, OER adoption in postsecondary settings was growing steadily, and that Open/Commercial partnerships (Follett and Lumen Learning, for example) were emerging. In addition to open textbooks, a number of purveyors were also bundling assessments, assignments and other ancillary resources designed to make a transition to OER for teachers and faculty easier to accomplish. The sections below address issues related to each of the six categories identified by SIIA.

Metadata

Learning resources that include robust metadata are designed to be searchable using standard web search engines (Google, Bing, etc.) and the search features built into OER repositories. The primary purposes for organizing OER resources with the appropriate metadata are 1) to enable educators and students to locate desired resources efficiently and accurately and 2) to ensure that information about learning resources and their usage is captured, collated, and correlated to other educational data systems (interoperability). OER aggregators such as OER Commons, Curriki, and Ck12 have committed to using metadata elements.

The [Learning Resource Metadata Initiative](#) (LRMI) now housed at the Dublin Core Metadata Initiative provides a set of consistent properties for describing digital learning materials. These properties—educational use, age range, duration, etc.—assist in categorization, cataloguing, and discoverability. With respect to accessibility specifically, a recent 2020 publication: [User Experience Guide for Displaying Accessibility Metadata](#) offers metadata techniques and examples for tech-savvy content developers to help end users locate accessible content. The Guide references metadata from both the [EPUB Accessibility Metadata](#) and the [ONIX Accessibility Metadata](#) taxonomies.

The Guide highlights a sequence of nine accessibility identifiers that can help orient content reviewers to the applicability of the content to the needs of particular users. The nine identifiers are listed below and directly linked to the definition detail provided in the Guide:

- [Screen Reader Friendly](#)
- [Audiobook](#)
- [Accessibility Summary](#)
- [Accessibility Conformance](#)
- [Certified By](#)
- [Certifier Credential](#)
- [Certifier Report](#)
- [Hazards](#)
- [All Accessibility Metadata](#)

Accessibility/Universal Design

With the aim of designing accessible OERs, programmers and designers are often in search of a checklist that can easily guide the creation of such materials. Unfortunately, this approach simplifies the purposeful creation of resources that are designed with learner variation in mind. Adhering to Section 508 standards for developing educational

resources is a necessary but insufficient step in meeting the needs of diverse learners. Just as cutting-edge architectural and engineering developments take baseline standards to a higher level and foster progress, those creating open educational resources can generate advancements in approaches to designing resources for all learners. Specifically, by adhering to best practices such as those outlined in detail at UDL on Campus' [Creating Accessible Open Educational Materials](#); the [Accessible Publishing Best Practice Guidelines for Publishers](#); the newly-posted [Accessibility Toolkit for Open Educational Resources \(OER\)](#) from the City University of New York, or the [Creating Accessible OER](#) collection from OER Commons (among others), educators and designers can optimize their OER content for rendering in the appropriate formats individual users require and retain compatibility with a variety of assistive technologies employed by individuals with physical, sensory, or learning disabilities.

Since content must be effectively conveyed and contextualized across all media used, it is much easier to satisfy accessibility requirements (such as synchronized video and captioning and audio description) when developers are, first, informed with detailed specs of the needed functionality of a digital resource prior to creation and, second, consulted during content design itself. Similarly, there must be close collaboration between editorial teams and developers and designers. This will ensure that image descriptions provided to support users of assistive technology and that can benefit all learners do not just meet accessibility requirements but also meet the intended pedagogical goal for including the images. While the goals of jointly created open resources are clear, the mechanisms that can foster purposeful and productive collaboration need to be more fully explored to support the growing presence of OERs in postsecondary settings and as OERs begin to take a more prominent role in K–12 education.

Standards/Course Alignment

Some resources designed to facilitate the identification and distribution of OERs indicate the alignment of these resources to the Common Core State Standards and others do not. The [OER Project](#) has linked its *World History* and *Big History* projects to standards in 10 states, and the California Department of Education provides a collection of standards-aligned links to [CCSS Resource Clearinghouses](#). Additional sites aggregating OERs for discovery purposes (e.g., [Curriki](#), [Ck12](#), [OER Commons](#)) provide an online means of searching resources aligned to specific state or national standards. Some purveyors of OER creation software offer utilities for teachers and other end users to align OERs to the CCSS. Smaller OER publishing operations and those not designed for K-12 settings may not offer this alignment, however.

