An Introduction to Open Education

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## Open Educational Resources

- Defining the "Open" in Open Content and Open Educational Resources
- Copyright and Open Licensing
- The Difference Between an Informational Resource and an Educational Resource
- Excludability
- Rivalry

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Open Educational Resources

A Definition

Stephen Downes

Open educational resources are materials used to support education that may be freely accessed, reused, modified and shared by anyone.

Stephen H. Foerster wrote:

This is simple, accurate, and effective. I'm not sure I'd really support the idea of an "official" definition, but when I have reason to describe succinctly what OER means, I'd personally be happy to use this version (https://edtechbooks.org/-MxIN)

I don't support the idea of an 'official' definition either. I was moved to offer this by Chris Pegler's post that suggested a short succinct account of OERs would be needed for pragmatic purposes, such as introducing the concept quickly to people unfamiliar with them.

The statement takes the classic three-part form of definition:

1. Name the entity ("Open educational resources")
2. State what larger class of entity the entity belongs to ("are materials used to support education")
3. State how they are distinct from other members of that larger class of entities ("that may be freely accessed, reused, modified and shared by anyone")

This definition avoids needless redundancies. Specifically, it avoids phrases like "digital or non-digital" which, on examination, mean the same as "everything". It also avoids formulations like "OERs are resources that..." because this has the form "resources are resources", which is not helpful.

The Nature of the Larger Class of Entities

The nature of the larger class of entities is described functionally, rather than essentially. By that, what I mean is that I have taken a term (materials) that is vague about the nature of the entity, and specified it according to how the entity is *used*, or in other words, by the 'function' to which the entity is put.

Why do we prefer to define the larger class of entities functionally? Because the idea of a definition is to capture what won't change about the entity. File formats change, media change. What doesn't change is what we want to be able to do with the entities, which in this case is to use them to support education.
There was a whole debate in the late 90s and early 00s about 'what is a learning object' that dragged on needlessly because people tried to define the *kind* of object (reusable, discoverable, digital, object-oriented, whatever) rather than how the object was used. So my thinking here is, let's avoid that.

(Pragmatism does not mesh well with essentialism.)

Why did I use the word 'education' rather than 'learning'. Because I wanted to capture not only the activities of those people who are engaged in learning, but also those people who intend to support learning - in other words, those who intend to educate. By using 'education' therefore I am referring (roughly) to both teachers and students, where by using 'learning' I would be referring only to students.

The Statement of How They Are Distinct

The statement of how they are distinct is stated as a modality, rather than essentially. That is, it describes what people may do with the entities. So again we are not trying to describe the nature of the objects - we don't care - but rather, what functions the objects support (as some might say, what are the 'affordances' of the objects).

Why do we prefer to describe how they are distinct as a modality? For the same reason as above, we want to capture what won't change about the entity. Media change, markets change, institutions change. What doesn't change is what we want to be able to do with the entities, which in this case is to access them, reuse them, modify them and share them.

The statement has two distinct parts:

1. A statement of what people we are talking about, in this case, "anybody", and
2. What they can do (access, reuse, modify and share).

Though typically omitted from accounts of OERs, the reference to 'anybody' is important. I want to be clear in this definition that we are referring not only to education providers, not only to teachers, not only to enrolled students, but to *anybody*, the entire population of humans. To me, this is the key part of the objective of the OER movement, the key point where it becomes more than just a technical discipline and embraces some sort of wider vision or idealism. It's the reason I support OERs.

The reference to "access, reuse, modify and share" is partially adapted from Wiley's account referenced here, which in turn is roughly modeled on Stallman's four freedoms. It is also partially adapted from Creative Commons. But it also incorporates some things I think are important:

Access - is most frequently left off the definition of OERs, and yet is the most important. Nothing else follows if you cannot access the resource, that is to say, obtain the resource (or a copy of the resource) for oneself. Fundamental to a resource being open, in my mind, is the ability of anyone to access it. This is what allows us to say that things like YouTube videos are at least *partially* open - whatever else their flaws, at least we can access them.

Use - is most frequently stated. I've chosen a deliberately vague verb here, because use varies depending on the resource. To use software, for example, we 'run' software, which is the first of Stallman's four freedoms. Or we may use a resource by reading it, studying it, watching it, playing it, whatever. Wiley's definition demands the freedom to 'reuse', which is a narrower definition of 'use'.

Modify - is explicit in all definitions. Wiley describes it in two ways, to "revise" and "remix". Stallman refers only to the ability to "modify" a resource. Creative Commons has a "derivatives" clause but is otherwise silent on modification.

Share - is again explicit in all definitions. Wiley describes the freedom "to share copies of the original content, your revisions, or your remixes with others." Stallman describes the rights to "redistribute copies" and "distribute copies of
your modified versions”. Creative Commons addresses sharing under the ‘share alike’ clause, which mixes two separate concepts. Since here we are merely defining OERs, and not creating licenses, we can simply use the term “share”.

A Note on Conversion

The definition of OERs is silent on the question of conversion, and deliberately so. Conversion is not a matter of definition, but a matter of licensing. Please allow me to explain.

The ‘conversion’ of an open educational resource is a modification of the resource, or conditions related to the resource, such that it is in some way transformed from being an open educational resource to something that is not an open educational resource. I describe it at length above (Reusable Media, Social Software and Openness in Education).

The license attached to an open educational resource determines whether or not the author will allow it to be converted into a non-open resource. My own view is that OERs should not be licensed in such a way as to allow conversion. Other people, for reasons of their own, disagree. That’s fine, but what I reject is the suggestion that a resource is not an OER unless it is licensed in such a way as to allow conversion.

What makes material used for learning an OER is not the license it carries with it, but rather, whether it allows anyone to access, use, modify and share the material.

File Formats

Having offered my commentary on the definition, I would like now to offer a few words on how the definition as proposed applies specifically to the issue of file formats.

Consider a statement like the following, asserted in this case by Wayne Macintosh:

If these projects used open licenses and open file formats, the digital objects would still be around for continuous improvement and reuse.

The point of the statement is to focus on the nature of the resources, and to argue that if the resources were of the right nature - that is, in the correct file format, and with the correct license, then the digital objects would still be around.

But, and this is a key point: the openness of the object is not in the object.

The openness, rather, is in what one can do with the object. If the user can do everything stipulated in the definition - access, use, modify, share - then the nature of the object becomes irrelevant. The reason why proprietary file formats are discouraged is because people using open source software cannot open them, edit them, share them. But the very same formats, if accessible via open source software, renders them open.

This has in fact happened. Formats such as PDF, SWF and DOC were at one time impenetrable, and useless to people running Linux. Today, it is the rare Linux user who is unable to access, download, read or play, modify and share resources in those formats. Yes, it requires some skill, but everything requires some skill.

Finally, the purpose of a functional definition - one based on the ability of a person to access, use, modify and share the resource - is that it enables a simple empirical test. Instead of metaphysical discussions about the nature of an object, we simply ask, “Can a person access the object, can a person use the object, etc.?”, and on being shown that they can, conclude that the resource is open.
"Freely"

I deliberately inserted the word "freely" into the definition. Carolina Rossini, for example, writes, "The word 'freely' however has always brought tons of problems in every area of free culture in regard to its accurate concept. Below, it feels like it refers to 'gratis' ...."

It does, and necessarily so, because with enough money any person can access, use, modify and share any resource, and the meaning of 'open' collapses into meaninglessness. If a person really wants to access an Acme proprietary format (say) all the person needs to do is buy the company and all secrets will be revealed. Other companies grant access for lesser amounts of money, by way of licenses.

The purpose of the word 'freely' in the definition is intended to stipulate that the resource may be access without conditions. This, by the definition, means without payment. Not 'payment at a reasonable cost'. Not 'payment to access but freedom to redistribute'. So yes, it involves the sense of gratis as well as the sense of libre. Because you cannot put a financial cost on free as in freedom. If you have to pay a poll tax, it is not freedom. It's freedom for those who can afford it.

'Freedom of access without conditions' entails a lot, and it extends far beyond mere access to the resource. One of the most correct things Wayne Macintosh has been saying here is that supporters of OERs should be looking beyond the OER movement specifically.

In the world of print publications, 'freedom of access' meant the institution of libraries and reading rooms. 'Freedom of access' meant universal public education in support of literacy. These were, quite rightly, viewed as guarantors of freedom and democracy. In the world of electronic media, we require the equivalent; in Canada, we built a network of 'Community Access Points' in libraries in every city and town in the country, and computer education has become part of universal public education in our country.

Yes, people will want to sell copies of openly licensed materials, and to build business models around these materials. I don't have a problem with that, but we need to understand that this is sometimes a process of conversion of a resource from open to non-open. Because it is no longer open if the only way to access a resource is to pay money for it.

How can commercialization co-exist with open educational resources? If we use the functional definition, then we have an answer. If a person can still freely access, use, modify and share a resource, then commercial use has not converted an open resource into a closed resource. But if access, use, modification and sharing are impaired, by whatever mechanism, then conversion has taken place, and the resource is no longer open.

Moncton, July 11, 2011

Previous Citation(s)

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Stephen Downes is a specialist in online learning technology and new media. Through a 25 year career in the field Downes has developed and deployed a series of progressively more innovative technologies, beginning with multi-user domains (MUDs) in the 1990s, open online communities in the 2000s, and personal learning environments in the 2010s. Downes is perhaps best known for his daily newsletter, OLDaily, which is distributed by web, email and RSS to thousands of subscribers around the world, and as the originator of the Massive Open Online Course (MOOC), is a leading voice in online and networked learning, and has authored learning management and content syndication software.

Downes is known as a leading proponent of connectivism, a theory describing how people know and learn using network processes. Hence he has also published in the areas of logic and reasoning, 21st century skills, and critical literacies. Downes is also recognized as a leading voice in the open education movement, having developed early work in learning objects to a world-leading advocacy of open educational resources and free learning. Downes is widely recognized for his deep, passionate and articulate exposition of a range of insights melding theories of education and philosophy, new media and computer technology. He has published hundreds of articles online and in print and has presented around the world to academic conferences in dozens of countries on five continents.

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https://edtechbooks.org/open_education/open_educational_resources.
Defining the "Open" in Open Content and Open Educational Resources

David Wiley

Openness

The terms "open content" and "open educational resources" describe any copyrightable work (traditionally excluding software, which is described by other terms like "open source") that is either (1) in the public domain or (2) licensed in a manner that provides everyone with free and perpetual permission to engage in the 5R activities:

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)

Legal Requirements and Restrictions Make Open Content and OER Less Open

While a free and perpetual grant of the 5R permissions by means of an "open license" qualifies a creative work to be described as open content or an open educational resource, many open licenses place requirements (e.g., mandating that derivative works adopt a certain license) and restrictions (e.g., prohibiting "commercial" use) on users as a condition of the grant of the 5R permissions. The inclusion of requirements and restrictions in open licenses make open content and OER less open than they would be without these requirements and restrictions.

There is disagreement in the community about which requirements and restrictions should never, sometimes, or always be included in open licenses. For example, Creative Commons, the most important provider of open licenses for content, offers licenses that prohibit commercial use. While some in the community believe there are important use cases where the noncommercial restriction is desirable, many in the community strongly criticize and eschew the noncommercial restriction.

As another example, Wikipedia, one of the most important collections of open content, requires all derivative works to adopt a specific license - CC BY SA. MIT OpenCourseWare, another of the most important collections of open content, requires all derivative works to adopt a specific license - CC BY NC SA. While each site clearly believes that the ShareAlike requirement promotes its particular use case, the requirement makes the sites' content incompatible in an esoteric way that intelligent, well-meaning people can easily miss.
Generally speaking, while the choice by open content publishers to use licenses that include requirements and restrictions can optimize their ability to accomplish their own local goals, the choice typically harms the global goals of the broader open content community.

**Poor Technical Choices Make Open Content Less Open**

While open licenses provide users with legal permission to engage in the 5R activities, many open content publishers make technical choices that interfere with a user’s ability to engage in those same activities. The ALMS Framework provides a way of thinking about those technical choices and understanding the degree to which they enable or impede a user’s ability to engage in the 5R activities permitted by open licenses. Specifically, the ALMS Framework encourages us to ask questions in four categories:

1. **Access to Editing Tools:** Is the open content published in a format that can only be revised or remixed using tools that are extremely expensive (e.g., 3DS MAX)? Is the open content published in an exotic format that can only be revised or remixed using tools that run on an obscure or discontinued platform (e.g., OS/2)? Is the open content published in a format that can be revised or remixed using tools that are freely available and run on all major platforms (e.g., OpenOffice)?

2. **Level of Expertise Required:** Is the open content published in a format that requires a significant amount technical expertise to revise or remix (e.g., Blender)? Is the open content published in a format that requires a minimum level of technical expertise to revise or remix (e.g., Word)?

3. **Meaningfully Editable:** Is the open content published in a manner that makes its content essentially impossible to revise or remix (e.g., a scanned image of a handwritten document)? Is the open content published in a manner making its content easy to revise or remix (e.g., a text file)?

4. **Self-Sourced:** Is the format preferred for consuming the open content the same format preferred for revising or remixing the open content (e.g., HTML)? Is the format preferred for consuming the open content different from the format preferred for revising or remixing the open content (e.g., Flash FLA vs SWF)?

Using the ALMS Framework as a guide, open content publishers can make technical choices that enable the greatest number of people possible to engage in the 5R activities. This is not an argument for “dumbing down” all open content to plain text. Rather it is an invitation to open content publishers to be thoughtful in the technical choices they make - whether they are publishing text, images, audio, video, simulations, or other media.

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**Previous Citation(s)**

Wiley, D. (n.d.). Defining the "Open" in Open Content and Open Educational Resources. opencontent.org
https://opencontent.org/definition/
Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University’s instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU’s Marriott School of Management.

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Copyright is established in federal law and varies from country to country. In the U.S., copyright was written into the original constitution in 1787, wherein it was stated that copyright is established "to promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries" (Article 1.8.8). Thus, at its foundation, copyright in the U.S. exists "to promote the progress of science and useful arts," and authors are given control of their creative works for a specified period of time so that they can profit from them, thereby encouraging them to create more.

Watch on YouTube

Key Terms
Types of Works

Copyright applies to any tangible or electronic creative work, such as a book, movie, video, song, lyrics, poem, picture, lesson plan, web page content, etc. Any creative work is copyrighted as soon as it is created. Intangibles, such as ideas, concepts, and mathematical equations and works that lack originality cannot be copyrighted.

Gaining Copyright

Since copyright applies as soon as a work is created, authors do not need to go through any process to copyright their works. They are copyrighted automatically. However, proving that you hold the copyright on your creative work is another matter. For instance, say that you write a novel and lend the manuscript to your neighbor to proofread. What is to prevent your neighbor from claiming that the novel is her creative work and, therefore, claiming to hold its copyright? To help in preventing and addressing copyright problems, the U.S. government allows copyright holders to register copyright with the U.S. copyright office. Thus, while an author does not need to do anything to copyright a work, they do need to go through a process if they would like to register the copyright of that work to safeguard against infringement.

The Copyright Symbol

The copyright symbol may be placed on a work to remind and inform users of its copyright status: ©. However, the copyright symbol is only a reminder. The absence of the symbol does not mean that the work is not copyrighted, and the presence of the symbol is not proof that the work is copyrighted (as will be discussed further in the case of public domain works).

Ownership

By default, the author of a work holds the copyright on that work. The main exception to this rule would be if the author was being paid by someone else to create the work and the author had signed a contract stating that work created while on-the-job belongs to the employer commonly known as "work for hire". Contracts might also stipulate that this depends upon when and where the work was created (during standard work hours vs. after work hours or in the office vs. at home). Some educator contracts state that creative works by an educator are owned by the educator, while others state that they are owned by the school or district. So, if you would like to know who holds the copyright of works you create as part of your job, you should check your teaching contract or contact your employer.

Usage

Copyright generally means that others cannot use copyrighted material without the permission of the author and that permissions are restrictive. For instance, downloading a bootleg version of a movie is a violation of copyright, because you did not purchase the copy from the copyright holder. Further, even if you do purchase the movie from the copyright holder, you can only use the movie in the ways that the copyright holder allows (e.g., for private home use, not for public use). Thus, by purchasing a copy of a work, you do not "own" that work in the sense that you are not free to do whatever you like with it. You must still abide by any copyright restrictions placed on the work, which might determine how and where you use the work, your ability to make copies of the work, and your ability to modify the work.

Linking

You can generally provide a web link to copyrighted material from your own materials without permission from the copyright holder. This is different from copying/pasting the copyright material into your own work, because it allows the copyright holder to maintain control of their content and to generate revenue through web traffic. The primary exception to this rule would be if you provided a link to materials that should not be publicly accessible and, therefore, allowed your users to bypass restrictions placed on the content by the copyright holder.

Losing Copyright

Copyright comes with a time limit. The purpose of this is that the U.S. government recognizes that copyright can only benefit the copyright holder for so long and that at some point copyright should expire. Currently, the U.S. copyright law
states that copyright ends 70 years after the death of the author. Upon expiration, copyrighted materials move into the public domain. Copyrighted materials may also lose their copyright status under other conditions. For instance, a copyright holder may relinquish the copyright status on their work, thereby allowing it to pass into the public domain.

Copyright and Technology

Advancing technologies, ranging from the player piano to the internet, have always had unintended consequences for copyright law, and copyright law has always been slow to keep up with advancing technologies. Copyright law has changed over time, but as new technologies empower us to share and use copyrighted materials in new ways and at greater scale, copyright law gradually changes in response.

Common Questions

- **Can I legally show my students videos from my Netflix account or other subscription streaming services?**
  No. Your license agreement does not allow you to do this.

- **When is a work copyrighted?**
  As soon as it is created or published.

- **Does a work need to be published to be copyrighted?**
  No, though it must be in some physical form (e.g., manuscript, recording).

- **Does an author need to register their work in order for it to be copyrighted?**
  No. Authors may register their work with the US copyright office to protect against infringement, but even unregistered works are copyrighted.

- **If something is labeled with a copyright symbol (i.e., ©), does that mean it is copyrighted?**
  Maybe. The symbol serves as a reminder, but the copyright might have expired.

- **If something is not labeled with a copyright symbol (i.e., ©), then is it copyrighted?**
  Maybe. Maybe not. The label has nothing to do with whether or not a work is copyrighted. The copyright label only serves to remind and to inform. If you see no label, you should assume that the work is copyrighted and look into the matter further.

- **Can I link to copyrighted materials?**
  In most cases, yes. Just be sure that you are linking to the resource as it is provided by the publisher (not uploaded to someone's personal server, etc.) and that your link does not bypass a copyright holder's login system.

- **Can I embed copyrighted materials into my presentation or website (e.g., YouTube videos)?**
  That depends on the terms of the license that the copyright holder has released the content under. Generally, if a site like YouTube gives you an embed script, then you are able to use it (provided that you do not change the script, remove attribution, etc.).

Additional Resources

Some additional resources that may be useful for exploring these issues include the following:

- [Copyright Crash Course](#)
- [Wikipedia: Copyright](#)
Fair Use

Fair Use is an exception or limitation to copyright law that allows you to use some copyrighted materials in particular circumstances without the copyright holder's permission. Specifically, if used for nonprofit educational purposes, some copyrighted materials may be used for teaching, but your use (a) should directly relate to your educational goals, (b) should only utilize a relatively small portion of the work, and (c) should not negatively impact the copyright holder's ability to profit from the work. Fair use means that copyright-restricted works can be used for educational purposes without permission under certain conditions. The four guiding principles that determine if use is fair are:

"Fair Use" Guiding Principles

- Nature of Use
- Type of Work
- Amount Used
- Commercial Impact

The first principle covers what you are doing with the content and whether your use aligns with the author's intended use. Fair use only applies to uses of works that are transformative in nature. This means that your intended use must be different from the author's intended use. Consider a novel. You can quote lines from a novel in a paper you write without permission from the novel's author, because you are writing the paper to analyze literary elements of the novel, not to tell a story. If, however, you took those same lines and placed them in your own novel, then that would not be an example of fair use, because your intended use would be the same as the original author's intended use. In education, this means that using someone else's educational content (e.g., an image from their textbook) would not generally be fair use, because your intent is the same as theirs (i.e., educational and, therefore, non-transformative).

The second principle gives greater flexibility in using informational or factual works than to artistic or creative works. Thus, copying a few pages from an encyclopedia is viewed as more conducive to fair use than doing the same with a detective novel, because the information's benefit to society is readily apparent.

The third principle ensures that you only use as much of the copyrighted material as is necessary to achieve your goal. Thus, quoting a line from a novel would be considered fair use, but copying multiple chapters of the novel for this purpose would not. This is both a quantitative and qualitative consideration, in that you should not use more than is needed but fair use also should avoid using the "heart" of a work.

And the fourth principle considers whether copyrighted material negatively impacts the author's ability to profit from it. If you copy an article to share with your class, this would prevent the copyright holder from selling access to the article, which would be a violation. However, if you were to copy only a paragraph of an article for this purpose, it is less feasible that the copyright holder would potentially lose money on this use. So, this use would be more defensible as fair use.

Examples

If it weren't for fair use, you wouldn't even be able to write a paper that quoted a famous author without permission, which would be a serious matter for scholarly progress. Consider this quote from The Fellowship of the Ring:

*All that is gold does not glitter, not all those who wander are lost; the old that is strong does not wither, deep roots are not reached by the frost.* - J. R. R. Tolkien
Without fair use, the inclusion of this quote in a paper on literary analysis or on this website would be a copyright violation, because I did not seek the author’s prior consent to make a copy of this text from his book or to distribute it online. However, my use in this case is a transformative use and is only large enough to make the educational point, so it is allowable. Would being able to read this quote on this website prevent someone from reading his book (thereby depriving the copyright owner of profits)? Certainly not. On the contrary, however, if I were to provide several chapters of Tolkien’s book online without prior permission from the copyright holder, then this would certainly be a copyright violation that could be acted upon.

Similarly, copying another teacher’s lesson plan, changing a few words, and posting it online would be a blatant copyright violation. Fair use becomes problematic in education if you are trying to use educational works in your own creations (e.g., materials created specifically for education, such as lesson plans or textbook chapters) and/or you are using too much (such that it might prevent the owner of the copyright from profiting from the work).

Guidelines

To determine if a desired use of copyright-restricted material would fall under fair use, ask yourself four questions:

1. Use: Is the use transformative? (Yes = Fair Use)
2. Type: Is the work informational/factual in nature? (Yes = Fair Use)
3. Amount: Is the use minimal? (Yes = Fair Use)
4. Impact: Does the use negatively impact the copyright holder’s ability to profit from the work? (No = Fair Use)

Fair use is a judgement call, but the call is made based on the answers to these four questions. Thus, if your answer to all four questions aligns with fair use, then your use would likely be judged as fair. If the answer to one question does not align with fair use, then your use might still be fair, but it increases the potential for it to be judged otherwise. And so forth. In many court cases, uses that met three criteria have been deemed as fair, and in others, uses that only met one or two criteria have been deemed as fair, but there is never any guarantee. In short, only a judge can determine if use is fair, but a judge would use these four guidelines in making the determination.

Institutional Rules

To help safeguard their institutions and employees, many schools will adopt rules for interpreting fair use. For instance, some institutions will allow copyrighted materials to be used up to a certain percent of the work (e.g., a section of a book can be copied as long as it constitutes 10% or less of the entire book). These rules are not perfect reflections of the law but are rather interpretations intended to protect.

Here’s a comparison. Let’s pretend that 55 mph is the speed limit throughout the U.S. but that the government allows for people to exceed this speed limit “a reasonable amount” in particular cases of emergency. If such a law existed, it would be up to judges to determine if any case of traveling faster than 55 mph constituted a legitimate emergency case and if the actual speed was reasonable. Like copyright, this law sounds fairly fuzzy. Let’s also say that you are a bus driver and your school has a rule that this law means that you should only exceed the speed limit if a child is hurt and in these cases you should never go faster than 65 mph. Though this is not actually what the law says, it is your school’s interpretation of the law and is intended to keep you and the school safe.

Thus, when considering institutional rules, you should recognize that they are intended to prevent you from breaking a rather fuzzy law but that they also may not entirely reflect what the law actually states. In any case, you are safest abiding by your institutional rules for fair use, because this helps to ensure that your institution will be on your side if there is any question about your copyright-restricted material use.

Parody

Parody is one example of fair use in which copyrighted materials may be used to critique the author. Thus, using an image of someone to critique that person would probably be fair use (as in the case of Galvin v. Illinois Republican Party). However, using one person’s copyrighted works to critique a different person or an unrelated social issue (as in
the case of many memes) would likely not be parody, since the copyrighted work is being used to make fun of something other than the author or the work itself.

Positive Examples
These are examples that would probably qualify as fair use (i.e. they probably do not violate copyright):

- Quoting a few sentences from a book in a paper on literary criticism;
- Adding text to a movie screenshot to critique/parody the movie;
- Including a paragraph of text from a book in a quiz as background for asking questions;
- Showing a short clip from a popular movie to analyze how it was made.

Negative Examples
These are examples that would probably NOT qualify as fair use (i.e., they probably violate copyright):

- Copying pages from a workbook for students to complete;
- Copying or remixing a lesson plan;
- Creating a calendar of pictures that were photographed by someone else;
- Including a popular song as background music on a YouTube video your students create;
- Holding a public screening of a movie in the school auditorium that you have purchased for personal use.

Navigating Fuzziness and Risk
Fair use can be very fuzzy, and it may be that educators violate fair use regularly in their classrooms without worrying about legal repercussions. Even if copyright is violated, the risks associated with violation tend to vary by use. For instance, if you copy a lesson plan for use in your classroom without first gaining permission, the odds are that you will not run into any legal issues. However, if you try to sell this same lesson plan online or share it on your teacher blog, then the legal risk increases. This does not mean that you should violate copyright discretely, but merely that this decision would be based upon a moral imperative rather than legal risk.

The Bottom Line
Fair use is complicated, only provides educators with limited opportunities for use, and is typically more of a headache than it is often worth when talking about any substantive use of copyrighted materials.
Additional Resources

The U.S. Government has recently started archiving court cases related to fair use, which may be instructive if you have specific questions about what courts are classifying as fair use and not.

Public Domain

Copyright law varies from country to country, but in the US, Public Domain is a technical term referring to works that are not subject to copyright protection.

Categories

In general, there are three groups of works that are in the public domain:

1. Old works for which the copyright has expired;
2. Exempt works that may not be copyrighted or that were created under certain conditions;
3. Any works that have been released to the public domain by their authors.

Old Works

Under the current US copyright law, any copyrighted work will automatically pass into the public domain 70 years after the death of the author. In general terms, this means that virtually all classics or materials older than 120 years or so are in the public domain. To determine if a specific work is in the public domain, however, you should find out when the author died and add 70 years in order to determine the date at which copyright expires. This time frame has gradually been lengthened in US history, so some works may still be in the public domain that were created less than 70 years ago.

For instance, the John Wayne and Maureen O'Hara movie McLintock! passed into the public domain in 1994.
Examples of public domain works

Exempt Works

Copyright can only be applied to specific types of works (e.g., books, movies, images) and cannot be applied to general knowledge. For this reason, you do not need to cite anyone when you state a fact (e.g., “Jupiter is a planet”). Works may also be exempt from copyright if they are created under certain conditions of employment. The most common example of this is when US federal employees create works as part of their jobs (e.g., active duty service men and women in the armed forces). Works that these individuals create (e.g., photos taken) may be placed in the public domain by virtue of their employment.

Released Works

Any author of a work may willingly choose to release that work into the public domain by simply labelling the work (e.g., “this work is in the public domain”). By doing so, the author gives anyone (e.g., individuals, corporations) the right to use their work for any purpose, without limitation or attribution.

Use
Since they are not subject to copyright protection, public domain works may be used for anything and may even be included in derivative works and may be sold. There are no restrictions on how these works may be used, so citations are not generally needed. However, if you are using public domain content in your own work, it would be helpful for others to know what parts are public domain so that they know how they might also reuse and remix your content.

### Public Domain Repositories

- Project Gutenberg
- Army Photos
- Library of Congress
- Internet Archive
- U.S. Fish and Wildlife Digital Library
- Digital Public Library of America

### "Open" Resources
The terms "open" and "free" colloquially have many meanings. "Free" generally has two that may be best understood by referring to their Latin equivalents: *gratis* and *libre*. In the context of openly licensed materials or Open Educational Resources (OER), *gratis* means that content and resources are provided at no cost. *Libre* means that you are free to do what you want with these resources.

As an example of this distinction, you may find a website with "free" videos or another teacher may give you a set of old textbooks for "free" (i.e. *gratis*), but you are not then able to do whatever you want with those videos and textbooks (i.e. not *libre*). Similarly, Facebook is a *gratis* service, because you do not pay a fee to use it, but it is not a *libre* service, because you have only limited access to download, delete, or control your data within Facebook. This is an important distinction, because many *gratis* resources are not *libre*, and when we talk about openness, we mean both *gratis* and *libre*.

*That is, Gratis + Libre = Open.*

**The Five "R's" of Openness**

Openness may mean different things to different people, but when we refer to openness in terms of open licensing, we mean openness that gives us freedom to do the five R's:

1. Retain
2. Reuse
3. Redistribute
4. Revise
5. Remix

Open Licensing

Sometimes authors of creative works who want to share them openly want to maintain some control over what others can do with their work. Open Licenses have arisen as a means for openly sharing content while at the same time preserving desired rights to the author.

Open licenses find a nice balance between the restrictions of copyright and the unfettered freedoms of public domain, making them a good option for anyone desiring to share their work with others. Authors of creative works have the right to release those works under any license they choose (except in cases where they have signed over that right to a publisher, employer, etc.). The table below provides three examples of common open licenses.

Table 1

Common Open Licenses

<table>
<thead>
<tr>
<th>Name</th>
<th>Image</th>
<th>Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creative Commons</td>
<td><img src="image" alt="Creative Commons" /></td>
<td>• <a href="https://creativecommons.org">Creative Commons</a></td>
</tr>
</tbody>
</table>
| GNU General Public License (GNU-GPL) | ![GNU General Public License](image) | • [GNU License](https://www.gnu.org/licenses/gpl.html)  
| MIT License                   | ![MIT License](image) | • [MIT License Template](https://opensource.org/licenses/MIT)  
• [Wikipedia: MIT License](https://en.wikipedia.org/wiki/MIT_License) |

Common Open Licenses

Creative Commons

To help authors to release their works easily and in a manner that safeguards the rights that they care about, a number of template licenses have been created by [Creative Commons](https://creativecommons.org). Many works found on the internet are licensed under one of these types of licenses, and in general, you do not need permission to use them in your work as long as you properly attribute (cite) them and abide by any additional requirements set forth in the license.

Creative Commons licenses come in a number of varieties. Two are merely restatements of [Public Domain](https), while the rest provide the author of a work the ability to retain varying levels of control of how the work may be used. The most general Creative Commons license is the **CC BY** or **Creative Commons Attribution** license, which basically means that others are free to reuse, redistribute, revise, and remix the creation as long as they properly cite the author. More information about each license is provided in the following table.

Table 2

Creative Commons License Brief Explanation Table
### Creative Commons License Brief Explanation Table

<table>
<thead>
<tr>
<th>License Type</th>
<th>Image</th>
<th>Brief Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public Domain - By Age</td>
<td><img src="PUBLIC_DOMAIN.png" alt="Public Domain" /></td>
<td>These works are not subject to copyright or their copyright has expired.</td>
</tr>
<tr>
<td>Public Domain - Released</td>
<td><img src="PUBLIC_DOMAIN.png" alt="Public Domain" /></td>
<td>These works are released to the public domain by their authors before the copyright has expired.</td>
</tr>
<tr>
<td>Creative Commons Attribution (CC BY)</td>
<td><img src="CC_BY.png" alt="Creative Commons Attribution" /></td>
<td>Others may reuse, redistribute, revise, and remix the creation as long as they cite you.</td>
</tr>
<tr>
<td>Creative Commons Attribution-ShareAlike (CC BY-SA)</td>
<td><img src="CC_BY-SA.png" alt="Creative Commons Attribution-ShareAlike" /></td>
<td>Others may reuse, redistribute, revise, and remix the creation as long as they cite you and share their creation under an identical license.</td>
</tr>
<tr>
<td>Creative Commons Attribution-NoDerivs (CC BY-ND)</td>
<td><img src="CC_BY-ND.png" alt="Creative Commons Attribution-NoDerivs" /></td>
<td>Others may reuse and redistribute the creation as long as they cite you. They may not remix it or revise it.</td>
</tr>
<tr>
<td>Creative Commons Attribution-NonCommercial (CC BY-NC)</td>
<td><img src="CC_BY-NC.png" alt="Creative Commons Attribution-NonCommercial" /></td>
<td>Others may reuse, redistribute, revise, and remix the creation as long as they cite you, but they may not use your creation for commercial purposes.</td>
</tr>
<tr>
<td>Creative Commons Attribution-NonCommercial-ShareAlike (CC BY-NC-SA)</td>
<td><img src="CC_BY-NC-SA.png" alt="Creative Commons Attribution-NonCommercial-ShareAlike" /></td>
<td>Others may reuse, redistribute, revise, and remix the creation as long as they cite you and share their creation under an identical license. They may not use your creation for commercial purposes.</td>
</tr>
<tr>
<td>Creative Commons Attribution-NonCommercial-NoDerivs (CC BY-NC-ND)</td>
<td><img src="CC_BY-NC-ND.png" alt="Creative Commons Attribution-NonCommercial-NoDerivs" /></td>
<td>Others may reuse and redistribute the creation as long as they cite you. They may not remix it, revise it, or use it for commercial purposes.</td>
</tr>
</tbody>
</table>

**Finding Resources**

In general, copyleft and creative commons licenses value open practices in that they seek to allow for works to be reused, redistributed, revised, and remixed, but licenses vary based upon what is required of the user to do so legally. For instance, the Creative Commons Attribution license (or CC-BY) requires the user of the work to give appropriate credit, to provide links to the license, and to not suggest that the original author endorses any new use of the resource.

More details on specific Creative Commons licenses are provided in the Attribution Quick Reference Guide. There are a number of libraries, search engines, and search engine settings that allow you to easily search for copyleft-licensed works. Some popular examples include:

- [Wikimedia Commons](https://commons.wikimedia.org)
- [Creative Commons Search](https://creativecommons.org/search)
- [Flickr Creative Commons](https://creativecommons.org/licenses/by/)
- [Vimeo Creative Commons](https://creativecommons.org/licenses/by/)
- [Creative Commons Music](https://creativecommons.org/licenses/by/)

If a work (e.g., picture, song, video, lesson plan, rubric) does not have a statement of copyright status attached to it, you should generally assume that it is copyrighted and should seek...
Open Content Providers

Open educational resources (OER) are made available from many different sources. This list, though not exhaustive, includes some of the more prominent providers. Explore these resources to find material that will be useful for you in your classroom, taking note of what licenses resources are released under. Watch this video to learn how to use a search engine to find openly licensed content.

Open Textbooks & Curricula

1. Open Textbook Library
2. CK-12
3. Saylor
4. Boundless
5. Connexions / OpenStax Library
6. Textbook Equity
7. BC Campus
8. Wiki Books
9. Odell Education
10. Cool4Ed
11. Merlot

Search Engines

1. OER Commons
2. Creative Commons Search
3. Google Advanced Search*
4. Google Advanced Image Search*
5. Yahoo Image Search**
Text Content Providers

1. Wikipedia - open encyclopedia
2. Simple English Wikipedia - simplified encyclopedia
3. Project Gutenberg - public domain texts
4. Wiki Source - source materials
5. Wiki Quote - quotations

Media Content Providers

1. Wikimedia Commons - open media
2. Digital Public Library of America - public domain works
3. LibriVox - public domain audio books
4. Photo Pin - open photos from Flickr
5. Internet Archive - public domain works
6. U.S. Army - public domain images
7. Flickr - creative commons images
8. Vimeo - creative commons videos
9. Creative Commons Music - various creative commons music sites
10. Jamendo - creative commons music
11. Animal Photos - animal photos
12. Library of Congress - public domain works
13. Internet Archive - public domain works
14. U.S. Fish and Wildlife Digital Library - public domain works (mostly)

Open Courses

1. Lumen Learning
2. Wikiversity

Tools

These tools are not technically open educational resources, but they can be used to aide you in creating, remixing, and sharing open educational resources.

1. Google Drive - write and create collaboratively
2. Rewordify - simplify difficult texts
3. Text Compactor - summarize texts
4. Simplish - simplify and summarize texts
5. Open Text Summarizer - summarizes nonfiction texts

Attribution

When utilizing someone else's work in your own, you should be sure to attribute the work. In education, we generally use formatting guidelines from the American Psychological Association (APA), and you should cite works according to these guidelines if required for a research paper or publication. However, in most situations, a simpler citation that includes the work's title, author, license, and url will be appropriate. All work licensed under an open license will generally require you to properly attribute (cite) the resource in order to use it in your own work. Failure to properly cite one of these works if it is used in your own work is a violation of copyright. At minimum, you should attribute such works with the following information:
### Attribution Items

<table>
<thead>
<tr>
<th>Title</th>
<th>What is the title of the work (e.g., name of article, picture, or song)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>Who created the work?</td>
</tr>
<tr>
<td>Source</td>
<td>Where did you find the work (e.g., url)?</td>
</tr>
<tr>
<td>License</td>
<td>What license is the work shared under (e.g., CC BY)?</td>
</tr>
</tbody>
</table>

As possible, you should also cite these works in such a way that it is clear to which portions of content the attribution refers and so that the attribution is prominent. For instance, if you include a Creative Commons image in a book you are writing, the attribution should be included as a caption under the image. When such attribution is not possible, including attributions in a works cited page is acceptable if it is clear to which content each reference belongs (e.g., providing page numbers).
**Common Questions**

If there is no author mentioned, how do I cite the resource?
Use the author of the website. If the website does not have a mentioned author, use the name of the website (e.g., “CK-12”).

What if there is no copyleft license or notice of public domain mentioned?
Remember, just because no copyright symbol is present does not mean that the work is open (e.g., not every page of a Harry Potter book has a copyright symbol on it, but it is still copyrighted). Since everything is automatically copyrighted, you should generally assume that all work is copyrighted and should not treat it as an open resource without further investigation.

May I use a copyrighted work if I properly cite the author?
This depends on what you are using it for (see the discussion of fair use), but generally, you must have written permission to use it in any significant way.

If something is marked as released under Creative Commons, but there is no specific license identified, which should I use?
You should probably either use the most restrictive license (CC BY-NC-ND) or the most common license (CC BY). Use your best judgment.

Can I modify or revise an openly licensed work?
This depends on the license. In most cases, yes, but you may need to release your new work under the same license. The primary times when you cannot do this would be when the license prohibits derivative works (e.g., any CC BY-ND and CC BY-NC-ND).

