National Center on Accessible Educational Materials

Open Educational Resources: Designing for All Learners

By Andrew Hashey & Skip Stahl

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National Center on AEM at CAST; 40 Harvard Mills Square, Suite 3; Wakefield, MA 01880-3233
Voice: (781) 245-2212 TTY: (781) 245-9320 Fax: (781) 245-5212 Web: http://aem.cast.org

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I. Overview

> ***Open Educational Resources:*** "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software; and any other tools, materials, or techniques used to support access to knowledge."[1]

This document has been designed to provide an overview of open educational resources (OERs) for elementary and secondary education personnel involved in the selection, acquisition, and/or use of instructional materials—general and special education teachers, administrators, assistive technology (AT) specialists, technology and curriculum coordinators, and creators of curriculum resources. These and other stakeholders need information about how OERs can—and are—being leveraged in K–12 educational contexts to meet the needs of all students, including those students with disabilities.

Situated at the intersection of where the OER field meets accessibility issues, this Guide 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 schools and classrooms. Lastly, the Guide 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.

Downes (2007) identifies four Rs to characterize OERs: the materials should be reusable, redistributable, revisable, and remixable.[2] In contrast to earlier paper-based and commercial products, OERs created with these allowances can provide utility and impact in ways their original creators may never have imagined.

[1] The William and Flora Hewlett Foundation: Open Educational Resources (Direct link: http://www.hewlett.org/programs/education/open-educational-resources)

[2] Downes, S. (2007). Models for Sustainable Open Educational Resources. Santa Rosa, CA: Interdisciplinary Journal of Knowledge and Learning Objects, 3, 29-44.

Recently, OERs have migrated from higher education to emerge as key resources in elementary and secondary settings. As of 2012, 22 states have expanded their instructional materials procurement policies to incorporate digital textbooks and/or OER initiatives.[3] Fueled by the convergence of free or open-license authorship, the distribution and storage capabilities of the Internet, and the desire to customize instructional resources at the school, region, or state level, education agencies are moving to implement these resources. In addition, an estimated tenfold savings compared to the purchase of commercial products has proved compelling.[4] Utah, Washington, Virginia, Texas, and Maine have embraced OERs through the development of state-wide initiatives that, in many cases, have supplanted traditional commercial textbooks and other curriculum materials in favor of OERs.[5]

The OER movement holds the potential to democratize avenues to learning where barriers have long stood. In order for students with disabilities to achieve equal benefit from OER-based learning opportunities, however, accessibility issues must be examined. Accessibility refers to the extent to which materials are appropriate and usable for students with sensory, physical, learning, and cognitive disabilities. This resource is an attempt to highlight the promise OERs, to identify challenges these resources might present to some learners, and to suggest ways to remedy some of the barriers individuals might encounter when creating, acquiring, or using them.

OER Vignette

The following vignette sets the stage for a consideration of both the benefits and challenges related to using OERs in a K–12 setting, with special emphasis on students with disabilities.

A local school district is looking for ways to both increase student engagement and learning while also curtailing materials costs. District administrators are seeking input about ways the district might save money in order to preserve one of their middle school

[3] Fletcher, G., Schaffhauser, D., & Levin, D. (2012). *Out of Print: Reimagining the K–12 Textbook in a Digital Age*. Washington, DC: State Educational Technology Directors Association (SETDA).

[4] Owens, S. (2013, January 17). The Growing Adoption of Creative Commons Textbooks. *U.S. News & Word Report.*

[5] Patrick, S., & Bliss, T. J. (2013). OER State Policy in K–12 Education: Benefits, Strategies, and Recommendations for Open Access, Open Sharing. Vienna, VA: International Association for K–12 Online Learning (iNACOL).

buildings whose students have performed below district-wide averages for several years now.

A technology specialist proposes the idea of replacing costly textbooks with open educational resources (OERs) where students would retain ownership of the materials and be free to annotate and interact with learning resources in ways that are not permissible with standard textbooks and resources. The specialist also points out that teachers would be free to customize these materials to better suit their curricular objectives and prepare students to meet increasingly rigorous college and career-ready standards while saving money for the district.