Check for Bias

Editorial oversight is a hallmark of savvy and responsible publishing, especially for content designed for public instruction. Authors who consciously design materials for the widest possible audience, including students with disabilities, are addressing variability from the outset and are more likely to monitor the orientation of their content for its balance. In the OER field, editorial oversight is often accomplished via user reviews and other types of crowd-sourcing approaches. Some states (for example, Washington, Kansas, Utah, California) that have incorporated open resources as key instructional materials have taken the important step of establishing editorial criteria and a review process for OER selection.

Assessments

The SIIA report notes that various types of assessments may be included with, embedded into, or aligned with, OERs. Fundamental to the fields of assessment and progress monitoring, however, is the extent to which OER resources are designed to track user data. Not simply end-of-lesson assessment information, but real-time data tracking—student log-on/off, activity dwell time, pathways, support/resource selection, etc. Without this rich trove of user information, fixed documents (such as PDFs) are as inert from a research perspective as they are instructionally. Such documents fail to advance the understanding of which materials, activities, and supports are truly critical to the process of education. When this type of user/material interaction data is available it can be correlated to academic achievement outcomes using learning analytics tools.

As K-12 and postsecondary schooling has moved (in many cases, precipitously, due to COVID-19) to incorporate online remote learning, Learning/Content Management Systems—networked structures that manage institution, school, class, student data—have become increasingly important and popular. A number of these systems are making their interoperability capacities, such as including student progress tracking and assessments, available for use with OER content.

Multiple Versions

Aside from the challenges presented by format compatibility issues and capacity to access and render OERs across multiple operating systems, browsers, player software, and devices, the most flexible and scalable OERs are those that are also extensible. Such OERs allow for the addition of region- or state-specific content that may be mandated by different municipalities and these become different versions of an OER as well as updated editions and improved copies do. Versioning issues highlight the difficulty of OERs' remaining topical and up-to-date. Many OERs are positioned as “one-

off” resources that become fixed in time and are not regularly updated as necessary to keep them current and vital. This may become increasingly more of a challenge as OERs of this type proliferate and resources required to update them may be simply unavailable. This is one of the disadvantages of OERs as there is typically no market incentive for issuing updated editions of a released resource.

VIII. Keys to Implementation

Only by identifying the most persistent barriers to OER implementation, and then assisting potential users in circumventing these barriers, will OERs assume solid viability within the educational landscape. Barriers to the creation of accessible OERs may manifest at many points along the continuum of OER lifespan, beginning even before their inception (e.g., policies influencing whether or not accessibility is considered in OER development) and continuing through classroom use (e.g., selection, acquisition, and use of accessible OERs for learning). The extent to which OERs become accessible and used will depend on a variety of factors, including policies, design decisions, selection and acquisition, and implementation, among others. We discuss key barriers below in these areas and offer strategies and related resources and examples to address each barrier.

Policy. A range of policy matters present challenges to the success of the OER movement, including concerns about (a) sustainability and infrastructure, (b) attribution, and (c) quality assurance and governance. In this context, states are beginning to shift from a regulatory/enforcement approach to one of support and technical assistance.⁴⁶ The Open High School of Utah—an online high school fully committed to using OERs exclusively—identified three broad areas of challenge in OER adoption and use: (a) awareness of policy and practices, (b) logistics of maintaining and disseminating resources, and (c) motivating stakeholders to share and distribute the resources they create.⁴⁷

Design. As referenced previously, interoperability—the secure, managed, and seamless flow of data across applications—has reached an inflection point in terms of its importance in the digital domain. That is, the extent to which applications are able to communicate without the aid of a third-party application has become paramount to its usability by the full range of potential learners. Absent shared data, technology users (and stakeholders) lose the capacity to efficiently track student progress without spending time and resources on transferring data across applications. A 2018 report by the State Education Technology Directors Association (SEDTA) offered a variety of strategies states can use to promote K12 interoperability. In terms of accessible OER implementation, this means that creating policies prioritizing interoperability in the

design stage can play an important role in creating OERs that are connectable with a wider range of applications, including learning management systems and assistive technology devices, and which are therefore more useful to the widest possible array of users. See Table 3 for additional strategies promoting interoperability.