Can I use Royalty Free work?
This is tricky. Royalty Free does not generally mean free as in *libre* (i.e. free to use for whatever). Rather, it typically means that you can use a work in a very specific way (e.g., print an image up to ten times) that will vary based upon the provider. So, *royalty free* is essentially just another way of saying *copyrighted*, but the material might be able to be used in some very limited manner without paying a fee.

If something is copyrighted, does that mean I cannot ever use it?
You can use it if you have the copyright holder’s permission. You can always contact the owner and ask her/him if you can use it. Open resources are handy, simply because they make it easier for you to use materials without asking permission every time you want to use something.

**Sharing Your Work**

As the author of a creative work, you can release your it under an open license or into the public domain. All you need to do is place the Creative Commons license on your work or state that the work is in the public domain, and this allows others to know how they can use it. For example, by simply placing “CC BY 3.0” below a picture, you give anyone the right to use it for any purpose as long as they attribute you as the author.

Public Domain or an Open License?
As the author of a creative work, you should consider the benefits of different ways of sharing your content. In short, if you don't care how it’s used but just want others to be free to use it, release it into the public domain. If you want to receive credit (be cited) when others use it, use CC BY 3.0. For a more detailed walkthrough of how you should release your content, follow the steps provided in the table below.

Table 3
Workflow for Choosing a License

<table>
<thead>
<tr>
<th>Step</th>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Do you want to allow anyone anywhere to use the work however they want without giving you credit?</td>
<td>Public Domain</td>
<td>Go to Step 2</td>
</tr>
<tr>
<td>2</td>
<td>Do you want to make sure that anyone who uses your work also shares their work in the same way?</td>
<td>Go to Step 3</td>
<td>Go to Step 4</td>
</tr>
<tr>
<td>3</td>
<td>Do you want to prevent others from profiting from your work?</td>
<td>CC BY-NC-SA</td>
<td>CC BY-SA</td>
</tr>
<tr>
<td>4</td>
<td>Do you want to prevent people from changing your work?</td>
<td>Go to Step 5</td>
<td>CC BY</td>
</tr>
<tr>
<td>5</td>
<td>Do you want to prevent others from profiting from your work?</td>
<td>CC BY-NC-ND</td>
<td>CC BY-ND</td>
</tr>
</tbody>
</table>

More details about the Creative Commons licenses may be found on the [Creative Commons website](https://creativecommons.org).

Example Statements

Releasing your work under an open license is easy. Just place a statement somewhere on your work that states what license you are releasing it under. The Creative Commons site provides a wizard to create a statement and image for you, or here are a few more examples:

- This work is released under a CC BY 3.0 open license by [Your Name Here].
- This work is released into the public domain.

Conclusion

This chapter has provided an overview of copyright, public domain, fair use, and open licenses. With this knowledge, teachers should feel sufficiently knowledgeable to use copyright-restricted resources in a legal manner. They should also be able to find and use public domain and openly licensed resources, to properly cite them, and to release their own creations openly.
Royce Kimmons
Brigham Young University

Royce Kimmons is an Associate Professor of Instructional Psychology and Technology at Brigham Young University where he seeks to end the effects of socioeconomic divides on educational opportunities through open education and transformative technology use. He is the founder of EdTechBooks.org, open.byu.edu, and many other sites focused on providing free, high-quality learning resources to all. More information about his work may be found at http://roycekimmons.com, and you may also dialogue with him on Twitter @roycekimmons.

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The Difference Between an Informational Resource and an Educational Resource

David Wiley

An informational resource is simply a collection of information. What would need to be added to an informational resource to make it an educational resource? Many people think of a textbook as the quintessential educational resource. To be minimally educational, I think a resource needs practice with feedback.

Recently I’ve been thinking about the difference between an informational resource and an educational resource. I’ve had the sense that an educational resource is an informational resource with a little something extra and have enjoyed coming back to this thought again and again over the last several weeks, trying to reduce this “something extra” to its simplest form.

Keeping the discussion informal, it seems that an informational resource is simply a compilation or collection of information – ideas, facts, processes, procedures, &c. I think of an encyclopedia as being the quintessential information resource – comprehensive, accurate, and well-organized. If you accept that definition (for sake of this argument), what would need to be added to an informational resource to make it an educational resource?

Many people think of a textbook as the quintessential educational resource. And I first started thinking about this question in the context of institutional open textbook grants. In the typical program, a faculty member proposes to write a textbook and receives funding to do so. As an expert in the discipline, the faculty member is likely highly qualified to create a resource that is comprehensive, accurate, and well-organized. However, in my formulation above, this would be an informational resource. What would need to be added to convert this book into an educational resource?

If the faculty member who received the grant did their graduate work in the United States, the odds are extraordinarily high that they never had a single university class in the science of teaching and learning. Even if they have attended the occasional hour-long lunchtime professional development seminar, they likely learned something significantly more tactical – like how to use their campus LMS – than anything pertaining to the science of teaching or learning. And here is a helpful hint about what it might take to change an informational resource into and educational resource: how might that grant-funded book be different if the faculty member who received the funding was required to truly partner with an instructional designer / learning scientist during the creation process?

Thinking about it this way, it seems like the minimum addition you would have to make to an informational resource to turn it into an educational resource is practice with feedback. Obviously, there is much more you would do if you bringing the full power of the teaching and learning research literature to bear on the design of the resource. But to be minimally educational, I think a resource needs practice with feedback. Without practice with feedback, it would remain a comprehensive, accurate, and well-organized informational resource.
David Wiley
Lumen Learning

Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University’s instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU’s Marriott School of Management.

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Excludability

Wikipedia

Introduction

In economics, a good, service or resource are broadly assigned two fundamental characteristics; a degree of excludability and a degree of rivalry. Excludability is defined as the degree to which a good, service or resource can be limited to only paying customers, or conversely, the degree to which a supplier, producer or other managing body (e.g. a government) can prevent “free” consumption of a good.

Excludability was originally proposed in 1954 by American economist Paul Samuelson where he formalised the concept now known as public goods (i.e. goods that are both non-rivalrous and non-excludeable). Samuelson additionally highlighted the market failure of the free-rider problem that can occur with non-excludeable goods. Samuelson's theory of good classification was then further expanded upon by Richard Musgrave in 1959, Garret Hardin in 1968 who expanded upon another key market inefficiency of non-excludeable goods; the tragedy of the commons.

Excludability was further expanded upon by Elinor Ostrom in 1990 to be a continuous characteristic, as opposed to the discrete characteristic proposed by Samuelson (who presented excludability as either being present or absent).

Ostrom's theory proposed that excludability can be placed on a scale that would range from fully excludable (i.e. a good that could theoretically fully exclude non-paying consumers) to fully non-excludeable (a good that cannot exclude non-paying customers at all).

This scale allows producers and providers more in-depth information that can then be used to generate more efficient price equations (for public goods in particular), that would then maximize benefits and positive externalities for all consumers of the good.

Definition matrix

A definition matrix can be used to broadly categorize goods and services based on their degree of excludability and rivalry. Considering excludability can be measured on a continuous scale, some goods and services would not be able to fall into one of the four common categories used:

- Private goods
- Common-pool resources
- Club goods
- Public goods

The definition matrix shows the four common categories in relation their rivalry and degree of excludability, alongside providing some examples of fully excludable goods, Semi-excludable goods and fully non-excludeable goods. Semi-excludable goods can be considered goods or services that a mostly successful in excluding non-paying customer, but are still able to be consumed by non-paying consumers. An example of this is movies, books or video games that could be easily pirated and shared for free.
<table>
<thead>
<tr>
<th>Excludability</th>
<th>Fully Excludable</th>
<th>Semi-Excludable</th>
<th>Fully Non-Excludable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivalrous</td>
<td><strong>Private Goods</strong></td>
<td>Piracy of copyrighted goods</td>
<td><strong>Common-pool Resources</strong></td>
</tr>
<tr>
<td></td>
<td>food, clothing, cars, parking spaces</td>
<td>like movies, books, video games</td>
<td>fish, timber, coal, free public transport</td>
</tr>
<tr>
<td>Non-Rivalrous</td>
<td><strong>Club Goods</strong></td>
<td>Sharing pay television or streaming subscriptions</td>
<td><strong>Public Goods</strong></td>
</tr>
<tr>
<td></td>
<td>cinemas, private parks, television, public transport</td>
<td>to more users than what is being paid for</td>
<td>free-to-air, air, national defense, free and open-source software</td>
</tr>
</tbody>
</table>

**Examples**

**Excludable**

The easiest characteristic of an *excludable good* is that the producer, supplier or managing body of the good, service or resource have been able to restrict consumption to only paying consumers, and *excluded* non-paying consumers. If a good has a price attached to it, whether it’s a one time payment like in the case of clothing or cars, or an ongoing payment like a subscription fee for a magazine or a per-use fee like in the case of public transport, it can be considered to be *excludable* to some extent.

A common example is a movie in a cinema. Paying customers are given a ticket that would entitle them to a single showing of the movie, and this is checked and ensured by ushers, security and other employees of the cinema. This means that a viewing of the movie is *excludable* and non-paying consumers are unable to experience the movie.

**Semi-Excludable**

Ranging between being fully excludable and non-excludable is a *continuous scale of excludability* that Ostrom developed. Within this scale are goods that either attempt to be excludable but cannot effective or efficiently enforce this excludability. One example concerns many forms of information such as music, movies, e-books and computer software. All of these goods have some price or payment involved in their consumption, but are also susceptible to piracy and *copyright infringements*. This can result in many non-paying consumers being to experience and benefit from the goods from a single purchase or payment.

**Non-Excludable**

A good, service or resource that is unable to prevent or exclude non-paying consumers from experiencing or using it can be considered *non-excludable*. An architecturally pleasing building, such as Tower Bridge, creates an aesthetic non-excludable good, which can be enjoyed by anyone who happens to look at it. It is difficult to prevent people from gaining this benefit. A lighthouse acts as a navigation aid to ships at sea in a manner that is non-excludable since any ship out at sea can benefit from it.

**Implications and inefficiency**

Public goods will generally be underproduced and undersupplied in the absence of government subsidies, relative to a socially optimal level. This is because potential producers will not be able to realize a profit (since the good can be obtained for free) sufficient to justify the costs of production. In this way the provision of non-excludable goods is a
classic example of a **positive externality** which leads to inefficiency. In extreme cases this can result in the good not being produced at all, or it being necessary for the government to organize its production and distribution.

A classic example of the inefficiency caused by non-excludability is the *tragedy of the commons* (which Hardin, the author, later corrected to the 'tragedy of the unmanaged commons' because it is based on the notion of an entirely rule-less resource) where a shared, non-excludable, resource becomes subject to over-use and over-consumption, which destroys the resource in the process.

### Economic theory

Brito and Oakland (1980) study the private, profit-maximizing provision of excludable public goods in a formal economic model. They take into account that the agents have private information about their valuations of the public good. Yet, Brito and Oakland only consider posted-price mechanisms, i.e. there are ad-hoc constraints on the class of contracts. Also taking distribution costs and congestion effects into account, Schmitz (1997) studies a related problem, but he allows for general mechanisms. Moreover, he also characterizes the second-best allocation rule, which is welfare-maximizing under the constraint of nonnegative profits. Using the incomplete contracts theory, Francesconi and Muthoo (2011) explore whether public or private ownership is more desirable when non-contractible investments have to be made in order to provide a (partly) excludable public good.
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Introduction

In economics, a good is said to be rivalrous or a rival if its consumption by one consumer prevents simultaneous consumption by other consumers, or if consumption by one party reduces the ability of another party to consume it. A good is considered non-rivalrous or non-rival if, for any level of production, the cost of providing it to a marginal (additional) individual is zero. A good is "anti-rivalrous" and "inclusive" if each person benefits more when other people consume it.

A good can be placed along a continuum from rivalrous through non-rivalrous to anti-rivalrous. The distinction between rivalrous and non-rivalrous is sometimes referred to as jointness of supply or subtractable or non-subtractable. Economist Paul Samuelson made the distinction between private and public goods in 1954 by introducing the concept of nonrival consumption. Economist Richard Musgrave followed on and added rivalry and excludability as criteria for defining consumption goods in 1959 and 1969.

Rivalry

Most tangible goods - both durable and nondurable - are rival goods. A hammer is a durable rival good. One person's use of the hammer presents a significant barrier to others who desire to use that hammer at the same time. However, the first user does not "use up" the hammer, meaning that some rival goods can still be shared through time. An apple is a nondurable rival good: once an apple is eaten, it is "used up" and can no longer be eaten by others. Non-tangible goods can also be rivalrous. Examples include the ownership of radio spectra and domain names. In more general terms, almost all private goods are rivalrous.

Non-rivalry

In contrast, non-rival goods may be consumed by one consumer without preventing simultaneous consumption by others. Most examples of non-rival goods are intangible. Broadcast television is an example of a non-rival good; when a consumer turns on a TV set, this does not prevent the TV in another consumer's house from working. The television itself is a rival good, but television broadcasts are non-rival goods. Other examples of non-rival goods include a beautiful scenic view, national defense, clean air, street lights, and public safety. More generally, most intellectual property is non-rival. In fact, certain types of intellectual property become more valuable as more people consume them (anti-rival). For example, the more people use a particular language, the more valuable that language becomes.

Non-rivalry does not imply that the total production costs are low, but that the marginal production costs are zero. In reality, few goods are completely non-rival as rivalry can emerge at certain levels. For instance, use of public roads,
Internet, or police/law courts is non-rival up to a certain capacity, after which congestion means that each additional user decreases speed for others. For that, recent economic theory views rivalry as a continuum, not as a binary category, where many goods are somewhere between the two extremes of completely rival and completely non-rival. A perfectly non-rival good can be consumed simultaneously by an unlimited number of consumers.

**Anti-rivalry**

Goods are [anti-rivalrous](#) and inclusive if my enjoyment increases with how many others consume the good. The concept was introduced by Steven Weber (2004), saying that when more people use [free and open-source software](#), it becomes easier and more powerful for all users.

Lessig noted that any [natural language](#) is anti-rivalrous, because its utility increases with how much it’s used by others. Cooper noted that efforts to [combat climate change](#) are perversely anti-rivalrous, because the US will benefit from the efforts of others to combat this problem, even if it refuses to do so.

**Types of goods based on rivalry in consumption and excludability**

There are four types of goods based on the characteristics of rival in consumption and excludability: Public Goods, Private Goods, Common Resources, and Club Goods.

These four types plus examples for anti-rivalry appear in the accompanying table.

<table>
<thead>
<tr>
<th>Excludable?</th>
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<tbody>
<tr>
<td>yes</td>
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<td></td>
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<tr>
<td>Rivalrous</td>
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<tr>
<td>Private Good</td>
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<tr>
<td>Non-rivalrous</td>
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<tr>
<td>Club / toll Good</td>
<td></td>
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<tr>
<td>Anti-rivalrous</td>
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<tr>
<td>&quot;network&quot; good, e.g., data on the internet; good that improves public health</td>
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<tr>
<td>&quot;symbiotic&quot; good, e.g., language</td>
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Types of goods based on consumption and excludability

Goods that are both non-rival and [non-excludable](#) are called [public goods](#). Examples include clean air, national defense, and free-to-air broadcast TV. It is generally accepted by mainstream economists that the market mechanism will under-provide public goods, so these goods have to be produced by other means, including government provision.

On the other hand, [private goods](#) are rival and excludable. An example of this could be an apple provided by a fruit store. An individual who consumes an apple denies another individual from consuming the same one. It is excludable because consumption is only offered to those willing to pay the price.

[Common resources](#) are rival in consumption and non-excludable. An example is that of fisheries, which harvest fish from a shared common resource pool of fish stock. Fish caught by one group of fishermen are no longer accessible to another group, thus being rivalrous. However, oftentimes, due to an absence of well-defined [property rights](#), it is difficult to restrict access to fishermen who may overfish.
Goods that are both non-rival and excludable are called club goods. Cable television is an example of this. A large television service provider would already have infrastructure in place which would allow for the addition of new customers without infringing on existing customers viewing abilities. This would also mean that marginal cost would be close to zero, which satisfies the criteria for a good to be considered non-rival. However, access to cable TV services are only available to consumers willing to pay the price, demonstrating the excludability aspect.
Research

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<tr>
<td>Open educational resources and college textbook choices</td>
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<tr>
<td>Thoughts on Continuous Improvement and OER</td>
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<td>Continuous Improvement of Instructional Materials</td>
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<td>Continuous Improvement Dashboards</td>
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<td>A/B Testing on Open Textbooks</td>
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<td>The Rise Framework</td>
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<td>Open Science in Education Sciences</td>
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Access it online or download it at https://edtechbooks.org/open_education/ii_research.
Textbooks are a vital component in many higher education contexts. Increasing textbook prices, coupled with general rising costs of higher education have led some instructors to experiment with substituting open educational resources (OER) for commercial textbooks as their primary class curriculum. This article synthesizes the results of 16 studies that examine either (1) the influence of OER on student learning outcomes in higher education settings or (2) the perceptions of college students and instructors of OER. Results across multiple studies indicate that students generally achieve the same learning outcomes when OER are utilized and simultaneously save significant amounts of money. Studies across a variety of settings indicate that both students and faculty are generally positive regarding OER.

Introduction

Textbooks are a traditional part of the educational experience for many college students. An underlying assumption of the use of textbooks is that students who utilize them will have enriched academic experiences and demonstrate improved class performance. Skinner and Howes (2013) point out that there are multiple benefits that stem from students reading their assigned materials, including increasing the baseline understanding that students bring to class. Darwin (2011) found positive correlations for students in accounting classes between completing the assigned reading and class performance. Similarly, Bushway and Flower (2002) found that when students were motivated to read by being quizzed on the material, their overall performance in the class improved.

At the same time, textbooks are not as widely read as professors might hope. Berry et al. (2010) surveyed 264 students taking finance courses and found that “only 18% of the students reported that they frequently or always read before coming to class. In contrast, 53% reported that they never or rarely read the textbook before coming to class” (p. 34). Part of the reason that textbooks are underutilized is that they are expensive. A survey of 22,129 post-secondary students in Florida found that 64% of students reported having not purchased a required textbook because of its high cost (Florida Virtual Campus 2012).
While increased access to textbooks alone will not ensure the success of college students, textbooks are generally recognized as being important learning resources. Because textbooks represent a significant percentage of expenses faced by college students, efforts should be made where possible to ameliorate these costs, as this could potentially increase student success. This is particularly true in the instances in which high-quality Open Educational Resources (OER) are available as a free substitute for commercial textbooks.

The purpose of this study is to provide a synthesis of published research performed in higher education settings that utilized OER. I will describe and critique the 16 published studies that investigate the perceived quality of OER textbooks and their efficacy in terms of student success metrics. I first provide a general review of the literature relating to OER.

**Review of literature**

The term “Open Educational Resources” comes from the 2002 UNESCO Forum on the Impact of Open Courseware for Higher Education in Developing Countries, in which the following definition for OER was proffered: “The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes” (UNESCO 2002, p. 24). The vision of OER was to enable the creation of free, universally accessible educational materials, which anyone could use for teaching or learning purposes.

In the intervening years much has been done to bring to pass the vision stated at that 2002 UNESCO meeting. Many OER have been created, including courses, textbooks, videos, journal articles, and other materials that are usually available online and are licensed in such a way (typically with a Creative Commons license) so as to allow for reuse and revision to meet the needs of teachers and students (Johnstone 2005; Bissell 2009; D’Antoni 2009; Hewlett 2013). In addition, much has been written about the history and theory of OER (Wiley et al. 2014). OER has moved from theory into practice; currently several options are available to locate high-quality open textbooks, a subset of OER often used to substitute for traditional textbooks. Among those providers are Openstax (openstaxcollege.org), The Saylor Foundation (saylor.org), and Washington State’s Open Course Library (opencourselibrary.org). The Minnesota Open Textbook Library (open.umn.edu/opentextbooks/) provides a clearinghouse of open textbooks and includes faculty reviews of these materials.

Notwithstanding the growth in resources relating to OER, Morris-Babb and Henderson (2012), in a survey of 2707 faculty members and administrators of colleges and universities in Florida, found that “only 7% of that group were ‘very familiar’ with open access textbooks, while 52% were ‘not at all familiar’ with open access textbooks” (p. 151). More recently, Allen and Seaman (2014) in their nationally representative survey of 2144 faculty members in the United States found that only 34% of respondents expressed awareness of OER.

In order for faculty to replace commercial textbooks with OER, they not only need to be aware of OER, they also want to know that OER have proven efficacy and trusted quality (Allen and Seaman 2014). The purpose of this study is to identify and discuss the 16 published research studies regarding the efficacy of OER in higher education and/or the perceptions of college students and teachers regarding the quality of OER. In the following section I describe the method utilized in selecting these articles.

**Method**

Six criteria were used to determine inclusion in the present study. First, the resource(s) examined in the study needed to be OER that were the primary learning resource(s) used in a higher education setting and be compared with traditional learning resources. It is important to note that OER vary widely in how they are presented. In some instances they may be a digital textbook (which could printed for or by students). OER can also be electronic learning modules. All types of OER were included in the present study. Second, the research needed to have been published by a peer-reviewed journal, or be a part of an institutional research report or dissertation. Third, the research needed to have data regarding either teacher and/or student perceptions of OER quality, or educational outcomes. Fourth, the study needed to have at least
50 participants and clearly delineated results in terms of the numbers of research subjects who expressed opinions about OER and/or had their learning measured. Finally, the study needed to have been published in English, and be published prior to October of 2015.

I identified potential articles for inclusion based on three approaches. One was to examine the literature cited in key efficacy and perceptions studies. A second was to perform a search of the term “Open Educational Resources” on Google Scholar, which yielded 993 articles. Many of these were easily excluded because based on the title or venue they clearly did not meet the above criteria. OER was not the main topic of some of these articles; moreover, a high number of the articles provided introductory approaches to OER or focused on theoretical applications of OER. Those that appeared to have the potential for inclusion were read to determine whether they met the above-mentioned criteria. The third and final approach was that I sent the studies I had identified to 246 researchers who had published on OER related topics and asked them if they were aware of additional studies that I had missed. The result of these approaches is the 16 studies discussed in the present study.

**Results—studies pertaining to student learning outcomes**

To date, nine studies have been published that focus on analyzing student learning outcomes when OER are substituted for traditional textbooks in higher education settings. In this section I review these studies and synthesize their overall results.

Lovett et al. (2008) measured the result of implementing an online OER component of Carnegie Mellon University's Open Learning Initiative (OLI). In fall 2005 and spring 2006 researchers invited students who had registered for an introductory statistics class at Carnegie Mellon to participate in an experimental online version of the course which utilized OER. Volunteers for the experimental version of the course were randomly assigned to either treatment or control conditions, with those who did not volunteer also becoming part of the control group, which was taught face-to-face and used a commercial textbook.

In the fall of 2005 there were 20 students in the treatment group and 200 in the control group. In spring of 2006 there were 24 students in the treatment group and an unspecified number of students in the control group. Researchers compared the test scores (three midterm and one final exam) between students in the experimental and control versions of the course for each of these two semesters and found no statistically significant differences.

In a follow up experiment reported in the same study, students in the spring of 2007 were given an opportunity to opt into a blended learning environment in which students who utilized OER in combination with face-to-face instruction would complete the course materials in half the time used by those taking the traditional version of the course. In this instance, the treatment and control groups (22 and 42 students respectively) were only drawn from those who volunteered to participate in the accelerated version of the course. The authors stated that “as in the two previous studies, in-class exams showed no significant difference between the traditional and online groups…[however] students in OLI-Statistics learned 15 weeks’ worth of material as well or better than traditional students in a mere 8 weeks” (pp. 10, 12). Five months after the semester ended (seven months after the end for the treatment students), a follow up test was given to determine how much of the material had been retained. No significant difference was found between the two groups.

In addition to comparing student exam scores, researchers examined student understanding of basic statistical concepts as measured by the national exam known as “Comprehensive Assessment of Outcomes in a first Statistics course” (CAOS). Research subjects in the spring of 2007 took this test at the beginning and end of the semester in order to measure the change in their statistics understanding. Students in the blended version of the course improved their scores by an average of 18%; those in the control group on average improved their scores by 3%, a statistically significant difference. This study is notable both for being the first published article to examine comparative learning outcomes when OER replace traditional learning materials and for its selection criteria of participation. The method used in the spring of 2007, when treatment and control groups were randomly selected from the same set of
participants, represents an important attempt at randomization that has unfortunately rarely been replicated in OER studies. At the same time, it should be noted that the sample sizes are relatively small and there was a confound between the method in which students were taught and the use of OER.

Bowen et al. (2012) can be seen as an extension of the study just discussed. They compared the use of a traditional textbook in a face-to-face class on introductory statistics with that of OER created by Carnegie Mellon University’s Open Learning Initiative taught in a blended format. They extended the previous study by expanding it to six different undergraduate institutions. As in the spring 2007 semester reported by Lovett et al. (2008), Bowen et al. (2012) contacted students at the beginning or before each semester to ask for volunteers to participate in their study. Treatment and control groups were randomly selected from those who volunteered to participate, and researchers determined that across multiple characteristics the two groups were essentially the same.

In order to establish some benchmarks for comparison, both groups took the same standardized test of statistical literacy (CAOS) at the beginning and end of the semester, as well as a final examination. In total, 605 students took the OER version of the course, while 2439 took the traditional version. Researchers found that students who utilized OER performed slightly better in terms of passing the course as well as on CAOS and final exam scores; however, these differences were marginal and not statistically significant.

Bowen et al. (2012) is the largest study of OER efficacy that both utilized randomization and provided rigorous statistical comparisons of multiple learning measures. A weakness of this study in terms of its connection with OER is that those who utilized the OER received a different form of instruction (blended learning as opposed to face-to-face); therefore, the differences in instruction method may have confounded any influence of the open materials. Nevertheless, it is important to note that the use of free OER did not lead to lower course outcomes in this study (Bowen et al. 2014) model how their 2012 results could impact the costs of receiving an education.

A third study (Hilton and Laman 2012), focuses on an introductory Psychology course, taught at Houston Community College (HCC). In 2011, in order to help students save money on textbooks, HCC’s Psychology department selected an open textbook as one of the textbooks that faculty members could choose to adopt. The digital version was available for free, and digital supplements produced by faculty were also freely available to HCC students.

In the fall of 2011, seven full-time professors taught twenty-three sections using the open textbook as the primary learning resource; their results were compared with those from classes taught using commercial textbooks in the spring of 2011. Results were provided for 740 students with roughly 50 % treatment and control conditions. Researchers used three metrics to gauge student success in the course: GPA, withdrawals, and departmental final exam scores. They attempted to control for a teacher effect by comparing those measures across the sections of two different instructors. Each of these instructors taught one set of students using a traditional textbook in spring of 2011 and other students using the open textbooks in fall of 2012.

Their overall results showed that students in the treatment group had a higher class GPA, a lower withdrawal rate, and higher scores on the department final exam. These same results occurred when only comparing students that had been taught by the same teacher. While this research demonstrated what may appear to be learning improvements, there were many methodological problems with this study. These limitations are significant, including the fact that the population of individuals who take an introductory psychology course in the spring may be different from the one that takes the same course in the fall. There was no attempt made to contextualize this potential difference by providing information about the difference between fall and spring semesters in previous years. In addition, changes were made in the course learning outcomes and final exam during the time period of the study. While there is no indication that the altered test was harder or easier than previous tests, it is a significant weakness. Moreover, there was no analysis performed to determine whether the results were statistically significant.

A fourth study, Feldstein et al. 2012, took place at Virginia State University (VSU). In the spring of 2010 the School of Business at VSU began implementing a new core curriculum. Faculty members were concerned because an internal survey stated that only 47 % of students purchased textbooks for their courses, largely because of affordability concerns. Consequently, they adopted open textbooks in many of the new core curriculum courses. Across the fall of
2010 and spring of 2011, 1393 students took courses utilizing OER and their results were compared with those of 2176 students in courses not utilizing OER.

These researchers found that students in courses that used OER more frequently had better grades and lower failure and withdrawal rates than their counterparts in courses that did not use open textbooks. While their results had statistical significance, the two sets of courses were not the same. Thus while these data provide interesting correlations, they are weak because the courses being compared were different, a factor that could easily mask any results due to OER. In other words, while this study establishes that students using OER can obtain successful results, the researchers compared apples to oranges, leading to a lack of power in their results.

In the fifth study, Pawlyshyn et al. (2013) reported on the adoption of OER at Mercy College. In the fall of 2012, 695 students utilized OER in Mercy’s basic math course, and their pass rates were compared with those of the fall of 2011, in which no OER were utilized. They found that when open materials were integrated into Mercy College, student learning appeared to increase. The pass rates of math courses increased from 63.6 % in fall 2011 (when traditional learning materials were employed) to 68.9 % in fall 2012 when all courses were taught with OER. More dramatic results were obtained when comparing the spring of 2011 pass rate of 48.4 % (no OER utilized) with the pass rate of 60.2 % in the spring of 2013 (all classes utilized OER). These results however, must be tempered with the fact that no statement of statistical significance was included. Perhaps a more important limitation is that simultaneous with the new curriculum came the decision to flip classroom instruction, thus introducing a significant confound into the research design. Mercy’s supplemental use of explanatory videos and new pedagogical model may be responsible for the change in student performance, rather than the OER.

In addition to the change in the math curriculum, Mercy College also adopted OER components based on reading in some sections of a course on Critical Inquiry, a course that has a large emphasis on reading skills. In the fall of 2011, 600 students took versions of the course that used OER, while an unspecified number of students enrolled in other sections did not use the OER. In the critical reading section of the post-course assessment, students who utilized OER scored 5.73, compared with those in the control group scoring 4.99 (the highest possible score was 8). In the spring of 2013, students enrolled in OER versions of the critical inquiry course performed better than their peers; in a post-course assessment with a maximum score of 20, students in the OER sections scored an average of 12.44 versus 11.34 in the control sections. As with the math results, no statement of statistical significance was included; in addition, no efforts were made to control for any potential differences in students or teachers. Another weakness of this aspect of the study is that there was significant professional development that went into the deployment of the OER. It is conceivable that it was the professional development, or the collaboration across teachers that led to the improved results rather than the OER itself. If this were to be the case, then what might be most notable about the OER adoption was its use as a catalyst for deeper pedagogical change and professional growth.

A sixth study (Hilton et al. 2013), took place at Scottsdale Community College (SCC), a community college in Arizona. A survey of 966 SCC mathematics students showed that slightly less than half of these students (451) used some combination of loans, grants and tuition waivers to pay for the cost of their education. Mathematics faculty members were concerned that the difficulties of paying for college may have been preventing some students from purchasing textbooks and determined that OER could help students access learning materials at a much lower price.

In the fall of 2012 OER was used in five different math courses; 1400 students took these courses. Each of these courses had used the same departmental exam for multiple years; researchers measured student scores on the final exam in order to compare student learning between 2010 and 2011 (when there were no OER in place) and 2012 (when all classes used OER). Issues with the initial placement tests made it so only four of the courses could be appropriately compared. Researchers found that while there were minor fluctuations in the final exam scores and completion rates across the four courses and three years, these differences were not statistically significant. As many of the studies discussed in this section, this study did not attempt to control for any teacher or student differences due to the manner in which the adoption that took place. While it is understandable that the math department wished to simultaneously change all its course materials it would have provided a better experimental context had only a portion of students and teachers been selected for an implementation of OER.
The seventh study (Allen et al. 2015), took place at the University of California, Davis. The researchers wanted to test the efficacy of an OER called ChemWiki in a general chemistry class. Unlike some of the studies previously discussed, researchers attempted to approximate an experimental design that would control for the teacher effect by comparing the results of students in two sections taught by the same instructor at back-to-back hours. One of these sections was an experimental class of 478 students who used ChemWiki as its primary learning resource, the other was a control class of 448 students that used a commercial textbook. To minimize confounds, the same teaching assistants worked with each section and common grading rubrics were utilized. Moreover, they utilized a pretest to account for any prior knowledge differences between the two groups.

Students in both sections took identical midterm and final exams. Researchers found no significant differences between the overall results of the two groups. They also examined item-specific questions and observed no significant differences. Comparisons between the beginning of the semester pre-tests and final exam scores likewise showed no significant differences in individual learning gains. This pre/post analysis was an important measure to control for initial differences between the two groups.

Researchers also administered student surveys in order to determine whether students in one section spent more time doing course assignments than those in the other section. They found that students in both sections spent approximately the same amount of time preparing for class. Finally, they administered the chemistry survey known as “Colorado Learning Attitudes about Science Survey” (CLASS) in order to discern whether student attitudes towards chemistry varied by treatment condition. Again, there was no significant difference.

The eighth study (Robinson 2015) examined OER adoption at seven different institutions of higher education. These institutions were part of an open education initiative named Kaleidoscope Open Course Initiative (KOCI). Robinson focused on the pilot adoption of OER resources at these schools in seven different courses (Writing, Reading, Psychology, Business, Geography, Biology, and Algebra). In the 2012–2013 academic year, 3254 students across the seven institutions enrolled in experimental versions of these courses that utilized OER and 10,819 enrolled in the equivalent versions of the course that utilized traditional textbooks. In order to approximate randomization, Robinson used propensity score matching on several key variables in order to minimize the differences between the two groups. After propensity score matching was completed, there were 4314 students remaining, with 2157 in each of the two conditions.

Robinson examined the differences in final course grade, the percentage of students who completed the course with a grade of C- or better, and the number of credit hours taken, which was examined in order explore whether lower textbook costs were correlated with students taking more courses. Robinson found that in five of the courses there were no statistically significant differences between the two groups in terms of final grades or completion rates. However, students in the Business course who used OER performed significantly worse, receiving on average almost a full grade lower than their peers. Those who took the OER version of the psychology course also showed poorer results; on average, they received a half-grade lower for their final grade (e.g. B + to a B). Students in these two courses were significantly less likely to pass the course with a C- or better.

In contrast, students who took the biology course that used OER were significantly more likely to complete the course, although there were no statistically significant differences between groups in the overall course grades. Across all classes there was a small but statistically significant difference between the two groups in terms of the number of credits they took, with students taking OER versions of the course taking on average .25 credits more than their counterparts in the control group. This study is notable in higher education OER efficacy studies in terms of its rigorous attempts to use propensity score matching to control for potentially important confounding variables.

In the ninth study, Fischer et al. (2015) performed follow-up research on the institutions participating in KOCI. Their study focused on OER implementation in the fall of 2013 and spring of 2014. Their original sample consisted of 16,727 students (11,818 control and 4909 treatment). From this sample, there were 15 courses for which some students enrolled in both treatment (n = 1087) and control (n = 9264) sections (the remaining students enrolled in a course which had either all treatment or all control sections and were therefore excluded). While this represents a large sample size,
students in treatment conditions were only compared with students in control conditions who were taking the same class in which they were enrolled. For example, students enrolled in a section of Biology 111 that used OER were only compared with students in Biology 111 sections that used commercial textbooks (not students enrolled in a different course). Thus when diffused across 15 classes, there was an insufficient number of treatment students to do propensity score matching for the grade and completion analyses.

The researchers found that in two of the 15 classes, students in the treatment group were significantly more likely to complete the course (there were no differences in the remaining 13). In five of the treatment classes, students were significantly more likely to receive a C- or better. In nine of the classes there were no significant differences and in one study control students were more likely to receive a C- or better. Similarly, in terms of the overall course grade, students in four of the treatment classes received higher grades, ten of the classes had no significant differences, and students in one control class received higher grades than the corresponding treatment class.

Researchers utilized propensity score matching before examining the number of credits students took in each of the semesters as this matching could be done across the different courses. Drawing on their original sample of 16,727 students, the researchers matched 4147 treatment subjects with 4147 controls. There was a statistically significant difference in enrollment intensity between the groups. Students in fall 2013 who enrolled in courses that utilized OER took on average two credit hours more than those in the control group, even after controlling for demographic covariates. ANCOVA was then used to control for differences in fall enrollment and to estimate differences in winter enrollment. Again, there was a significant difference between the groups, with treatment subjects enrolling in approximately 1.5 credits more than controls.

This study is unique in its large sample size and rigorous analysis surrounding the amount of credits taken by students. In some ways, its strength is also a weakness. Because of the large number of contexts, OER utilized, number of teachers involved, and so forth, it is difficult to pinpoint OER as the main driver of change. For example, it is possible that the level of teacher proficiency at the college that taught Psychology using open resources was superior to that of the college where traditional textbooks were used. A host of other variables, such as student awareness of OER, the manner in which the classes were taught were not analyzed in this study; these could have overwhelmed any influence of OER. Moreover, the authors neglect to provide an effect size, limiting the ability to determine the magnitude of difference between the control and treatment courses. At the same time, one would expect that if using OER does significantly impact learning (for good or bad), that that finding would be visible in the results. The lack of difference between the groups indicates that substituting OER for traditional resources was not a large factor in influencing learning outcomes.

Table 1 summarizes the results of the nine published research studies that compare the student learning outcomes in higher education based on whether the students used OER or traditional textbooks.