Although these benefits seem to merit serious consideration by those responsible for procuring materials for the district, other educators seem concerned with how they can ensure that digital resources are appropriate for students with a diverse array of characteristics and abilities. Specifically, they are unsure about how to ensure OER are accessible to students with disabilities. Many students with disabilities in this middle school are educated alongside their non-disabled peers, and, while they are familiar with resources for making print-based materials accessible, several teachers have raised concerns about how to evaluate, select, and adapt digital materials for use in their classrooms with a wide range of learners. Fortunately, the technology specialist who originally raised the possibility of using OERs has examined many facets of OER usage in K–12 settings.

II. Emerging Potential for 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.[6] The emergence of the OER movement is predicated on the idea that knowledge is an invaluable world resource; and the opportunity to share, use, and re-use it can be facilitated by technology and the Internet.[7] Research and reporting on OER usage has identified numerous potential benefits of OERs, including expanded access to learning

[6] The United Nations. (1948). The Universal Declaration of Human Rights.

[7] Smith, M. S. & Casserly, C. M. (2006). The promise of open educational resources. *Change: The Magazine of Higher Learning*, *38*(5), 8-17.

resources, cost savings, and flexibility in content development—among other advantages (synthesized in Table 1 below).[8]

Table 1. Advantages of Digital Open Educational Resources

Context	Opportunities
Federal, State, and District Level	• Promote knowledge sharing and dissemination of resources • Leverage taxpayer funds to achieve reduced content-development or acquisition costs • Increase speed at which technological and curricular developments are achieved through collaboration • Potential to increase quality of resources through co-creation • Create bridges between formal, informal, and non-formal learning
K–12 Educators	• Increase access to resources • Improve flexibility in crafting of course materials that align with local requirements and curricular goals • Increase ability to produce and disseminate quality course materials • Increase recognition as a result of creating high quality materials
K–12 Learners	• Improve access to a wider range of educational resources • Empower learners to co-construct their own personal learning pathways

Cost Savings

The potential cost savings of OER adoption has been further detailed in a large (N = 1,200; middle and high school students) study published in 2012.[9] In this study only two

[8] Panke, S. & Seufert T. (2012). What's educational about Open Educational Resources? Different theoretical lenses for conceptualizing learning with OER. *Journal of E-Learning and Digital Media*.

of twenty 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 commercial textbook was amortized to $11.43/year during a seven-year cycle of use compared to $5.14/year for the OERs selected.

Using these figures as a baseline, the cost savings to an average-sized district of 10,000 students would amount to more than $1.7M during a similar cycle.[10] This study also compared academic outcomes of students using OERs *versus* those using traditional commercial textbooks and found "the substitution of open textbooks for traditional textbooks does not appear to correlate with a significant change in student outcomes."[11] The authors cautioned that this finding was only descriptive due to limited usage and achievement data associated with OER use and that additional experimental research was needed to validate these initial impressions. While this study did not document an increase (or decrease) in academic achievement, the students' usage of OERs as consumables—note-taking in the margins, highlighting text in color, etc.—contrasts with the traditional quest to preserve commercial textbooks for future class use. It also illustrates that OER use is not a detriment to academic outcomes.

Cost savings associated with OER usage alone predicts broader adoption as districts move to reduce expenditures while also seeking to improve outcomes for students. Despite the philosophical, pedagogical, and financial motives underlying the use of open educational resources, there is a need to better examine the ways in which students with disabilities may be affected by OER adoption and usage.

Flexibility in Content Creation

With continued advances in technology infrastructures, evidence of a "digital divide" seems less obvious: individuals' physical access to devices and networks has certainly improved. With society's increasing reliance on digital access to carry out everyday functions, however, the divide has greater stakes attached to it. Although the gap

[9] 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.

[10] Ibid.

[11] Ibid.

between haves and have-nots may be narrowing, it is also becoming deeper with digital tools assuming ever-more-important roles in our day-to-day lives.[12] In other words, those who do not or cannot access digital resources are at an ever-greater disadvantage in terms of their ability to successfully function in society. 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 K–12 learners in mind.