Selection & Acquisition. An essential prerequisite in the broader quest to render OERs usable is ensuring accessible OERs are discoverable by a wide audience. In a 2016 qualitative study examining 218 higher education faculty members' perspectives on OER, researchers identified several common barriers, including insufficient awareness of OERs and difficulty discovering or locating OERs.⁴⁸ Additional k-12 challenges include finding OERs that align to educational standards that may be already foundational to a district or school's curriculum. We underscore the importance of helping teachers locate OERs that will be accessible to all learners, including those with disabilities, as well as those with diverse needs and preferences.

Implementation & Evaluation. Exploring the incentives by which OERs can be more broadly implemented is an essential element in the quest to render OERs usable and accessible to a wider audience. Belikov and Bodily (2016) identify several enablers faculty describe as motivating their adoption and use of OERs, including (a) delivering student cost savings, (b) ability for faculty to improve course materials based on student feedback, and (c) institutional support such as course load reductions or other kinds of assistance in creating OERs. We agree with these suggestions and support an added focus on accessibility as a further mechanism by which teachers can support the needs of all learners in their classroom.

While challenges such as these are likely to persist, and new obstacles will presumably emerge, the centrality of accessibility to OER's mission underscores its role in ensuring the basic civil rights of its prospective users. While ensuring civil rights is a critical consideration within all elementary, secondary, and postsecondary education, it should be noted that postsecondary learners are volunteers, while K-12 students are learners mandated to be enrolled in school with the goal of receiving a free and appropriate education. This reality puts considerable responsibility on elementary and secondary schools to address the needs of all their learners, and accessible OERs can be a key tool for equity in service of this mission.

A Framework for Addressing These Barriers

Referenced earlier, the [CARE Framework for OER Stewardship](#) offers some guidance for establishing educationally solid and inclusive OER materials and practices. The CARE acronym includes:

1. **Contribute:** OER stewards actively contribute to efforts, whether financially or via in-kind contributions, to advance the awareness, improvement, and distribution of OER; and
2. **Attribute:** OER stewards practice conspicuous attribution, ensuring that all who create or remix OER are properly and clearly credited for their contributions; and
3. **Release:** OER stewards ensure OER can be released and used beyond the course and platform in which it was created or delivered; and
4. **Empower:** OER stewards are inclusive and strive to meet the diverse needs of all learners, including by supporting the participation of new and non-traditional voices in OER creation and adoption.⁴⁹

These four principles, examined and expanded upon by the authors, advance the concept of “stewardship” as a mutually important dialogue between creators and consumers. This concept is equally applicable in elementary, secondary, and postsecondary settings and provides a set of attainable principles for incorporating OERs into educational practice. Presenting the concept of “inclusion” as a foundational pillar of the OER movement ably reinforces the need for accessibility.

Conclusion

Even after the immediate impacts of the COVID-19 pandemic are addressed through a comprehensive public health campaign that allows the reopening of schools for face-to-face instruction, the changed landscape of education will require innovative solutions to address budgetary and other implications. OER, which were originally developed to address inequities resulting from the high cost of educational materials, provide much more than a solution to economic challenges post-COVID. When implemented along with an inclusive pedagogy based on Universal Design for Learning there is the potential to reimagine education to ensure it truly reaches all learners. Considering accessibility as a foundational component of UDL would result in the creation of materials that are not only more widely available to a greater number of learners but also support the varied ways in which learners consume content. In this revised publication, the authors have provided a survey of the various systemic challenges that need to be addressed to realize the full potential of OER for everyone, including students with disabilities and other diverse learners.