<table>
<thead>
<tr>
<th>Study</th>
<th>N treatment</th>
<th>N control</th>
<th>Attempted to control for teacher variables</th>
<th>Attempted to control for student variables</th>
<th>Randomization</th>
<th>Measurement</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lovett et al. (2008)</td>
<td>66</td>
<td>242</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>CAOS, exam scores</td>
<td>N.S. in exam scores, significant difference in CAOS, favoring OER</td>
</tr>
<tr>
<td>Bowen et al. (2012)</td>
<td>605</td>
<td>2439</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>CAOS, exam scores, pass rate</td>
<td>N.S.</td>
</tr>
<tr>
<td>Hilton and Laman (2012)</td>
<td>370</td>
<td>370</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Exam scores, GPA, withdrawal rate</td>
<td>Potentially favorable, but statistical</td>
</tr>
<tr>
<td>Study</td>
<td>N treatment</td>
<td>N control</td>
<td>Attempted to control for teacher variables</td>
<td>Attempted to control for student variables</td>
<td>Randomization</td>
<td>Measurement</td>
<td>Results</td>
</tr>
<tr>
<td>-----------------------</td>
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<td>-------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Feldstein et al. (2012)</td>
<td>1393</td>
<td>3569</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Grade, withdrawal rate</td>
<td>Favors OER with very large limitations.</td>
</tr>
<tr>
<td>Pawlyshyn et al. (2013)</td>
<td>1295</td>
<td>Not given</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Exam scores, pass rate</td>
<td>Potentially favorable, but statistical significance not discussed</td>
</tr>
<tr>
<td>Hilton et al. (2013)</td>
<td>1400</td>
<td>26,764</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Completion rates, exam scores</td>
<td>N.S.</td>
</tr>
<tr>
<td>Allen et al. (2015)</td>
<td>478</td>
<td>448</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Exam scores, CLASS</td>
<td>N.S.</td>
</tr>
<tr>
<td>Robinson (2015)</td>
<td>3254</td>
<td>10,819</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Completion, grade, credits taken</td>
<td>Two of the seven classes favored traditional textbooks. One favored OER. Other four N.S. Students using OER took slightly more credits</td>
</tr>
<tr>
<td>Fischer et al. (2015)</td>
<td>4909</td>
<td>11,818</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Completion, grade, credits taken</td>
<td>One of the 15 classes favored traditional textbooks. Five favored open. Other nine N.S. Students using OER took slightly more credits</td>
</tr>
<tr>
<td>Total</td>
<td>13,770</td>
<td>32,379</td>
<td>7 no, 2 yes</td>
<td>5 no, 4 yes</td>
<td>7 no, 2 yes</td>
<td>CAOS, CLASS, completion rate, credits taken, exam scores, GPA, pass rate, withdrawal rate</td>
<td>Three studies reported N.S. Three had results that favored OER. One favored traditional textbooks. Two did not discuss the statistical significance of the results</td>
</tr>
</tbody>
</table>
Results—studies pertaining to student and teacher perceptions of OER

Two of the studies referenced in the above section on student learning outcomes also included data that pertained to student and/or faculty perceptions of OER. Feldstein et al. (2012), surveyed the 1393 students who utilized OER. Of the 315 students who responded to this survey, 95 % strongly agreed or agreed that the OER were “easy to use” and 78 % of respondents felt that the OER “provided access to more up-to-date material than is available in my print textbooks.” Approximately two-thirds of students strongly agreed or agreed that the digital OER were more useful than traditional textbooks and that they preferred the OER digital content to traditional textbooks.

Hilton et al. (2013) surveyed 1400 students and forty-two faculty members who utilized math OER; 910 students and twenty faculty members completed these surveys. The majority of students (78 %) said they would recommend the OER to their classmates. Similarly, 83 % of students agreed with the statement that “Overall, the materials adequately supported the work I did outside of class.” Twelve percent of students neither agreed nor disagreed. An analysis of the free responses to the question, “What additional comments do you have regarding the quality of the open materials used in your class?” showed that 82 % were positive. Faculty members were likewise enthusiastic about the open materials. Of the 18 faculty members who responded to questions comparing the materials, nine said the OER were similar in quality to the texts they used in other courses, and six said that they were better.

In addition to these two studies, I identified seven other articles that focus on teacher and/or student perceptions of OER. As will be discussed in a later section, many of these articles share significant weaknesses, namely the limitations of student perceptions and the potential biases of teachers involved in the creation or adoption of OER.

The first of these studies (Petrides, Jimes, Middleton-Detzner, Walling, & Weiss, Petrides et al. 2011), drew on surveys of instructors and students who utilized an open statistics textbook called Collaborative Statistics (a revised version of this textbook is now published by OpenStax and is titled Introductory Statistics). In total, 31 instructors and 45 students participated in oral interviews or focus groups that explored their perceptions of this OER.

The researchers stated that “Cost reduction for students was the most significant factor influencing faculty adoption of open textbooks.” (p. 43). The majority of students (74 %) reported they typically utilized the book materials online, rather than printing or purchasing a hard copy. Cost was cited as the primary factor behind this decision. In addition, 65 % of students stated they would prefer to use open textbooks in future courses because they were generally easier to use.

The second study (Pitt et al. 2013) examined student perceptions of two pieces of OER that were used to help students improve in their mathematics and personal development skills. These OER were used in a variety of pilot projects, including as resources for community college students who had failed mathematics entrance exams.

In total, 1830 learners used the two OER. For a variety of reasons only 126 of these students took surveys regarding their perceptions of the learning materials. Of those who completed the surveys, 79 % reported overall satisfaction with the quality of the OER. An additional 17 % stated they were undecided about their satisfaction with the OER, and only 4 % expressed dissatisfaction with the materials. While this study reported overall positive perceptions of OER it is limited by the extremely low response rate.

The third study (Gil et al. 2013) reported on a blog that heavily utilized OER. Students enrolled in the Computer Networks course at the University of Alicante (located in Spain) used this blog in conjunction with their coursework. Between June 2010 and February 2013, 345 students enrolled in the course. Of these students, 150 (43 %) completed surveys about their perceptions of the blog that featured OER in contrast with blogs they had used in other courses.

Students were asked questions such as, “In terms of organisation, were you more or less satisfied with the Computer Networks blog versus other blogs at the University of Alicante?” On average, 40 % of students said that the blogs featuring OER were of equal quality to the blogs that did not feature OER, 45 % of students said the blogs with OER were superior and 15 % said they were inferior. While this study shows that a strong majority of users ranked the OER blog as
good as or better than non-open blogs it is limited given the generally accessible nature of blogs. It is not clear from the article what it was about the blogs with OER that made them superior to the blogs that did not feature them. Thus it is difficult to determine the degree to which it was the OER or some other factors that led to the favorable student views.

The fourth and fifth studies (Bliss et al. 2013a, 2013b) both examined OER adoption at the KOCI institutions that used OER. Bliss et al. (2013a) reported on surveys taken by eleven instructors and 132 students at seven KOCI colleges. Seven of the instructors believed that their students were equally prepared (in comparison with previous semesters) when OER replaced traditional texts; three reported that their students were more prepared, with one feeling that students were less prepared. All instructors surveyed said they would be very likely to use open texts in the future. Students in this study were also very positive regarding OER materials. When invited to compare the OER with the types of textbooks they traditionally used, only 3% felt the OER were worse than their typical textbooks. In contrast, 56% said they were the same quality; 41% said they were better than typical textbooks.

Bliss et al. (2013b) extended this study by surveying an additional 58 teachers and 490 students across the eight KOCI colleges regarding their experiences with OER. They found that approximately 50% of students said the OER textbooks had the same quality as traditional textbooks and nearly 40% said that they were better. Students focused on several benefits of the open textbooks. The free nature of their open texts seemed vital to many students. For example, one student said, “I have no expendable income. Without this free text I would not be able to take this course.” Researchers found that 55% of KOCI teachers reported the open materials were of the same quality as the materials that had previously been used, and 35% felt that they were better. Lower cost and the ability to make changes to the text were reasons that many teachers felt that the OER materials were superior.

The sixth study, Lindshield and Adhikari (2013), sought to understand student perceptions of a course “flexbook” being utilized in face-to-face and distance courses in a class called “Human Nutrition,” offered at Kansas State University. This flexbook is a digital OER textbook that is easily adaptable by instructors and available to students in a variety of formats. The authors wanted to determine if perceptions and use of flexbooks were different in an online section of a Human Nutrition class as compared to a face-to-face class, which also used the flexbook. Out of the 322 students who took the course between spring 2011 and spring 2012, 198 completed a survey in which they answered questions about their experience with the OER.

The researchers found that both online and face-to-face students had favorable perceptions of the OER flexbooks they utilized, with the online classes having higher, but not statistically significant, levels of satisfaction. On a seven point scale (7 = strongly agree) students gave an average response of 6.4 to the question, “I prefer using the flexbook versus buying a textbook for HN [Human Nutrition] 400.” Moreover, they found that students disagreed or somewhat disagreed with statements to the effect that they would like to have a traditional textbook in addition to the OER.

The seventh study (Allen and Seaman 2014) surveyed 2144 college professors regarding their opinions on OER. They used a nationally representative faculty sample randomly selecting faculty members from a database that purportedly includes 93% of all higher education teaching faculty in the United States. Faculty respondents were equally split between male and female and approximately three-quarters were full-time faculty members.

Of those surveyed, 729 (34%) expressed awareness of OER. Of the subset that was aware of OER, 61.5% of respondents said that OER materials had about the same “trusted quality” as traditional resources, 26.3% said that traditional resources were superior, 12.1% said that OER were superior. 68.2% said that the “proven efficacy” were about the same, 16.5% said that OER had superior efficacy and 15.3% said that traditional resources had superior efficacy. It is important to note that the faculty members in this study expressed awareness of OER, but had not necessarily utilized OER in their pedagogy, as had the instructors in the previously cited perception studies. Thus we cannot be certain about the object of their perceptions or the extent to which they accurately define OER. This research would have been significantly strengthened had it provided information about a subset of teachers who had used OER as the primary learning material in their classroom.

Table 2 summarizes the results of the nine published research studies that provide data regarding student and/or teacher perceptions of OER.
<table>
<thead>
<tr>
<th>Study</th>
<th>N completed student surveys</th>
<th>N completed teacher surveys</th>
<th>Summary of results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petrides et al. (2011)</td>
<td>45</td>
<td>31</td>
<td>Cost was cited as an important factor for both teachers and students. Two-thirds of students preferred using OER instead of traditional textbooks</td>
</tr>
<tr>
<td>Feldstein et al. (2012)</td>
<td>315</td>
<td>N/A</td>
<td>Approximately two-thirds of students strongly agreed or agreed that they preferred the OER digital content to traditional textbooks</td>
</tr>
<tr>
<td>Pitt et al. (2013)</td>
<td>126</td>
<td>N/A</td>
<td>79% of students reported overall satisfaction with the quality of the OER, with 17% undecided and 4% dissatisfied</td>
</tr>
<tr>
<td>Gil et al. (2013)</td>
<td>150</td>
<td>N/A</td>
<td>40% of students said the OER resource was equal to non-OER, 45% favored OER, 15% favored non-OER</td>
</tr>
<tr>
<td>Hilton et al. (2013)</td>
<td>910</td>
<td>20</td>
<td>83% of students believed the OER supported their work in the course and 78% would recommend OER to classmates. Half of the instructors said OER was of equal quality as traditional texts, with 33% favoring OER and 17% favoring traditional textbooks</td>
</tr>
<tr>
<td>Lindshield and Akhiri (2013)</td>
<td>198</td>
<td>N/A</td>
<td>Both online and face-to-face students had favorable perceptions of the OER flexbook. Students reported that they strongly preferred using the OER instead of purchasing a textbook</td>
</tr>
<tr>
<td>Bliss et al. (2013a)</td>
<td>132</td>
<td>11</td>
<td>Approximately 50% of students said OER had the same quality as traditional textbooks; 41% said OER were superior. 60% of instructors reported students were equally prepared with OER; 30% said they were better prepared. All instructors said they would be very likely to use open texts in the future</td>
</tr>
<tr>
<td>Bliss et al. (2013b)</td>
<td>490</td>
<td>58</td>
<td>Approximately 50% of students said OER textbooks had the same quality as traditional textbooks and nearly 40% said that they were better. 55% of teachers reported that the open materials were of the same quality as the materials that had previously been used, and 35% felt that they were better</td>
</tr>
<tr>
<td>Allen and Seaman (2014)</td>
<td>N/A</td>
<td>2144</td>
<td>Only 34% of U.S. college faculty surveyed were aware of OER. Of those that were, 62% said that OER materials had about the same “trusted quality” as traditional resources, with 26% favoring traditional resources and 12% favoring OER. 68% said the “proven efficacy” of OER and traditional textbooks were about the same 16.5% felt OER was superior and 15.3% traditional resources were superior</td>
</tr>
<tr>
<td>Total</td>
<td>2366</td>
<td>2144</td>
<td>In general, a strong majority of students and teachers believe that OER are as good or better than traditional textbooks</td>
</tr>
</tbody>
</table>

**Discussion**

In total 46,149 students have participated in studies relating to the influence of OER on learning outcomes. Only one of the nine studies on OER efficacy showed that the use of OER was connected with lower learning outcomes in more instances than it was with positive outcomes, and even this study showed that the majority of the classes were non-significant differences. Three had results that significantly favored OER, three showed no significant difference and two
did not discuss the statistical significance of their results. In synthesizing these nine OER efficacy studies, an emerging finding is that utilizing OER does not appear to decrease student learning.

These results must be interpreted with caution however, for many reasons. First, it is important to note that, as stated previously, it is not clear how OER might have been used in each of the above contexts. In some instances, open textbooks are printed and utilized just as traditional textbooks. In other contexts students access OER only through digital methods. These design differences make it difficult to directly connect learning gains/losses with the OER directly. For example, it is theoretically possible that adopting an open digital textbook led to increased access but that students obtained sub-optimal results because they read them online instead of in print. It cannot be determined whether differences in design did make a difference in these studies; however, Daniel and Woody (2013) have shown that in some contexts it appears that there is no difference in student performance when they read electronic versus print versions of a textbook.

It is also important to note that the research designs discussed in this paper were insufficient to claim causality, and some were quite weak. Significant design flaws such as changing final exam metrics between comparison years or comparing different (rather than identical) courses severely curtail the usefulness of some of these studies. Likewise, a consistent problem with confounding the adoption of OER with a change in the delivery method (e.g., from traditional to blended learning) is an issue that needs to be addressed in future studies that attempt to determine the impact of OER adoption.

In some respects, these limitations are not surprising. Confrey and Stohl (2004) examine 698 peer-reviewed studies of the 13 mathematics curriculum that are supported by the National Science Foundation as well as six different commercial products. They found that “The corpus of evaluation studies as a whole across the 19 programs studied does not permit one to determine the effectiveness of individual programs with a high degree of certainty, due to the restricted number of studies for any particular curriculum, limitations in the array of methods used, and the uneven quality of the studies” (p. 3). If such heavily funded curriculum across nearly 700 studies have only inconclusive results, we should not be surprised that the effects of OER adoption are relatively modest.

Those who wish to engage in further OER efficacy research may benefit from adapting aspects of the studies that incorporate stronger research designs. For example, the techniques used by Allen et al. (2015) represent an important attempt to control for teacher and student effects. The approach taken by Lovett et al. (2008) and Bowen et al. (2012) to randomize treatment and control groups based on those who volunteer is another technique that could benefit further OER efficacy studies. Studying patterns of enrollment intensity connected to OER, subject to propensity score matching (as did Robinson (2015) and Fischer et al. (2015)) may be an important approach to testing the hypothesis that open textbooks can help hasten progress toward graduation. While not evenly administered throughout all of the studies, the collective implementation of techniques such as randomization and attempts to control for student and teacher differences do indicate that some serious efficacy research has been done, and much more is needed.

Ideally future research could be structured in such a way that students are randomly assigned to open and traditional textbooks, an option that admittedly would be difficult to pursue. The approach taken by Allen et al. (2015) of administering a pretest at the beginning of a course to account for any pre-existing student differences may be a more realistic approach. I believe that replicating Allen et al. (2015) in different contexts is the most viable approach to increasing the base of significant efficacy studies on OER. In addition, researchers could explore questions such as, “How do students use OER as opposed to traditional textbooks?” All of the OER efficacy research that has been done presupposes that the textbook (whether traditional or open) influences learning. Is this in fact the case? Does the amount of time or manner in which students engage with the learning resource influence outcomes?

In terms of student and teacher perspective of OER, a total of 4510 students and faculty members were surveyed across nine studies regarding perceptions of OER. In no instance did a majority of students or teachers report a perception that the OER were less likely to help students learn. In only one study did faculty state that traditional resources had a higher “trusted quality” than OER (however nearly two-thirds said they were the same). Across multiple studies in various settings, students consistently reported that they faced financial difficulties and that OER provided a
financial benefit to them. A general finding seemed to be that roughly half of students found OER to be comparable to traditional resources, a sizeable minority believed they were superior, and a smaller minority found them to be inferior. This is particularly noteworthy given some research that indicates that students tend to read electronic texts more slowly than their counterparts who read in print (Daniel and Woody 2013).

These findings however must be tempered first with the notion that they rely heavily on student perceptions, which in some instances appear to revolve more around improving efficiency rather than learning (Kvavik 2005). The fact that students saved significant amounts of money by using OER likely colored their perceptions of the value of OER as learning resources. It may be that cost-savings or convenience (e.g., not having to carry around heavy backpacks) influenced student perceptions more than learning growth. Similarly, many of the teachers who were surveyed in these studies were involved in the creation or selection of the OER used in their classes. This has the potential to significantly bias their perception of the quality of the resources.

I propose that future perceptions study overcome these limitations by providing a context in which students and teachers evaluate traditional and open textbooks in less-biased settings. For example, students and teachers could be recruited to compare textbooks that they have not created, used or purchased. They could blindly (without knowing which textbooks are OER) evaluate the textbooks on a variety of metrics including their ease of use, accuracy of information and so forth. While this would have the disadvantage of people giving more cursory evaluations (not having utilized the textbooks throughout a semester) it would have the advantage of mitigating the potential biases described in the previous paragraph.

Conclusion

The collective results of the 16 studies discussed in this article provide timely information given the vast amount of money spent on traditional textbooks. Because students and faculty members generally find that OER are comparable in quality to traditional learning resources, and that the use of OER does not appear to negatively influence student learning, one must question the value of traditional textbooks. If the average college student spends approximately $1000 per year on textbooks and yet performs scholastically no better than the student who utilizes free OER, what exactly is being purchased with that $1000? The decision to employ OER appears to have financial benefits to students (and the parents and taxpayers who support them) without any decrease in their learning outcomes. This last statement must be said tentatively, given the varying rigor of the research studies cited in this paper. Nevertheless, based on the 16 studies I have analyzed, researchers and educators may need to more carefully examine the rationale for requiring students to purchase commercial textbooks when high-quality, free and openly-licensed textbooks are available.

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**Previous Citation(s)**

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John has a Masters degree from Harvard and a Ph.D from BYU, both in Education. John loves to teach and his research focuses on issues relating to both religious topics and Open Educational Resources (OER). John has published several books with Deseret Book, including Considering the Cross: How Calvary Connects Us with Christ. He is also the author of the video course and podcast “Seeking Jesus.” John loves teaching, reading and spending time with his family. For more information about John Hilton III see http://johnhiltoniii.com (religious education website) and http://openedgroup.org (educational technology website).
Thoughts on Continuous Improvement and OER

David Wiley

Improvement in post secondary education will require converting teaching from a solo sport to a community-based research activity. (Herbert A. Simon, 1986)

The faculty Lumen work with carry an enormous workload. Some have research, grant writing, and publication responsibilities in addition to teaching their courses. Some teach five or six courses per semester. Some have committee assignments and additional service responsibilities. Some drive across town several times per day as they try to string adjunct appointments at three institutions together into a career that pays the rent. All of our faculty have expertise in their discipline. Few have formal training in teaching or learning.

Herbert Simon, quoted above, was an “above average” faculty member. He won both the Turing Award for his work in computer science and the Nobel Prize for his work in economics. But even he realized that we can’t expect individual faculty to stay at the cutting edges of their discipline, teaching and learning practice, educational research, and the ever-changing technologies that can be used in the service of learning. This is why Simon called for us to come together as a community – there are countless ways in which education needs to be improved, and no one person, institution, or organization has the time or expertise to do it all alone. We need each other.

The role Lumen is choosing to play in the community working to improve education is to enable and empower learners and faculty with highly effective learning materials that become more effective every semester. And this process of making OER more effective every semester – also known as “continuous improvement” – is where we see some of the most exciting opportunities to collaborate with faculty.

Continuous improvement is an iterative cycle. In the case of OER, the continuous improvement cycle involves:

- Creating or selecting OER for use in your course,
- Instrumenting the OER for measurement,
- Measuring the effectiveness of OER in supporting student learning,
- Identifying areas where student learning was not effectively supported,
- Making changes to the learning design of the OER in those underperforming areas, and
- Beginning the cycle again.

Developed with funding from the Bill and Melinda Gates Foundation, Lumen’s Waymaker courses are designed specifically to support this continuous improvement process, and we have been refining our process for several years in collaboration with a small group of faculty. You can see an example of the difference in OER before and after we applied this internal continuous improvement process here:
While we’re still refining the tools we’ve created to support this work, we are now eager to open our continuous improvement process to all faculty members, with the goal of making it a genuinely community-based research activity. Here’s what we’re doing this fall:

- We have analyzed data from Spring 2018 to empirically determine which learning outcomes students struggled with the most in five Waymaker courses. (Learn more about this process in this accompanying blog post.)
- For each course, we have published a collection of “Learning Challenges Leaderboards” listing the learning outcomes students struggled with the most, together with links to the OER that didn’t adequately support student learning.

The RISE and Shine Initiative

We invite you to engage with us in a community-based continuous improvement process. We’re calling this initiative RISE & Shine. RISE is the analysis that identifies which content needs work (you can read more about RISE here). Once we’ve identified that content, we invite faculty to Shine by contributing their expertise to the improvement of OER.

You can participate by taking one or more of these steps:

1. **Raise your hand.** Complete this form to let us know you’d like to be part of conversations about improving learning with OER. We’ll share Learning Challenges updates and include you in what’s happening in your discipline.
2. **Reflect.** Look at the Learning Challenges Leaderboard in your discipline. Think about what you do to make learning better for your students as you’re tackling these challenging topics, and compare that with the approach taken in the aligned OER. How would you do things differently?
3. **Share ideas.** Have ideas about how we should make the OER supporting these difficult topics more effective? Share them here.
4. **Share improvements.** Do you have a short video, an interactive activity, an edited version of the existing OER, or any other improved content you’ve developed to improve your students’ understanding? If so, submit them using this form. Whenever your contributions are included in Lumen course materials, your work is attributed. And you’ll be able to see the effect your contributions have on student learning in the next semester’s Learning Challenges Leaderboard update.
At Lumen we’re serious about making improving education a community-based research activity. That’s why we collaborate with faculty throughout the course improvement process, openly license the improvements we make to content, publish our continuous improvement frameworks in open access journals, and open source many of the tools we create to support our continuous improvement efforts.

However, we’re just one company. Truly transforming education will require more people and organizations to adopt a continuous improvement mindset. Given the amount of effort and the range of expertise required to engage in continuous improvement, Simon’s admonition to do this work collaboratively resonates with us as being deeply true.

We hope you’ll become part of this community-based effort with us.

The potential of the “data revolution” in teaching and learning, just as in other sectors, is to create much more timely feedback loops for tracking the effectiveness of a complex system. In a field where feedback is already well established as a vital process for both students and educators, the question is how this potential can be realized through effective human-computer systems (Buckingham Shum and McKay, 2018).

Open educational resources (OER) are educational materials whose copyright licensing grants everyone free permission to engage in the 5R activities, including making changes to the materials and sharing those updated materials with others. Consequently, everyone who wants to continuously improve OER has permission to do so. (Not so with traditionally copyrighted materials, whose licensing allows only the rightsholder to alter and improve the content.) Permission to make changes is a necessary – but not sufficient – condition for continuous improvement.

In addition to permission to make changes, improvement requires a capacity for measurement. We can say we’ve changed OER without measuring the impact of those changes, but we can only say we’ve improved OER when we have measured student outcomes and confirmed that they have actually changed for the better.

Continuous improvement of OER, then, is the iterative process of:

- Instrumenting OER for measurement,
- Measuring their effectiveness in supporting student mastery of learning outcomes,
- Identifying areas where student mastery of those learning outcomes was not effectively supported,
- Making changes to the learning design of the underperforming OER aligned to those learning outcomes, and then
- Beginning the cycle again so we can:
  - Measure the impact of those changes and determine whether or not they were actually improvements (not just changes), and
  - Identify additional areas that need strengthening.

Engaging in the continuous improvement of OER in this manner allows us to make OER support learning more effectively each semester.

Learning Design and Continuous Improvement

Lumen instruments OER for measurement at the individual learning outcome level. Outcome alignment is at the very core of both our learning design process and our continuous improvement process. The outcome alignment process has three parts.

First, we collaborate with faculty to identify each of the individual skills we want to support students in mastering. These detailed outcomes are, like all the content Lumen creates, licensed CC BY. Second, we align each individual page of content with the one or more outcomes whose mastery it supports. Finally, we align each assessment item with the outcome it is designed to assess. In the case of Waymaker Microeconomics, for example, that means aligning over 2,350 individual assessment items appearing in pre-tests, interactive practice opportunities, self-checks, and end of module quizzes with the appropriate learning outcome.
If that sounds like an incredible amount of work, that's because it is!

But it's worth it. In addition to providing benefits in the learning design process that we don't discuss here, outcome alignment is fundamental to the continuous improvement process. With assessment items aligned to individual outcomes in pre-tests, practices, self-checks, and end-of-module quizzes, we can model learning over time, from the beginning of the module (the pre-test occurs before students see any OER) to the second attempt on the end of module quiz (after students have used and reused the OER). Similarly, because all course content is outcome-aligned, we can examine how patterns of OER usage correlate with performance on aligned assessments.

Analyzing the Effectiveness of OER

This process begins with a RISE analysis. I published the RISE framework last year with Bob Bodily and Rob Nyland, two amazing PhD students at BYU. Earlier this year I also published an open source implementation of RISE in the Journal of Open Source Software. RISE analysis divides performance on assessments into two categories, higher and lower, and usage of OER into the same two categories, higher and lower. These are matrixed to create four ways of diagnosing how OER are working in support of student learning.

<table>
<thead>
<tr>
<th>Higher Grades</th>
<th>Low motivation or high life distraction, too much material, technical or other difficulties accessing resources</th>
<th>Low student prior knowledge, inherently easy learning outcome, highly effective content, poorly written assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective resources, effective assessment, strong outcome alignment</td>
<td>Poorly designed resources, poorly written assessments, poor outcome alignment, difficult learning outcome</td>
<td></td>
</tr>
</tbody>
</table>

Each outcome in the course is placed in one of these four categories, as in the visualization below. We focus first on those outcomes in the lower right corner, where usage of OER is high but performance on aligned assessments is low. These are places where effort invested in improving OER is most likely to improve student learning. Below we have drawn a blue diamond three standard deviations out from the origin (mean OER usage on the x-axis and mean assessment performance on the y-axis) to make it easier to visually identify outliers in need of immediate attention.

Making Targeted Improvements to OER

In the past, once the OER most in need of improvement were identified, we reached out to individual faculty to invite them to participate in the process of analyzing and improving course materials in collaboration with Lumen's learning engineers and course designers. Moving forward, we will use the Learning Challenges Leaderboards to make this information public and invite the community to participate in the process of revising, remixing, finding, or creating new OER to better support student learning.

(In addition to continuously improving the OER based on outcomes data, we also make a wide range of other updates to our courses. For example, we update OER based on faculty feedback, current events, and the availability of new OER. We make improvements to assessments based on the results of item analysis, make improvements to features of the Waymaker platform (like faculty and student nudges) based on ways they correlate with student performance, and make improvements to supplementary materials based on faculty feedback.)

The Role of Learning Materials in Education

It would be easy to look at the effort Lumen invests in improving OER and other courseware components and come to the conclusion that we think learning materials are the most important part of education. That would be a mistake. We believe deeply that the contributions made by the learner and the faculty both significantly outweigh the importance of learning materials. However, we also believe that highly effective learning materials can dramatically amplify the efforts
of learners and faculty. For example, we know that highly effective learning materials can help learners reach the same levels of mastery in half the time compared to materials that follow a traditional textbook design (Lovett et al., 2008).

There are myriad ways in which education needs to be improved. The role Lumen is choosing to play in the community working to improve education (which extends far beyond problems relating to learning materials) is to enable and empower learners and faculty with highly effective learning materials that become more effective every semester.

We're working to engage a broad community of educators and institutions in the work of improving education by continuously improving OER course materials. We're trying to make this complex task more transparent, measurable, and participatory. Given the creativity and commitment of the community we serve, we have every hope of success.

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David Wiley
Lumen Learning

Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University's instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU's Marriott School of Management.

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Continuous Improvement of Instructional Materials

David Wiley, Robert Bodily, & Ross Strader

From time to time new technologies provide us with a qualitatively different ability to engage in previously possible activities. For example, 20 years ago it was already possible to publish an essay online. You simply used the command line program Telnet to login to a remote server, navigated into the directory from which your webserver made html files available to the public, launched the pico editor from the command line, wrote your essay, and manually added all the necessary html tags. Today, open source blogging software like Wordpress makes publishing an essay online as easy as using a word processor. Yes, it was possible to publish essays online before, but the modern experience is qualitatively different.

“Evaluate” is the final step in the traditional ADDIE meta-model of instructional design, and it has always been possible—if, at times, expensive and difficult—to evaluate the effectiveness of instructional materials. Modern technology has made the process of measuring the effectiveness of instructional materials a qualitatively different experience. Gathering data in the online context is orders of magnitude less expensive than gathering data in classrooms, and open source analysis tools have greatly simplified the process of analyzing these data.

Historically, any needed improvements discovered during the evaluation process would take a significant amount of time to reach learners, as they could only be accessed once new editions of a book were printed or new DVDs were pressed. Again, modern technology makes the delivery of improvements a qualitatively different exercise. When instructional materials are delivered online, instructional designers can engage in continuous delivery practices, where improvements are made available to learners immediately, as often as multiple times per day.

The modern approach to continuous improvement designed for use in the context of online services described by Ries (2011), called the “build - measure - learn cycle,” is illustrated in Figure 1.

Figure 1

The Build - Measure - Learn Cycle
In this chapter we adapt the build - measure - learn cycle for use by instructional designers who want to engage in continuous improvement. Because our focus is on the improvement of instructional materials, our discussion below does not include a discussion of the creation of the first version of the materials. (The first version of the materials could be open educational resources created by someone else or a first version that you created previously.)

The chapter will proceed as follows:

- **Conceptual Framework:** We argue that all instructional materials are hypotheses, or our best guesses, informed by research, about what instructional design approach will support student learning in a specific context. Thinking this way will naturally lead us to collect and analyze data to test the effectiveness of our instructional materials.
- **Build:** We describe the implications of designing for data collection, together with the instrumentation and tooling that must be built in order to collect the data necessary for continuous improvement.
- **Measure:** We describe the process of analyzing data in order to identify portions of the instructional materials that are not effectively supporting student learning.
- **Learn:** We discuss methods to use when reviewing less effective portions of the instructional materials and deciding what improvements to make before beginning the cycle again.
- **Technical Note:** We briefly pause to discuss the role of copyright, licensing, and file formats in continuous improvement.
- **Worked Example:** We demonstrate one trip through the cycle with a worked example.
- **Conclusion:** We end with some thoughts about the imperative implied for instructional designers by the existence and relative ease of use of continuous improvement approaches like the build - measure - learn cycle.
Conceptual Framework

Instructional Materials Are Hypotheses

People who design instructional materials (who we will refer to as instructional designers throughout) make hundreds of decisions about how to best support student learning. Each decision is a hypothesis of the form “in the context of these learners and this topic, applying this instructional design approach in this manner will maximize students’ likelihood of learning.” The ways in which these individual decisions are interwoven together creates a network of hypotheses about how best to support student learning.

Hypotheses Need to Be Tested

It reveals a fatal lack of curiosity for an instructional designer to simply say “these materials were designed in accordance with current research on learning” without following through to measure their actual effectiveness with actual learners in the actual world. While designing instructional materials in accordance with research is a positive first step, to our minds the most important measure of the quality of instructional materials is the degree to which they actually support student learning. Questions of whether or not the materials are informed by research, are finished on schedule and on budget, are stunningly beautiful, render correctly on a mobile device, or were authored by a famous academic become meaningless if students who use the materials do not learn what the designers intended.

Initial Hypotheses Are Seldom Correct

Hypotheses need to be refined in an ongoing cycle of improvement. Data collected during student use of content and from assessments of learning can be used to identify specific portions of the instructional materials (i.e., specific instructional design hypotheses) that are not successfully supporting student learning. Once these underperforming designs (hypotheses) are identified, they can be redesigned, improved, and incorporated into a new version of the instructional materials. The updated collection of instructional design hypotheses can then be deployed for student use, and the cycle of continuous improvement can begin again.

Build: Designing for Data, Instrumentation, and Tools for Data Collection

In order to be able to engage in continuous improvement, instructional materials must be designed for data collection. There must be a unifying design framework that will allow data from a wide range of sources to be aggregated meaningfully. The method we will describe throughout this chapter organizes instructional materials around a network of learning outcomes. In this method of designing for data collection, all instructional materials (e.g., readings, simulations, videos, practice opportunities) are aligned with one or more learning outcomes. All forms of assessment, both formative or summative, are also aligned with one or more learning outcomes (this alignment must be done at the individual assessment item level.)

Once instructional materials have been designed for data collection, tools and instrumentation must be created so that the data can actually be collected and managed. The system that mediates student use of the instructional materials (e.g., a learning management system) must be capable of (a) expressing the relationships between learning outcomes, instructional materials, and assessments, (b) capturing data about student engagement with these instructional materials, and (c) capturing item-level data about student engagement with, and performance on, assessments. The data collected by the system should be able to answer questions such as, for any given learning outcome, what instructional materials in the system are aligned with that outcome? (If instructional activities are “aligned with” a learning outcome, student engagement with the instructional activities should support mastery of the outcome.) For any given learning outcome, what assessment items in the system are aligned with that outcome? (If assessments are “aligned with” a learning outcome, student success on these assessments should provide evidence that they have mastered the outcome).
Measure: Using RISE Analysis to Identify Less Effective Learning Materials

As described in Bodily, Nyland, and Wiley (2017), activity engagement data and assessment performance data can be analyzed together to identify learning outcomes whose aligned instructional materials are not sufficiently supporting student mastery (as demonstrated by performance on aligned assessments). The purpose of Resource Inspection, Selection, and Enhancement (RISE) analysis is to identify learning outcomes where students were highly engaged with aligned instructional materials, but simultaneously performed poorly on aligned assessments.

Each point in Figure 2 represents a learning outcome. The x-axis is engagement with instructional materials and the y-axis is assessment performance, both converted to z-scores. The bottom-right quadrant (high engagement, low performance) indicates which outcomes should be targeted for improvement and are numbered to indicate the order in which they should be addressed.

Figure 2

A RISE Analysis Plot

An open source software implementation of RISE analysis is described in Wiley (2018). This greatly simplifies the process of running RISE analyses, as long as appropriate data on learning outcome names, content engagement, and assessment performance are available.
Learn: Understanding Why Learning Outcomes End up in the Bottom Right Quadrant

Once learning outcomes are identified as being in the bottom right quadrant of a RISE analysis plot, the cause of the problem can be isolated. For brevity, we will refer to learning outcomes in the bottom right quadrant of a RISE analysis plot as "underperforming learning outcomes" below. The root of the problem can generally be identified in two steps.

The first step in isolating the problem with an underperforming learning outcome is evaluating assessments aligned with each learning outcome. Are the assessments accurately measuring student learning? Questions to ask at this stage include: are there technical problems with the assessment? Are items miskeyed? Are other sources of spurious or construct-irrelevant difficulty present? Are measures of reliability, validity, or discrimination unacceptably low? If the answer to any of these questions is yes, improvements should be made to problematic assessments, after which the instructional designer can stop working on this learning outcome and move onto the next. There is likely no need to make improvements to instructional materials aligned with this learning outcome.

If the aligned assessments are functioning as intended, the instructional designer can move on to the second step—reviewing the instructional materials to determine why they aren't sufficiently supporting student learning. This process is highly subjective and brings the full expertise of the instructional designer to bear. The instructional designer reviews the instructional materials aligned with the learning outcome and asks questions about why students might be struggling here. For example:

- Is there a mismatch between the type of information being taught and the instructional design approach originally selected? For example, if students are learning a classification task, are examples and non-examples provided without a specific discussion of the critical attributes that separate instances from non-instances?
- Is there a mismatch in Bloom's Taxonomy level between the learning outcome, the instructional materials, and the assessment? (For example, are the learning outcome and instructional materials primarily the Remember level, while the assessments require students to Apply?)
- Have the instructional materials failed to provide learners with an opportunity to practice in a no/low-stakes setting and receive feedback on the current state of their understanding?

We cannot list every question an instructional designer might ask, but we hope these examples are illustrative. Talking with students can also be incredibly helpful at this stage. These conversations are an effective way for the instructional designer to zero in on root causes of students' misunderstandings.

Once the instructional designer believes they have identified the problems (i.e., they have a new hypothesis about how to better support student learning), new or existing instructional materials and assessments can be created, adapted, or modified. Students can also be powerful partners and collaborators in creating improvements to the instructional materials (e.g., OER-enabled pedagogy as described by Wiley and Hilton (2018)).

When this (Build) process is completed, the new or improved materials can be released to students immediately. Once students are using the new version of the materials, this use will result in the creation of new data which the instructional designer can examine using RISE analysis (Measure). These analyses support the instructional designer in forming new hypotheses about why students aren't succeeding (Learn). When this continuous improvement process is followed, instructional materials should become more effective at supporting student learning with each trip through the cycle.

Technical Note: The Role of Copyright and File Formats

Before adaptations or modifications can be made, instructional designers must have legal permission to make changes to the instructional materials. Because copyright prohibits the creation of derivative works that are often the result of the improvement of instructional materials, one of two conditions must hold. In the first condition, the instructional...
designer (or their employer) must hold the copyright to the instructional materials, making the creation and distribution of improved versions legal. In the second condition, the instructional materials must be licensed under an open license (like a Creative Commons license) that grants the instructional designer permission to create derivative works (aka improved versions of the instructional materials).

Legal permission to create derivative works can be rendered ineffective if the instructional materials are not available in a technical format amenable to editing (e.g., HTML). ALMS analysis as described in Hilton, Wiley, Stein, and Johnson (2010) includes four factors to consider regarding the “improvability” of instructional materials. The first factor is Access to editing tools—is the software needed to make changes commonly available (e.g., MS Word) or obscure (e.g., Blender)? The second factor is the Level of expertise required to make changes—is the content easy to change (e.g., Powerpoint) or difficult to change (e.g., an interactive simulation written in Javascript)? The third factor is whether or not the instructional materials are Meaningfully editable—is the document a scanned image of handwritten notes (this text is not easily editable) or an HTML file (easily editable)? The final factor is Source file access—is the file format preferred for using the resource also the format preferred for editing the resource (e.g., an HTML file) or are the preferred formats preferred for using and editing the files different (e.g., PSD versus JPG)?

If the instructional materials you are working with do not belong to you or your employer, are not openly licensed, or are available only in file formats that are not conducive to adaptation and modification, you may not be able to engage in continuous improvement.

A Worked Example

Lumen Learning, a company that offers instructional materials for college classes that can be adopted in place of traditional textbooks, offers a Biology for Non-majors course in its Waymaker platform. This platform allows instructional designers to enter learning outcomes and align all instructional materials and assessment items with the learning outcomes. A RISE analysis was conducted using the content engagement data and assessment performance data for all students who took the Biology for Non-majors course during a semester. Among the top 10 underperforming learning outcomes it identified, the RISE analysis revealed that students were performing poorly on assessments aligned with the learning outcome “compare inductive reasoning with deductive reasoning” despite the fact that students were engaging with the aligned instructional materials at an above average rate (see outcome 1 in Figure 3 below). This learning outcome was selected for continuous improvement work.