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, their primary utility lies in facilitating access for those who benefit least from current conditions.[13] Although the shift towards the use of OERs in K–12 settings can be seen as largely broadening options for students, it is essential to ensure OERs are indeed open to all learners regardless of disability status. Recent research in post-secondary settings suggests that students with disabilities are not consistently able to maximize their participation in OER-based learning pursuits. Students with disabilities in K–12 settings may encounter similar difficulties when interacting with OERs, thus representing a new frontier of accessibility concerns in the K–12 digital landscape.[14]

Digital Access

According to Rose and Meyer (2002), variability across learners should always be regarded as a constant. Therefore, the design of effective OERs, like any other instructional and learning resources, requires forethought if those resources are to meet

[12] Conole, G. (2012). Fostering social inclusion through open educational resources (OER). *Distance Education, 33*(2), 131-134.

[13] 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.

[14] Florida Virtual Campus. (2012). *2012 Florida Student Textbook Survey*. Tallahassee, FL: Author.

the needs of learners with different abilities.[15] State and local education agencies, charged with ensuring equal access to digital learning opportunities, will increasingly evaluate the utility and quality of OERs by the extent to which those resources are usable by the full array of learners they are responsible for educating.[16] This represents a step in the right direction, though much work remains in achieving the planning and foresight necessary to create a groundswell in accessible OER development and implementation.

Efficacy-Based Research

In contrast to the development and instructional efficacy validation often required of commercial (print) textbooks and their associated instructional materials by states or other purchasing agencies, the current research related to the educational efficacy of OERs is spotty at best. This has partly to do with the informal nature of OER publishing and associated lack of research-based distribution and procurement protocols and partly to do with the fact that OERs exist as only one component in the digital learning universe where content, delivery, data, and discussions are all part of the education process. This connectivist view of learning postulates that digital learning requires both a learner and a learning community and that knowledge occurs at the intersection of the two. Reviewing the efficacy of OERs through this lens as well as those of activity theory and social constructivism, research has explored the importance of self-regulation and engagement as important factors influencing the success or failure of students using OERs.[17] An inquiry by Panke and Seufert (2012) noted that OERs present distinct challenges for efficacy research and determined that it was unlikely that a single theoretical framework or approach would prove to be sufficient in capturing both the potential and the liabilities of these resources.

[15] Rose, D. & Meyer, A. (2002). *Teaching every student in the digital age: Universal Design for Learning*. Alexandria, VA: Association for Supervision and Curriculum Development.

[16] _____. Frequently Asked Questions About the June 29, 2010 Dear Colleague Letter. (2011). Washington, DC: Office for Civil Rights.

[17] Panke, S. & Seufert T. (2012). What's educational about Open Educational Resources? Different theoretical lenses for conceptualizing learning with OER. *Journal of E-Learning and Digital Media*.

IV. Addressing OER Design Challenges

The State Educational Technology Directors Association (SEDTA) in its 2012 report *Out of Print: Reimagining the K–12 Textbook in a Digital Age* applauds the inherent flexibility of digitally-based OERs for "reuse, remixing, and redistribution" and references the National Educational Technology Plan of 2010 and its support for the use of malleable digital curriculum materials as well as the major investment by the Department of Labor in the development of OERs for community college use.[18, 19, 20] The SEDTA report focuses on the widespread benefits of digital learning materials in general and the emergence of state-led initiatives to incorporate OERs into their respective adoption or purchasing practices in particular. Mirroring the emergence of free or public domain resources in music, video, and trade print books, the combination of networked technologies and digital media makes the use of openly licensed and free materials available to schools as well. The SEDTA report encourages the evaluation and use of OERs as a component of a rich and diverse digital curriculum.

A growing body of media and materials depicted as "educational" and rated by crowd-sourcing 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. Emerging from similar concerns regarding the quality of OERs, a March 2013 report from the Software & Information Industry Association (SIIA) report highlights seven such areas of concern related to OER development and use in elementary and secondary schools.[21] Industry developers perceive these factors as important when

[18] Fletcher, G., Schaffhauser, D., & Levin, D. (2012). *Out of Print: Reimagining the K-12 Textbook in a Digital Age*. Washington, DC: State Educational Technology Directors Association (SETDA).