Endnotes

- 1 Office of Educational Technology, United States Department of Education, n.d.
- 2 <http://opencontent.org/definition/>
- 3 Bliss, T J and Smith, M. 2017. A Brief History of Open Educational Resources. In: Jhangiani, R S and Biswas-Diener, R. (eds.) Open: The Philosophy and Practices that are Revolutionizing Education and Science. Pp. 9–27. London: Ubiquity Press. DOI: <https://doi.org/10.5334/bbc.b>. License: CC-BY 4.0
- 4 <https://tech.ed.gov/open/states/>
- 5 Ibid
- 6 <https://www.federalregister.gov/documents/2020/09/15/2020-20379/applications-for-new-awards-fund-for-the-improvement-of-postsecondary-education-open-textbooks-pilot>
- 7 Ibid; <https://www.federalregister.gov/d/2020-20379/p-39>
- 8 McKinsey & Company (2020), The Next Normal: The Recovery will be Digital, <https://www.mckinsey.com/featured-insights/coronavirus-leading-through-the-crisis>
- 9 Kohli S., Timelin B., Fabius V., Moulvad Veranen S. (2020), How COVID-19 is Changing Consumer Behavior – Now and Forever, McKinsey & Company, <https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/a-global-view-of-how-consumer-behavior-is-changing-amid-covid-19#>
- 10 Adapted from Zhang, X., Tlili, A., Nascimbeni, F., Burgos, D., Huang, R., Chang, T. W., ... & Khribi, M. K. Accessibility within open educational resources and practices for disabled learners: a systematic literature review. Smart Learn. Environ. 7 (1), 1–19 (2019).
- 11 <https://www.un.org/en/about-us/universal-declaration-of-human-rights>
- 12 Wiley, D., Hilton III, J., Ellington, S., & Hall, T. (2012). [A preliminary examination of the cost savings and learning impacts of using open textbooks in middle and high](#)

[school science classes](#). The International Review of Research in Open And Distance Learning, 13(3), 262-276.

13 Ruth, D. (2018). 48 percent of colleges, 2.2 million students using free OpenStax textbooks this year. Houston, TX: Rice University News & Media. Retrieved from <https://news.rice.edu/2018/08/01/48-percent-of-colleges-2-2-million-students-using-free-openstax-textbooks-this-year/>.

14 Nyamweya, M. (2018). A new method for estimating OER savings. Scholarly Publishing and Academic Resources Coalition (SPARC).

15 Baker, B. D., Weber, M., & Atchison, D. (2020). Weathering the storm: School funding in the COVID-19 era. Phi Delta Kappan, 102(1), 8-13.

16 Daniel, S. J. (2020). Education and the COVID-19 pandemic. Prospects, 1-6.

17 Ibid

18 [Van Allen, J.](#) and [Katz, S.](#) (2020), "Teaching with OER during pandemics and beyond", [Journal for Multicultural Education](#), Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/JME-04-2020-0027>

22. Berger, Z. D., Evans, N. G., Phelan, A. L., & Silverman, R. D. (2020). Covid-19: control measures must be equitable and inclusive.

19 Berger, Z. D., Evans, N. G., Phelan, A. L., & Silverman, R. D. (2020). Covid-19: control measures must be equitable and inclusive.

20 Hobbs, T. D., & Hawkins, L. (2020). The results are in for remote learning: It didn't work. Wall Street Journal, 5.

21 Lane, A. B. (2008). Widening participation in education through open educational resources. In T. Ilyoshi & M. S. Vijay Kumar (Eds.), Opening up education: the collective advancement of education through open technology, open content, and open knowledge (pp. 149–163). Cambridge, MA: MIT Press.

22 Bliss, T J and Smith, M. 2017. A Brief History of Open Educational Resources. In: Jhangiani, R S and Biswas-Diener, R. (eds.) Open: The Philosophy and Practices that are Revolutionizing Education and Science. Pp. 9–27. London: Ubiquity Press. DOI: <https://doi.org/10.5334/bbc.b>. License: CC-BY 4.0

23 Distance Learning: Challenges Providing Services to K-12 English Learners and Students with Disabilities during COVID-19 GAO-21-43: Published: Nov 19, 2020. Publicly Released: Nov 19, 2020.

24 Huang, R., Liu, D., Tlili, A., Knyazeva, S., Chang, T. W., Zhang, X., ... & Holotescu, C. (2020). Guidance on open educational practices during school closures: Utilizing OER under COVID-19 pandemic in line with UNESCO OER recommendation. Beijing: Smart Learning Institute of Beijing Normal University.