Figure 3

Biology for Non-Majors RISE Analysis Plot
A review of the aligned assessment items by an instructional designer revealed that the items appeared to be keyed correctly and free from other problems. Following this review of the aligned assessments, the instructional designer reviewed the aligned instructional materials guided by the question, “why are students who use these instructional materials not mastering the outcome?” The analysis revealed that the instructional materials for this outcome were comprised of two paragraphs of text content, each of which defined one of the terms. No other instructional materials were provided in support of mastery of this learning outcome and students appeared to be unable to remember which of these similar sounding terms was which.

The instructional designer decided to make minor edits to the existing paragraphs to improve their clarity and also to create an online interactive practice activity (Koedinger et al., 2017) in support of this learning outcome. This activity provided students with mnemonic tools to help them remember which term is which, and combined these mnemonics with practice exercises in which students classify examples as either inductive or deductive and receive immediate, targeted feedback on their performance. The online interactive practice activity can be viewed in context at https://edtechbooks.org/-QwUE.

These new and updated instructional materials are now integrated into the existing materials and are being used by faculty and students across the United States. After another semester is over, the RISE analysis will be rerun. This new analysis will either confirm that the improvements to the instructional materials have improved student learning, in which case other underperforming learning outcomes will be selected for continuous improvement, or they will confirm that there is still work to do to better support student learning of this outcome.

**Conclusion**

Modern technologies, including the internet and open source software, have radically decreased the cost and difficulty of collecting and analyzing learning data. Where evaluation alone was once prohibitively difficult and expensive, today the entire continuous improvement process is within reach of those who design instructional materials for use in online
classes and other technology-mediated teaching and learning settings. While Ries (2011) described the build - measure - learn cycle as a way to rapidly increase a company’s revenue, we see a clear analog in which similar approaches can be used to rapidly increase student learning. We now live in a world where it is completely reasonable to expect instructional materials to be more effective at supporting student learning each and every term.

We invite the reader to help us make this possible state of affairs the actual state of affairs by engaging in continuous improvement activities in their own instructional design practice. And in the spirit of continuous improvement, we further invite the reader to join us in developing and refining the processes described in this chapter—in part by completing the survey at the end of this chapter and providing us feedback on how the chapter can be improved.

References


Previous Citation(s)

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Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University's instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU's Marriott School of Management.

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Ross Strader
Lumen Learning
Continuous Improvement Dashboards

Bill Kemsley

*Learning is a product of interaction.* (Elias, 2011, p. 1)

Each semester, a student’s interactions with peers, teachers, and content leads to learning (see Moore, 1989). As formal education increasingly takes place online, these interactions take on new forms. Students might have conversations with fellow students and their teachers asynchronously through discussion boards and synchronously through video conferencing software, or they might read textbooks, watch educational videos, complete projects, and take quizzes and tests. As students interact in online environments, they leave digital breadcrumbs of their learning experience that help reveal their learning paths, norms, and behaviors. However, understanding what these bits of data mean can be difficult and has necessitated the emergence of the new field of Learning Analytics, which focuses on “the measurement, collection, analysis, and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs” (SOLAR, 2012, p.1).

When learning analytics data is visualized and reported, people can understand and implement changes in response to the data to improve learning. A common tool to report data about learners and their learning environment is a learning analytics dashboard (LAD). For instance, learning analytics dashboards are increasingly becoming incorporated into Learning Management Systems (LMS; Park & Jo, 2015, p. 110), wherein a student logging into an LMS may have access to a student-facing dashboard that provides feedback from the teacher on assignments and provides recommendations of content areas to study further. Conversely, a teacher logged into an LMS for the same course may have access to a teacher-facing dashboard that identifies struggling students and suggests ways to intervene.

Student- and teacher-facing LADs fulfill a variety of purposes. Student-facing LADs report information about students’ online learning experiences, provide feedback, encourage self-reflection and self-awareness, and motivate learners to achieve performance outcomes (Roberts, Howell, & Seaman, 2017, p. 318). To accomplish these purposes, student-facing LADs include features such as links to additional readings, information about course difficulty, progress within a course, other students’ time management practices, and personalized feedback on performance in relation to peers and learning outcomes (Roberts et al., 2017, p. 318).

Teacher-facing LADs, on the other hand, are frequently used to identify struggling students. In addition, they may also be used to help teachers better understand their courses, reflect on teaching strategies, and identify ways to improve course design (Viberg, 2019, p. 2), although these purposes are less prevalent than that of identifying at-risk students. Teacher-facing LADs with early warning systems for at-risk students may use complex predictive modeling and can include data sources such as students’ previous academic histories, current grades, time spent in different sections of the LMS, and clickstream data about learning activities (Viberg, 2019, pp. 1-2).

Continuous Improvement Learning Analytics Dashboards

While student- and teacher-facing LADs remain the most common types of LADs, dashboards have also been created to facilitate the continuous improvement of online learning resources. This emerging type of LAD, known as a continuous improvement LAD, provides feedback to educational content creators about the quality and performance of educational
content (see Figure 1). Continuous improvement LADs are relatively new, but they have been incorporated into online educational platforms such as textbook publishing platforms (e.g., EdTech Books), university library websites (Loftus, 2012), and government websites focused on educating the public (Desrosiers, 2018).

Figure 1

Example of a Continuous Improvement Learning Analytics Dashboard

When designing a learning analytics dashboard, designers must consider who the dashboard is trying to influence and what assumptions it is making about deficits contributing to poor performance. While a complete analysis of the underlying value systems of each type of LAD is beyond the scope of this chapter, Table 1 may be helpful in understanding intended audiences and designer beliefs about deficits that influence the design of each type of LAD. Stated simply, this means that the intended audience and design of each type of dashboard implies that the problem is located in a particular place. This deficit might be ascribed to the student (e.g., poor study habits), the teacher (e.g., poor pedagogy), or the content (e.g., poor design).

Table 1

Targets of Underlying Deficit Mindsets that Influence Different Types of LADs

<table>
<thead>
<tr>
<th>Target of Deficit Mindset</th>
<th>How to Improve Student Performance</th>
<th>Types of LADs Influenced by Value System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student</td>
<td>Encourage student effort</td>
<td>Student-facing LAD</td>
</tr>
<tr>
<td></td>
<td>Modify student behavior</td>
<td>Teacher-facing LAD</td>
</tr>
<tr>
<td>Teacher</td>
<td>Improve teaching strategies</td>
<td>Teacher-facing LAD</td>
</tr>
<tr>
<td></td>
<td>Intervene with at-risk students</td>
<td></td>
</tr>
</tbody>
</table>
Note that each type of deficit mindset lends itself to specific actions that dashboard users can take to improve the learning experience. For example, students can study more and better manage their time; teachers can improve their teaching strategies, motivate and inspire their students, and adjust the resources they use; and content creators can improve the quality of their content. Rather than attributing poor performance to external factors, such as how students are using content or which teaching strategies are employed, a continuous improvement LAD attributes poor performance to poor content quality and uses metrics that help content creators improve their content. When designing a continuous improvement LAD, then, dashboard designers should ensure that the information displayed on the dashboard is relevant to and actionable by content creators and that it also provides ongoing information about how content changes are impacting student performance.

As a recent example of a continuous improvement LAD, in 2018, the Massachusetts Digital Services team developed a dashboard that helped “Mass.gov content authors make data-driven decisions to improve their content” (Desrosiers, 2018). The dashboard took data from a variety of sources, including Google Analytics, Siteimprove, and Superset, and integrated the data into the website's content management system (CMS). As a result, content authors could simply select an Analytics tab when editing their content to view performance metrics and access recommendations to improve their content. The team also collected ongoing online survey data to obtain direct feedback from Mass.gov users about their satisfaction with the site, reasons for using the site, and suggestions to improve the site.

After eight months of analyzing potential performance indicators and validating indicators with five partner agencies using a sample set of the website's 100 most-visited pages, the dashboard developers summarized performance indicators into four categories: (1) findability, (2) outcomes, (3) content quality, and (4) user satisfaction (Desrosiers, 2018). Each category received a score from 0-4, which was then averaged to create an overall score. In addition, the dashboard included general recommendations for ways content creators could improve content in each of the four categories.

The dashboard was valuable to content creators, because it showed how specific content pages were performing over time and provided specific suggestions on how to improve content. For example, if a content creator saw that a page about SNAP benefits had a Content Quality score of 2, the content creator could find and implement recommendations from the dashboard, such as “Use SiteImprove to check for broken links and fix them” and “Spell out acronyms the first time you use them” (Desrosiers, 2018).

As this example illustrates, designing an effective continuous improvement LAD can be a complex task that requires a deep understanding of both the dashboard users (in this case, the creators of the Mass.gov content pages) and the people accessing the content (in this case, the visitors to Mass.gov). Just as a continuous improvement LAD facilitates iterative improvements to an educational website or platform's content, this example suggests that an iterative process can be used in designing and developing the dashboard itself, wherein user feedback can be used to improve the usability and efficacy of the dashboard.

**Best Practices in Designing a Continuous Improvement LAD**

The data analyzed and visualizations displayed on a continuous improvement LAD for a government website would likely be very different from those on a different site, such as an online textbook publishing platform, “because pedagogical, technical and organisational aspects of learning are complex, [and] they must be carefully interpreted within the used context” (Viberg, 2019, p. 1). Yet, despite differences from one continuous improvement LAD to another, effective continuous improvement LADs may share several characteristics.
In 2004, as analytics dashboards were emerging in business and other fields, data visualization consultant and author Stephen Few defined a dashboard as “a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance” (p. 3). Fifteen years later, dashboards have become a widely used data analytics tool, and several recommendations have been suggested for designing effective dashboards. Many of these recommendations fall within four categories: (1) design for the dashboard's intended purpose; (2) choose relevant metrics; (3) ensure data is current and accurate; and (4) use effective visual displays. I will now describe each of these recommendations in detail.

**Design for the Dashboard’s Intended Purpose**

First, the purpose of a dashboard should direct the dashboard’s design. As explained previously, continuous improvement LADs facilitate the continuous improvement of online content and are informed by a content-deficit mindset. In addition, the design of continuous improvement LADs is influenced by the needs of the content creators using the dashboards and by the type of educational content assessed by the dashboards.

Designers of continuous improvement LADs may benefit from frequent communication and collaboration with content creators (De Laet, 2018). Through interviews and surveys, dashboard designers can better understand the information content creators need to know about the students using the learning content so they can change the content to better meet the students’ needs. For example, authors publishing textbooks on an online textbook publishing platform may desire to know which textbook chapters are most relevant to students and which topics students have a hard time understanding. These questions may help dashboard designers choose appropriate metrics for the dashboard that pertain to this information. Dashboard designers can show iterations of the dashboard design to content creators and use their feedback to inform subsequent iterations of the dashboard’s design.

**Choose Relevant Metrics**

Second, metrics are the building blocks of any dashboard and of the visualizations displayed on that dashboard. Metrics are “measures of quantitative assessment used for assessing, comparing, and tracking performance” and comparing current performance with historical data or objectives (Young, 2019). Metrics should emanate consciously and directly from the intended purpose of the dashboard. In the case of continuous improvement LADs, metrics should be selected that measure and provide actionable data for content creators to evaluate student learning and improve content.

In business analytics, the term key performance indicators (KPIs) is used to identify meaningful metrics. The implication that metrics should measure only important, or key, indicators and that the measurement is one of performance applies neatly to continuous improvement LADs. Are students able to successfully demonstrate learning through knowledge assessments and other exercises? How often is a particular learning product (e.g., a textbook or educational video) accessed or completed? How do students rate the quality of the resource? Put simply, continuous improvement LADs should report key metrics to content creators to help them improve their content.

**Ensure Data Are Current and Accurate**

Third, regardless of which metrics are selected, a dashboard is only useful if it is based on current, accurate information. Dashboards should be connected to accurate data sources and should be updated regularly so that content creators can make informed decisions on how to improve their content. While some types of dashboards, such as strategic business dashboards, may only need data to be updated monthly, quarterly, or even annually, other types of dashboards, such as operational business dashboards, may require real-time data updates (Few, 2013). Designers of continuous improvement LADs should consider both the purpose of the dashboard and the needs of dashboard users when determining which data sources to use and how frequently the data should be updated.

Continuous improvement LADs often require data integration, which is defined as “the process of collecting data from disparate locations and systems, and presenting [the data] in a meaningful and useful way” (Boonie, 2016, p. 1). For example, as mentioned previously, the Mass.gov dashboard combined data from Google Analytics, Siteimprove,
Superset, and other sources. Dashboard designers should ensure that data from disparate databases has been properly transformed and normalized before being integrated into a continuous improvement LAD (Boonie, 2016).

**Use Effective Visual Displays**

And fourth, after selecting appropriate metrics and integrating relevant data sources, dashboard designers must decide how to effectively display data. A variety of books and research articles have been written about dashboard design and data visualization (see Knaflic, 2015; Few, 2012; & Few, 2013); in this section, I will describe a few outstanding principles.

To begin, continuous improvement LADs should display high-level summaries that can be viewed and interpreted at a glance. Because humans have limited working memory, they are not able to store large amounts of visual information at a time (Yoo, Lee, Jo, & Park, 2015). As a result, dashboards are less effective if users must scroll through large amounts of content or select various tabs to identify and piece together information. Instead of having excessive visualizations, dashboards should prioritize information and display on a single screen the information that is most important. In accordance with psychologist George A. Miller’s observation (1956) that the average person can hold 7, plus or minus 2 objects in working memory, some dashboard designers recommend that no more than 5 to 9 visualizations be displayed on a dashboard’s primary view. Interactions such as buttons, tabs, tooltips, and scrolling can be used to display additional content without overwhelming the user; however, the dashboard should not rely on these interactions to report key information (Bakusevych, 2018).

As Stephen Few explained (2004), a defining characteristic of a dashboard is “concise, clear, and intuitive display mechanisms” (p. 3). Dashboards should not use ostentatious or distracting visuals; rather, dashboards should apply minimalistic design principles that draw attention to important data. For example, dashboards should appropriately use negative space (sometimes called white space) so that the information is not too crowded and relevant data stand out to users (Bakusevych, 2018).

Dashboards designers should select the appropriate visuals to display different types of information. For example, bar charts are useful in comparing values at a point in time (e.g., current quality rating of an educational video) whereas line charts are useful in comparing values over time (e.g., total student savings as a result of using an open educational resource textbook). While a large variety of graph types may be used to report data, Tables 2 and 3 about common graph types may prove useful in deciding which visuals to display for different types of data (see Bakusevych, 2018 & Knaflic, 2015, pp. 35-69).

**Table 2**

*Purposes of Common Graphs Representing Data at a Point in Time*

<table>
<thead>
<tr>
<th>Analyze relationships</th>
<th>Compare values</th>
<th>Analyze composition</th>
<th>Analyze distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scatterplots</td>
<td>Bar/column charts</td>
<td>Tree map</td>
<td>Scatterplots</td>
</tr>
<tr>
<td>Bubble charts</td>
<td>Circular areas charts</td>
<td>Heat map</td>
<td>Histograms</td>
</tr>
<tr>
<td>Network diagrams</td>
<td></td>
<td>Pie/donut chart</td>
<td>Bell curves</td>
</tr>
</tbody>
</table>

**Table 3**

*Purposes of Common Graphs Representing Data Over Time*
As Tables 2 and 3 indicate, graphs may be used to analyze relationships, composition, and distribution, as well as to compare values. Whether the data depict a specific point in time or illustrate changes over a period of time influences which type of graph should be used.

Dashboards directed toward users whose native language reads from left to right should display the most important information in the upper left and then organize the rest of the information in a Z-pattern. In other words, dashboard designers should design with the assumption that users will view the first row of visualizations from left to right and then move down to the next row following the same patterns. Graphs with related information should be close to each other so users do not have to look back and forth between distant areas of the dashboard.

In addition to following these general recommendations, dashboard designers should use effective visual displays to address a challenge unique to continuous improvement LADs; namely, the data used to inform actions is iterative. When content creators make adjustments to content based on feedback from the dashboard, the data about that content is no longer valid for making further judgments. For example, a continuous improvement LAD on an online textbook publishing platform may display the scores of knowledge check questions. If a content creator observes that a specific question has low scores, the content creator may clarify parts of the chapter or adjust the wording of the knowledge check question. In either case, after the adjustments are made, the data about the knowledge check scores are no longer valid.

As this example illustrates, each iteration, improvement, or adjustment made to content invalidates previous data about that content. How can effective visual design address this problem? To compensate for the problem of invalid data, continuous improvement LADs must clearly document iterative changes to content. In the case of the adjusted knowledge check question, the dashboard must visually show content creators how scores to the knowledge check question changed in relation to the adjustments made. By clearly displaying when content changes occurred, content creators can see to what extent their changes led to desired outcomes, and can know when additional changes are needed.

**Conclusion**

As students enroll in online classes and engage with digital content, they leave behind an abundance of data that, if properly collected, reported, and analyzed, can lead to enhanced learning. Learning analytics dashboards are an effective tool to visualize and report these data so students, teachers, and content creators can make informed decisions about their role in the learning process. An emerging type of LAD, known as a continuous improvement LAD, helps content creators make incremental improvements to their content using data about student performance with the content and user feedback. While the metrics and visualizations of continuous improvement LADs vary depending on the type of content the dashboard seeks to improve, several data visualization and dashboard best practices may help in designing an effective continuous improvement LAD. These practices include designing for the dashboard’s intended purpose, selecting relevant metrics, maintaining accurate and up-to-date data, and using effective visual displays. As more educational platforms begin to collect and report data about the quality and performance of their content, content creators using these platforms will be able to make informed, data-driven decisions about how to improve their content and increase student learning.
References


Previous Citation(s)


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Brigham Young University

This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/open_education/continuous_improvemento.
A/B Testing on Open Textbooks

A Feasibility Study for Continuously Improving Open Educational Resources

Royce Kimmons

This study examined the feasibility of employing A/B tests for continuous improvement by focusing on user perceptions of quality of six chapters of a popular open textbook over the course of a year. Results indicated non-significant differences in all cases but also suggest that future work in this area should (a) employ A/B testing at a broader, less-granular (e.g., platform-level) scale to increase sample sizes, (b) explore autonomous approaches to experimentation and improvement, such as bandit algorithms, and (c) rely upon more universally collected dependent variables to reduce sample size limitations emerging from self-reports.

Open educational resources provide great promise to instructional designers as low-cost, high-impact educational materials that can be used, shared, remixed, and adapted with ease. Especially when viewed through the lens of the “5Rs” of openness (Wiley, n.d.)—Retain, Revise, Remix, Reuse, Redistribute—or the lens of “expansive openness” (Kimmons, 2016), such resources give instructional designers the ability to create and share learning materials at a massive scale, to adapt existing resources for better meeting the needs of target learners, and to remix resources from various authors into multi-faceted and rich learning experiences.

Because of the ubiquity of textbooks in higher education, the open textbook as a medium promises to be a valuable means for providing learning opportunities to many students while also driving down costs. Students at four-year universities in the U.S. currently spend an average of $1,240 on textbooks per year (College Board, 2019), and textbook cost hikes have far outpaced inflation, consumer costs, and recreational book costs, making higher education opportunities more cost-prohibitive and requiring students to skip meals, enroll in fewer courses, and work longer hours (Whitford, 2018). While open textbooks provide an opportunity for universities to drive down student costs and to improve learning experiences, open textbooks are not widely used (Seaman & Seaman, 2018). This is presumably due to perceptions of time limitations emerging from tenure and promotion practices and perceptions that open textbooks are of relatively poor quality when compared to their copyright-restricted alternatives (Kimmons, 2015; Martin & Kimmons, 2020).

Though systemic challenges to open textbook adoption may be outside the realm of instructional designers to address, one clear way that we can make a difference is to help improve the quality of these resources. Some initial work has sought to establish quality metrics for open textbooks and other open resources (Bodily et al., 2017; Woodward et al., 2017), and Dinevski (2008) proposes that the quality control of these resources is relatively unique by placing
accountability in the hands of learners, teachers, and local designers to address localized or demographic-specific needs, rather than upon market-driven publisher considerations. Furthermore, though traditionally published textbook editions are viewed as static entities that are either high- or low-quality, because of their live and open nature, open textbooks can also undergo continuous improvement efforts that iteratively improve their quality over time, correcting mistakes, refining formatting, and providing supplements as needed to improve learning (Wiley et al., 2021).

For these reasons, applying continuous improvement cycles to open educational resources is of increasing interest to designers, but we are only just beginning to figure out how to do this well, especially when large-scale data are involved and resources are being used by a wide array of learners. Borrowing from the software development field (the same field where the notion of openness came from, to begin with; Kimmons, 2016; Open Source Initiative, n.d.; Stallman, 2013), it seems reasonable to consider how modern approaches to software improvement might apply to educational resources as well. As a promising example, A/B or split testing is an approach to software development that places at least two different versions of a product in front of random sets of actual users and analyzes their behaviors over time to determine which is superior (Kohavi & Longbotham, 2017).

When it comes to education, A/B testing has been proposed not only as a process for improving design but also as a process for choosing between competing pedagogical methods or other decisions of educational importance (UpGrade, n.d.). In the case of open textbooks, A/B testing would require having at least two versions of content that users interact with. The “A” version (otherwise called the original version or control) represents the default version of the resource as originally created by the author, while the “B” version (otherwise called the experimental flight or fork) represents a variation of the resource that the researcher hypothesizes might yield differing behaviors or results. To make comparisons, audience size for each version may not need to be equal, and relative sampling for different versions may involve an assessment of the urgency and relative importance of experimental variations. As readers are assigned to the competing versions of the textbook, a variety of analytics could be collected to test which version is superior, and successive tests could theoretically be employed on the same resource to gradually improve it in many different ways.

Bringing these ideas together, this study explores the feasibility of using A/B testing to inform continuous improvement and increase the perceived quality of open textbooks. Relying upon data collection and analysis mechanisms of a popular open textbook for undergraduate and teacher education, the guiding research question of this study was “How feasible is it to conduct A/B testing on highly-used open textbook chapters for the purpose of improving perceptions of quality?”

**Methods**

To conduct this study, experimental flights were created within the EdTech Books system by copying six chapters as new flights (or “B” versions), adjusting their contents, and setting each chapter’s "Flight Mode" to "Automatic." The automatic mode meant that whenever any reader navigated to the chapter, they were randomly assigned to either view the original or the experimental flight. This assignment was done without the reader’s awareness and ensured true randomization. Flight assignment was enabled for a period of 12 months (February 2020 to February 2021), and results were then analyzed to compare reader behaviors and perceptions for the time period. As a methodological note, though this timeframe coincided with the COVID-19 pandemic in many countries and resulting shifts to online and remote learning might have influenced overall usage of open resources, such a shift would not be expected to influence the types of user behaviors measured here between groups. For instance, though more people might have started reading the textbooks because of the pandemic, we would not expect this to influence the relationship between text size within the textbooks and reading behaviors. For this reason, we did not conclude that the targeted timeframe for the study should be considered as an additional variable or meaningful frame of analysis.
Context

EdTech Books is a free online publishing platform for open textbooks. Built with PHP, MySQL, and Javascript, the platform operates on four guiding values of freedom, accessibility, usability, and quality, providing authors with tools to easily create, remix, and share textbooks (Kimmons, n.d.). Currently, the platform provides content to roughly 50,000 unique readers per month, representing students, teachers, and the general public. Content is provided in simple HTML via web pages and also as PDFs for download, representing millions of page views over the course of its two-year lifespan.

Central to the mission and design of EdTech Books is the goal of supporting continuous improvement and improved perceptions of open textbook quality. Toward this end, the system provides A/B testing features, quality assurance mechanisms, advanced analytics, and various other tools to support ongoing analysis, adjustment, and improvement of materials. However, since the notion of continuous improvement is not commonly connected to the development of published materials, like textbooks, it is unclear how to do this well and how to develop systems that both empower and encourage authors to engage in this process.

For this study, I analyzed results from six experiments conducted within EdTech Books upon separate chapters of a popular open textbook: *The K-12 Educational Technology Handbook* by Ottenbreit-Leftwich and Kimmons (2020). This textbook has been accessed over 120,000 times in its short lifespan and is widely used for teacher education courses and professional development efforts and is also commonly accessed from search engine results on topics related to technology's role in education.

Participants

As readers accessed the textbook on the platform for the first time, they were notified that the system collects anonymous analytics related to their behaviors, and they were given the option to opt-out of being tracked in this way. For this study, I focused on opted-in reader data associated with this single textbook.

As with other textbooks in the platform, readers of the textbook accessed chapters in many ways but generally fell into two categories: (a) formal learners who accessed chapters from links or LMS embeds associated with official university courses and (b) non-formal or informal learners who accessed chapters from organic search engine results (e.g., those searching Google for “tech integration”). Backlink analysis of the textbook revealed that it was heavily used by students at a number of universities, including Brigham Young University, Marist University, Oklahoma State University, State University of New York, Montana State University, Purdue University, and others. The breakdown of formal vs. non/informal learners, however, varied from chapter to chapter with some chapters like “Technology Integration” experiencing a relatively even split between the two and others exhibiting high skew in one direction or the other. Even within these categories, we would expect to find great variation in reader goals, purposes, and activities, as higher education institutions use these resources for diverse courses. For the purpose of this study, reader type was not considered in data analysis, and the flight assignment procedure did not take reader category into consideration for random assignment, meaning that the demographics of both the original and experimental versions of each chapter would be expected to exhibit similar distributions of reader types to the overall chapter. This was an intentional design decision but assumes that optimal design decisions for improving perceived quality would not vary by reader category.

Dependent Variable

Because perceptions of poor quality are a major barrier to open textbook adoption and diffusion (Kimmons, 2016; Martin & Kimmons, 2020) and the improvement of perceived quality is a major goal stated on the platform, we constructed experiments with the goal of improving reader perceptions of quality, as measured by a simple survey. This single-question survey was provided as an unobtrusive “End-of-Chapter Survey” at the bottom of each chapter that asked the following: “Overall Quality: How would you rate the overall quality of this chapter?” Possible responses were coded to an ordinal scale as follows: (1) “Very Low Quality,” (2) “Low Quality,” (3) “Moderate Quality,” (4) “High Quality,” and (5) “Very High Quality.” The form was then automatically submitted as readers navigated away from the chapter or closed their browser tab, resulting in an average quality rating of 4.1/5.0 for the targeted textbook chapters (n = 963...
ratings, $SD = .67$). Results also exhibited a strongly negative skew, with only 4 ratings (0.4%) falling below "Moderate Quality" (see Figure 1). These ratings represented results from 810 different users with the average user leaving 1.19 ratings across chapters in the book ($SD = .75$, $Max = 10$).

**Figure 1**

*Distribution of Textbook Ratings*

<table>
<thead>
<tr>
<th>Quality Level</th>
<th>Ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low Quality</td>
<td>2</td>
</tr>
<tr>
<td>Low Quality</td>
<td>2</td>
</tr>
<tr>
<td>Moderate Quality</td>
<td>141</td>
</tr>
<tr>
<td>High Quality</td>
<td>532</td>
</tr>
<tr>
<td>Very High Quality</td>
<td>286</td>
</tr>
</tbody>
</table>

Chart showing the distribution of textbook ratings

The unobtrusive and optional nature of this survey helped to avoid Hawthorne effects in results and provided similar benefits to those found in the analysis of public internet data sources (Kimmons & Veletsianos, 2018), even though some interpretive power was lost with limited contextual information about readers. This approach also provided minimal risk, effort, and discomfort to users and prevented analyses from being classified as human subjects research according to NIH definitions, because the process (a) did not collect information about individuals and (b) did not include identifiable data, such as demographics, names, user type information (e.g., student vs. faculty), or IP addresses. This means that the sample size for each experiment was limited to those who anonymously answered the quality assurance measure at the end of the chapter, which accounted for around 1% of readers for each chapter.

Though such a low response rate would be troubling in some research settings, the fact that readers were randomly assigned to the two groups helps to alleviate concerns of self-selection bias, and low rates of response will always be a necessity when using unobtrusive measures of relatively free-roaming user activities like these. This point is of special importance when studying open resources, because most of the traffic (or user behavior) associated with these resources constitutes lurking (Bozkurt et al., 2020) or those who may briefly open the chapter without any intent to actually read it. To illustrate, Google Analytics reported that the bounce rate for the book in this time period (or the number of users who navigated away after viewing only one page) was 71.85% with the average user session lasting less than 3 minutes. This is why, for instance, MOOCs have such notoriously low completion rates (Gütl et al., 2014; Rivard, 2013) and why when studying open environments and resources it makes sense to limit analyses to users whose behaviors suggest an intent to participate in the behaviors we are measuring (e.g., Veletsianos et al., 2021).

Judging by user scrolling behaviors, time on page, textual length, and chapter text complexity for the target textbook, it is estimated that only about 22.7% of page views actually constituted a “read” of the contents, and among those who read the contents, there was no incentive or prodding to complete the end-of-chapter survey. Yet, such data should nonetheless be valuable for understanding user perceptions of resources in the same way that user ratings are valuable on sites like Amazon or Yelp to determine the quality of products or services, even if the relative representation of ratings is very small in comparison to the total number of customers on those sites.
Embedded automatically by the platform at the end of every chapter, quality assurance surveys provided results to authors in an “Analytics” dashboard at the flight, chapter, and book levels (see Figures 2 and 3). In the “Analytics” dashboard at the flight level, an additional table was also provided to authors that provides statistical comparisons between the original and the experimental flight (see Figure 4). These tables allowed authors to compare reader behaviors between the original and the experimental flight on the “Overall Quality” measure as well as embedded learning checks and surveys in the chapter. In the provided example, for instance, each row (except for the final “Overall Quality” row) represents a different learning check within the chapter, and the table reveals to the author whether the experimental flight influenced performance on the learning measure. Because these learning measures are chapter-dependent, they cannot be compared between chapters and will not be included in this study. However, common learning measures could be compared in future studies as readers are more likely to complete these than quality assurance surveys, thereby providing more robust sample sizes at a faster rate.

**Figure 2**

*Screenshot of the Analytics Overview for a Chapter on EdTech Books*

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall Rating</td>
<td>4.1/5.0</td>
</tr>
<tr>
<td>Total Ratings</td>
<td>253</td>
</tr>
<tr>
<td>Page Views</td>
<td>19.0K</td>
</tr>
<tr>
<td>Tracked Views</td>
<td>20.7K</td>
</tr>
<tr>
<td>PDF Downloads</td>
<td>443</td>
</tr>
<tr>
<td>Cost Savings</td>
<td>$1.2K</td>
</tr>
<tr>
<td>Reading Ease</td>
<td>Very Difficult (28.1)</td>
</tr>
<tr>
<td>Grade Level</td>
<td>12+</td>
</tr>
<tr>
<td>Word Count</td>
<td>5,111</td>
</tr>
<tr>
<td>Reading Time</td>
<td>27 minutes</td>
</tr>
<tr>
<td>Predicted Reads</td>
<td>5.9K</td>
</tr>
<tr>
<td>Reading Likelihood</td>
<td>28%</td>
</tr>
<tr>
<td>Last Updated</td>
<td>2020-06-28 17:28:21</td>
</tr>
</tbody>
</table>

Chart showing the analytics categories to evaluate a chapter on EdTech Books

**Figure 3**

*Screenshot of a Chapter Quality Display for a Chapter*
<table>
<thead>
<tr>
<th>Selection</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low Quality</td>
<td>0</td>
</tr>
<tr>
<td>Low Quality</td>
<td>1</td>
</tr>
<tr>
<td>Moderate Quality</td>
<td>47</td>
</tr>
<tr>
<td>High Quality</td>
<td>133</td>
</tr>
<tr>
<td>Very High Quality</td>
<td>72</td>
</tr>
</tbody>
</table>

Screenshot Showing the Chapter Quality Ratings

**Figure 4**

Screenshot of a Flight Comparison Table

<table>
<thead>
<tr>
<th>Original</th>
<th>no stock photos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Change</td>
</tr>
<tr>
<td>teacher-values</td>
<td>Mean</td>
</tr>
<tr>
<td>1.37</td>
<td>336</td>
</tr>
<tr>
<td>networked-thinking</td>
<td>0.72</td>
</tr>
<tr>
<td>stimulus</td>
<td>0.81</td>
</tr>
<tr>
<td>inner-workings</td>
<td>0.74</td>
</tr>
<tr>
<td>prior-experiences</td>
<td>0.75</td>
</tr>
<tr>
<td>tech-admin-values</td>
<td>1.6</td>
</tr>
<tr>
<td>principal-values</td>
<td>0.96</td>
</tr>
<tr>
<td>pck</td>
<td>0.69</td>
</tr>
<tr>
<td>plc</td>
<td>0.81</td>
</tr>
<tr>
<td>rat</td>
<td>0.94</td>
</tr>
<tr>
<td>usefulness</td>
<td>3.93</td>
</tr>
<tr>
<td>Overall Quality</td>
<td>4.09</td>
</tr>
</tbody>
</table>

Chart showing a flight comparison table
Independent Variables

To improve perceived quality of the targeted chapters, format- and content-based experiments were created for six different chapters in the textbook, with each experimental flight representing a different variable to be tested. When creating learning content, design decisions are highly contextual. For instance, there is no consensus in the design research literature on whether video is useful for learners simply because the answer depends so much upon contextual factors—such as (a) the type of video, (b) the quality of video, (c) its relationship to the text, (d) the age and characteristics of the learner, etc.—and even proposing decontextualized design decisions that are intended to be universally applied (like “what are the effects of video on instruction?”) has come to be viewed as a misguided or altogether confounded research strategy (Honebein & Reigeluth, 2021). The alternative to this is to employ research efforts in iterative, continuous improvement where a variety of strategies might be tested in deeply contextualized ways to improve learning products, such as adding or removing a specific video to a live textbook chapter. Toward this end, this study focused on six chapters in a single textbook and experimentally tested a different design change for each chapter (representing two versions of each chapter) to determine the feasibility of testing and revising these kinds of design decisions on-the-fly with live products. For instance, in the “Technology Integration” chapter, the experimental flight removed stock photos to determine whether the mere presence of photos influenced perceptions of quality. Similarly, in the “Lifelong Learning” chapter, the experimental flight removed an introductory video for the same purpose. Other changes made to remaining chapters included (a) adding extra images (for “Information Literacy”), (b) removing direct illustrative quotations (for “Online Professionalism”), (c) increasing the font size (for “Online Safety”), and (d) changing the sans-serif font style to a serif font (for “Universal Design for Learning”). In every case, chapters were set to “Automatic” flight assignment for a one-year period, and a series of Welch’s t-tests were conducted to determine whether the change influenced overall quality ratings for the chapter in the target time period.

In constructing these experiments, we did not expect to see drastic differences in results, but we did anticipate that if we could identify small formatting or content changes that resulted in small quality differences, then as these changes were aggregated together and applied to the entire textbook, overall quality could be improved in meaningful ways. For instance, even if adjusting stock photos, fonts, or videos only affected less than a 10% change each in perceived quality, by applying these results to all of the chapters we hoped to be able to improve chapters in ways that would show significant aggregate benefit. Additionally, because all of these experiments reflected relatively low-cost adjustments to resources that are used by a large number of people, even small improvements would be expected to have considerable relative advantage. For instance, if a small change can improve readability by only 1% of a textbook with a readership of 50,000, that small change could mean that 500 more people might actually benefit from the resource. Thus, though small improvements may historically be treated as insignificant in educational settings that are constantly seeking after silver-bullet or 2-sigma solutions (e.g., Bloom, 1984), when we move into the realm of high-impact open resources that we can adjust at low-cost, even tiny improvements can yield drastic results in learning for the broad population.

Results and Discussion

The simple result of this study is that after one year of constant data collection on a popular open textbook, all experiments came back as having statistically non-significant effects on perceived open textbook chapter quality. It is no secret that educational research exhibits a strong bias against reporting null effect studies, which leads many researchers to not publish valuable work and contributes to “publication bias, a positively skewed research base, and policy and practices based on incomplete data” (Cook & Therrien, 2017, p. 149), but even though results for this study were non-significant, the results may nonetheless be valuable for informing ongoing research and practice with continuous improvement efforts and open educational resources.

Table 1 provides a summary of the results for all six experiments, and there are at least two items of interest from the results that seem noteworthy. First, though non-significant, the Cohen’s $d$ values for several of the experiments approach levels that suggest mild to moderate strength (e.g., $d = .58$ in the case of removing the introductory video for “Lifelong Learning,” and $d = .45$ in the case of switching to a serif font for “Universal Design for Learning”). Though we
cannot say for sure, these values suggest that with a larger sample size we might see effects that could mildly influence overall chapter quality perceptions, let alone aggregate effects.

Table 1

Results Summary of A/B Test Experiments for Specific Chapters

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Original Version (A)</th>
<th>Experimental Flight (B)</th>
<th>Welch's t-Test</th>
<th>p-value</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Stock Photos</td>
<td>4.09</td>
<td>4.19</td>
<td>1.66</td>
<td>NS</td>
<td>0.23</td>
</tr>
<tr>
<td>Remove Intro Video</td>
<td>4.19</td>
<td>3.95</td>
<td>-1.92</td>
<td>NS</td>
<td>0.58</td>
</tr>
<tr>
<td>Add Extra Images</td>
<td>4.16</td>
<td>4.16</td>
<td>-1.34</td>
<td>NS</td>
<td>0.38</td>
</tr>
<tr>
<td>Remove Quotations</td>
<td>4.26</td>
<td>4.16</td>
<td>-1.04</td>
<td>NS</td>
<td>0.23</td>
</tr>
<tr>
<td>Increase Font Size</td>
<td>4.21</td>
<td>4.16</td>
<td>-0.04</td>
<td>NS</td>
<td>0.01</td>
</tr>
<tr>
<td>Serif Font Style</td>
<td>4.09</td>
<td>3.88</td>
<td>-1.29</td>
<td>NS</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Building off of this, the second noteworthy element is the seemingly small sample size for each experiment. Though I explained this phenomenon and provided justification for why we might not expect larger sample sizes from free-roaming user behaviors above, the difficulty that this places on using these data for continuous improvement is that we seem to need an absurdly large amount of reader activity in order to collect a sufficient amount of optional self-report data for reliable testing. However, these results suggest that doing such work is feasible but that it just takes time and lots of data, especially when data are collected in unobtrusive ways and focus on user perceptions rather than discrete behaviors. Using the “Technology Integration” chapter as an example, only 1.2% of original version readers and 2.0% of experimental flight readers answered the quality survey, which means that even though tens-of-thousands of users read the chapters, we still were not able to rely upon these users’ data to provide sufficient evidence for improvement. This is further exacerbated by what is likely the low effect that each of these factors (on their own) has on overall perceptions of chapter quality, because smaller effects will require larger sample sizes to prove significance, and if we are only conducting experiments that we expect to have small effects, then even relatively large datasets may leave us wanting for significance. Furthermore, if these data were to be used in ongoing continuous improvement efforts, authors and researchers would find themselves in the predicament of having to throw out previous data every time they made an iterative improvement, because the original version would no longer be a valid control. The upshot of this reality is that even with a large reader base, using optional self-report data to improve open textbooks may not be a feasible approach to continuous improvement (at least not until the reader base reaches hundreds of thousands of users or more), making it difficult for most authors to make meaningful, data-driven improvements to their textbooks.