[19] U.S. Department of Education, Office of Technology. (2010). *Transforming Education: Learning Powered by Technology* (the National Education Technology Plan). Washington, DC: Author.

[20] United States Department of Labor. (n.d.). Trade Adjustment Assistance Community College and Career Training Grant Program Resources. Washington, DC: Author.

[21] Collins, S. & Levy, P. (2013). SIIA Guide to the Use of Open Educational Resources in K–12 and Postsecondary Education Resources. Washington, DC: Software & Information Industry Association.

OERs are viewed not only as individual learning objects but as key components in an interconnected digital learning ecosystem. These issues are vital to 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 Common Core State 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.** Maintaining multiple versions is almost always necessary for use of resources with a variety of browsers, operating systems (OS), and devices (including legacy 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.[22]

Many OERs, especially open-source textbooks and their associated resources, begin as traditional print works that are transformed for digital delivery (often into Word or PDF format) and may not include multimedia, network, hyperlink, or data-tracking capabilities available to today's digital media. Other OERs are built and distributed in HTML or EPUB format and not only take advantage of one or more of these capabilities but can be optimized for use across multiple device types: desktops, laptops, tablets, and smart phones. Both potential and challenge increase with complexity: digital OERs converted from print works are generally easy to distribute but remain instructionally inert and isolated; media-rich OERs with interactivity and inherent connectedness are more engaging but require far more deliberate design with respect to the potential challenge areas raised in SIIA's 2013 report.

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,

[22] Ibid.

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 (detailed in a previous COLSD report) 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 the EPUB3 accessibility standards promulgated by the International Digital Publishing Forum (IDPF) and/or the EDI*t*EUR guide to accessible publishing, 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.[23, 24]

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 programmers are, first, informed with detailed specs of the needed functionality of a digital resource prior to creation; and, second, consulted during content design itself (such as video in this example). 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 as OERs begin to take a more prominent role in K–12 education. The following section details several aspects of design for consideration in OERs developed for use in K–12 settings.

Metadata

The goal of the Learning Resource Metadata Initiative (LRMI) is to establish a process for including metadata within digital educational resources to enhance their discoverability and describe their applicable instructional use (grade level, content area, and—soon—accessibility supports, CCSS alignment, etc.). Learning resources that are LRMI-compliant are designed to searchable using standard web search engines (Google, Bing, etc.) and to be compiled and commented upon at the Learning Registry, a federally-supported initiative. The primary purposes of the LRMI initiative are 1) to enable educators and students to locate desired resources efficiently and accurately

[23] Hilderly, S. (2012). *Accessible Publishing: Best Practice Guidelines for Publishers*. Geneva: Accessible Books Consortium/World Intellectual Property Organization.

[24] Garrish, M. (n.d.). *EPUB3 Accessibility Guidelines*. Seattle, WA: International Digital Publishing Forum.

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 all or most of the LRMI's chosen metadata elements.

Accessibility/Universal Design

In contrast to the range of options available to schools for retrofitting a print work to increase its accessibility (for example, digitizing it via an inexpensive scanner and optical character recognition software), virtually no schools have the knowledge or capacity to retrofit digital materials effectively. A variety of federal education and civil rights statutes compel all educational institutions to provide equitable access to educational opportunities for students with disabilities and access to technology-mediated opportunities in particular.[25] This charge, however, is not consistently being met across the educational landscape, and, again, data from OER usage in college settings reveals some cause for concern.