25 Ibid

26 Wiley, D. & Hilton III, J. (2018). Defining OER-Enabled Pedagogy. *International Review of Research in Open and Distributed Learning*, 19 (4).
<https://doi.org/10.19173/irrodl.v19i4.3601>

27 Zhang, X., Tlili, A., Nascimbeni, F., Burgos, D., Huang, R., Chang, T. W., ... & Khribi, M. K. (2020). Accessibility within open educational resources and practices for disabled learners: A systematic literature review. *Smart Learning Environments*, 7(1), 1.

28 Ibid

29 Basham, J. D., Blackorby, J., Stahl, S., & Zhang, L. (2018). Universal design for learning: Because students are (the) variable. *Handbook of research on K-12 online and blended learning* (, 477-507.

30 Rose, D.H. & Meyer, A. (2002). *Teaching every student in the digital age: Universal Design for Learning*. Alexandria, VA: ASCD.

31 <https://www2.ed.gov/programs/otp/applicant.html>

32 <http://www.ascd.org/ascd-express/vol13/1314-whitepaper.aspx>

33 Hilton, J. (2016). Open educational resources and college textbook choices: a review of research on efficacy and perceptions. *Educational Technology Research and Development*, 64(4), 573–590. <https://doi.org/10.1007/s11423-016-9434-9>

34 Blomgren, C., & McPherson, I. (2018). Scoping the nascent: An analysis of K-12 OER research 2012-2017. *Open Praxis*, 10(4), 359-375.

35 Hilton III, J., Larsen, R., Wiley, D., & Fischer, L. (2019). *Substituting open educational resources for commercial curriculum materials: Effects on student*
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mathematics achievement in elementary schools. *Research in Mathematics Education*, 21(1), 60-76.

36 Leite, W., Cetin-Berber, D., Huggins-Manley, A., Collier, Z., & Beal, C. (2019). The relationship between Algebra Nation usage and high-stakes test performance for struggling students. *Journal of Computer Assisted Learning*, 35(5), 569–581.
<https://doi.org/10.1111/jcal.12360>

37 Hilton, J. (2019). Open educational resources, student efficacy, and user perceptions: a synthesis of research published between 2015 and 2018. *Educational Technology Research and Development*, 1-24.

38 Clinton, V., & Khan, S. (2019). Efficacy of open textbook adoption on learning performance and course withdrawal rates: a meta-analysis. *AERA Open*, 5(3), 2332858419872212.

39 Hilton III, J., Larsen, R., Wiley, D., & Fischer, L. (2019). Substituting open educational resources for commercial curriculum materials: Effects on student mathematics achievement in elementary schools. *Research in Mathematics Education*, 21(1), 60-76.

40 Federal Register /Vol. 85, No. 101 /Tuesday, May 26, 2020 /Rules and Regulations

41 <http://gameaccessibilityguidelines.com/excel-checklist-download/>

42 <https://medium.com/oberonamsterdam/how-to-create-an-accessible-app-and-why-you-should-5493f41f8bdb>

43 <https://developers.google.com/appmaker/accessibility/make-accessible-apps>

44 <https://www.adobe.com/accessibility/products/acrobat/faq.html>

45 Ash, K. (2012, October 15). [Common Core Drives Interest in Open Education Resources](#). *Education Week* 6(1), 42–45.

46 SEDTA Report (2018)- State Education Leadership for Interoperability: Leveraging Data for Academic Excellenc

47 Tonks, D., Weston, S., Wiley, D., & Barbour, M. K. (2013). [“Opening” a New Kind of High School: The Story of the Open High School of Utah](#). *International Review of Research in Open & Distance Learning*, 14(1).

48 Belikov, O. & Bodily, R. (2016). Incentives and barriers to OER adoption: A qualitative analysis of faculty perceptions. *Open Praxis*, 8(3), 235-246. International Council for Open and Distance Education. Retrieved from <https://www.learntechlib.org/p/173537/>.

49 [Toward a Sustainable OER Ecosystem: The Case for OER Stewardship](#)