To address both of these issues, future research and development efforts would likely benefit from three key practices. First, rather than doing testing at the individual chapter or even book level, these sorts of tests might best be explored at the platform level where flights are created on all content to test for small changes. For instance, instead of removing stock photos on only the “Technology Integration” chapter, running a platform-wide flight of all chapters and programmatically removing stock photos for randomly-selected users would allow platform developers to determine the value of stock photos for EdTech Books users broadly with comparative swiftness. Similarly, doing a site-wide analysis of the effect that textual complexity has on reading likelihood reveals that likelihood goes down as complexity goes up, suggesting that as authors write chapters they should generally aim to simplify language (see Figure 5). The trade-off with this platform-level approach is that it would lose context, because not all chapters might benefit equally from the presence or lack of stock photos due to different content and audiences and some content might require greater textual complexity, but it would at least provide platform developers with data-based guidelines to provide suggestions to authors on what effects their decisions might be having on readers (e.g., “including more than three stock photos is predicted to reduce user quality perceptions of your chapters by 11.5%”).
Figure 5

Relationship Between the Reading Grade Level of Chapters and Reading Likelihood

![Chart showing the relationship between reading grade level and reading likelihood](image)

*Note. $R^2$ Linear = 0.199*

Second, many of these types of tests can potentially become automated not just at the random assignment phase but also at the implementation and continuous improvement phase. For instance, if a font size experiment was implemented across an entire platform with a font-size increment of 10%, the system could create an experiment that increases font size for random users by 10% while reducing it by 10% and leaving it the same for others. This site-level test could continue until enough data were collected to determine which of the choices was optimal. In probability theory, this type of approach is called a “bandit algorithm” as it attempts to address the “multi-armed bandit problem” by maximizing positive outcomes (e.g., chapter reads, positive ratings) while simultaneously employing an exploratory mechanism to discover whether other options or features might improve results (Berry & Fristedt, 1985). Employing bandit algorithms for improving any design feature could utilize an infinite number of variables (e.g., different font sizes, types, or colors) in experimental ways that both produce actionable results and minimize undesirable outcomes. For many design decisions, this could allow continuous improvement to occur in an automated fashion without the need for authors or even developers to manually adjust designs to respond to experimental results. Rather, the design of the platform could become self-correcting in many regards to account for ongoing user behaviors.

And third, though relying on self-report data like quality ratings may still have a place (especially in larger scale analyses), more granular and faster improvements would need to rely upon unobtrusive user behavior data that is more universally collected. For instance, based on the textual complexity of a chapter and the time-on-page behaviors of a reader, we can determine whether each user actually read the page. Using this as the dependent variable would mean that we would have reliable experimental data for all learners rather than just the small subset that self-report data provides and would allow us to predict how experimental changes are affecting behaviors for all learners (e.g., does
changing the font style influence the likelihood that a user will read the page?). Though this may limit our experiments in some ways, it would allow for rapid and continuous improvement (especially when coupled with the other suggestions above) that would not be readily possible while waiting for self-report data.

Furthermore, many of these possible dependent variables would likely be correlated to one another. For instance, conducting a simple post hoc bivariate correlation of quality measures, predicted reads, and textual complexity on all chapters in the platform with at least 10 quality ratings ($n = 63$) revealed a significant, moderate relationship between these variables (see Table 2). This suggests that even if the primary goal is to improve perceived quality of textbooks, movement toward this goal might be accomplished in part by engaging in efforts that seek to influence more easily measurable variables (like reading likelihood).

### Table 2

<table>
<thead>
<tr>
<th>Bivariate Correlations of Chapter Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textual Complexity</td>
</tr>
<tr>
<td>---------------------</td>
</tr>
<tr>
<td>Quality Rating</td>
</tr>
<tr>
<td>Textual Complexity</td>
</tr>
</tbody>
</table>

* Denotes significance at the $p < .05$ level.

** Denotes significance at the $p < .01$ level.

### Conclusion

In conclusion, though the experiments presented in this study yielded non-significant results, findings remain valuable for helping researchers and authors interested in engaging in data-driven continuous improvement efforts for several reasons. First, this study points out the relative difficulty of engaging in these efforts at a granular level (e.g., at the chapter or resource level), especially when the resources that we are seeking to improve do not enjoy viral popularity. Rather, such efforts are likely best addressed at the system level where experimental flights may be created with, randomized for, and aggregated from many different resources at once. Second, due to the relative simplicity of many of these experimental conditions, platform developers should explore automating not just the randomization aspect of A/B tests but also the actual implementation and experimental creation of tests, allowing the system to iteratively experiment-improve-experiment in valuable directions by employing bandit algorithms. And third, because these efforts rely upon unobtrusive data collection, continuous improvement will most effectively be influenced by data that can be collected from as many users as possible without relying upon low-probability participation metrics such as prompting users to answer a survey or to provide a rating. Incorporating these suggestions into any open textbook continuous improvement effort would offer great promise for making the most of user experience data that is readily available in many open platforms today. By doing so, the theoretically achievable goal is to create continuous improvement systems that are not only comparable to traditional publishing mechanisms but that far exceed them in ensuring the usefulness, usability, and perceived quality of open resources.

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http://opencontent.org/definition/

https://edtechbooks.org/id/continuous_improvement

doi:10.19173/irrodl.v18i6.3170

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**Previous Citation(s)**


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Royce Kimmons is an Associate Professor of Instructional Psychology and Technology at Brigham Young University where he seeks to end the effects of socioeconomic divides on educational opportunities through open education and transformative technology use. He is the founder of EdTechBooks.org, open.byu.edu, and many other sites focused on providing free, high-quality learning resources to all. More information about his work may be found at http://roycekimmons.com, and you may also dialogue with him on Twitter @roycekimmons.
The Rise Framework
Using Learning Analytics to Automatically Identify Open Educational Resources for Continuous Improvement

Robert Bodily, Rob Nyland, & David Wiley

The RISE (Resource Inspection, Selection, and Enhancement) Framework is a framework supporting the continuous improvement of open educational resources (OER). The framework is an automated process that identifies learning resources that should be evaluated and either eliminated or improved. This is particularly useful in OER contexts where the copyright permissions of resources allow for remixing, editing, and improving content. The RISE Framework presents a scatterplot with resource usage on the x-axis and grade on the assessments associated with that resource on the y-axis. This scatterplot is broken down into four different quadrants (the mean of each variable being the origin) to find resources that are candidates for improvement. Resources that reside deep within their respective quadrant (farthest from the origin) should be further analyzed for continuous course improvement. We present a case study applying our framework with an Introduction to Business course. Aggregate resource use data was collected from Google Analytics and aggregate assessment data was collected from an online assessment system. Using the RISE Framework, we successfully identified resources, time periods, and modules in the course that should be further evaluated for improvement.

Introduction

Adoption of Open Educational Resources (OER) is increasing throughout the field of education. According to the Hewlett Foundation (n.d.),

OER are 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 (para. 2).

Because of the intellectual property licenses of OER, those who adopt them are allowed to exercise the 5R permissions - retain, reuse, revise, remix, and redistribute. This means that faculty can modify OER to meet the specific needs of students. Additionally, faculty can modify their content after a course concludes based on student performance and other feedback. While OER are licensed in a manner that permits their revision and improvement, this permission provides no information about what should be changed or improved.

The process known as continuous improvement relies on student data regarding assessment performance and content use to create a feedback loop to improve curriculum. Using data from the student learning process is the domain of
learning analytics - an emerging field defined as "the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Siemens, 2010, para. 6). While a small portion of learning analytics research has focused on using analytics to evaluate courses to improve design (Pardo, Ellis, & Calvo, 2015; Rienties, Toetenel, & Bryan, 2015), no studies focus on continuous improvement of content using learning analytics. This is likely because textbooks and other digital courseware traditionally used in courses are subject to copyright restrictions that make it illegal for faculty to continuously improve or change it. Consequently, the continuous improvement process can provide faculty with information about what needs revising, but not the permission to do so.

The purpose of this paper is to explicitly connect strengths of OER (reusable and editable content) with strengths of learning analytics (unobtrusively collected course evaluation data) to enable the continuous improvement of educational content. First, we review the literature surrounding OER use, learning analytics and design, and continuous course improvement. Then, we propose the RISE (Resource Inspection, Selection, and Enhancement) Framework for using learning analytics to identify resources that need continuous improvement. Finally, we present a case study using content usage and assessment data collected from an OER course to apply our framework in a real-world scenario.

Literature Review

As the adoption of OER has increased, so have efforts to conduct research on the impact of OER. Bliss, Robinson, Hilton, and Wiley (2013) outlined a framework categorizing the four major areas that OER research should address: cost, outcomes, use, and perceptions (COUP). This study focuses on the use aspect of this framework. While the majority of use studies have focused on (1) faculty adoption of OER or (2) ways that users exercise the 5R permissions (retain, reuse, revise, remix, redistribute) - we are focusing on the way in which students use OER.

In looking at the studies that have examined student use of OER, we have separated them into the following categories for our analysis: self-report use data, digital download data, and digital access data tied to outcomes.

Self-Report

These research studies have tried to understand a variety of facets of student use of OER, including frequency and motivation for use. Bliss et al. (2013) surveyed 490 students from eight community colleges that had recently adopted OER in place of a traditional textbook as part of Project Kaleidoscope. Overall, there was no difference in students’ responses to how often they used their textbook and how often they used their Project Kaleidoscope texts, with a majority of students using their textbooks more than 2-3 times per week.

Looking exclusively at students using OER, Lindshield and Adhikari (2013) conducted a survey with face-to-face and online students asking them about their resource use. They found that online students used the resources more often - two-thirds of online students used the resources twice a week or more while only one-third of on-campus students reported doing the same. Like Bliss et al. (2013), they also found that the majority of students were using their textbooks more than 2-3 times per week.

Internationally, Olufunke and Adegun (2014) looked at student use of OER at an African university. While students reported a high level of use (2.21 out of 3), it is unclear if the researcher properly defined OER for their research subjects - the question prompt read "I get relevant learning materials online." Students may have been reporting on their online learning materials usage generally rather than specific OER use. In another usage study from a Chinese University, Hu, Li, Li, and Huang (2015) reported that 79% of students had used some form of OER. Sixty percent of them reported using OER to assist their own personal learning, citing OER videos as the most frequently used.

Taking a qualitative approach to OER use, Petrides, Jimes, Middleton-Detzner, Walling, and Weiss (2011) held focus groups with students who had used a digital open textbook in their class. While their research did not specifically ask about frequency of use, students reported that the availability of the resources had a positive impact on their study habits.
One of the most interesting use studies we found was an evaluation of open science textbooks from the Open Textbook Project. Here, Price (2012) examined how teachers and secondary students used open textbooks in their class. Overall, she found that teachers using Open Textbook Project textbooks reported using a greater portion of the textbook compared with teachers using traditional textbooks (63% vs. 50%). In order to further investigate student use of open textbooks, the author examined student markings (e.g., highlighting or notes) in their textbooks. While she found no markings in the traditional textbooks (because such marking is prohibited by school policies), she found that students using open textbooks did mark up their textbook - at points mostly prescribed by the instructor.

While self-report data on student use of OER is useful in helping us gain a preliminary understanding of how students use OER, this is not necessarily a scalable method of collecting OER use data and may suffer from self-report bias, or biases introduced due to the nature of human memory or some people’s desire to appear to fit an ideal. To obtain a more comprehensive understanding of how students use OER, we next discuss the studies which collected digital access or download data on how frequently students interacted with their textbooks.

**Digital Access**

Other studies have tried to get better measures of student OER use by looking at access to online learning materials. An example of this is Feldstein et al. (2012) who conducted a 1-year pilot study with 991 students in nine core courses at Virginia State University. These courses adopted Flat World Knowledge OER textbooks in place of traditional textbooks. In the study, the authors tracked student resource downloads during fall and spring semesters. They found that more students viewed OER textbooks online in OER sections of the course when compared with those that purchased textbooks in a traditional section of the course (90% vs 47%). They also found that PDF was the preferred method of resource download, ePub and MOBI file downloads increased over time, and self-report file preference was consistent with actual download usage.

Allen et al. (2015) conducted a study at UC Davis that used ChemWiki, an online chemistry OER, as the primary text in place of a commercial textbook. The treatment group consisted of 478 students that used ChemWiki and the control group consisted of 448 students that used a traditional textbook. A weekly time-on-task survey was sent to students to determine how much they were using their respective resource. They found that there was a moderate correlation between self-report resource use (time spent) and actual resource use (number of pageviews in the ChemWiki resource). In addition, while the ChemWiki group spent 24 minutes more with the resource each week than the traditional textbook group, all students spent the same amount of time studying per week.

These use studies are measuring use in an unobtrusive way and help us better understand how much students use OER. However, they are not connecting student resource use to student outcomes. This connection between resource use and achievement scores is essential to enable continuous course improvement. The studies discussed in the next section describe the results from linking outcomes to resource use.

**OER Use and Outcomes**

Lovett, Meyer, and Thille (2008) described a multiyear study of the Open Learning Initiative (OLI), an OER project from Carnegie Mellon University. While the majority of their study was focused on comparing outcomes of face-to-face sections of an Intro to Statistics class with online sections exclusively using OLI, a part of their study examines OER use. They ran a correlation between the time spent on certain activities in the course and assessments that aligned to them. Overall, they found a moderate \( r = .3 \) correlation between time spent on an activity and performance on an assessment.

In a similar study from OLI, Steif and Dollár (2009) wanted to see if learning gains in a mechanical engineering course were related to use of the OLI course materials. To measure this, they looked at the correlation between the amount of cognitive tutors (a type of online activity) completed and performance gains for a module. The correlation was positive, but relatively low \( r = .274 \).
In a final study linking performance and OER usage, Gil Vázquez, Candelas Herías, Jara Bravo, García Gómez, & Torres Medina (2013) looked at statistics from an OpenCourseWare (OCW) that they developed for a computer networks class. The content consisted of a blog, multimedia videos, electronic documents, and interactive simulations. In the first part of the study, the researchers surveyed and interviewed students in the class to get their opinion on the resources - which was positive overall. Additionally, the researcher examined the link between OER use and student performance. They found that there was a strong, but not statistically significant, relationship between OER use and achieving a high grade ($r = .74, p = .068$).

Thus far we have focused on studies relating to student use of OER. With respect to using learning analytics to inform course redesign, little literature exists in connection with OER. We next examine pertinent literature outside of OER to understand how learning analytics has been used in the course redesign process.

Learning Analytics and Redesign

Although learning analytics can provide instructors and designers with the information they need to evaluate and redesign their courses, there are only a few studies examining how learning analytics can support the course redesign process. First we will review a few articles that examined course design implications suggested through learning analytics. Second, we will review articles discussing frameworks or case studies of course redesign using learning analytics.

Course Design

Rienties, Toetenel, and Bryan (2015) examined the relationship between course design, online resource use, and student achievement using 32 courses at the Open University. Their cluster analysis yielded “four distinctive learning design patterns: constructivist, assessment-driven, balanced-variety, and social constructivist” (p. 318). These course design patterns had an impact on student engagement and student achievement. Based on these findings, it is important to be mindful of what kind of design is used if the goal is to foster increased student engagement and achievement.

Pardo, Ellis, and Calvo (2015) argued that learning analytics data does not provide enough context to inform learning design by itself. They used the Student Approaches to Learning framework to conduct a mixed-methods study investigating the benefit of using quantitative and qualitative data to evaluate learning design. In an engineering class of 300 students, they found that their quantitative and qualitative approach improved the course evaluation and affected how they interpreted the quantitative data. This study illustrates the need for both quantitative and qualitative data to ensure the most accurate learning design evaluation. Because of this information, we have included a quantitative and a qualitative component to our content improvement framework (discussed in the The RISE Framework section).

Course Redesign

Lockyer, Heathcote, and Dawson (2013) primarily look at the intersection of learning analytics and learning design. Learning design is a field interested in documenting specific instructional sequences so educators can copy and change sequences according to local needs. Towards the end of their article, they mention how learning analytics can benefit course design: “Revisiting the learning analytics collected during the course can support teachers when they are planning to run the course again or when the learning design is being applied to a different cohort or context” (p. 1454). This article is useful in providing a framework to bridge the gap between learning analytics and learning design. This framework focused on course sequence, but did not discuss implications for content revisions. More research is needed to facilitate continuous course improvement in text content using learning analytics.

In another research study, Morse (2014) sent a survey to 71 program chairs at universities asking them what kinds of data would be beneficial to help them redesign their courses. Using this data, Morse developed a framework for the kinds of data that would be useful in redesigning courses. This framework includes knowledge support requirements, data requirements, interface requirements, and functional requirements. These requirements may be useful in helping instructors evaluate and improve several aspects of their course, but again, does not address how to make content changes in a course.
Continuous improvement is a term indicating a feedback loop between learning analytics data and instructional design stakeholders so they can make data driven decisions about course design. Wiley (2009) discusses the benefits of using analytics for continuous improvement in an OER setting - in this case the Open High School of Utah (OHSU):

> Because the Open Curriculum is licensed in such a way that we can revise materials directly, OHSU is able to engage in a highly data-driven curriculum improvement process. As students go through the online courses, their clicks and learning paths can be tracked and recorded. This information can be combined with item response theory and learning outcome analysis data to set priorities for curriculum or assessment revision empirically. This data-driven process of curriculum improvement should allow the Open Curriculum to reach a very high level of quality very quickly (p. 38).

This continuous improvement process is also discussed by the Online Learning Initiative (OLI). Strader and Thille (2012) said “A key attribute of the OLI environment is that while students are working through the course, we are collecting analytics data and using those data to drive multiple feedback loops” (p. 204). These feedback loops are illustrated in Figure 1. They continue,

> Analysis of these interaction-level data allow us to observe how students are using the material in the course and assess the impact of their use patterns on learning outcomes. We are then able to take advantage of that analysis to iteratively refine and improve the course for the next group of students (p. 204).

![Figure 1. Feedback loops used in the Online Learning Initiative. Figure is licensed under a CC-BY License, by Strader and Thille (2012).](image)

While analytics help us identify what resources to modify in the continuous improvement process, we also need to have legal permissions to modify and improve the content. Wiley and Green (2012) discuss this benefit of using OER and learning analytics together: “OER provide instructors with free and legal permissions to engage in continuous quality-improvement processes such as incremental adaptation and revision, empowering instructors to take ownership and control over their courses and textbooks in a manner not previously possible’ (p. 83). The unique nature of OER allows
instructors and designers to improve curriculum in a way that might not be possible with a commercial, traditionally copyrighted learning resource.

While the aforementioned authors have discussed the possibilities of using analytics to engage in continuous improvement of OER, we were unable to locate any publications showing results from this process. In addition, we were unable to find a framework to help with the continuous improvement of content, meaning online text resources or textbooks in general. Synthesizing the results from our literature review, we have determined that a framework is needed to assist stakeholders in identifying which pieces of content need additional attention to facilitate continuous course improvement. This is particularly interesting in an OER context where instructors have the legal permissions necessary to change and improve content. In the remainder of this paper we will provide a framework for evaluating OER using learning analytics to facilitate their continuous improvement. We will then provide an example of how to apply this framework using data from an OER-based online course.

**The RISE Framework**

In order to continuously improve open educational resources, an automated process and framework is needed to make course content improvement practical, inexpensive, and efficient. One way that resources could be programmatically identified is to use a metric combining resource use and student grade on the corresponding outcome to identify whether the resource was similar to or different than other resources. Resources that were significantly different than others can be flagged for examination by instructional designers to determine why the resource was more or less effective than other resources. To achieve this, we propose the Resource Inspection, Selection, and Enhancement (RISE) Framework as a simple framework for using learning analytics to identify open educational resources that are good candidates for improvement efforts.

The framework assumes that both OER content and assessment items have been explicitly aligned with learning outcomes, allowing designers or evaluators to connect OER to the specific assessments whose success they are designed to facilitate. In other words, learning outcome alignment of both content and assessment is critical to enabling the proposed framework. Our framework is flexible regarding the number of resources aligned with a single outcome and the number of items assessing a single outcome.

The framework is composed of a 2 x 2 matrix. **Student grade on assessment** is on the y-axis. The x-axis is more flexible, and can include resource usage metrics such as pageviews, time spent, or content page ratings. Each resource can be classified as either high or low on each axis by splitting resources into categories based on the median value. By locating each resource within this matrix, we can examine the relationship between resource usage and student performance on related assessments. In Figure 2, we have identified possible reasons that may cause a resource to be categorized in a particular quadrant using resource use (x-axis) and grades (y-axis).

<table>
<thead>
<tr>
<th>High Grades</th>
<th>Low Grades</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Grades</td>
<td>Grades</td>
</tr>
<tr>
<td>High student prior knowledge, inherently easy learning outcome, highly effective content, poorly written assessment</td>
<td>Low motivation or high life distraction of students, too much material, technical or other difficulties accessing resources</td>
</tr>
<tr>
<td>Effective resources, effective assessment, strong outcome alignment</td>
<td>Poorly designed resources, poorly written assessments, poor outcome alignment, difficult learning outcome</td>
</tr>
</tbody>
</table>

**Figure 2.** A partial list of reasons OER might receive a particular classification within the RISE framework.

By utilizing this framework, designers can identify resources in their courses that are good candidates for additional improvement efforts. For instance, if a resource is in the High Use, High Grades quadrant, it may act as a model for other resources in the class. If a resource falls into the Low Use, Low Grades quadrant, it may warrant further evaluation.
by the designers to understand why students are ignoring it or why it is not contributing to student success. The goal of the framework is not to make specific design recommendations, but to provide a means of identifying resources that should be evaluated and improved. To further explain the framework, we next conduct a case study implementing the framework in an Introduction to Business class.

**Case Study Methods**

Participants (n = 1002) consisted of students enrolled in several sections of a Fall 2015 Introduction to Business course taught using a popular OER courseware platform. This course had an OER online text, videos, simulations, formative assessments, practice assessments, and summative assessments. The assessment system tracked student assessment scores for each question and quiz. Resource use data was collected using Google Analytics.

Resource use was measured using pageviews of the online resources normalized by the number of students that attempted assessment items for that outcome. We opted to use pageviews because content ratings were not available for these resources and time spent could not be accurately tracked, as students may have left a page open for days at a time without actually using the resource. This metric, pageviews per student, was the best way to analyze resource use data because not all students attempted or were assigned to complete all outcomes. Because we tracked page use using Google Analytics, resource use was aggregated at the class level rather than the student level. One potential problem with using Google Analytics for resource use in an OER context was that because resource pages are public, page use was not restricted to students in the course. We address this specific limitation below. Figure 3 shows all user pageviews compared with pageviews generated by search engine traffic (likely non-student views). Given the extremely limited number of pageviews generated by search engine traffic, we believe the pageview measure is an accurate representation of student resource use in the course.

Resource Evaluation Process

Once the metrics for page use and grades were collected, we applied the RISE framework by inspecting and selecting certain resources using a three-phase process. First, we conducted an outer quadrant analysis. After plotting all of the resources by their pageviews and grades, we identified the resources that were furthest away from the "origin" (where the average number of pageviews intersects the average grade). After resource identification and selection, a designer could evaluate the resources qualitatively to make the resources more useful for the students in the course. This evaluation process is not discussed in this paper but will be included in future work. Second, we examined all of the resources according to their page type (reading, video, simulation, etc.). Our goal in this phase was to look at what types of resources were more useful in helping students achieve course outcomes. Third, we identified extreme outliers for all of the resources and identified possible reasons for the anomalies.
Case Study - Applying the Framework

The process of applying the RISE Framework is described below, and includes an outer quadrant analysis, analyses within each quadrant, analysis by page type, and extreme outlier analysis.

Outer Quadrant Analysis

After removing extreme outliers (discussed below), the distribution of resources versus grades can be seen in Figure 4. This scatterplot is divided into four quadrants:

- **Quadrant 1** - Greater than average use, greater than average grades
- **Quadrant 2** - Less than average use, greater than average grades
- **Quadrant 3** - Less than average use, less than average grades
- **Quadrant 4** - Greater than average use, less than average grades

![Figure 4. Scatterplot of all resources. The dashed blue line indicates an additive z-score greater than three, which is our cutoff point for resource identification.](image)

We will now look more in depth at the examples in each of these quadrants outside our cutoff value. To identify the resources that were on the furthest regions of the quadrants, we used an additive z-score approach. We calculated the z-score (standardized distance from the mean in standard deviation units) of the resources for both its use and its associated grades, calculated the absolute value, and added them together. The resulting combined z-score is an indicator of how far away from the mean each data point exists in multivariate space. We use this metric to identify which resources should be further examined for continuous course improvement.

There are other measures indicating distance from the mean in multivariate space that could have been used - Mahalanobis distance for example. To see what differences exist between this approach and Mahalanobis distance, we ran an analysis using Mahalanobis distance as the distance calculation instead of our additive z-score approach. Our analysis yielded similar results, so we decided to keep the additive z-score approach because adding together z-scores for multiple variables is much easier to explain and calculate than the Mahalanobis distance.
Quadrant 1 Analysis

The resources in quadrant 1 are those for which use was high and performance on outcomes related to the page was high. As stated earlier, possible reasons for this could be that the resource was helpful in achieving outcomes or that the alignment between the resource and outcomes assessment was particularly good. The top resources for this quadrant are shown in Table 1. After further analysis, Getting Down to Business, What Is Business?, and Factors of Production were discarded from further analysis because these resources were the resources for the first module in the course. The beginning of the course effect on page use was limited to the first module in the course, so we did not need to control for time in the course for other resource pages. The remaining three resources in this quadrant merit further analysis.

Table 1

<table>
<thead>
<tr>
<th>Page title</th>
<th>Grade</th>
<th>PV/student</th>
<th>Z-Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading: The Four Ps of Marketing</td>
<td>0.81</td>
<td>1.64</td>
<td>3.65</td>
</tr>
<tr>
<td>Reading: Sole Proprietorship and Partnerships</td>
<td>0.82</td>
<td>1.56</td>
<td>3.52</td>
</tr>
<tr>
<td>Reading: Fredrick Taylor's Scientific Management</td>
<td>0.83</td>
<td>1.46</td>
<td>3.25</td>
</tr>
<tr>
<td>Reading: Getting Down to Business</td>
<td>0.73</td>
<td>1.75</td>
<td>3.11</td>
</tr>
<tr>
<td>Outcome: What Is Business?</td>
<td>0.73</td>
<td>1.75</td>
<td>3.1</td>
</tr>
<tr>
<td>Reading: Factors of Production: Inputs and Outputs</td>
<td>0.79</td>
<td>1.53</td>
<td>3.01</td>
</tr>
</tbody>
</table>

*Note. This column is the absolute value of the z-score for grade and PV/student added together.

Quadrant 2 Analysis

The resources in quadrant 2 are those for which use was lower than average but performance on outcomes related to the page was high. This may indicate that the students had a high level of previous knowledge of the outcome, the assessment was too easy, or the content was easy to understand. The top pages for this quadrant are shown in Table 2. All four of these resources were located in the same course module, so it is likely these resources are showing up in this quadrant because the outcome is too easy. Students did not think it was worth reviewing the content for this outcome, and it did not impact their grades as they still scored well on the outcome.

Table 2

<table>
<thead>
<tr>
<th>Page title</th>
<th>Grade</th>
<th>PV/student</th>
<th>Z-Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcome: Recruiting Employees</td>
<td>0.88</td>
<td>0.53</td>
<td>3.4</td>
</tr>
<tr>
<td>Self-Check: Recruiting Employees</td>
<td>0.88</td>
<td>0.57</td>
<td>3.24</td>
</tr>
<tr>
<td>Self-Check: Employee Performance</td>
<td>0.86</td>
<td>0.54</td>
<td>3.04</td>
</tr>
<tr>
<td>Outcome: Employee Performance</td>
<td>0.86</td>
<td>0.55</td>
<td>3.01</td>
</tr>
</tbody>
</table>

*Note. This column is the absolute value of the z-score for grade and PV/student added together.
Quadrant 3 Analysis
The resources in quadrant 3 are those for which use and performance on outcomes were lower than average. This may indicate that the students were unmotivated for some reason or that the outcomes were difficult and the resources were not sufficiently helpful in supporting student understanding. The top resources in this quadrant are shown in Table 3. To understand why these resources are located within this quadrant, we looked at what module the resources came from as well as how far into the semester they were given. All of the pages in quadrant three were from the same module given about one-third of the way through the semester. In addition, the resources were from two outcomes located right next to each other in the module. Further analysis should be conducted to understand the low use and low grades on these outcomes.

Table 3

<table>
<thead>
<tr>
<th>Page title</th>
<th>Grade</th>
<th>PV/student</th>
<th>Z-Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video: Legal Rights Under Implied Warranties</td>
<td>0.53</td>
<td>0.57</td>
<td>3.6</td>
</tr>
<tr>
<td>Self-Check: Warranties</td>
<td>0.53</td>
<td>0.58</td>
<td>3.58</td>
</tr>
<tr>
<td>Outcome: Warranties</td>
<td>0.53</td>
<td>0.62</td>
<td>3.42</td>
</tr>
<tr>
<td>Self-Check: Mergers and Acquisitions</td>
<td>0.51</td>
<td>0.74</td>
<td>3.17</td>
</tr>
<tr>
<td>Outcome: Mergers and Acquisitions</td>
<td>0.51</td>
<td>0.75</td>
<td>3.14</td>
</tr>
</tbody>
</table>

*Note. This column is the absolute value of the z-score for grade and PV/student added together.

Quadrant 4 Analysis
The resources in quadrant 4 are those for which use was higher than average, but performance on outcomes related to the resources was lower than average. This may indicate that the resources or their assessments were poorly aligned to the outcome, the content was not helpful in preparing for the assessments, or that the assessments were too difficult. The top resources in this quadrant are shown in Table 4. Two of these resources, *External Forces* and *What is International Business?* were discarded from further analysis because they were both located within the first two modules of the course, which explains the high resource use. The remaining five resources merit further analysis to understand the low grade on the outcome and the higher than average resource use.

Table 4

<table>
<thead>
<tr>
<th>Page title</th>
<th>Grade</th>
<th>PV/student</th>
<th>Z-Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading: The Organization Chart and Reporting Structure</td>
<td>0.64</td>
<td>1.89</td>
<td>4.56</td>
</tr>
<tr>
<td>Reading: Organizing</td>
<td>0.64</td>
<td>1.65</td>
<td>3.65</td>
</tr>
<tr>
<td>Reading: Financial Ratio Analysis</td>
<td>0.56</td>
<td>1.29</td>
<td>3.3</td>
</tr>
<tr>
<td>Reading: Product Liability</td>
<td>0.58</td>
<td>1.33</td>
<td>3.2</td>
</tr>
<tr>
<td>Reading: External Forces</td>
<td>0.58</td>
<td>1.34</td>
<td>3.14</td>
</tr>
</tbody>
</table>
Comments on the Individual Quadrant Analyses

From our outer quadrant analysis we were able to identify multiple resources as well as multiple time periods or modules in the course that are worth further analysis and evaluation by an instructional designer. We do not go through the resource evaluation in this paper. Instead, the RISE Framework is meant to help identify resources that should be evaluated.

Page Type Analysis

In the next phase of our evaluation case study, we divided the resources according to their page type for further evaluation. In the course, there were five types of resources: reading, self-check, outcome description, video, and simulation. We calculated the mean performance and usage for each of these resource types and overlaid them on the means of the resources as a whole. By looking at performance versus page use for each of these page types, we hope to gain insights into how the type of page contributes to overall student performance. Such results may help designers identify the most effective modalities for helping students understand concepts.

Reading Pages

Reading pages primarily consist of longer sections of text that cover the course outcomes. Reading pages may also contain embedded videos. After examining the scatterplot in Figure 5, reading pages had higher use than other page types; however, despite higher use, reading pages had the same average grade as the rest of the page types.

![Figure 5. Scatterplot for Reading Pages.](image)

Self-Check Pages

In a self-check page, students take a formative assessment that covers the content of the previous section. The students are given objectively scored assessment items with immediate feedback upon submission. The students can
take the assessment items as many times as they like and then move onto the next section when they feel that they are ready. Figure 6 illustrates that use was lower for self-check pages when compared to all of the resources, while performance on outcomes was approximately the same.

![Figure 6. Self-check pages.](image)

**Outcome Pages**

Outcome pages come at the beginning of a section and describe what the student will learn to do within that section. The outcome page also includes a list of the learning activities that will take place within that section. Figure 7 shows that student grades were approximately the same for outcome pages; however, use was slightly lower when compared to the resources as a whole.
Video Pages

Similar to reading pages, the purpose of video pages is to help students understand the outcomes covered in a section. While the video page may contain text, the primary purpose of this text is to give context to the video before the student watches it. Figure 8 shows that the use of video pages was lower than the resources as a whole and that performance on outcomes related to those pages was markedly lower. One hypothesized explanation is videos were only created for concepts that were historically more challenging for students. Thus, we cannot determine the true effectiveness of video pages without comparing to historical use and grade data. This is an interesting question that should be examined in future research.
Simulation Pages

Simulation pages contain instructions and a link to an externally hosted simulation. These simulations allow students to learn the course outcomes in a game-like environment. The most popular simulation used in the course is the Chair the Fed game (https://edtechbooks.org/-WycF). In this game, students set national monetary policy as the chairmen of the Federal Bank. They can see the effect that setting the fed funds rate has on unemployment and inflation. Figure 9 shows that performance on outcomes was similar to other resources as a whole. Surprisingly, use of simulation pages was slightly lower than other pages. It could be that students felt the simulation was an optional activity and would not help them succeed in the course.

![Figure 9. Simulation Pages.](image)

Extreme Outlier Analysis

In the final phase of our analysis, we examined one outlier that was removed from the original data set because of an extreme pageviews value. This resource is described in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Page title</th>
<th>Grade</th>
<th>PV/student</th>
<th>Z-Score*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading: Stages of an Economy</td>
<td>0.83</td>
<td>2.82</td>
<td>7.79</td>
</tr>
</tbody>
</table>

*Note. This column is the absolute value of the z-score for grade and PV/student added together.

The extreme outlier resource, *Stages of an Economy*, had more pageviews than any other resource in the class. Upon further analysis in Google Analytics, we found that this page had 1,500 views from search engine traffic and only 1,626 views from direct traffic. Direct traffic comes from people clicking on a link (such as the link within the course). By removing the search engine traffic, the pageview per student value for this page drops down to a number similar to the other resources in the course.
Design Implications

Reading pages were used more than any other page type in the case study course. However, it was unclear whether this was because students were revisiting reading pages or because they were choosing not to visit the other pages in the course. To investigate this, we used the Unique Pageviews column from Google Analytics instead of the Pageviews column and reconducted our analyses. There were no meaningful differences between the analysis using Unique Pageviews and Pageviews. This suggests that some students are choosing to skip Outcome and Self-Check pages in order to get to the reading pages more quickly.

This finding has some interesting design implications. For example, if students are going to skip summary and self-check pages in order to view reading pages, assuming outcome and self-check pages are useful, it might be worthwhile to include outcome and self-check information on the same page as the reading. Perhaps students would be more likely to answer formative self-check items or preview the outcome if it is included on the same page as the reading pages.

Enhancement

The last step in the RISE framework is enhancement. Throughout the article we have discussed the ways in which we have attempted to automate the resource inspection and selection stages of the framework. Enhancement is the ultimate purpose for the framework; however, this stage is not possible to automate. For this reason, we will discuss what the enhancement stage would look like as implemented in the framework.

Using the automated resource inspection and selection support, an instructional designer would receive a list of resources in each quadrant that differed significantly from other resources in the course. The designer then works their way through this list critically examining the associated assessments (e.g., using confirmatory factor analysis and item response theory analysis to check item loadings on outcomes and item function) and the associated resources (e.g., checking for mismatches between the type of learning outcome and the instructional strategies employed, differences in the language used to describe key concepts in the resources and assessments, issues with reading level, or examples that students may find difficult to understand). If time were not limited, faculty and designers could engage in this level of deep review of all resources used to support learning in the class; however, because time is scarce, there is a strong need for a system that can automatically surface resources most in need of improvement.

As mentioned previously, these improvements are uniquely enabled when the resources are open, as the designer has the legal ability to modify and adapt course content. Once changes are made to the content, the course can be taught again and the process of tracking continues for another semester. The designer can then compare the resource use and outcomes from the previous semester to determine if the course changes improved student use of resources and student achievement on the outcome.

Limitations/Future Research

The major limitation of our study is we only have access to aggregate course level data, when student level resource use and assessment data would have been more desirable. While this limits a few of the analyses that we can conduct, there is still benefit for continuous course improvement by looking at aggregate resource use and assessment data to improve content. In this study, we successfully identified a number of resources that merit further evaluation. In future studies we will track resource use at the student level, which will allow our analyses to be much more sensitive.

To further validate this framework, more case studies should be conducted. These studies can make additions to our basic framework and apply it in new test cases (e.g., a case study with content ratings). Our goal in this paper was to provide a sample framework that was automatable and easy to use. Future research, including studies we intend to conduct, can provide a more nuanced version of the framework for supporting continuous improvement.
In addition, future research should add sophistication to our simplified construct of resource use. Rather than only looking at number of pageviews per student, distinct patterns of resource use (like skipping Outcome and Self-check pages) should be identified and examined individually in relation to performance on assessments. Additional metrics such as time spent or content ratings should also be examined to determine the benefits and drawbacks to using these metrics when compared with resource use.

Longitudinal studies investigating the effects of course content redesign is another logical step that would build on this paper. We are planning on conducting a deeper design analysis of the pages identified by our framework and then running our analysis again on a new dataset to examine the effect of our design changes on student use and grades.

**Conclusion**

Because the continuous improvement process can consume a significant amount of time and many institution's incentive systems provide greater rewards for other activities (like writing grants or publishing articles), most faculty and instructional designers never engage in the process systematically. The framework described above provides a fully automatable method for identifying the OER that could potentially benefit from continuous improvement efforts. Both the quadrant analysis and the resource type analysis can immediately provide faculty and instructional designers with the information they need to focus in quickly on the most problematic areas of a course. This framework (and we hope to see others like it emerge) can eliminate the need for significant investments of time and data science skill in the first step of the continuous improvement process - identifying what needs improving. We hope the availability of the framework will dramatically increase continuous improvement of OER-based courses as they continue to multiply in number.