A 2011 Hewlett Foundation/Virtual Ability study reviewed 60 open-source college textbooks in light of federal and international accessibility guidelines.[26] Fifty-six percent of these materials were web-based; 42% were downloadable PDF documents. Nearly half of the web-based textbooks (42%) had accessibility problems with page layout, headers, and tables; none of the PDFs reviewed were accessible. On a positive note, the products from OER aggregators Connexions, Flat World Knowledge, and Open Learn were shown to be moderately accessible. This study also noted that, functionally, digital instructional materials such as open-source textbooks could not be separated from their delivery medium: if a web site hosting materials was inaccessible then students with disabilities were effectively blocked from using that resource. The recent accessibility survey of educational products from the Center on Online Learning and Students with Disabilities found that readily discoverable accessibility information was available for approximately half of the open source products reviewed.[27]

[25] The Center on Online Learning and Students with Disabilities (2012). The Foundation of Online Learning for Students with Disabilities. Lawrence, KS: Author.

[26] DeWinter, C., Daly, U., & Krueger, A. (2011). Accessibility Review Of Open Educational Resources. AEGIS Conference Proceedings.

[27] The Center on Online Learning and Students with Disabilities (2012). A Quick Guide to Accessible Products in Education. Lawrence, KS: Author.

In March, 2014, The State Educational Technology Directors Association (SEDTA) published a companion piece to the 2012 report *Out of Print: Reimagining the K–12 Textbook in a Digital Age.* In a policy brief entitled *The Accessibility of Learning Content for All Students, Including Students with Disabilities, Must be Addressed in the Shift to Digital Instructional Materials*.[28] This publication emphasizes the importance of accessible learning materials, references Universal Design for Learning as a guiding framework, provides guidance on the legal foundations of accessibility, and offers a 6-point checklist for state and district leaders to consider when considering digital curricula in general and OERs in particular.

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 some do not. Some sites aggregating OERs for discovery purposes (e.g., Curriki, Ck12, OER Commons, MyOER) provide an online means of searching resources aligned to specific state or Common Core standards. Other OER stakeholders provide online tools for OER classification (Achieve.org.'s OER Evaluation Tool, for example) and some purveyors of OER creation software offer utilities for teachers and other end users to align OERs to the CCSS. Smaller OER publishing operations 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 actively moved to incorporate open resources as key instructional materials have established editorial criteria and a review process for OER selection.

[28] State Educational Technology Directors Association. (2014). *The Accessibility of Learning Content for All Students, Including Students with Disabilities, Must be Addressed in the Shift to Digital Instructional Materials*. Washington, DC: Author..

Assessments

The 2013 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.

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.

V. Selecting Accessible OERs

Until educators and education agencies themselves are able to assess and select OERs that are accessible to the wide spectrum of learners they aim to reach, the goals of the OER movement will remain unmet. As with the evaluation of any resources used for instructional and learning purposes, there are a variety of approaches that decision makers might employ to evaluate OERs. The process can be open and participatory or more closed; it might be centralized around a group of peers or an administration or

more decentralized.[29] Regardless of the process enacted to review the quality and accessibility of OERs, the expectation to engage in such a process is clear.

The Rehabilitation Act of 1973 was amended in 1998 by Congress to include enforceable standards related to ensuring that technologies—both hardware and software—purchased by the federal government were accessible to individuals with disabilities. While Section 508 only requires that this standard be applied to federal government procurements, any state receiving funds through the Technology Related Assistance for Individuals with Disabilities Act of 1988 (the "Tech Act") are also required to adhere to them. Since many vendors of digital hardware and software sell products both to the federal and the education markets, Section 508 accessibility requirements have become the accepted national baseline for accessible product development.

One resource that can be useful to examine when exploring a digital product is a Voluntary Product Accessibility Template (VPAT) which includes a producer's or vendor's description of a product's level of conformance to 508 guidelines. The VPAT is often used in procurement processes—see this posting from the U.S. Department of State:. A well-developed VPAT can provide a detailed product accessibility overview and ease product comparisons; however, the majority of OER developers and distributors do not provide VPATs for their materials.

The Center on Online Learning and Students with Disabilities (COLSD) maintains a VPAT table on their web site at. Its "Purposerful Sampling" is a collection of nearly 100 products often used in elementary and secondary online learning. Materials are categorized by the extent to which accessibility information is readily discoverable in their product information or on their respective web sites. The table is designed to provide stakeholders—educators and developers alike—with a resource for determining the ways in which a product may be appropriate for use in a school or classroom that seeks the active and full participation of students with disabilities.