**References**

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Journal</th>
<th>Year</th>
<th>DOI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hu, E., Li, Y., Li, J., &amp; Huang, W.</td>
<td>Open educational resources (OER) usage and barriers: A study from Zhejiang University, China.</td>
<td>Educational Technology Research &amp; Development</td>
<td>2015</td>
<td>10.1007/s11423-015-9398-1</td>
</tr>
<tr>
<td>Lindshield, B. L., &amp; Adhikari, K.</td>
<td>Online and campus college students like using an open educational resource instead of a traditional textbook.</td>
<td>Journal of Online Learning and Teaching</td>
<td>2013</td>
<td>10.1177/0002764213479367</td>
</tr>
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**Previous Citation(s)**

Dr. Bob Bodily is a Senior Data Scientist and Educational Researcher at Lumen Learning. He focuses on building educational data pipelines, creating actionable reports, and generating insights to improve teaching and learning. His interests include using data to continuously improve course materials, building nudges to influence student and faculty behavior, and crowdsourcing educational content improvements and assessment items. He is currently working on educational technologies to improve teaching and learning at wadayano.com and statstest.com.

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The Open Science movement has gained considerable traction in the last decade. The Open Science movement tries to increase trust in research results and open the access to all elements of a research project to the public. Central to these goals, Open Science has promoted five critical tenets: Open Data, Open Analysis, Open Materials, Preregistration, and Open Access. All Open Science elements can be thought of as extensions to the traditional way of achieving openness in science, which has been scientific publication of research outcomes in journals or books. Open Science in education sciences, however, has the potential to be much more than a safeguard against questionable research. Open Science in education science provides opportunities to (a) increase the transparency and therefore replicability of research and (b) develop and answer research questions about individuals with learning disabilities and learning difficulties that were previously impossible to answer due to complexities in data analysis methods. We will provide overviews of the main tenets of Open Science (i.e., Open Data, Open Analysis, Open Materials, Preregistration, and Open Access), show how they are in line with grant funding agencies’ expectations for rigorous research processes, and present resources on best practices for each of the tenets.

Open Science is an approach to research making its way through different areas of science. While many proponents of Open Science herald its function simply in improving research practices, Open Science has much more to offer researchers. Using Open Science practices can help the field as a whole to increase outcomes for individuals with learning disabilities (LD) by providing opportunities for improving research practices, supporting replication research, and serving as a catalyst for new, previously not possible, research questions. In this article, we will build on previous papers promoting Open Science practices in education science to increase transparency and trustworthiness (e.g., Cook, 2016; Cook et al., 2018; A. H. Johnson & Cook, 2019; van der Zee & Reich, 2018). In particular, we will elaborate on the benefits of using Open Science practices for LD researchers specifically and expand on those practices valued by grant funding agencies in education. We aim to show how, from an Open Science perspective, many aspects of educational research already fit best research practices. In addition, we will introduce Open Science practices that are current and applicable to education sciences.

What Is Open Science?
The Open Science movement tries to increase trust in research results and open the access to all elements of a research project to the public. Central to these goals, Open Science has promoted five critical elements: Open Data, Open Analysis, Open Materials, Preregistration, and Open Access. All Open Science elements can be thought of as extensions to the traditional way of achieving openness in science, which has been scientific publication of research...
outcomes in journals or books (Nosek et al., 2012). First, Open Data refers to the practice of making all raw data used in an analysis publicly available (Nosek et al., 2012; Nuijten, 2019), as opposed to presenting only summary data in a scientific publication, usually in the form of means and standard deviations. In this article, we consider Open Data to comprise only of data collected during a research study and exclude sharing materials related to intervention and data analysis (as these are described in different elements, Open Analysis and Open Materials). Open Data is one of the elements of Open Science to which grant funding agencies attribute most value. Providing access to data from federally funded research stems from the idea that data collected with public funds ultimately belong to the public, with research institutions serving as the stewards of the data. Sharing data openly gives other researchers the chance to combine these data sets for subsequent analysis. For example, several longitudinal studies examining students with LD and other comorbid conditions might be combined into one pooled sample spanning early elementary through high school. With this pooled sample, longer trajectories of symptomatology could be conducted using high-powered growth models (Curran & Hussong, 2009), giving insight into the development of the comorbidity across all levels of education without having to follow one cohort for over 12 years. Besides combining data sets that only include individuals with LD, LD researchers could also reuse data sets not specifically about individuals with LD. Many classroom intervention projects, for example, include students with LD. Data from these projects might be reanalyzed to show disaggregated intervention effects, for example, a difference in the expected time it would take students to reach proficiency (T. L. Johnson & Hancock, 2019).

The purpose of the second element, Open Analysis, is to provide consumers of research with a detailed task analysis of the steps researchers took to obtain final statistical results, starting at the raw data (Klein et al., 2018), as opposed to the shortened version usually specified in a scientific publication. This task analysis will likely include procedures used to clean raw data (i.e., correcting errors in data and making sure formatting is consistent) and to transform variables, as well as details about statistical procedures. In addition, it should provide detailed documentation of the software used for the analysis, including the packages (in case of open source) or add-ons (with commercial software) and the specific version used. Open Data and Open Analysis are often considered under one umbrella and some journals that are encouraging this practice have adopted a badge system whereby researchers receive an Open Data badge that is published with their article when the authors include access to their data and code. Other institutions, such as the National Institutes of Health (NIH) and the Institute of Education Sciences (IES), consider Open Data to be different from Open Analysis. Open Analysis can benefit research in LD, for example, because it might provide the exact criteria used in a study for classifying students as LD. Other researchers can then use the same criteria in their study to make results better comparable across research studies.

With adherence to the third element, Open Materials, researchers make sure anyone can reproduce a study’s procedures by providing all materials used in the study (Klein et al., 2018). The type of materials will differ according to the type of study, but might include all research created assessments, questionnaires, intervention protocols, and implementation fidelity checklists. Replication is important for research in LD to understand under which circumstances and for which population a specific intervention works. To directly replicate a study, however, the intervention should be followed as close to the original as possible. Often, published manuscripts only provide a snapshot or description of a subset of the materials used in the study limiting the opportunity for replication and evaluation. Besides facilitating replications, sharing study materials openly gives practitioners the opportunity to access tools that could benefit individuals with LD.

The fourth element of Open Science is Preregistration. In a preregistration, researchers delineate the parameters of their study by clearly describing their hypotheses, methods for data collection, and data analysis plan in a study protocol before executing a study (Nosek & Errington, 2019; van’t Veer & Giner-Sorolla, 2016). Preregistration is complete when the study protocol is uploaded to an online registry and available to the public to download. Some journals accept the submission of study protocols as Registered Reports. Registered Reports include an introduction section and undergo the same peer-review process as regular manuscripts. In the write-up of a study, researchers can refer back to the study protocol to indicate deviations from the original plan and, by doing so, indicate which results are confirmatory and differentiate them from those that are exploratory. In this way, we can be sure of the veracity of the results and make informed decisions about future research or policy benefiting individuals with LD.
The last element, Open Access, may be the most fundamental element of Open Science. By adhering to Open Access, researchers do their best to make sure the results of science are available to anyone, not just the individuals that have a subscription to a specific journal (Klein et al., 2018; Norris et al., 2008). To do this, researchers can publish in Open Access journals, pay extra fees to traditional journals to let an article become Open Access, or provide pre- and postprints of articles on preprint servers. Open Access benefits the LD community in general, by ensuring all stakeholders (i.e., researchers, practitioners, family members, and policy makers) have access to the latest research.

**Progress Toward Open Science**

Due to the recent influx of comments and emphasis on Open Science related to high impact failures to replicate original research, it may seem that Open Science is a buzzword associated with a relatively new phenomenon that is mainly an issue in psychology. The so-called replication crisis in psychology has had extensive coverage in scientific literature and the media since the late 2000s. It was dubbed the replication crisis after researchers found only 36% of statistically significant results published in prominent Psychology journals could be replicated and a large majority of this 36% resulted in effects smaller than the original effects (Open Science Collaboration & Others, 2015). However, the roots of the Open Science movement go back much further than the crisis. The current Open Science movement is the result of multiple decades of concerns about how science is conducted and how researchers engage the public through the results of their research. For example, selective outcome reporting and HARKing (hypothesizing after results are known) were flagged as problematic in the 1960s for psychologists (Meehl, 1967) and in the 1990s for epidemiologists (Taubes & Mann, 1995).

A central tenet of Open Science, increasing the access of data, analyses, and results to the general public, has a long history. In fact, David (1994) states that Open Science likely started in the 17th century during the Scientific Revolution. Scientific publishing was established under the assumption that printed versions of results would open science to the general public, allowing full disclosure of knowledge and public replicability (National Research Council, 2003). Beyond opening science through summary data in publications, making the full raw data collected as part of a research project open to the public became the normal in the late 1940s, through the start of repositories or archives for social sciences research data (Bisco, 1966). As such, sharing full raw data is also not a new phenomenon in science.

In medicine, the lack of reproducibility of outcomes and transparency of reports of clinical trials (Pocock et al., 1987) led to the creation of the Consolidated Standards of Reporting Trials (CONSORT) in 1996 with the intention to increase transparency of research methods and results (Begg et al., 1996). Adoption of the CONSORT guidelines has led to an increase in quality of medical clinical trial reporting (Plint et al., 2006). In addition, many grant funding agencies in medicine soon required researchers to preregister clinical trials (www.clinicaltrials.gov), a result of the FDA Modernization Act of 1997. Preregistration in medicine requires specifying methods, recruitment, and primary outcomes before a trial is conducted. As a result, the reported number of positive findings has decreased while the number of null results that were published increased (Kaplan & Irvin, 2015), expanding the knowledge of the true impact of new treatments. This example shows the gradual shift in a major research area over the last four decades to incorporate more and more details on data, design, and analysis with the objective to increase trust in published research results. In total, Open Science practices are not new.

**Open Science in Educational Sciences**

Open Science practices are also not new in education science. Similar to the other sciences, researchers in education science voiced similar concerns about research practices throughout 20th and 21st centuries. For example, in the early 1980s, Peterson and colleagues (1982) appealed to the applied behavior analysis field to provide more details in descriptions of independent variables. With better descriptions, they argued, failures to replicate might be alleviated, because replicators may not implement an intervention as intended (Peterson et al., 1982). More recently, as a response to the lack of transparency and the limited ability to evaluate the merits of research from published reports, special education researchers came together in the early 2000s to establish indicators of research quality for correlational,
group design, single case, and qualitative research (Brantlinger et al., 2005; Gersten et al., 2005; Horner et al., 2005; Thompson et al., 2005). Around the same time, the IES started the What Works Clearinghouse. This initiative sets standards for what can be considered high-quality research and then reviews this work to provide publicly available information about educational programs, products, and practices, with the ultimate goal of helping educators provide evidence-based instruction and interventions that work (U.S. Department of Education, What Works Clearinghouse, n.d.).

More recently, federal grant funding institutions that support research in education and LD, such as the NIH, the National Science Foundation (NSF), and the IES, have set forth recommendations and requirements that align with Open Science practices. Since 2013, data collected during a project funded by any federal grant institution is mandated to be open and accessible to the public (Executive Order No. 13,642, 2013). All three grant funding agencies require applicants to include a data management plan, that is, a plan detailing how the final research data is going to be shared with the public. These funding agencies also house articles written about their funded projects in specific public access repositories (i.e., ERIC for IES, PubMed Central for NIH, and NSF-PAR for NSF).

In addition to requiring a data management plan and public access to articles, IES adopted the Standards for Excellence in Educational Research (SEER) Principles in their 2019 grant application cycle (U.S. Department of Education, Institute of Education Sciences, 2018). The SEER Principles are not practices researchers have to adhere to mandatorily to secure funding, but, ultimately, research projects will receive indications of excellence according to their adherence levels (U.S. Department of Education, Institute of Education Sciences, 2018). The SEER Principles cover both the period leading up to and following a research project and include practices intended to increase transparency such as preregistration, open analysis, and open data. In addition, the SEER Principles support the scaling up and generalization of results through providing Open Materials.

By focusing on producing high-quality research and adhering to mandates from funding agencies, many individual researchers are, perhaps unintentionally, moving toward adhering to the practices heralded by Open Science. Recent papers advocating the adoption of Open Science practices in education argue these practices are a safeguard against questionable research actions such as HARKing, selective outcome reporting, and p-hacking (e.g., Cook, 2016; van der Zee & Reich, 2018). Particularly in special education, providing evidence of these questionable actions is seen as an argument to stimulate a shift in academic culture, in particular, a shift toward Open Science practices (e.g., Cook, 2016). Open Science in education sciences, however, has the potential to be much more than a safeguard against questionable research. Open Science in education science provides opportunities to (a) increase the transparency and therefore replicability of research and (b) develop and answer research questions about our population of interest (i.e., individuals with LD and learning difficulties) that were previously impossible to answer due to complexities in data analysis methods.

**Increasing Transparency**

One important aspect of research on, and interventions for, students with LD is understanding the parameters within which findings hold. These parameters could be related to various characteristics, such as participants, the environment, and the interventions (Coyne et al., 2016). For example, a particular reading intervention may have evidence to be useful with students in K-2, but that does not mean it is equally effective for students in grades 3 to 5. Similarly, some patterns may be present in children in an urban environment, but not in those living in rural settings. To find out where these parameters lie, research should go through several phases, from piloting a study, to direct replication, and finally to conceptual replications (Coyne et al., 2016). Direct replications are a way to ensure effects found in a study are robust, and not due to “error, bias, or chance” (Coyne et al., 2016, p. 250). Direct replications are essentially duplicates of the original study and difficult to realize in applied educational research. In fact, in a comprehensive review of 36 special education journals, Makel and colleagues (2016) found only 90 direct replications in 45,490 articles. Conceptual replications help define the parameters of an effect (Nosek & Errington, 2019). These replications can be closely aligned to the original study, with only a low number of dimensions different from the original study (Coyne et al., 2016), for example, examining the effect of an intervention using the same intervention materials and training, grades, and population, but conducting the study in a different geographical area (e.g., Gersten et al.,
2015), or extending the length of the intervention (e.g., Toste et al., 2019). When more dimensions change, a replication is considered distal and will speak to the generalizability of the effect, for example, when changing both the group size of an intervention and the geographical area (e.g., Doabler et al., 2019). Ideally, researchers move systematically through the different phases of replication.

The importance of this phase structure for defining these parameters is not limited to Open Science. In fact, they are reflected in both grant funding structures of the NSF and IES. Moreover, IES includes mention of these parameters in their mission and this commitment is reflected in their recent commitment to funding replications of previous positive interventions. Specifically, IES holds “finding out what works for whom under what conditions” (U.S. Department of Education, Institute of Education Sciences, 2018) as a central goal. To achieve this goal, IES funds projects under the themes of Exploration, Development and Innovation, and Initial Efficacy and Follow-Up. Similarly, NSF funds projects as Exploratory, Design and Development, Impact, and Implementation and Improvement. For conceptual replications, IES has added a different funding competition specifically focused on reading and mathematics interventions that have previously shown to be effective (CFDA 84.305R and CFDA 84.324R).

Besides funding agencies, replication is also prominent in the discussion of finding evidence-based practices in single case design research (Horner et al., 2005). The proposed criteria by Horner and colleagues (2005) for determining if an intervention has sufficient evidence base include five different direct or distal, high-quality replications across three different researchers in three different geographical areas.

To be able to execute direct or conceptual replications, researchers will need access to the original materials, including intervention materials, assessments, and data analysis plans. Traditionally, researchers would have to reach out to other researchers to request materials and more information. Requesting information from authors may not have a high success rate for various reasons (Manca et al., 2018). For example, researchers may have changed institutions and the listed contact email address may therefore not be valid anymore. By adhering to the principles of Open Science and having materials such as Analysis publicly available in a central repository, such problems could be avoided, and more replications may be performed increasing our knowledge on the boundaries of intervention effects.

Developing and Answering Novel Research Questions

A second benefit of Open Science methods is they can serve as a catalyst for research. While data are often collected with a particular hypothesis in mind, it is likely other research questions could be answered using different models with the same data. For example, a large number of researchers have answered a copious amount of questions using data freely available from the Early Childhood Longitudinal Studies (ECLS) and the Schools and Staffing Survey (SASS). These large-scale data sets may seem fundamentally different from research project data. However, data sets from multiple projects can be combined with each other. The combination of data sets in common repositories can be a powerful tool to foster creativity and stimulate novel research questions. As an example, the combination of about 230 individual data sets on children's language in the Child Language Data Exchange System (CHILDES), an open data repository, has led to the publication of over 5,000 articles. While it is not impossible that the original researchers might have reached this number of publications, it is more likely the repository gave other researchers a chance to explore a new question or theory.

Besides opening up data to allow others to ask novel questions, combining data can help answer questions that researchers were not able to answer in their own sample due to low numbers of participants, or low numbers of behavioral occurrence (Bainter & Curran, 2015; Curran & Hussong, 2009). This is also especially important in research on LD. Students with LD often comprise the left tail of a normal distribution. Thus, within any given sample of students, the number of students with LD will be low. It is often either time consuming or extremely costly to collect enough data on our population of interest to be able to run analyses with sufficient power. Other research groups, however, may have very similar data. Combined, these data may generate a sample size of students with LD that provides enough power to answer novel questions.

For example, to examine if students’ scores on executive functioning measures predicted reading disabilities, Daucourt and colleagues (2018) combined eight different data sets. The original data sets included student achievement data
from reading intervention studies. However, the original research did not include measures of executive functioning. Daucourt and colleagues sent out an additional parental questionnaire to all students that included items related to executive functioning. Their final sample included only those students from the original studies whose parents returned the additional questionnaire and the sample consisted of about 10% of the original sample (i.e., 420 students). Around 30% (i.e., 139) of these students were considered having a reading disability. The authors were then able to show that lower executive functioning was related to reading disability.

In this particular example, Daucourt and colleagues (2018) were able to capitalize on existing data to run a relatively low-cost study. By using the already collected reading achievement data from the original intervention studies, they avoided having to unnecessarily spend resources on assessments and were able to append these data with the parent questionnaire. In other cases, collecting additional data may not be necessary. With the same eight data sets, researchers could examine the impact of the original reading interventions on only the subset of students with reading disabilities. Whether or not additional data collection is needed, researchers will need to be able to find and access the data sets containing their variables and populations of interest.

**Open Science in Practice**

Adopting and adhering to Open Science practices is a crucial step toward improving lives of individuals with LD through sound research. We will now provide overviews of the main tenets of Open Science (i.e., Open Data, Open Analysis, Open Materials, Preregistration, and Open Access) and resources on best practices for each of the tenets. A guide to the actions and decisions researchers will need to make to follow Open Science practices is presented in Figure 1. In this visual overview, we present options for both projects that are already in progress and those that are still in the design phase.

![Figure 1](https://nih.figshare.com/)

Figure 1. Flowchart of decision and actions to take at various stages of a research project for common elements of open science.

**Open Data**

In most publications, authors present summary data on the variables of interest. To increase transparency and spur reuse of these data, Open Science urges researchers to make all data, at the individual level, publicly available (Nosek et al., 2012; Nuijten, 2019). Providing Open Data involves uploading a raw, yet curated data set to an online, public repository. Many funding agencies consider publicly available data sets permanent products of the grant. Deposited in a public repository, data set will obtain a digital object identifier (DOI) and is therefore a citable, permanent product of a research project. This guarantees data sets remain accessible with the same identifier over longer periods of time.

Researchers can include this product on their CVs and show the impact of their work beyond publications through the number of times their data set was used in secondary analyses. Recognizing the amount of time and resources that are associated with curating and archiving a data set, funding agencies such as the NIH allow part of a budget to be allocated specifically for this purpose.

There are several online repositories available for archiving data sets. These repositories contain data from a wide range of disciplines, such as the Open Science Framework (www.osf.io), Figshare (http://www.figshare.com), and the Inter-university Consortium for Political and Social Research (ICPSR) (http://www.icpsr.umich.edu/). Increasingly, discipline-specific repositories are being developed, such as LDbase (http://www.ldbase.org/), a repository for data specific to research focused on learning differences and LD, and Databrary (https://nyu.databrary.org/), a repository for developmental video data. In addition, grant funding agencies may have their own repository. For example, the NIH supports DASH, a repository for data and specimens collected by NICHD grantees (https://dash.nichd.nih.gov/) and the National Database for Autism Research (NDAR; https://nda.nih.gov/). The NIH is currently exploring other archiving options for data sets that are not fully aligned with domain-specific repositories. A first attempt to this end is a specific NIH instance of Figshare (https://nih.figshare.com/). Finally, there is a specific repository for qualitative social science
research (https://qdr.syr.edu/). Each repository may have specific requirements for depositing and storage of data (e.g., allowing embargoes, allowing researchers to self-deposit, types of data files supported). Table 1 provides an overview of several of such requirements for the repositories listed above.

| Table 1. Selected Features of Several Public Repositories Hosting Educational Data. |

Table 1. Selected Features of Several Public Repositories Hosting Educational Data.

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Preparing data to be deposited in an online repository requires more than uploading files. Researchers should take several steps before data are ready to be shared. First, a raw data set needs to be cleaned and deidentified before making it available. Curating a data set involves removing all identifiable information about participants (such as birthdays, names), checking for out-of-range values, and ensuring consistency across variables (Klein et al., 2018). In line with the IES SEER principles, it is not necessary for a researcher to share all data that were collected, but at a minimum all data that were used in any publications. Finally, researchers should make decisions about access options. Besides making the data available immediately, many repositories can restrict access to a data set during an embargo period or release data only to researchers who requested access.

In addition to a raw data file, it is also imperative to include metadata. Metadata can be described as information that can support the "discovery, understanding, and stewardship" of other data (Day, 2005, p. 10). In other words, metadata can help researchers locate data sets that possibly contain information they are interested in and evaluate if the data can be used to answer their question. For educational research, the information provided in metadata will relate mostly to the context and procedures of data collection and storage and is often made available through a codebook. A codebook contains the names of the variables, their labels, specific text of a questionnaire, the values of the variable and their labels, and how missing data is indicated for each variable, and scoring rules. If variables have been transformed before analysis, additional information about the methods used to do so might be included ("What is a Codebook?" n.d.). Several commercial software programs exist that can generate codebooks based on survey data (e.g., StatPac). In addition, the Document, Discover, and Interoperate alliance (DDI) provides an online tool to generate interactive codebooks that can handle postprocessing and ongoing data collection (https://ddialliance.org). For R-users, several packages exist that can add the metadata to data sets such as codebook (Arslan, 2018).

Adhering to Open Data may seem a daunting task. The Digital Curation Centre (DCC) has helpful resources on all aspects of data management and curation, including which data to share, best way to organize data, and how to write a good data management plan (www.dcc.ac.uk). Many academic librarians are also well versed in data curation and can be valuable resources when preparing data to be shared. Working collaboratively with experts in data management and curation will help researchers make their data findable, accessible, interoperable, and reusable.

Open Analysis

With Open Analysis, researchers provide a detailed account of all steps taken in the statistical analysis, beginning at the raw data and ending with the final statistical results (Klein et al., 2018). Providing the complete steps of an analysis is important for several reasons. First, during any analysis, a researcher has the freedom to make choices on how to run the analysis. This is sometimes called the researcher degrees of freedom (Simmons et al., 2011). Using varying analytical decisions can lead to differences in analysis outcomes. Carefully annotating the decisions, in addition to commenting on the analysis itself, will provide the necessary details to understand the analysis for the study. In addition, this annotated workflow provides researchers who are new to a statistical analysis with an overview of the decisions that need to be made, and they may gain a deeper understanding for the specific statistical techniques. It is also possible that preparing documentation of data analysis can lead to the discovery of errors in code (Epskamp, 2019), giving authors the opportunity to rectify results.
Second, statistical software packages have different default settings for certain operations (Epskamp, 2019). This may seem problematic only for more complex and advanced statistical methods, such as structural equation models; however, even more commonly used statistical analyses are handled slightly different in different software. Running an unbalanced analysis of variance (ANOVA) model with the default options in SPSS can yield different estimates of parameters than the default in R, because each program calculates the differences between groups based on a different combination of components, called Type I, II, or III sums of squares (see Navarro, 2017, for a detailed explanation of the different types and how they influence parameter estimates). While these differences may be small, they could lead to erroneous decisions about irreproducibility. By providing details about the software, its version, and possible additional packages used in their workflow and write-up of the study, researchers can avoid confusion about their results.

Open Analysis documentation will look different for each project. Many (commercial) statistical software programs will allow the researcher to save the syntax (e.g., Mplus, SPSS, and SAS), sometimes including annotations. Open-source statistical software, such as R, Python, and JASP, always allow a researcher to save the complete workflow with comments. It is likely data analysis will not always be shared perfectly. Researchers may be unable to share a complete workflow, or the workflow may only work on certain systems, leaving users of other systems to evaluate the analysis based on code alone (Klein et al., 2018). Rather than to let this be a deterrent for sharing all together, it is preferred to share any part or version of a workflow available. If it is impossible to share syntax, for example, for data analysis performed in a spreadsheet program, researchers could share screenshots of the flow of menu options used to perform an analysis or a step-by-step description of decisions made (Epskamp, 2019; Klein et al., 2018). By sharing what is available, even if it seems scant, researchers can demystify their analysis and increase transparency.

Open Materials

In many journal articles, researchers include small sample items of a measure or limited examples of study protocols, such as intervention steps or implementation fidelity checklists. However, these materials are seldom sufficient for replication of a research project. Previous page restrictions in journals may influence the limited sharing of research materials, but with the advent of repositories and cloud-based storage, it is possible for researchers to share all details of their study with other researchers (Grahe, 2018). By adhering to Open Materials, researchers add to the overall transparency of their project and give independent researchers the opportunity to carefully control the differences between their project and the original project (Grahe, 2018; Klein et al., 2018).

When sharing research materials, it is best to be as exhaustive as possible. At a minimum, all study protocols, assessments, and stimuli needed to successfully run a replication study should be uploaded (Grahe, 2018). It is likely, however, that there is a need to add specific walk-throughs or instructions for parts of the project. In the case of intervention materials, for example, it will be helpful to note the degree of flexibility an interventionist has in going off script. Additional important materials include blank informed consent forms (Lewis, 2020). If sharing materials infringes on copyright, for example, for commercialized assessments and intervention materials, these materials do not have to be provided by the researcher, given that they are openly available already (Grahe, 2018).

Providing Open Materials, particularly the most essential materials, is likely the least complicated and time consuming of the open science practices. In many cases, materials have already been created and are likely stored in the project’s digital location. Most of the data repositories mentioned in the Open Data section allow researchers to add materials to their data sets for easy access. Similar to Open Data, repositories can assign DOIs to the materials, making them citable products of a project.

Preregistration

In a preregistration, researchers delineate the parameters of their study by clearly describing their hypotheses, methods for data collection, and data analysis plan in a study protocol before data analysis is conducted (van’t Veer & Giner-Sorolla, 2016). The ultimate goal of preregistration is to provide transparency on the research process. Transparency through preregistration does not imply a plan cannot be changed. On the contrary, preregistration can be an iterative process allowing researchers to specify how they responded to unforeseen challenges during the research design and
collection analysis (Gehlbach & Robinson, 2018). For example, many researchers are currently forced to adapt research protocols due to COVID-19. In this case, an original preregistration protocol of a study examining the relation between independent reading, motivation, and LD may have included three waves of in-person data collection. Due to restrictions on face-to-face contact, researchers changed the setting for the last wave of data collection to video conferencing. The updated protocol should specify this change and address potential implications of interpreting the outcomes of the last wave given the change in setting.

In addition, some analyses may be difficult to list specifically. For example, researchers may have a set of predictor variables to include as random variables in a hierarchical linear model based on their substantive theory. During the model building process, however, some of these variables do not appear to vary in their slope across clusters and adding the random slope does not increase the fit of the model. The researcher decides to drop these variables. The final model depends on outcomes of intermediate tests of significance. In this case, the data analysis section should consist of a clear decision-making process for the inclusion or exclusion of variables. Researcher may also list contingencies to the original analysis plan (Gehlbach & Robinson, 2018). When uploaded to a registry, preregistrations are assigned an ID number and each iteration of a preregistration receives a specific time-stamp so that the history and appropriateness of the changes can be assessed by others.

Several of these registries exist, some with a wide range of topics, and others more specific. For systematic reviews and meta-analyses, for example, protocols are typically uploaded to Cochrane (https://us.cochrane.org/) or PROSPERO (https://edtechbooks.org/-vw5q). Both organizations provide extensive documentation on their sites guiding researchers through the protocol and registration process with specific templates to follow. Specifically for intervention research, registries are hosted by the Society for Research on Educational Effectiveness (SREE) (https://sreereg.icpsr.umich.edu/), OSF (www.osf.io), and AsPredicted (www.aspredicted.org). Most of these registries mainly support experimental and quasi-experimental group design studies and provide templates with guiding questions. Recently, the field of special education has also called for preregistration of single case research (A. H. Johnson & Cook, 2019) and it is certainly also possible to preregister qualitative studies.

For Registered Reports, a full introduction and methods section of a manuscript are submitted to a journal and then it goes through typical peer-review process. This process gives outside experts the opportunity to provide feedback on the design of the study, potentially signaling flaws or suggesting improvements and expansions. After this peer-review process, the journal may give a “provisional acceptance,” which means the journal will publish the study when executed according to plan regardless of the findings (Nosek et al., 2019; van’t Veer & Giner-Sorolla, 2016). With respect to education and research with LD populations in particular, several journals have specific guidelines for submitting registered reports including Exceptional Children and Scientific Studies of Reading. The Center for Open Science (COS) provides lists of other journals accepting registered reports and journals that have published special issues with registered reports (https://cos.io/rr/).

Preregistration is the most prominently featured aspect of Open Science in the SEER Principles. The SEER principles focus on the comparison between what was proposed and what was eventually done and reported. Besides promoting transparency, making protocols available before the start of a research projects helps to make a distinction between outcomes that were hypothesized before a study began (i.e., confirmatory results) and exploratory results that were the result of unexpected patterns in the data. The exploratory results might warrant subsequent confirmatory research especially designed to test the new hypothesis. This distinction between confirmatory and exploratory outcomes is the main benefit of preregistration and registered reports (Cook et al., 2018; van’t Veer & Giner-Sorolla, 2016). This does not mean that exploratory analyses are precluded from research. On the contrary, Open Science values exploratory analyses as a means to find unexpected results. These analyses and results should merely be noted as exploratory.

Open Access

Open Access refers to making research reports publicly available without a subscription barrier (Klein et al., 2018; Norris et al., 2008). For many researchers, reading about a certain method, data set, or intervention in a paper is the stimulus to examine the issues more carefully and possibly to conduct direct or conceptual replications (Kraker et al., 2011). When research is presented Open Access, more researchers will have the opportunity to engage with the research.
Grant funding agencies already expect research articles to become available to the public and have their own outlets. In the case of research sponsored by IES, it is expected papers are made available to the public through ERIC; NIH grantees used PubMed Central, and NSF uses its own public access repository, NSF-PAR. Research in several different areas has shown that articles published Open Access (either through the journal or through self-archiving) get cited more often than articles behind a paywall (e.g., Eysenbach, 2006; Metcalfe, 2006; Norris et al., 2008). In general, there are two ways to share manuscripts with the public. Using the Green way, researchers post their work on preprint archives; using the Gold way, researchers either publish in a fully Open Access journal, or pay additional fees to the publishing journal to make the manuscript Open Access (Harnad et al., 2004). These fees differ per journal and can be as high as US$3,000, with an average cost of about US$900 (Solomon & Björk, 2012). To help researchers with the cost of making research open access, many universities now have grant programs specific to this purpose. In addition, costs for Gold access in journals can be written in budget justifications of major grants.

Many of the journals in which research on LD is published allow researchers to post preprints and postprints (i.e., Exceptional Children, Exceptionality, Learning Disability Quarterly, Journal of Learning Disabilities, The Journal of Special Education). The website hosted by SHERPA/ROMEO (https://edtechbooks.org/-DDfk) has information on the archiving policies for most journals related to education science and LD, as well as their access options. Preprints can take the form of near-final versions of a manuscript that has been submitted, or the final version, accepted for publication. Some journals require a preprint to be the unformatted version of the manuscript. Several archives exclusively hosting preprints exist. EdArXiv is a recently established archive for educational preprints and associated with the OSF repository and authors can link preprints hosted on EdArXiv to their OSF projects. There are several benefits of posting a preprint to an online archive. First, all papers that are archived receive a DOI and thus can be cited and referenced, prior to the lengthy peer-review process begins. This speeds up the impact our science can have. Relatedly, the archives will also track the number of downloads and citations of these papers. More importantly, the archives allow the researcher to protect their work legally by assigning it a license, such as a Creative Common license (https://edtechbooks.org/-sihS). Even if papers are theoretical, purely exploratory, or were not written from open science at the start, authors can make sure their work is accessible to all by posting preprints. See Fleming (2020) for a useful flowchart on the decisions on posting preprints.

Recommendations

It may seem the benefits of adhering to Open Science practices are limited mostly to grant funded research. The present focus on grant requirements served as a narrative thread to show how education science is adapting toward more Open Science practices. In fact, it is equally important and beneficial for unfunded research to become more open. For example, it is likely that these projects are conducted with smaller sample sizes. Studies with small sample sizes are more prone to Type I error, that is, reporting a statistically significant effect that occurred by chance (Simmons et al., 2011). Preregistering a study with a small sample provides transparency on the hypothesized relation and data analysis, making it easier for other to interpret the reliability of the results. In addition, data sets from several unfunded studies can also become a larger, unified data set.

How can LD researchers without current projects adhere and promote Open Science practices? First, it is never too late to share data and materials from previous projects, regardless if they were used in a publication. Even if a specific intervention did not yield statistically significant increases in students’ abilities, the data still contain valuable information about the student population that might be of interest to others and that could potentially be combined with other existing data. In addition, researchers conducting meta-analyses may be interested in using unpublished studies to combat outcomes skewed through publication bias (Rothstein & Hopewell, 2009). Increased precision in meta-analytic effect sizes will provide better estimates of the potential of an intervention, which in turn may limit the implementation of interventions that do not benefit students with LD. Similar to data, sharing materials from studies that have concluded can be valuable. This can provide opportunities to early career researchers or researchers with less access to funding to conduct small replication studies without having to spend resources on developing already
existing materials. This can increase the research output in the LD field, hopefully resulting in more robust knowledge on interventions and their generalizability in less time.

Second, researchers can actively promote the culture shift toward Open Science practices. One way to encourage new norms is by talking about them in conversations with colleagues. For example, when collaboratively planning a new study, researchers can raise the possibility of preregistration or even propose replication research with openly available materials. Moreover, researchers can advocate to have discussion of these practices be included in research methodology courses offered to graduate students (Gehlbach & Robinson, 2018).

Finally, the review processes for both grant proposals and manuscripts submitted for publication are other opportunities. Reviewers of manuscripts can ask to see data and analyses (Davis et al., 2018), attempt to rerun the provided analyses to see to what degree the results are reproducible (Kraker et al., 2011), check previous studies or studies that are highly similar to compare outcomes (Kraker et al., 2011), and check if preprints or preregistration files are available to compare the proposed analyses with those reported. In the case of grant proposals, reviewers can check how investigators plan to share data, outcomes, and materials after termination of their project.

Conclusion

“The goal of intervention research in special education is to identify effective practices for students with disabilities and accumulate rigorous and trustworthy evidence about the conditions under which these practices are more or less effective” (Coyne et al., 2016, pp. 251–252). By embracing the central tenets of Open Science: Open Data, Open Analysis, Open Materials, Preregistration, and Open Access, researchers in LD can create an environment more conducive to this goal. Open Data gives the possibility to combine data sets and answer hitherto impossible questions; Open Analysis help other researchers rerun data to verify outcomes and learn to program complex models; Open Materials let other researchers replicate studies with more precision; Preregistration allows for improvements in design before a study is executed increasing the overall quality of the work and transparency about research decisions; and Open Access provides a larger audience for important work. The tenets of Open Science together can give an impetus to a more collaborative effort that will ultimately benefit the education and lives of individuals with LD.

Authors’ Note
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## Future Directions

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What is Open Pedagogy?

David Wiley

*Using OER the same way we used commercial textbooks misses the point. OER are: free to access, free to reuse, free for remixing. How can we extend, revise, and remix our pedagogy based on these additional capabilities? There are many, many potential answers to this question.*

Hundreds of thousands of words have been written about open educational resources, but precious little has been written about how OER – or openness more generally – changes the practice of education. Substituting OER for expensive commercial resources definitely save money and increase access to core instructional materials. Increasing access to core instructional materials will necessarily make significant improvements in learning outcomes for students who otherwise wouldn't have had access to the materials (e.g., couldn't afford to purchase their textbooks). If the percentage of those students in a given population is large enough, their improvement in learning may even be detectable when comparing learning in the population before OER adoption with learning in the population after OER adoption. Saving significant amounts of money and doing no harm to learning outcomes (or even slightly improving learning outcomes) is clearly a win. However, there are much bigger victories to be won with openness.

Using OER the same way we used commercial textbooks misses the point. It's like driving an airplane down the road. Yes, the airplane has wheels and is capable of driving down on the road (provided the road is wide enough). But the point of an airplane is to fly at hundreds of miles per hour – not to drive. Driving an airplane around, simply because driving is how we always traveled in the past, squanders the huge potential of the airplane. So what is the analogous additional potential of open educational resources, compared to commercial textbooks and other commercial resources? OER are:

- Free to access
- Free to reuse
- Free to revise
- Free to remix
- Free to redistribute

The question becomes, then, what is the relationship between these additional capabilities and what we know about effective teaching and learning? How can we extend, revise, and remix our pedagogy based on these additional capabilities? There are many, many potential answers to this question. Here's one example.

Killing the Disposable Assignment

If you've heard me speak in the last several months, you've probably heard me rail against “disposable assignments.” These are assignments that students complain about doing and faculty complain about grading. They're assignments that add no value to the world – after a student spends three hours creating it, a teacher spends 30 minutes grading it, and then the student throws it away. Not only do these assignments add no value to the world, they actually suck value out of the world. Talk about an incredible waste of time and brain power (an a potentially huge source of cognitive surplus)!
What if we changed these “disposable assignments” into activities which actually added value to the world? Then students and faculty might feel different about the time and effort they invested in them. I have seen time and again that they do feel different about the efforts they make under these circumstances.

But which effective practices specifically might we remix in order to kill the disposable assignment? I love John Hattie's book *Visible Learning* as a source for finding effective practices. In the book Hattie compiles findings across over 800 meta-analyses of 50,000 studies of 80,000,000 students to arrive at average effect sizes for over 130 influences on learning, including student influences, teacher influences, teaching influences, and school influences. Here are a few that resonate with me, together with their effect sizes as estimated by Hattie, a brief description, and page numbers from the first edition:

**Teacher Student Relationships** = 0.72
"Developing relationships requires skills by the teacher – such as the skills of listening, empathy, caring, and having positive regard for others…. Teachers should learn to facilitate students’ development by demonstrating that they care for the learning of each student as a person and empathizing with students." Pp. 118-119.

**Teacher Clarity** = 0.75
Clarity – as rated by students (not other teachers) – in “organization, explanation, examples and guided practice, and assessment of student learning.” P. 126.

**Worked Examples** = 0.57
"Worked examples reduce the cognitive load for students such that they concentrate on the processes that lead to the correct answer and not just providing an answer." P. 172.

**Organizing and Transforming** = 0.85
“Overt or covert rearrangement of instructional materials to improve learning. (e.g., making an outline before writing a paper)…. The types of strategies included in this category (such as summarizing and paraphrasing) promote a more active approach to learning tasks.” Pp. 190-191.

**Feedback** = 0.73

**Reciprocal Teaching** = 0.74
"The emphasis is on teachers enabling their students to learn and use cognitive strategies such as summarizing, questioning, clarifying, and predicting…. The effects were highest when there was explicit teaching of cognitive strategies before beginning reciprocal teaching." P. 204.

**An Example of Open Pedagogy**
When you can assume that all the materials you’re using in and with your class are open educational resources, here's one way to remix the effective practices listed above with OER in order to provide you and your students with opportunities to spend your time and effort on work that makes the world a better place instead of wasting it on disposable assignments.
Begin by establish relationships of trust with students. You’re about to ask them to do something they’ve probably never tried before. They won’t follow you if they don’t trust you.

Provide a clear description of the assignment – students will revise and remix the core instructional materials of the class (which are OER) with other OER and with their own original work in order to create a small tutorial (in any medium) on a topic that students in the course generally struggle with. They will then use their tutorial to teach the topic to one of their peers. The best tutorials will be integrated into the official OER collection or open textbook for use by other students starting next semester.

In addition to a clear description of the assignment, you should also provide a detailed description of how the assignment will be graded and/or examples of high-quality student work.

Show a variety of worked examples. If this is the first time you’re using this valuable assignment, use the OER that you’ve compiled to support student learning as your examples. Talk students through the process of selecting existing resources and remixing them into something that specifically supports their learning. If you have existing student work that you can show, even better.

Invite students to engage in the remix activity (aka organizing and transforming) with an eye toward their upcoming peer tutoring interactions (using strategies like summarizing, questioning, and clarifying in the design of their remix).

Provide constructive feedback to students on their remix and invite them to revise their tutorials.

Once the revisions are complete, invite students to engage in the reciprocal teaching experience. After reciprocal teaching, invite the students to make a final round of revisions based on their partner’s experience with the materials.

After your review, publicly congratulate the students whose tutorials will be integrated into the official course materials for next semester.

This assignment clearly leverages the reuse, revise, remix, redistribute permissions of open educational resources in order to enable students to extend and improve the official instructional materials required for the course. Because students know their work will be used both by their peers and potentially by future generations of students, they invest in this work at a different level. Because the assignment encourages them to work in any medium they prefer, students pick something they’ll enjoy, which leads them to invest at a different level. Because any one of these remixes might end up helping next semester’s students finally grasp the concept that has proven so difficult in the past, faculty are willing to invest in feedback and encouragement at a different level.

Examples of Student Work in the Context of Open Pedagogy

I’ve been iterating over a version of this approach for several years now. While nothing is universally effective, it tends to result in insanely awesome student work. An early version of this assignment back in 2007 brought you Kennedy and Nixon debating the merits of blogs and wikis, Rick Noblenski: Blasting Caps Expert and Wiki Advocate, and a father and son confrontation over District Policies Regarding Blogs and Wikis.

Later versions of this assignment brought you versions of the open textbook Project Management for Instructional Designers, which now includes multiple video case studies; completely rewritten examples in-text; alignment with the Project Management Professional certification exam; an expanded glossary; and downloadable HTML, PDF, ePub, MOBI, and MP3 versions of the book (among other improvements). The book is also used as the official course text at least one other university.

Of course I’m not the only one experimenting with these kinds of assignments ~ Murder, Madness, and Mayhem: Latin American Literature in Translation is another one of my favorites (see this essay for a description).

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What makes this assignment an instance of open pedagogy instead of just another something we require students to do? As described, the assignment is impossible without the permissions granted by open licenses. This is the ultimate test of whether or not a particular approach or technique can rightly be called “open pedagogy” – is it possible without the free access and 4R permissions characteristic of open educational resources? If the answer is yes, then you may
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Previous Citation(s)


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Dr. David Wiley is the chief academic officer of Lumen Learning, an organization offering open educational resources designed to increase student access and success. Dr. Wiley has founded or co-founded numerous entities, including Lumen Learning, Mountain Heights Academy (an open high school), and Degreed. He was named one of the 100 Most Creative People in Business by Fast Company, currently serves as Education Fellow at Creative Commons, and leads the Open Education Group in Brigham Young University's instructional psychology and technology graduate program. He has been a Shuttleworth Fellow, served as a Fellow of Internet and Society at Stanford Law School, and was a Fellow of Social Entrepreneurship at BYU's Marriott School of Management.

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https://edtechbooks.org/open_education/what_is_open_pedagog.
OER-Enabled Pedagogy

David Wiley

Over the last several weeks there has been an incredible amount of writing about open pedagogy and open educational practices (samples collected [here](#) by Maha). There have been dozens of blog posts. Countless tweets. There was a well-attended (and well-viewed) conversation via Google Hangout. At the Hewlett OER Meeting last week over a dozen people spent another hour talking about the issue during the unconference time. There were additional conversations on the topic during walks through the incredibly beautiful countryside outside Toronto. I had particularly helpful talks with John Hilton and Rajiv Jhangiani – but don’t blame them if you don’t like what you read below.

I’m convinced that the terms “open pedagogy” and “open educational practices” are understood so differently by so many people that there is literally no hope of achieving a useful consensus about the meaning of either of these terms. Some definitions are centered on OER. Some are centered on the public, linkable nature of the “open web.” Some are centered on social justice. Some are centered on collaboration. Some are centered on innovation. Some are centered on learner empowerment. Some are exercises in the permutations of these. There have even been arguments made that a clear definition would somehow be antithetical to the ideal of open.

As I said, there appears to be no consensus coming for the meaning of either of these terms. For my own personal purposes of writing, researching, and advocating, the absence of a shared understanding of these terms removes any utility I previously hoped they had. Consequently, I don’t think I’ll use these terms any longer or participate in the discussion about their meanings going forward. Others will doubtless continue this deeply interesting conversation and I wish them well as they do – I am in no way criticizing them as I withdraw from these conversations.

My curiosity in this space has always been about understanding something very specific. As I’ve described it many times:

1. We learn by the things we do.
2. Copyright restricts what we are permitted to do.
3. Consequently, copyright restricts the ways we are permitted to learn.
4. Open removes these restrictions, permitting us to do new things.
5. Consequently, open permits us to learn in new ways.

What teaching and learning practices are possible (or practical) in the context of OER that aren't possible when you don't have permission to engage in the 5R activities? What are the impacts on learners and teachers of engaging in these practices? *That* is what I want to understand. And I need something to call that so I can talk about it, research it, write about it, and advocate for it. I need a completely empty phrase that I can fill with my specific meaning so that there can be no confusion about definitions when the term is used.

After brainstorming, gathering some feedback, and running some Google searches, I’ve decided on the term “OER-enabled pedagogy.” Google has no record of this phrase ever being used, so it should serve my purposes of both conveying my intended meaning and avoiding argument.

Here's the definition of “OER-enabled pedagogy”: 

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**OER-enabled pedagogy** is the set of teaching and learning practices only possible or practical when you have permission to engage in the 5R activities.

As for usage, the phrase “OER-enabled pedagogy” can be used as-is to talk about how the 5R activities facilitate new kinds of teaching and learning in general. You can also put one or more additional words inside the phrase, like “OER-enabled constructionist pedagogy,” when you’re trying to describe the additional learning-mediating leverage the 5R activities give you in the context of a specific model of teaching and learning.

For some definitions of “open pedagogy,” OER-enabled pedagogy can be categorized as a form of open pedagogy (but not for other definitions). For some definitions of “open educational practices,” OER-enabled pedagogy can be categorized as a type of open educational practice (but not for other definitions).

You may find the idea of OER-enabled pedagogy utterly uninteresting. That’s ok. I find it thrilling and energizing and recharging and inspiring. And I’m excited to stop arguing about definitions and get back to doing the work of designing, enacting, researching, and advocating for OER-enabled pedagogy.

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https://edtechbooks.org/open_education/oer_enabled_pedagogy.
Open Pedagogy: The Importance of Getting it in the Air

David Wiley

The Parable of the Restrictive Roads

Once upon a time there was a pastoral country of beautiful fields and rolling hills. The simple people there enjoyed a relaxed pace of life, part of which included a good deal of walking.

One day, a young lady announced a remarkable invention. She called it an automobile. The people had never seen anything like it, and everyone was immediately smitten with the speed and comfort of travel it provided. Trucks soon followed these first cars, as did motorcycles, and then four-wheelers. But before long, these remarkable inventions began to take their toll on the country's beloved landscape.

The people proposed a novel solution to this novel problem. They created "roads." And with the creation of these roads a new law was made requiring "all the different motorized vehicles to remain upon the roads." As the roads were built and the law enforced, people were able to simultaneously travel great distances in comfort and enjoy the scenic beauty of their homeland.
Decades later, a young man announced another new invention – the airplane. It could fly – opening up countless new possibilities for travel and commerce. However, as the young man began selling his inventions to the excited populace, the government reminded them that the law requires “all the different motorized vehicles to remain upon the roads.” People could buy this “airplane” if they wished, but the law required them to drive it on the road – they would not be allowed to fly them. Of course, a few renegades got their airplanes briefly off the ground, but they were prosecuted swiftly and harshly, and made examples of.

Despite the inventor’s impassioned explanations of the new technology’s incredible potential, and protests by large groups of people, it seemed as if the antiquated law would prevent the new technology’s potential from ever being realized. How would they ever get their planes in the air?

**Another Old Law Meets a New Technology**

Centuries ago, in response to a new technology called the printing press, copyright laws were created. Among other things, these laws prohibited people from making copies of books and other creative works and distributing those copies.

Centuries later, a new technology was invented called the internet. The internet made it possible to produce copies of creative works and send those copies around the world both instantaneously and for free. These new capabilities enabled completely unimagined possibilities in multiple domains, but immediately the antiquated (and now far overreaching) copyright law reared its head. It looked as if the rules that governed the internet would be the same laws that governed the 500 year old printing press. Internet users would be required to drive their airplanes on the road.

**Open Content Meets the Internet**

Traditionally copyrighted creative works are “immune” to the incredible capabilities of the internet because what the internet makes technologically possible their copyright makes legally impossible. Long before the internet was a gleam in an engineer’s eye, copyright law had already prohibited much of what the internet would make possible.

However, when creative works are distributed under open licenses that provide people with 5R permissions (like the Creative Commons licenses do), those works becomes “susceptible” to the power of the internet. What the internet makes technologically possible their open licenses make legally possible.

**The Importance of Getting In the Air**

When an educator makes the choice to adopt traditionally copyrighted textbooks and other materials, they are choosing to drive their airplane on the road. They are choosing to ignore the incredible potential afforded by the internet.

When an educator makes the choice to adopt open educational resources they are choosing an airplane that can actually be flown. They are putting themselves in a position where the entire, unbounded possibility of the internet lies open before them.
Simply adopting open educational resources will not make one's pedagogy magically change to take advantage of the capabilities of the internet. Adding legal permission to technological capacity only creates possibilities – we must choose to actively take advantage of them. There is nothing about OER adoption that forces innovative teaching practices on educators. Sadly, many of the educators who choose OER end up driving them on the road, anyway.

Open Pedagogy

"Open pedagogy" is the universe of teaching and learning practices that are possible when you adopt OER but are impossible when you adopt traditionally copyrighted materials. Earlier than infancy, this field is still embryonic in its development. This is largely due to the fact that copyright is so universal in its overreaching that it has become ubiquitous, pervasive, ambient. The restrictions of copyright shackle and direct our behavior as invisibly but constantly as the proverbial water the proverbial fish is incapable of seeing. As I've written before:

At it's core, the question of open pedagogy is "what can I do in the context of open that I couldn't do before?" This turns out to be terribly difficult, because of the ubiquity (even ambience?) of copyright in our lives. An educator asking the question "what can I do pedagogically if I don’t have to worry about copyright?" is a bit like an aerospace engineer asking, "what could I do in rocket design if I no longer had to worry about gravity?" or a politician asking "what could I do if I no longer had to worry about the party system?" or a researcher asking "what could I do if funding were no longer a constraint?" (Evolving Open Pedagogy)

People continue to confuse free with open because they underconceptualize "open." In this impoverished view they think the only – or primary – benefit of open educational resources is their impact on affordability. To some degree it’s understandable that people focus on OER’s affordability because each and every time someone adopts OER we immediately see that financial impact. However, I believe the potential impact of open pedagogy on learning is even greater than affordability-through-open's impact on learning.

The field desperately needs more work focused in this area. Our current collection of examples of open pedagogy, things like Murder, Madness and Mayhem or Project Management for Instructional Designers, is pathetically small. These and a tiny handful of other examples are simultaneously groundbreakingly innovative (compared to current practice) and sadly unimaginative (compared to what could be). Mike Caufield's work with federated wikis is a more radical example of teaching practices that are possible only in the context of open content. But we need at least 15 – 20 more examples that are as different from current practice as Mike's fedwiki work is, before we can have a substantive conversation about open pedagogy.
Looking Ahead: Open Pedagogy and OER Adoption

Making progress in open pedagogy is also critically important to winning the long-term OER adoption battle. The current best arguments for OER adoption focus on benefits to students – things like improved academic outcomes and cost savings. But it is faculty who must make the OER adoption choice, often with no incentive more direct than "doing what's right for students." Powerful examples of open pedagogy will give faculty a specific, direct, even selfish reason to adopt OER. As faculty come to understand that OER give them orders of magnitude more academic freedom than traditionally copyrighted materials do, we will significantly accelerate the adoption of OER.

This accelerated adoption of OER will, in turn, significantly increase the quality (through open pedagogy) and affordability (through cost savings) of education for learners everywhere. And that is, after all, what we are trying to do.

Previous Citation(s)


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A Look at the Future of Open Educational Resources

Stephen Downes

Open Educational Resources (OER) have been traditionally defined as educational contents that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution. As the nature of educational content changes with new technology, however, so does the nature of OER. This paper explores the impact of four major types of technology on our understanding of OER: cloud infrastructure, open data, artificial intelligence, and decentralized networks. It is argued that these technologies result in a model of dynamic and adaptive resources that will be created at the point of need and will draw on constantly changing requirements and data sources. They will be created through distributed community-based processes, and they will support a pedagogy based on supporting student experiences rather than content transmission. As a result, the emphasis on content publication and licensing will decrease, while questions of access and interoperability will move to the fore.

Introduction

Online and distance education have been from the outset dependent on the design and distribution of learning resources. Absent the traditional face-to-face instruction offered by a teacher or professor, it was necessary to develop what were called ‘course packages’ containing readings, quizzes and exercises, and guidance to help the students manage their own learning in the absence of a classroom.

Traditionally these packages were proprietary to the institution offering the course; each institution would create its own course package.

Additionally, materials would be created by publishers for use in both distance education and traditional classrooms. Gradually, however, there emerged a desire to make use of new Internet technologies, to pool resources, and to be able to share the cost and benefit of learning resources between teachers and institutions. This practice became widespread, and ultimately included high-profile examples such as MIT’s OpenCourseWare.
Concurrently, in the field of computer technology a similar desire led to the creation of a type of computer program intended for sharing. Originally, programs were distributed as ‘shareware’ and were free to use but could not be sold. Operating systems such as GNU/Linux were distributed as ‘free software’ where the right to use and redistribute the software were restricted by what Richard Stallman called the “four freedoms”: the freedom to run the program, the freedom to read the source code, the freedom to modify the program, and the freedom to redistribute the program under the same license.

These ideas come together in the form of ‘open educational resources’ (OER). The idea was that educational content could be ‘free’ in the same manner as free software by licensing it using an open content license. Around the same time, an organization called Creative Commons introduced a set of licenses designed for this purpose. Thus, OER came to be defined (by organizations such as UNESCO) in terms of its licensing: “Open Educational Resources (OER) are teaching, learning and research materials in any medium—digital or otherwise—that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions” (UNESCO, 2002).

The development of the concept of the OER raised at the same time the question of the sustainability of OER. Course packages can be expensive to produce, and the expectation among advocates of OER was that students would not pay for them. Initial OER projects were supported by government, institutional and foundation support, but generally with the expectation that these projects would become self-sustaining over time. The development of OER thus began to focus on commercial viability, and models of OER distribution came to include bundling (where an OER is combined with a commercial product for sale, thus making access to the OER contingent on purchasing the commercial content), enclosure (where access to OERs is limited by the requirement to pay tuition or subscription fee), or conversion (where a free resource is converted to a commercial resource, for example, by changing it from digital form to paper-based form).

Additionally, the nature of digital resources, and of online learning generally, began to change. The early web was dominated by pages and documents, but the later web (often referred to as web 2.0) focused on social interactions and user-generated content. This change impacted online learning as well, and the focus shifted from course packages to online interaction. The development of the MOOC beginning in 2008 led to a model where students created and distributed their own educational resources and participated in learning networks.

In the present day, the model whereby publishers create and distribute openly licensed static content is drawing to a close. A ‘web page’ today is actually a dynamic resource, connected to live data generated by cloud services. The contents can change minute by minute, and these changes are often driven by the activities of people using the page. The ‘design’ or ‘content’ of an OER may actually be designed by the page design, or the pedagogical practice it supports, rather than the content created and transmitted by its users.

The concept of the OER is in flux. The purpose of this article is to focus on how these technological changes are changing the nature of OER. It will look at the impact of four key technologies—cloud technologies, open data, artificial intelligence, and content-based addressing. It’s true that in discussions of educational resources we don’t necessarily want to begin by focusing on technology, but in this case understanding the technology is important because the technology is going to create some affordances for us that will change the shape of open educational resources within ten to twenty years.

In the final two sections, we will return to the pedagogical question and examine the impact of these changes and discuss how we in the educational sector, will need to adapt in response to that impact, in order to shape it in the future.

**New OER Technologies**

**Cloud**

Access to content that is stored on the cloud requires an Internet connection. It’s true that a lot of people, and especially people in the global south, cannot easily access cloud-based resources, but more and more as time goes by, access will
improve and we will be looking at cloud environments and cloud technologies in order to support open educational resources.

By ‘cloud’ hosting, we mean storing and accessing our content on computers accessible through the Internet. What’s important about these computers is not simply that they are hosted and managed by Internet service providers, but also that the resources are not on any particular computer, and indeed, might be spread across a number of computers.

What that means, is a shift from resources created by content providers or publishers to resources created collaboratively or cooperatively.

For example, Figure 1 depicts a web-based article about open educational resources. On the screen, we see what looks like an ordinary website, but this website is actually hosted on a site called GitHub (https://github.com/). What's important about this website is that it isn't just a website. It's something that multiple people can contribute to.

GitHub enables people to create their own copy, or ‘clone’ the website in question. Or they can start editing the document to create a new version, known as a ‘fork’ of the original article.

GitHub was originally designed for cloud-based collaborative authoring of software, but sites like this demonstrate that it can be used for any sort of content.

This changes the dynamics of open publishing and open educational resource publishing because it removes the divide that exists in the traditional environment between the author and publisher and the consumer. It makes the consumer equally a part of the creation.

In addition to creating and reading documents in the cloud, we can create and run full applications on these remote
computers. These applications are encased in virtual machines or ‘containers’. We can run them and interact with them through a web browser, or, just like the contents of a cloud-based document, we can download these applications to our own computer and run them on our own computer. Services like Vagrant, Docker and Kubernetes make this possible today.

“Open Data is an umbrella term describing openly-licensed, interoperable, and reusable datasets which have been created and made available to the public” (Atenas & Havemann, 2015).

What this means is that the types of resources that we will be working within the future as open educational resources will not simply be documents, will not simply be textbooks, but will actually be functioning programs and even fully functioning virtual computers that people can work with, manipulate, use to create things like videos or audio or new applications of their own, develop their own content, and share them over the cloud.

**Open Data**

In addition to cloud hosting, and partially as a result of it, people are beginning to think about open data as a new type of open learning resource.

For example, in Canada's open data portal (located at [https://edtechbooks.org/-vQs Canada.ca/en/open-data](https://edtechbooks.org/-vQs Canada.ca/en/open-data)) readers can browse by subject. Under a topic like ‘law’, for example, they can research the law of monetary penalties, statistics, questionnaires that members are asking people to fill, etc. This is all part of open government. But it's also a whole set of resources that are accessible as educational resources.

![Government of Canada Open Data Portal](https://edtechbooks.org/-vQs Canada.ca/en/open-data)

**Figure 2. Government of Canada Open Data Portal**

Because it's data it's not really usable directly as a learning resource—it’s not structured with educational outcomes in mind. However, when open data are made available through an application programming interface (API) it can be integrated into learning resources. The Government of Canada has created a new ‘API Store’ (at [https://edtechbooks.org/-HzHZ api.canada.ca/en/homepage](https://edtechbooks.org/-HzHZ api.canada.ca/en/homepage)) which hosts and publish APIs which allows developers to access and leverage government datasets and services for integration into apps or other services.

An example of this is an application called Jupyter Notebooks ([https://jupyter.org/](https://jupyter.org/)). Jupyter Notebooks are online text-based notebooks containing computer programs such that you can use Jupyter Notebooks to run the computer...
programs it contains on your own computer. The programs allow the reader to change the program from inside the notebook and then run it again, producing a new result. Readers can either download a Jupyter Notebook application to run on the desktop, or they may access a service called Binder (https://mybinder.org/) to read and use a Notebook through a web browser.

Additionally, because the Notebook is running an actual computer program, it can access live data as it runs. For example, a notebook might address an analysis of housing in Eastern Canada. It may contain a program that displays housing data in a graph or diagram. Each time the program is run, this data is accessed anew from the API and the presentation of information in the Notebook is fully current (Hirst, 2018).

The potential is enormous. For example, Naughton (2019) takes a student “from an idea for a protein all the way to expression of the protein in a bacterial cell, all without touching a pipette or talking to a human.” The post includes embedded computer code and interoperates with a ‘cloud lab’ to actually manipulate the instruments and create the protein samples.

Additionally, there is a program called Jupyter Graffiti that enables an instructor to animate a Jupyter notebook, in other words, to display the operation of the program as though it were a video. “Jupyter Graffiti are recorded, interactive demonstrations that live inside your Notebooks ... Since a Graffiti ‘video’ is a live replay of the instructor’s interactions, you can pause it any time—and when it’s paused you can dive in to play with the instructor’s work right in the Notebook (execute it, copy it, change it, execute it again)—and then resume playback when you’re ready.”

Graffiti thus blends the instructor role, which is to model and demonstrate, with the learner role, which is to practice and reflect.

So the document isn’t just a document anymore, it’s a computer program that we can change and run again, thereby learning both about the subject matter and learning about computer programming. These computer programs can use open data such as the data that we just looked at on the government of Canada website as their input. So we can be working with open data using a Jupyter notebook that I’m running either on my browser or running on my local desktop.

This changes the conception of an educational resource from something static to something that’s interactive, to something that can be used to create, as well as to consume. An educational resource isn’t a single resource that’s served from a static web server. It is part of an environment sometimes called a ‘headless website’ or ‘decoupled CMSs’ (Koenig, 2018). The database is located in one place, the web page is located in another place, the programming environment is in another place, and these can be either in the cloud, or on a local area network, and users can switch back and forth from Internet to cloud as they wish.

AI will be used to facilitate learning processes, provide student support, assessment and feedback, manage business processes, and help with identity and security.

**Artificial Intelligence**

Open AI and open artificial intelligence algorithms are already becoming available and are beginning to be used in online learning. For example, the OpenAI project (https://openai.com/) offers “open-source software tools for accelerating AI research, and release blog posts to communicate our research.” Related projects include the Open AI Gym (https://gym.openai.com/docs/) and various cloud AI projects offered by companies like Google and Microsoft. Additionally, many resources are available through Jupyter Notebooks to help people learn about artificial intelligence.

What is relevant to open education is that the services offered by these programs will be available as basic resources to help build courses, learning modules, or interactive instruction. For example, Figure 3 illustrates a simple case. It takes the URL of an image, loads it, and connects an online artificial intelligence gateway offered by Microsoft as part of its Azure cloud services using an API key generated from an Azure account.
The Azure AI service automatically generates a description of the image, which is used as an alt tag, so the image can be accessible; the alt tag can be read by a screen reader for those who aren't able to actually see the image. In this case, the image recognition technology automatically created the text “a large waterfall over a rocky cliff,” along with a more complete set of analytical data about the image.

![Analyze image:](https://edtechbooks.org/-WJF)

Figure 3. AI-based image captioning with Azure [https://edtechbooks.org/-WJF](https://edtechbooks.org/-WJF)

This may appear to be a trivial example, but it addresses a clear need in the creation and use of open educational resources. It reduces the need for humans to create image metadata, thereby making the images much more discoverable, and much easier to use to create open and accessible resources.

The widespread availability of AI will make these capacities available not only to instructors and developers, but to everyone, greatly enhancing the capacity of people to create their own learning resources without relying on publishers.

Artificial Intelligence has wide application in education. A recent survey (HolonIQ, 2019) projected the use not only of artificial vision and image recognition technology, but also a similar impact for voice and language processing, algorithms and hardware.

What's important is not simply that artificial intelligence exists, but that it will be easily accessible as a service to the population as a whole. For example, some journalists created a facial recognition machine for only USD 60 (Chinoy, 2019). It uses input from publicly accessible web cameras showing people walking on the street, and compared the faces to images of people on nearby corporate websites. The facial recognition software is a service (on theoreti.ca Geoffrey Rockwell suggests it might be Amazon's Rekognition). This is something almost anyone could do.

While to date, most applications of AI discussed in relation to education and learning have been in the areas of learning analytics and automated course generation, it is arguable that in the future the more useful applications will actually support interactivity and community-based creation of open educational resources. For example, Cognii [http://www.cognii.com/](http://www.cognii.com/) is “enabling personalized deeper learning, intelligent tutoring, open response assessments,
and pedagogically rich analytics”, Magpie (https://edtechbooks.org/-wDXT filtered.com/magpie) “provides learning opportunities based on challenges” such as tests or quizzes and X5GON (https://www.x5gon.org/) “fully automates the creation of OER courses.” AI technologies will provide people with ways to interact with remote services in a way that helps them create new multi-media artifacts to be used for teaching, for art, or for business, and it might help them create these by creating alts tabs, it might help them create them by criticizing their text, or it might help by generating some text for them (deWaard, 2019).

**Content Addressable Resources for Education**

To introduce the concept of Content Addressable Resources for Education (CARE) we need to look more deeply at some of the technologies previously discussed. Supporting these are technologies sometimes categorized under the heading of ‘blockchain’. But the word ‘blockchain’ is not really a good descriptor, because it shifts the focus to cryptocurrencies and financial networks. The wider term ‘distributed ledger technology’ is more appropriately applied to the methods being used to store and access digital resources on distributed and decentralized networks.

An example of such a network is called the Interplanetary File System (https://ipfs.io/). The idea is this: instead of accessing an online resource using a URL the way web browsers work now, we access the resource based on its content using what is called ‘content-based addressing’. (Benet, 2014). The URL used on the web today references the location of a web resource; that is, it is associated with the Internet address of a specific web server. So, someone accessing Uber.com is getting that from a very specific service hosted by one specific server.

![Figure 4. Distributed Hash Table](image)

This system has already been modified to a considerable degree to address weaknesses in the concept. A single server might be far away. It might be a single point of failure. So, a system of load balancing and content distribution networks treat the URL as a virtual address and redirect requests to where the content is actually located. Despite these improvements, location-based access protocols are still based on a single point of failure, so that if the resource is not at that location, it cannot be found at all, except through indirect means such as a web search, and if the address is ‘spoofed’, it can result in people downloading unwanted content.

With content-based addressing the user is essentially asking whether anyone has some specific content. This content might be located anywhere on the network. It is expected that it may be in multiple locations on the network. In the case of blockchain technologies like BitCoin, every node in the network has the content being requested, so the nearest node can respond. In the case of IPFS, a subset of the nodes will have the content, and so the request may be passed from one node to the next until the content is found. In the case of GitHub, individuals can have copies of their own subsets of the content stored locally, and use content addressing for version control and updating.
Content-based addressing is important because it allows us to have multiple copies of a resource out there on the Internet, and once a resource is created and published in this way, it is permanently open. It is permanently open because there are multiple independent copies of this resource. So, things like licensing and that become less and less important.

To make content easier to identify, instead of relying on the entire content, content-based networks generate a ‘hash’ of the content. This is a cryptographic version of the content, that is, the output of an encryption algorithm, such that for any given resource there’s a unique hash value, and this value maps to that resource, and only that resource. So, the search is based on the hash value, and anyone who has a resource matching that value can send the resource. For security, the recipient can apply the hashing algorithm to any content they receive to check whether the hash from what they were sent matches the hash they were asking for? If yes, they know they’ve been sent the real resource.

Consequences

These new technologies provide the basis for speculation about the future of open educational resources.

First, the creation and the use of open educational resources will merge. In traditional educational publishing a resource is first created by an author and then later consumed by a reader. The purpose of the resource is to transmit information from the author to the reader. Even collective models of content creation, such as the wiki, operate in this way. The reader of a wiki expects to learn from content that has been created by the authors. Such a resource, while it may change from time to time, is generally static, and the flow of information is generally one-way, from producer to consumer.

However, new models of open educational resources will be more like tools that students use in order to create their own learning content, which they will then consume or use for some other purpose. For example, the educational use of a Jupyter Notebook, say, is not to present a certain body of content to the reader, but rather, to allow the reader to select their own source of open data, to manipulate that data by manipulating the algorithms provided, and then to use the results of that manipulation for their own purposes.

We see this, for example in the development of the Creative Commons open educational strategies that is being authored by multiple people and shared on GitHub. The development of educational strategies is an ongoing process. It is not a process that needs to converge toward a single outcome; people will want to develop different strategies for different purposes and different environments. So the process is not (or should not be) based on collectively writing a single document, but rather, collectively working within a common environment for the production of documents as needed.

Thus, in an environment like GitHub, individuals can access this document, clone it, and have their own copy on their own computer. They can make changes to that copy and then recommend those changes back to the original authors, who are free to accept them or reject them. They can use what has been created as a starting point, and diverge from that point, or combine it with other content from other repositories, to create something completely unique.

From the pedagogical perspective, the learning happens not through the consumption of the content but through the use of the content. People learn to write computer programs, for example, by using GitHub to copy programs from other repositories and manipulate those programs (just as a person might borrow a tool and work with that tool).

Second, licensing issues fade into the background. This should be seen as a welcome development. Laws governing content licensing and copyright differ from jurisdiction to jurisdiction around the world, and the interpretation of even common licensing standards, such as Creative Commons, is often unclear and requires litigation to resolve (Harris, 2018, p. xi). The complexity of licensing content has prompted Creative Commons to create and offer a Certificate course in the subject (Creative Commons, 2019).

One reason licensing fades to the background is that most resources are created and used only once. The resource taps into current data and may be localized or adapted to the content consumer. The tools employed to manipulate the
resources are adapted from a common ‘pattern language’ of open access algorithms and tools; proprietary tools simply aren’t useful in a one-off context such as data-driven online resources.

An additional reason is that the static components of the learning resources are distributed through decentralized networks. The nature of these networks is such that all nodes of the network participate in content distribution, and therefore, the contribution of content to the network grants de facto a license to reproduce the content. Access restrictions on content are therefore government not by licensing, but rather, by access restrictions on the network as a whole, for example, through authentication.

Finally, access conditions previously stipulated by licensing are embedded in the resource itself. Technologies such as encryption, hashing and blockchain create a record of ownership and provenance of any resource, and the conditions related to access of the resource are recorded either indirectly, through means of access controls, or directly, by means of a smart contract (Bodó, Gervais, & Quintais, 2018).

Third, the form of learning changes with the use of next-generation open educational resources. Developers are now able to use live data for real world applications, or local or downloaded data for training or for simulations. This shifts the locus of learning from the content—which will change on a day-to-day basis—to the use or application of the resource. For example, if an educational resource consists of a Jupyter Notebook containing an averaging algorithm, ‘learning’ will not consist of remembering the algorithm, but rather, it will consist in the use and modification in order to adapt to novel scenarios.

Because students are learning through practice and use, the learning ‘content’ (that is, the tools and algorithms) can be the same in the classroom or learning environment as they are in an actual work environment. It is, for example, like learning architecture by using the same computer-assisted drawing (CAD) software as is used by professional architects, using data drawn from open architectural drawing data networks (OPSHub, 2018).

What’s Needed?

What do we need, what do we need to know, what do we need to master, in order to get to this?

The first, and perhaps most important, is to change our mindset a bit. We need to change our framing, and in particular, we need to start thinking in terms of data and networks rather the documents, to get away from the idea that we’re publishing course packages, chapters, and modules. The existing system of learning and publishing is designed around static and unchanging resources, however, in this future, resources will need to be created as-needed to address current data and current contexts.

The focus of instructional design, therefore, shifts from a foundation of content-based learning objectives to one based on (perhaps less-well defined) capacities and skills. These capacities and skills will themselves be fluid and adaptive to current environments, and learning to work in these environments will be more like achieving a fluency rather than remembering specific sentence structures or even vocabularies.

Instructional designers should be thinking in terms of environments and experiences. These environments will need to be fit for purpose—that is, they will need to generate real outcomes, whether they are used to design a building or to pilot a ship. Designers will also need to focus on the experiences learners have in these environments. It’s not about the contents of the resource anymore, but rather the contents coming from open data, and this data might be anything possible within the constraints of the system.

Second, it will take some time for instructors and designers to learn how to think this way. GitHub, for example, requires a huge learning curve (GitLab, 2017). There is a change of perspective required in order to see works (whether software or content or other media) as dynamic, as branched, as modular, and as interoperating. Instructors and designers will require user-friendly interfaces that assist in this change of perspective. This will take something like the content management system of next-generation interactive cloud technology. In the early years of the web open educational
resources were really difficult to create until things like Blogger and Facebook and Twitter and some publishing services like Rice's Connexions came along. This is what will be needed for this next generation as well.

Again, it’s a shift in focus from the content to the interactions and operations. It’s about how to merge this data with this application or this capability or this bit of artificial intelligence to create a learning experience for a person. This is a very different way of thinking about instruction and instructional design than what instructors and designers may be used to, and it will require practice and application on new leading design systems in order to support this transition.

Third and finally, designers and developers will need to learn to co-create cooperatively. This is not the same as collaboration, where small or large teams work on a certain product or outcome. Cooperative work involves multiple individuals and groups working within a common environment or infrastructure, and helping support that network or infrastructure for mutual benefit, while working on different objectives or outcomes.

Part of this involves building and sharing resources in common. But an equally large part of it involves being able to work in the open, or as it is sometimes called, ‘open working’. Examples exist in, say, the philosophy of ‘open science’, where “many of the benefits envisaged for open methods relate to how far they enable not only access but active participation in a research community by newcomers and outsiders, and maintain low barriers to this participation.” Internships, co-op student placements, apprenticeships and sport development leagues all embody the same principle.

Concluding Remarks

Students today face the challenge of complex and rapidly changing work and study environments. These challenges, and the affordances enabled by new technologies, are driving a new generation of learning resources. These resources will be dynamic and adaptive. They will be created at the point of need by AI-assisted learning design systems and will draw on constantly changing requirements and data sources. These resources will not teach by means of content transmission, but rather, will require that students interact with both the data and algorithms, modifying the resource and creating solutions to real-world challenges. They will work using the same tools as people already working in the field, adapting to changes in the tool alongside the experts, working with and alongside them in a cooperative open working environment.

In this scenario, our understanding of the concept of the ‘open educational resource’ changes from a definition based on the concepts and metaphors of textbooks and libraries, and toward one based on the concepts of data-processing networks, cloud services and applications, decentralized encryption-based ledgers, and AI-assisted design and information processing. OERs will no longer facilitate learning by means of content transmission, but rather by constituting parts of, and working within, distributed cooperative networks, supporting the student experience as they become fluent in new challenges and new technologies.

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Previous Citation(s)

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Stephen Downes is a specialist in online learning technology and new media. Through a 25 year career in the field Downes has developed and deployed a series of progressively more innovative technologies, beginning with multi-user domains (MUDs) in the 1990s, open online communities in the 2000s, and personal learning environments in the 2010s. Downes is perhaps best known for his daily newsletter, OLDaily, which is distributed by web, email and RSS to thousands of subscribers around the world, and as the originator of the Massive Open Online Course (MOOC), is a leading voice in online and networked learning, and has authored learning management and content syndication software.

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Pragmatism vs. Idealism and the Identity Crisis of OER Advocacy

Rajiv Jhangiani

Editor's Note

This was originally posted to Rajiv Jhangiani's blog on February 15, 2017.

In a couple of weeks I will be in Cape Town, presenting at the 2017 OE Global Conference. This blog post is a preview of some of the ideas I will discuss during my talk (which shares the title of this blog post). A longer version of this post is currently under review in Open Praxis.
The open education movement has made and continues to make great strides, with the creation, adaptation, and adoption of OER slowly but surely becoming mainstream practice. However, as the adolescent OE movement enters a growth spurt that may see its use as primary courseware triple within five years, some noticeable paradoxes have emerged that hint at an identity crisis within the OE movement and, in particular, within OER advocacy.