[29] Ischinger, B. (2007). *Giving Knowledge for Free: The Emergence of Open Educational Resources Centre for Educational Research and Innovation*. Washington, DC: Organization for Economic Co-operation and Development.

The widespread national adoption of the Common Core State Standards (CCSS) has provided OER initiatives with a set of grade-aligned academic achievement goals and an increased interest in the use of OERs.[30] This has led to the development of a set of CCSS rubrics to assist K–12 education personnel in rating selected resources for accessibility, among other attributes.[31]

> ***Metadata:*** Information about a resource, such as title, author, ISBN, grade level, content

As an example of the type of guidance felt to be important to address accessibility issues, the not-for-profit organization Achieve.org has created a set of eight rubrics to support the selection of OER resources. Achieve subsequently partnered with OER Commons which hosts the rubric on their site as an evaluation tool. Using the Achieve rubrics, online tool ratings can become appended to the OERs available from OER Commons. They can also be made discoverable by attaching readily identifiable metadata about the resource through the Learning Resource Metadata Initiative (LRMI) processes. Essentially, the LRMI metadata will enable users to effectively search for and locate desired materials. (A more detailed explanation of metadata is provided elsewhere in this paper.) The Achieve rubrics are designed to assess OERs' alignment with the Common Core State Standards and Rubric VIII is specifically designed to guide an evaluation of the accessibility of an OER resource. Table 2 below provides some detail related to Achieve's accessibility rubric.[32]

Table 2. Achieve.org's Rubric VIII

Accessibility Feature	YES/NO OR N/A	Comment or Explanation	Organization that Maintains the Standard
Available in tagged PDF format	TBD	TBD	Adobe

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

[31] _____. Rubrics for Evaluating Open Education Resource (OER) Objects. Washington, DC: Achieve, Inc.

[32] Ibid.

Accessibility Feature	YES/NO OR N/A	Comment or Explanation	Organization that Maintains the Standard
Available in ePUB format	TBD	TBD	International Digital Publishing Forum
Accessible course within an open learning management system (LMS)	TBD	TBD	Moodle
Accessible course within another learning management system (LMS)	TBD	TBD	LMS provider
Available in an accessible media format and includes alternative text or subtitles (i.e., for video)	TBD	TBD	Provider or publisher
Includes alternative text (i.e., for images)	TBD	TBD	Provider or publisher
Includes captions and subtitles (i.e., for video)	TBD	TBD	Provider or publisher
Includes flash accessibility functions (i.e., for SWF format)	TBD	TBD	Adobe
Includes functionality that provides accessibility	TBD	TBD	Provider or publisher
Complies with WC3 WCAG2 recommendations for web pages	TBD	TBD	WC3 Recommendations
Compliant with Section 508 of the Rehabilitation Act	TBD	TBD	U.S. Government
Is accessible as determined by Utah State University's Web Accessibility Evaluation (WAVE) Tool	TBD	TBD	Utah State University's WebAIM
Available in National Accessible Instructional Materials Standard (NIMAS) format (i.e., accessible XML)	TBD	TBD	NIMAC at American Printing House for the Blind NIMAS Center at CAST

Accessibility Feature	YES/NO OR N/A	Comment or Explanation	Organization that Maintains the Standard
Complies with audio/video cassette production standards	TBD	TBD	ITA standards
Complies with DVD/DVD-ROM production standards	TBD	TBD	DVD Forum specifications
Complies with Blu-ray disk production standards	TBD	TBD	Blu-ray Disk Association's UDF 2.5
Complies with NCAM guidelines for movies, web, and multimedia	TBD	TBD	NCAM Guidelines

While examining ways to assess existing OER content for accessibility is important, addressing OER development processes represents an opportunity to ensure that accessibility features are considered at the point of creation—not examined as an afterthought. Retrofitting existing digital materials for accessibility is a costly and labor-intensive process that even well-funded organizations are hard-pressed to achieve. Since producers and users of OERs often have no centralized funding mechanisms to support the retrofitting efforts of previously created materials, approaching design and development with accessibility in mind is critical to realizing the OER movement's goals of openness and equity.

VI. Barriers in OERs (Implementation)

One of the five developments the Hewlett Foundation has proposed as being an *enabler* of the OER movement is improvement in the applicability of and access to OER resources to ensure more open participatory learning. A range of issues, however, present challenges to the success of the OER movement, including concerns about (a) sustainability and infrastructure, (b) intellectual property rights, and (c) quality assurance (see Table 2 for a summary of challenges). A recent report on the Open High School of Utah—an online high school fully committed to using OERs exclusively—identifies 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.[33] While challenges such as these will likely continue to emerge, by emphasizing the critical nature of individuals' ability to access OERs, the Hewlett Foundation's focus on access underscores the centrality of basic civil rights. Perhaps nowhere is this more important than when OERs are used in K–12 settings where such rights are guaranteed through a variety of legislative mandates.

[33] 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).

Table 3. Potential Challenges of Digital Open Educational Resources

Context	Challenges	Recommendations
Federal, State, and District Level	Technical barriers of maintaining an OER repository and facilitating its use Need for awareness of licensing policies and legal barriers (i.e., understanding Creative Commons licensing, acquiring permission to use copyrighted material, etc.)	Consider functionality needs from the ground up as new content is built or acquired, including distribution, submission process, metadata, accepted formats, search functions, use of permanent URLs (permalinks), and revision and edition issues Develop and maintain centralized quality assurance processes with attention to legal expectations in the areas of education, civil rights, and copyright law
K–12 Educators	Required instructional technology skills (as well as basic technology skills such as computer literacy) needed to ensure proper classroom use of resources Quality assurance related to OERs selected for use Alignment with Common Core, state, and/or local standards	Increase access to (and participation in) technology-focused professional development initiatives: Adopt quality assurance approaches for use within districts Obtain materials aligned to standards such as OER Commons, etc. Utilize Achieve.org's rubrics to determine the extent of OER alignment with CCSS
K–12 Learners	Issues concerning accessibility of OERs (especially for students with disabilities) Unequal access to mobile/home-based technology and Internet connections	Request information from producers related to OER accessibility: Do resources conform to any established access standards (Section 508, WCAG2)?

VII. Progress Towards Potential

The transformative impact open educational resources have played on a global scale sets high expectations for the use of these resources in K–12 settings. Understanding the potential as well as the challenges OER integration represents for students with disabilities will help stakeholders approach OER creation, selection, acquisition, and implementation in more purposeful and effective ways. The common perspective that celebrates OERs' power to enable access for learners that historically have been physically prevented from participating in educational opportunities should devote equal concern to the functional accessibility of such resources. In much the same way that the World Wide Web has generally increased educational opportunities for learners across the geographical spectrum, OERs have the power to increase access and opportunities for learners across the ability spectrum. Yet a progressive, critical stance towards the use of OERs in K–12 settings will benefit all stakeholders by examining and improving the design process and the consideration of functional accessibility.

Clearly, more targeted economic and curricular analyses are needed to assess the cost-savings potential of the widespread adoption of OERs. Resources that can be acquired for little or no cost may, in fact, sustain this economic benefit throughout their period of use and thus emerge as instructionally and as financially smart choices. Conversely, resources free to acquire and use may engender costs once implemented as maintenance, updating, and/or state or national standards alignment dictates. In a similar manner, the lack of efficacy research associated with the extent to which OERs sustain or increase academic achievement needs to be remedied, since providing potential adopters with a solid evidence base can not only meet state or local curriculum procurement requirements but associates specific OERs with positive achievement outcomes.

Only with a more inclusive notion of accessibility that embraces the diversity of abilities and disabilities can we begin to shift the focus from hardware, software, and network barriers to one that gives equal consideration to the array of other more complex accessibility barriers such as the ability to use and interact with a resource. In order for meaningful progress to occur within the context of K–12 OER usage, SEAs and LEAs, educators, and other stakeholders must (a) be aware of resources relevant to evaluating and selecting OERs accessible to a wide range of learners, (b) help bolster evaluative mechanisms that allow for a more robust evaluation of OERs' accessibility considerations, and (c) foster approaches to OER design and development which consider accessibility features from the outset. In order for OERs to support established goals of providing more equitable access to education for groups that have been long under-served by traditional educational structures, the OER movement will achieve the

greatest gains by supporting accessibility-oriented design and development initiatives. Specifically, those initiatives maintaining a focus on disability and accessibility considerations from the outset will enable a wider and more robust application of OER to settings in which students with a variety of ability levels and learner characteristics can equally benefit from the many affordances of open-sourced educational products.

VIII. Resources

For educators seeking to create OERs and attend to accessibility from the outset—a key component of universal design—there are a number of resources and tools specifically aimed at supporting the design and production of accessible OERs.

The International Digital Publishing Forum (IDPF) has produced a set of detailed accessibility guidelines for content creators who are developing resources using the EPUB3 specification for e-books. This resource, *EPUB3 Accessibility Guidelines*, specifically targets best-practice approaches for addressing the accessibility of text, media, and navigation in EPUB3 products and can be useful for any author desiring information about how to create accessible digital media products.

The UK-based JISC (Joint Information Systems Committee) has posted extensive OER guidance for content creators, including *Accessible Documents, Presentations, and Spreadsheets*—a series of tutorials focused on how to embed accessibility features in commonly used document creation software (Word, PowerPoint, PDF, etc.).

The FLOE (Flexible Learning for Open Education) Project at OCAD University in Toronto has made available a free resource for OER creators: the *Inclusive Learning Design Handbook*. This resource is designed to guide the accessible creation of OERs across a wide variety of media: text, audio, images, and video. Associated with the FLOE Project is the FLUID Project and its open-source OER creation tool, *Infusion*, for creating accessible web-based resources suitable for instruction.[34]

Cannect.org has produced a *How-To Guide for Creating Accessible Online Learning Content* (Direct link: http://projectone.cannect.org/) that offers a highly detailed, step-by-step approach to creating accessible online learning content. While the guidance provided in this resource goes well beyond what are typically thought of as OERs, it provides a very comprehensive overview of the importance of ensuring accessibility for

[34] _____. (2013). Open Educational Resources infoKit. Bristol, UK: JISC.

both digital content designed for instruction and for learning management systems that deliver that content.

The Open Educational Resources Infokit produced by the UK-based Higher Education Academy/JISC Open Educational Resources Programme offers both a highly-detailed overview of the importance of designing for accessibility from the outset and the XERTE Online Toolkit (XOT)—an open-source tool for OER creation with explicit emphasis on attending to accessibility features.[35]

Two free resources offered by CAST, UDL BookBuilder and UDL Studio are online resources to facilitate the creation of digital books (BookBuilder) and curriculum projects (Studio) designed with both accessibility and universal design for learning (UDL) features.[36, 37] Both of these online tools offer models, step-by-step instructions, and comprehensive background information on the effective use of differing types of digital media: text, audio, images, and video—to achieve instructional goals. UDL BookBuilder specifically targets the creation of digital books that can be read online or off, while UDL Studio provides a frame for curriculum development inclusive of features that facilitate comprehension (e.g., highlighting, accessible text, vocabulary support), encourage action and expression (e.g., note-taking, prompts for writing, a drawing feature, and an audio recording option), and recruit and sustain engagement (e.g., with video, teacher feedback, collaborative whiteboard use).

For the more technically inclined The UDL Curriculum Toolkit offers all of the features of UDL Studio along with additional capabilities. The Toolkit can also be used to track student progress and see and compare student responses, highlighting, and notes. It also enables teachers to provide individual or group feedback. For research purposes, the application includes detailed logging of students' actions and the ability to turn program features on or off.[38]

[35] _____. (2013). Open Educational Resources infoKit. Bristol, UK: JISC.

[36] _____. CAST, Inc. (2012). UDL BookBuilder.

[37] _____. CAST, Inc. (2011). UDL Studio.

[38] _____. CAST, Inc. (2012). UDL Curriculum Toolkit.