Free vs. Freedom

Open education advocates customarily define OER as "beyond free," based on the permissions to reuse, revise, remix, retain, and redistribute these resources. However, in practice, OER advocacy often centres on the unaffordability of commercial textbooks and the cost savings associated with the adoption of open textbooks (i.e. merely "free"). On the one hand, this appears appropriate, even pragmatic, given the significance of the burden of student loan debt in North America and the impact of escalating textbook costs on students’ educational choices and outcomes. Moreover, textbooks are a familiar entity to academics, and, unlike with tuition fees and costs of living, faculty control adoption decisions and consequently the cost of required course materials. At the same time, this narrow focus on cost savings is immediately less relevant in countries where faculty are less reliant on expensive textbooks. In fact, it may not even be pragmatic in North America, as recent research shows that the cost of resources is among the least-considered factors for U.S. faculty when assigning required course materials. Moreover, although a cost-savings framing appeals most directly to student groups, as pointed out it is faculty who control adoption decisions. Finally, framing OER in terms of zero cost (one among many implications of open licensing) may unintentionally constrain the use of the permissions that come along with OER and disengage faculty from the opportunity to move away from bending their courses onto the structure of a textbook. Indeed, faculty who reuse, redistribute, and retain OER (themselves a minority) continue to greatly outnumber those who revise and remix OER, a pattern that may be perpetuated through the best of intentions of OER advocates. As Weller and his colleagues put it:

if cost savings were the only goal, then OERs are not the only answer. Materials could be made free, or subsidized, which are not openly licensed. The intention behind the OER approach is that it has other benefits also, in that educators adapt their material, and it is also an efficient way to achieve the goal of cost savings, because others will adapt the material with the intention of improving its quality, relevance or currency. (pp. 84-85)

Evolution vs. Revolution

OER advocates often highlight the advantages of the internet and digital technologies, especially as they enable the marginal cost of reproduction and distribution of educational resources to approach zero. However, the OER movement itself continues to grapple with questions from a pre-digital past, such as the responsibility of updated editions of open textbooks and the development of ancillary materials such as question banks. Although OER funders may (rightly) consider these matters stumbling blocks which, if not addressed, would inhibit uptake, employing the language of the commercial textbook industry runs the risk of dragging along a traditional mindset based on the top-down delivery of static and (falsely) scarce information. This begs a broader question: If open educational practices are a game changer, why are OER advocates playing by the rules of the commercial textbook industry?

Framing OER as free, digital versions of expensive print textbooks also risks playing directly into the hands of commercial textbook publishers who are in the midst of a pivot away from a business model based on selling “new editions” of print textbooks every three years to one based on leasing 180-day access to digital content delivery platforms. As post-secondary administrators begin to more seriously consider the social and fiscal consequences of high textbook costs, it will be tempting for them to capitulate to aggressive sales pitches from publishing coalitions that exchange faculty choice and student agency for slightly discounted digital textbooks. In order to avoid the most effective arguments of OER advocates being further co-opted by commercial publishers (e.g., see this product brochure from Pearson Education for their digital platform that cites data on the impact of OER adoption on student outcomes) and especially to realize the full potential of OER, the goal posts must be placed further than simply cheaper textbooks.
As Robin DeRosa, an open educator who clearly favours revolution over evolution, puts it, “Fundamentally, I don’t want to be part of a movement that is focused on replacing static, over-priced textbooks with static, free textbooks.”

**Resources vs. Practices**

The tensions between cost savings and textbooks on the one hand and the affordances of open licenses and digital technologies on the other are manifested by contrasting emphases on OER vs. open educational practices (OEP). The latter is a broader, superordinate category that encompasses the adoption of OER and even open course design and development, but which places pedagogy (and therefore students) at its core. OEP most often manifests in the form of course assignments in which students update or adapt OER (e.g., with local examples or statistics), create OER (e.g., instructional videos or even test questions), or otherwise perform scaffolded public scholarship (e.g., writing op-ed pieces or annotating readings on the open web). Crucially, adopting OEP requires more of a shift of mindset than does adopting OER, more critical reflection about the roles of the instructor and the student when education continues to be based on content consumption rather than critical digital literacy despite information (and misinformation) being abundant. As David Wiley writes in his blog (albeit with the byline “pragmatism over zeal”), “when faculty ask themselves ‘what else can I do because of these permissions?’, we've come within striking distance of realizing the full power of open.”

Happily, advocating for OEP avoids the problem of inadvertently striking a judgmental tone when describing non-OER users (who may have excellent reasons supporting their choice) because discussions about innovation are not driven by guilt or avoidance. Rather, OEP articulates a vision of education that is aspirational and driven by an approach motivation. Within this broader vision, significant cost savings to students are the least significant benefit of OER.

**Idealism vs. Pragmatism**

The psychologist Erik Erikson articulated an eight-stage theory of psychosocial development that centered on an adolescent crisis between identity and role confusion (1956). During this stage, which persists through the college years, the adolescent begins to struggle with questions about who they really are and what they hope to achieve.

Although Erikson developed his theory to better understand lifespan development within individuals and not social movements, it is difficult to ignore the parallels between the tensions of an adolescent OE movement and the adolescent identity crisis that he described. Specifically, I believe that the frictions described above between “merely free” and “beyond free,” resources and practices, and evolution and revolution are each symptomatic of a psychosocial crisis within the OE movement that pits pragmatism against idealism.

Although OER advocates may understand and even experience both impulses, their goals and strategies often reflect one or the other. For example, whereas idealists push for for radical change that questions the status quo, pragmatists seek to build incrementally on the status quo. Whereas idealists might work through collaborative networks such as faculty learning communities, pragmatists might work to create grant programs for individual faculty to create, adapt, or adopt OER. And whereas idealists emphasize student-centered, personalized solutions that foreground process and agency, pragmatists emphasize instructor-centered turnkey solutions that foreground content and efficiency.

Outline like this, it is easy to recognize the merits of both strategies. Indeed, idealists would do well to recognize that open textbook adoption tangibly benefits students in material and educational terms that are not insignificant. On the other hand, pragmatists might recognize that the idealistic approach is appealing to those for whom the construct of a traditional textbook is a dinosaur best served by a meteor strike (and can therefore be pragmatic).
An Integrative Solution to the Crisis

Given that Erikson believed that the individual could not be understood in terms that were separate from his or her social context (1959), I believe the key to resolving this crisis lies with an integrated approach that is sensitive to the diversity across and within the audiences whom we seek to serve.

As I have written elsewhere:

For faculty who enjoy experimenting and innovating, open textbook adoption does feel like a meagre position to advocate. These are instructors who care deeply about authentic and open pedagogy, who may take full advantage of the permissions to revise and remix, and who understand that adopting OEP is really just about good pedagogy and in that sense is not at all radical.

On the other hand,

there are faculty who currently adopt high-priced, static textbooks but care enough about their students to feel guilty about this decision (principled agents in a principal-agent dilemma). In at least some of these cases, the ensuing guilt leads them to bend the course to map onto the textbook, which, while not an example of great pedagogy, could be construed as an empathic response that ameliorates both their guilt and their students’ resentment. This is . . . where the social justice case for open textbooks may resonate particularly well.

According to Weller and his colleagues, there are three categories of OER users:

1) The OER active are

engaged with issues around open education, are aware of open licenses, and are often advocates for OERs . . . An example of this type of user might be the community college teacher who adopts an openly licensed textbook, adapts it and contributes to open textbooks. (pp. 80-81)

2) OER as facilitator

may have some awareness of OER, or open licenses, but they have a pragmatic approach toward them. OERs are of secondary interest to their primary task, which is usually teaching . . . Their interest is in innovation in their own area, and therefore OERs are only of interest to the extent that they facilitate innovation or efficiency in this. An example would be a teacher who uses Khan Academy, TED talks and some OER in their teaching. (p. 82)

3) Finally, OER consumers

will use OER amongst a mix of other media and often not differentiate between them. Awareness of licences is low and not a priority. OERs are a “nice to have” option but not essential, and users are often largely consuming rather than creating and sharing. An example might be students studying at university who use iTunes U materials to supplement their taught material. For this type of user, the main features of OERs are their free use, reliability and quality. (p. 85)

This taxonomy serves as a useful guide to OER advocates seeking to diversify or tailor their outreach strategy. For instance, OER consumers may be most interested in open textbooks and related ancillary resources that can be deployed with little or no effort. For this group, unfettered access for their students is highly desirable, with cost savings a nice bonus. On the other hand, the OER active group will be more sensitive to the impact of cost savings while also keen to learn more about the permissions to revise and remix OER. Finally, those in the OER as facilitator group will be excited by the potential to involve students in the creation or adaptation of OER via renewable assignments. Of course, this is far from an exhaustive list of strategic possibilities and only aims to illustrate the mechanics of an integrative approach.

Despite its merits, it would be naïve to believe that adopting an integrative approach would eradicate all tension within the OE movement. Idealists may continue to insist on the application of CC licenses that meet the definition of “free cultural works.” Pragmatists, on the other hand, will acknowledge that OER creators may have reasonable grounds for
including a Noncommercial (NC) or even a NoDerivatives (ND) clause, even though an Attribution-only license (CC-BY) facilitates the maximum impact of OER. Pragmatists may also want to first ensure basic access for all whereas idealists may think it arrogant to insist that students first need access to required resources before partnering in pedagogical innovation. But while these tensions will not disappear, I believe it essential that we recognize both drives and have a deliberate, nuanced conversation about how best to harness both idealism and pragmatism in service of the goals of the OE movement.

So What’s Next?

In Erikson’s lifespan theory, the stages that follow adolescence pit intimacy against isolation (young adulthood), generativity against stagnation (middle adulthood), and, finally, integrity against despair (later adulthood). If these at all suggest a trajectory for the OE movement beyond its current adolescence, its advocates should aim for the next phase to involve a lot more collaboration among faculty and students, both across institutions and cohorts. This shift will require tools that support radically transparent collaboration (e.g., see the Rebus Community for Open Textbook Creation) but especially a break from traditional (opaque, territorial, top-down) approaches to curriculum design and development. As the proverb says, “if you want to go quickly, go alone. If you want to go far, go together.”

Greater collaboration and a true democratization of the process of OER development will in turn engender a move away from philanthropic, government, and other unsustainable funding models in favour of a grassroots-based, community-driven, self-sustaining approach that resembles a bazaar in its connectivity and generativity far more than it does a cathedral.

Achieving this, while neither easy nor assured, is a necessary step for the OE movement on its path to becoming more critical, more self-aware, and more inclusive of a diversity of voices. In other words, a movement characterized by integrity, not despair.

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Recognizing and Overcoming Obstacles: What It Will Take to Realize the Potential of OER

Julie Irvine, Royce Kimmons, & Jacob Rogers

Open educational resources (OER) are free, openly licensed materials that users can retain, reuse, revise, remix, and redistribute at any time. OER provide educators and students with significant, lasting benefits that far exceed what copyright-restricted materials can offer. Students who use OER save substantial amounts of money per term, savings that equate to greater financial security, and students can use the money they would have spent on expensive course materials to pay for food, health insurance, or tuition. Freeing up these funds helps eliminate some economic and access barriers, particularly for first-generation students, and can make community college attendance far less expensive. In a 2018 study, approximately half of surveyed two-year college students faced housing and food insecurity.footnote1 At many community colleges, “the cost of books per year exceeds the cost of tuition.”footnote2 This means that steadily increasing textbook costs are unconscionable because they can prevent students from enrolling and completing their degrees while also making it difficult to provide for basic needs. In contrast, utilizing OER in more courses can alleviate some of the financial burden students face, decreasing the odds that they will withdraw from a course or not finish their degree.footnote3

In addition to saving thousands of dollars on course materials by using OER, students can also experience greater freedom in their learning. OER allow students to access essential information on the first day of a course—without waiting for financial aid or books to arrive—and throughout their lifetimes. This unfettered access can increase performance in coursework and also promote lifelong learning and engagement in education.footnote4 Additionally, because these materials allow for continuous improvement and adaptability to students’ needs, students can receive a more targeted, differentiated, and richer learning experience in courses where instructors use OER.footnote5

Just as students benefit from the versatility OER provide, educators benefit from creating and utilizing these resources in their courses. One significant advantage for instructors is the ability to remix and edit content as needed to localize and adapt materials to individual and group needs, thereby promoting equity and differentiation for individuals and underserved learners. Instructors can also increase the impact and reach of their authored resources by releasing them openly, making content available to anyone, anywhere, at any time, thereby capitalizing on an open access bump.footnote6 Furthermore, reducing barriers to publication and dissemination of materials can also empower the voices of traditionally marginalized educators, such as adjuncts, women, and BIPOC faculty, encouraging more democratized and open scholarship.footnote7

Most educators believe that OER present benefits unmatched by traditional copyrighted resources, yet most faculty still don’t use them and do not have any plans to use them in the future.footnote8 Why this disparity? Failure to shift to OER cannot be interpreted simply through a lens of faculty deficiency—such as laziness, lack of interest, or greed—because faculty generally want to shift to OER. Rather, they are met by systemic and institutional barriers—including perceived lack of OER quality, issues surrounding accessibility and usability, and perceived lack of time—which prevent progress.footnote9 For OER to proliferate, institutions need to address barriers that short-circuit positive motivations among faculty, giving them space to make these valuable shifts.
Perceptions of Quality

Faculty and students alike often view open textbooks as being poor in quality. Although this perception isn't entirely unfounded, it is resolvable. Traditional publishing models that rely on multiple rounds of editing and review by specialized personnel—such as graphic designers and editors—set a narrow standard for how faculty perceive quality, a standard that may be much more based on factors such as aesthetics and grammar than on learning design, content accuracy, or usefulness to students. This means that without hiring specialized personnel for help, even someone who is an expert in a field generally can't publish an open textbook that, on its surface, will look as good as a commercial alternative.

To solve this issue, colleges and universities can provide faculty with editors and graphic designers who can be involved in the publication of open materials. Additionally, the tools used for creating OER should be designed to make quality a top priority. Whether institutions choose to hire students as editors and graphic designers, use freelance professionals, or provide publishing support in another form, faculty will benefit from the combined institutional support and the skills of others during the authoring process. This will make resulting OER more amenable to adoption. Furthermore, online platforms that host OER (e.g., EdTech Books, Equity Press, PressBooks, OpenStax, CK-12) can provide user guides that walk authors through the publication process and offer simple tools to enhance the finished work, such as automated accessibility and grammar checks. Those guides and the addition of editors and designers can mitigate the barriers of perceived quality, lack of skill, lack of institutional support, and even lack of time that some faculty face. Just as learning produces the best results when it is done collaboratively, OER are best produced with the help of diverse experts using tools specifically designed for the purpose of creating quality content.

OER can afford the opportunity to redefine the quality of textbooks (and other resources) by refocusing our perceptions of quality on how beneficial resources are for learners. When we as educators and leaders remove process-oriented parameters surrounding our understanding of what makes quality course material (e.g., peer review) and instead focus on the produced materials themselves, we open doors for OER to help us rethink the possibilities of what we can expect from our resources.

One way we can redefine our understanding of quality is by looking at student involvement with learning materials. Currently, curricula and course materials are predetermined by higher education institutions and faculty. Students receive book lists at the start of every term, purchase hundreds of dollars' worth of material they will likely only use during that semester, and then face the challenge of trying to sell those materials at a fraction of their cost or else have sixty-dollar paperweights on their shelves. Nowhere in this process are students actively engaging with their learning, nor are they involved in creating course content that will facilitate lifelong learning for themselves and their peers.

In contrast, what if students were involved in the creation, improvement, or evaluation of their own textbooks? Christina Hendricks provides examples of students who have contributed invaluable research, writing, and revision to existing OER, fostering continuous improvement for curricula at many institutions. Scott Woodward, Adam Lloyd, and Royce Kimmons articulated a path for how students’ vetting of textbooks could itself be a valuable curricular activity. In addition, many faculty have experimented with approaches to having students develop OER as primary course learning activities. Combining OER with student-led learning can also eliminate disposable assignments—assignments that “add no value to the world” and are therefore unmotivating. When students provide input or direct their own learning in these ways, OER and coursework can be more effective by overcoming motivational and authenticity barriers to student learning.

Similarly, OER allow textbook quality to be redefined through the lens of continuous improvement. This lens ensures that the goal of producing textbooks is not just to publish a text but also to regularly review the content and update it according to students’ needs and a changing world. Updating OER content may take into account new research findings or increased awareness of social, ethical, and cultural considerations. Continuous improvement also allows for remixability of text content at any time, which encourages dynamic learning experiences. Tools such as collaborative authorship, embedded learning checks in the text, and PDF availability provide opportunities for students and faculty to interact with OER in meaningful ways that will help improve the quality of the texts over time, and

Footnote 10
Footnote 11
Footnote 12
Footnote 13
Footnote 14
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Footnote 16
collaborative authorship can specifically ameliorate the lack of time and support some faculty face when trying to publish or improve existing resources.

**Accessibility and Usability**

Another barrier to the widespread use of OER is the lack of technological tools for sharing and adapting resources, which results in poor accessibility and usability of the OER. Because our goal as content creators, instructors, and faculty should be to provide quality learning opportunities to as many individuals as possible, we must consider the needs of our audience. Even though the content of a textbook may be well written, edited, and produced, it does no good if the book itself is inaccessible or unusable to parts of its intended audience. This discrepancy between consumable content and accessibility was shown in a study of K–12 websites across the United States. The study found that "95.5 percent of school home pages had a detectable [accessibility] error of some kind, with the average site having over 24 errors." This study also found that most errors were at the system level rather than the content level, and similar results have been found for college and university websites. Examples of potential accessibility issues that occur at the system level include the following:

- Lack of alternative text for images
- Inappropriate font sizes
- Lack of sufficient contrast between the text and background
- Incorrect order of the text (especially heading levels and layout of the information)
- Lack of compatibility with mobile devices
- Incorrect use of tables within the text
- Lack of transcripts available for videos

Such findings can be applied to OER in the sense that content creators need to work in lockstep with software developers who are familiar with these technologies to solve system-level accessibility and usability issues before OER are published on a website. Many of the accessibility and usability issues that exist in OER can be remedied with careful attention to system-level design by developers creating tools to seamlessly address them at the software (rather than content) level. Many OER publishing platforms such as EdTech Books are increasingly employing mobile-first design strategies, appropriate heading structures, high contrasts, sufficient font sizes, options for multiple formats (e.g., HTML, PDF), search features, and various other design decisions promoting usability and accessibility that carry over to highly usable content. Each of these solutions is an example of how institutions can support educators by correcting common problems both before and after texts are published, and such attention to system-level solutions creates more accessible and higher-quality OER that can benefit students with various needs.

Usability can also be addressed at the content level by adapting content to appropriate reading levels. As content authors focus on the needs of their audience, they must consider their backgrounds. Some students may be learning English as a second language and require content that is more compatible to their reading level. Other students may be first-generation college students or come from homes where academic language is not commonly used. Each of these students will benefit from course materials that use language better targeted to their individual cases. One solution to this barrier that some platforms now provide is utilizing Flesch-Kincaid or other reading scores to continually evaluate the language used in OER and use this to signal to authors when content needs to be simplified. This solution transforms technology from a barrier into a support for educators who are publishing open content. For example, if an instructor primarily writes at a 12th-grade reading level, that instructor can use automated reading scores to reevaluate and adjust the writing style to be more appropriate for students at all levels, much as prominent publications such as *The New York Times* and *The Wall Street Journal* do with their content. When this barrier is solved, educators enhance students’ learning flow and ability to interact with course content, and attention to all of these considerations reduces the time students would otherwise spend trying to troubleshoot technological or content problems.
Perceived Time Commitment

Finally, perhaps the greatest barrier to OER creation and adoption among higher education faculty stems from a perceived lack of time to devote to these activities, which is generally interpreted through a lens of the compatibility of these activities with the work expectations necessary for tenure, promotion, grant seeking, or simply keeping one's job. Interpreting OER efforts through the three-pronged lens of faculty work requirements—research, teaching, and citizenship—may uncover some obvious overlaps, such as between improving course content and teaching, but the major barrier seems to be that faculty and their evaluators do not consider OER work to be scholarly in nature. After all, who would spend time writing an open textbook when one's job security is almost wholly dependent upon publishing scientific articles or securing grants? This is perhaps the most difficult problem to solve in the diffusion of OER in higher education, but some solutions may be found by encouraging a rethinking of what we mean by scholarship and scholarly impact.

At the heart of scholarship is the notion of impact. Scientific journals and other professional outlets are typically ranked in terms of particular impact metrics, like impact factor or h-index, and scholars use these rankings as proxies for determining the reach that their work is having on their scientific communities and on society more broadly. However, just as OER may empower us to rethink what we mean by “quality,” they may also empower us to rethink what we mean by “impact.” In our case, Royce Kimmons has published broadly in scientific journals and highly regarded edited volumes but has also provided similar content as open textbook chapters. As an example, one of his chapters on copyright considerations for teachers that was published traditionally in an edited volume has been downloaded 1,300 times, while his open textbook chapter with similar content has been accessed or downloaded 10-times more frequently. Which of these venues is having the greater impact on the intended professional community and society broadly? Though expectations of tenure committees will not change instantly, OER may provide opportunities to reconsider the potential reach and impacts that scholars should be having on the world and their professional communities, and OER platforms can support this by providing detailed analytics and impact measurements to authors. In the case above, the open chapter hosted by EdTech Books gathers detailed evidence about impact, including page views, downloads, reads, backlinks, reading likelihood, and even predicted cost savings to readers. With such metrics in hand, faculty may find themselves in a better position to justify the time they spend with OER and thereby influence institutions to take a broader view of scholarly impact beyond a single, esoteric metric.

Closing the Gap to OER Adoption

Students and faculty agree that OER are clearly beneficial in education. However, due to some clear barriers, OER are largely untapped resources at many colleges and universities, and OER creation may be viewed as incompatible with how faculty members’ job performance is evaluated. Lack of support, technological tools, quality, skill, and time prevents many educators from publishing or using OER, but with a little rethinking and innovation in the tools we use and the processes we follow, those barriers can be reduced or altogether eliminated. Doing so will provide benefits to students, by driving down costs and improving learning materials, and also to faculty, by improving teaching and scholarly impact. Rethinking our practices and tools in these ways can increase students’ educational opportunities and quality of learning and allow faculty scholars to amplify their voices and increase their impact, both in their fields and in the world at large.
Notes


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Julie is an undergraduate student at Brigham Young University. She is majoring in editing and publishing and minoring in creative writing. Julie has three years of editing experience and over five years of writing experience. She loves editing, writing, and storytelling. Julie has been an editor for EdTech Books for 1.5 years, and she has enjoyed working on open resource textbooks, writing research articles, and bringing the vision of EdTech Books to university students. If you’d like to reach out to Julie about editing or writing opportunities, she can be reached by email or through her LinkedIn profile.

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Assumptions and Challenges of Open Scholarship

George Veletsianos & Royce Kimmons

Researchers, educators, policymakers, and other education stakeholders hope and anticipate that openness and open scholarship will generate positive outcomes for education and scholarship. Given the emerging nature of open practices, educators and scholars are finding themselves in a position in which they can shape and/or be shaped by openness. The intention of this paper is (a) to identify the assumptions of the open scholarship movement and (b) to highlight challenges associated with the movement’s aspirations of broadening access to education and knowledge. Through a critique of technology use in education, an understanding of educational technology narratives and their unfulfilled potential, and an appreciation of the negotiated implementation of technology use, we hope that this paper helps spark a conversation for a more critical, equitable, and effective future for education and open scholarship.

Assumptions and Challenges of Open Scholarship

Openness in a variety of educational and scholarly practices has gained wide interest and attention in recent years (Wiley, 2006; Wiley & Hilton, 2009). Activities associated with openness are often envisioned to occur within widely accessible online venues such as social media, and might include such activities as open teaching, the production and dissemination of open educational resources, publishing in open access journals, keeping a professional blog, and sharing of research data in online venues. In this paper, we will use the term open scholarship to refer to teaching and research practices that espouse openness and we will refer to those scholars who participate in such practices as being part of the open scholarship movement.

Many scholars hope and anticipate that open practices will broaden access to education and knowledge, reduce costs, enhance the impact and reach of scholarship and education, and foster the development of more equitable, effective, efficient, and transparent scholarly and educational processes. Wiley and Green (2012, p. 88) note that “only time will tell” whether practices of open scholarship will transform education or whether the movement “will go down in the history books as just another fad that couldn’t live up to its press.” Given the emerging nature of such practices, educators are finding themselves in a position in which they can shape and/or be shaped by openness (Veletsianos, 2010). The intention of this paper is (a) to identify the assumptions of the open scholarship movement and (b) to highlight challenges associated with the movement’s aspirations of broadening access to education and knowledge. The goal of this paper is not to frame open scholarship as a problematic alternative to the status quo. Instead, as we see individuals, institutions, and organizations embrace openness, we have observed a parallel lack of critique of open educational practices. We find that such critiques are largely absent from the educational technology field, as members of the field tend to focus on the promises of educational technologies, rarely pausing to critique its assumptions.
Selwyn (2011b, pp. 713) even charges that our field's inherent positivity "limits the validity and credibility of the field as a site of serious academic endeavour." Our intention is to spark a conversation with the hopes of creating a more equitable and effective future for digital education and scholarship. To this end, this paper is divided into three major sections. First, we review related literature to introduce the reader to the notion of open scholarship. Next, we discuss the assumptions of openness and open scholarship. We then identify the challenges of open scholarship and discuss how these may limit or problematize its outcomes.

**Review of Related Literature**

We view open scholarship as a collection of emergent scholarly practices that espouse openness and sharing. Boyer's (1990) framework of scholarship is often used as a starting point for defining scholarly practices in the digital age, and a number of authors have sought to update Boyer's model to reflect contemporary thinking related to scholarly practice (e.g., Garnet & Ecclesfield, 2011; Heap & Minocha, 2012; Pearce et al., 2010; Weller, 2011). Nonetheless, there appears to be little consensus in the field about what exactly constitutes open scholarship. In this paper, we take an inclusive approach to open scholarship and consider it to take three major forms: (1) open access and open publishing, (2) open education, including open educational resources and open teaching, and (3) networked participation. In our previous work, we have discussed networked participatory scholarship, which is the third component of open scholarship and refers to scholars' uses of online social networks to share, critique, improve, validate, and enhance their scholarship (Veletsianos & Kimmons, 2012). We are taking an inclusive approach to open scholarship because we believe that this is reflective of current scholarly practice. All three manifestations noted above are instances of open scholarship, but they are enacted or made visible in different forms. Within our frame of understanding, open scholarship is a set of phenomena and practices surrounding scholars' uses of digital and networked technologies underpinned by certain grounding assumptions regarding openness and democratization of knowledge creation and dissemination.

Next, we discuss what open scholarship has come to look like and by laying out some of the core, shared assumptions of these manifestations, we will provide the groundwork for a discussion related to limitations, problems, or unaddressed issues within the open scholarship movement.

**What Does Open Scholarship Currently Look Like?**

Discussions of openness gained traction after Friedman (2005) argued that digital technologies and open sourcing of software had helped to connect knowledge centers across the globe, thereby "flattening" the world and helping to create an even playing field between nations, groups, and individuals in a variety of ways (e.g., economics, research, etc.). More recently, Bonk (2009) built upon this idea and argued that digital technologies are specifically acting to democratize the education process. He argues that "anyone can now learn anything from anyone at anytime" and believes that this shift in the educational milieu offers a "new hope for educating citizens of this planet" (pp. 7–8). Similarly, proponents of the open scholarship movement have argued that by participating with emerging technologies scholars can help to democratize knowledge production and dissemination via public online venues such as blogs and social networking sites. For example, Kumashiro et al. (2005) suggested that "technological changes are going to flood how we currently think about, do, and represent research" (p. 276), Greenhow, Robelia, and Hughes (2009) posited that "participatory internet technologies... have the potential to change the way academics engage in scholarship" (p. 252), and Garnett and Ecclesfield (2011) argued that social media could empower scholars to "co-create" knowledge through networks.

These observations and projections have taken form in a variety of emergent open practices amongst scholars, including (1) publishing in open access journals and submitting publications and data to institutional or national repositories; (2) maintaining digital presence via blogs, microblogs, personal websites, and social networking sites; and (3) providing and making use of open educational resources and leading and engaging in open courses and open teaching practices. We give a brief overview of each of these and then discuss some underlying assumptions and characteristics that they share.
Open Access Journals and Institutional Repositories

As increasing numbers of print media are being replaced by digital equivalents and as issues of copyright infringement and illegal sharing become more common, scholars have begun questioning the traditional publication process and sharing their work more freely through online venues. Open access (OA) publishing has grown rapidly over the last fifteen years (Laakso et al., 2011), and OA journals have quickly arisen as

- an option for scholars to publish their work so that anyone with an Internet connection can access scholarly work without facing traditional financial, legal, or technical barriers;
- a means for limiting potentially abusive publisher behaviors; and
- a way of returning control of scholarly work to the authors (c.f. Furlough, 2010; Wiley & Green, 2012).

Researchers have also found open access to be financially prudent for universities and institutions interested in starting a journal (Getz, 2005; Houghton & Sheehan, 2006) and have found that OA journals may produce a greater impact (in terms of readership and citations) than non-open access (NOA) journals (Brody & Harnad, 2004; Evans, 2008; Evans & Reimer, 2009; Eysenbach, 2006; Getz, 2005; Kurtz & Brody, 2006; Lawrence, 2001; Lewis, 2006; Norris et al., 2008).

Further, researchers have found that some OA journals can attain a high level of impact within just a few years of launch and that OA journal articles are twice as likely to be cited as their NOA peers (Brody & Harnad, 2004; Kurtz & Brody, 2006).

Though a causal relationship between a journal’s impact and its OA status alone is not supported by research findings (Craig et al, 2007; Davis, 2006; Davis & Fromerth, 2007; Gargouri et al., 2010; Henneken et al., 2006; Moed, 2006) and “OA will not make an uneuseable (hence unciteable) paper more used and cited” (Gargouri et al., 2010, p. 18), it becomes clear that “wherever there are subscription-based constraints on accessibility, providing OA will increase the usage and citation of the more useable and citeable papers” (Gargouri et al., 2010, p. 18). As a result, Getz (2005, p.17) anticipated that such increased usage may lead to scholarship being “of wider influence in our society and across the planet,” forecasting that “[open scholarship] researchers are likely to be more productive and students will learn more by using open scholarship” and that “within ten years, open journals are likely to dominate scholarly communication.” Empirical evidence from Hajjem, Harnad, and Gingras (2005) supports this argument, as these authors found that 1.3 million NO papers in ten disciplines that were self-archived between 1992 and 2003 have had more citations than papers that were not self-archived.

In addition to OA publications, many scholars have found benefit in sharing their data and manuscripts via institutional or national repositories in hopes of improving research and development (Houghton et al., 2009; Lynch, 2003) and making tax-funded research (often conducted by public universities) available to the public (Kuchma, 2008). Ukraine, for instance, has moved to a mandated OA system for all publicly funded research, and there has been similar interest in the United States (Kuchma) and in projects funded by the European Union (European Commission, 2012).

Digital Presence through Blogs, Microblogs, Personal Web Sites, and Social Networking Sites

Web 2.0 technologies have helped to make Web site creation and self-publishing seamless and easy, contributing to an increasing incidence of individual presence online. A simple web search will reveal personally maintained Web sites or blogs for a number of education scholars, prominent and emerging alike. In addition, social networking sites (SNS) has recently risen in popularity to such an extent as to make platforms like Facebook, Twitter, and LinkedIn common household and editorial topics. A recent survey in the United States by the Pew Internet & American Life Project (Hampton et al., 2011) for example reports that 39% of adult Internet users (30+ years of age) currently use an SNS and that on a typical day 25% of all adult internet users utilize an SNS. Such data are not limited only to the US. In Canada for example, about 60% of individuals who use the Internet have a profile on an online social networking site (Ipsos, 2011). Higher education faculty have also adopted SNS in growing numbers. Moran, Seaman, and Tinti-Kane (2011), for instance, found that amongst nearly two thousand higher education faculty surveyed, well over 90% were at least aware
of the major SNS and over 50% of all surveyed visited Facebook in the previous month, with over 40% posting something to the SNS in that time.

Use of these digital spaces may reflect an interest in having debate platforms for scholars who seek to live as public intellectuals, recording and sharing logs of research, or offering spaces around which critical discussions of the scholarly enterprise can occur (Kirkup, 2010; Walker, 2006). By maintaining a web presence, scholars may express their opinions, solicit feedback, reflect, share information pertaining to their professional practice, network with colleagues, reach multiple audiences, and cultivate their identity as scholars (Veletsianos, 2012; Kjellberg, 2010; Martindale & Wile, 2005; Nardi, Schiano, & Gumbrecht, 2004).

While scholars have also considered the pedagogical value of SNS within the classroom (Veletsianos & Navarrete, 2012b; Bull et al., 2008; Greenhow & Robelia, 2009a, 2009b; Mazer et al., 2007; Mazer et al., 2009; Munoz & Towner, 2009), in a survey conducted by Moran et al. (2011), it was found that 45% of higher education respondents use Facebook for professional, non-classroom purposes. Such nonclassroom uses of SNS may reflect an interest in online social grooming or using online tools as “a means to improve one’s reputation and status as well as access to resources and social and practical solidarity” (Tufekci, 2008, p. 546) and are indicative of a larger cultural movement toward online culture building and connection such that, for many scholars, it may now be “hard to think of a life offline” (Beer, 2008, p. 521).

Nevertheless, the tendency to use SNS in organized professional contexts appears to be limited. For example, online science-related journals that have experimented with community commenting platforms to support scholarly discussion around articles have exhibited a low volume of comments (Neylon & Wu, 2009), suggesting that though culturally we have come to use SNS for a variety of purposes, enthusiasm for these media has not fully carried over to professional scholarly purposes.

Open Educational Resources, Open Teaching, and Open Courses

The open educational resources (OER) and open teaching movements seek “to provide open access to high quality digital educational material” (Caswell, et al., 2008) in a “spirit similar to that of free and open software” (Wiley, 2003) and OA journals. UNESCO (2002) defines OER as “the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes” (p. 22), and OECD (2007) defines OER as “digitized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research” (p. 10). Major projects and examples that could fall under the umbrella of OER include OER Commons, MIT OpenCourseWare, the Wikimeda Foundation, Project Gutenberg, Creative Commons, Flat World Knowledge, and Saylor.org. Though there is no universally accepted definition of what constitutes OER, the overarching characteristics of OER are “resources that reside in the public domain or have been released under an intellectual property license that permits their free use or re-purposing by others” (Atkins, Seely Brown, & Hammond, 2007, p. 4). The OER movement has gained worldwide attention as a wide variety of governmental, institutional, and philanthropic organizations have adopted OER policies and have supported OER development (Hoosen, 2012), and it is believed that such practices have the potential to provide “individuals who might otherwise never have the opportunity to experience post-secondary learning a free and open chance to participate” (Wiley & Green, 2012, p. 88). Though still in its infancy, the OER movement has exhibited some positive outcomes (Wiley, 2010) though not necessarily a “discernable impact” (Wiley, Hilton, Ellington, & Hall, 2012). For instance, an exploratory investigation of open textbook adoption in the state of Utah by Wiley et al. (2012) found significant cost reductions that were accompanied by no significant changes in learning outcomes as measured by standardized test scores.

Closely related to the OER movement is the practice of creating open courses that a number of faculty members and universities have begun adopting. Similar to MIT’s OpenCourseWare project, numerous universities have made available course materials to the public in the form of syllabi, video lectures, audio recordings, course notes, presentation files, and other learning objects. Building off of this idea, institutions have also recently begun offering a type of free online course referred to as massive open online courses (MOOCs). In these courses, primary activities emphasize connected
learning through active aggregation of information, “remixing” aggregated information through building relations to earlier experiences, repurposing information by generating digital artifacts, and sharing (Kop & Fournier, 2010). The major difference between MOOCs and OER is that the former are intended to serve as online learning environments that support learners in the educational process (e.g., providing feedback, completing assignments, sharing information, etc.), rather than merely making content available to them. As Fini (2009) explains, “open online courses may be considered to be a special type of OER, which solves the problem of the lack of interaction that is typical of most OER initiatives,” and “the real potential of an OOC [open online course] is to be found in the emergence of learning networks among participants in a many-to-many relationship, rather than the traditional one-to-many model of interactions between a teacher and his or her students” (p. 3). Prominent examples of MOOCs include the Connectivism and Connective Knowledge (CCK08) course offered by Siemens and Downes (2008), Jim Groom’s (2011) Digital Storytelling course (#ds106) at the University of Mary Washington, Thrun and Norvig’s (2011) Introduction to Artificial Intelligence course at Stanford, MITx’s Circuits and Electronics course (2012), and the courses offered by educational startups such as Coursera, Udacity, and EdX.

What Do these Practices Say about Open Scholarship?

Given these examples of open scholarship, we should be able to recognize some common themes and assumptions about openness, sharing, and Internet technologies that unite such practices. First, open scholarship has a strong ideological basis rooted in an ethical pursuit for democratization, fundamental human rights, equality, and justice. As the Budapest Open Access Initiative (2002) explains, the aim of openness is “building a future in which research and education in every part of the world are ... more free to flourish,” thereby reflecting ideals of democracy, free speech, and equality. Caswell, Henson, Jensen, and Wiley (2008) further explain this ideological basis with a statement of belief:

*We believe that all human beings are endowed with a capacity to learn, improve, and progress.*  
*Educational opportunity is the mechanism by which we fulfill that capacity. Therefore, free and open access to educational opportunity is a basic human right, ... [and] we have a greater ethical obligation than ever before to increase the reach of opportunity.* (p. 26)

Directing these desires for ensuring basic human rights, transparency, and accountability is a sense of justice or fairness in scholarly endeavors. Based on this ideological foundation, openness and sharing in scholarship are seen as fundamentally ethical behaviors that stand as moral requirements for any who value ideals of democracy, equality, human rights, and justice.

Second, open scholarship emphasizes the importance of digital participation for enhanced scholarly outcomes. Arguments for openness tend to focus on addressing the short-comings and limitations of current institutionalized practices through faculty participation in online spaces. For instance, Greenhow, Robelia, and Hughes (2009, p. 253) argue that Web 2.0 “tools might positively affect—even transform—research, teaching, and service responsibilities—on if scholars choose to build serious academic lives online, presenting semipublic selves and becoming more invested in and connected to the work of their peers and students.” Throughout these arguments for openness, the undesirable alternative is depicted as being “closed” or unresponsive to calls for equity, sharing, and transparency.

Third, open scholarship is treated as an emergent scholarly phenomenon that is co-evolutionary with technological advancements in the larger culture. Though ideals espoused in the first assumption are not new developments, their re-introduction into and re-emphasis in discussions of scholarship come in conjunction with the development and diffusion of a variety of social technologies. As Wiley and Green (2012) point out, open practices “allow the full technical power of the Internet to be brought to bear on education” (p. 82), and though causal relationships between technology developments and social trends are multidimensional, historical precedents suggest that social trends evolve in conjunction with technology development in a negotiated and co-evolutionary manner (cf. Veletsianos & Kimmons, 2012; Binkley, 1935). Thus, when discussing openness in scholarship, technology must be seen as both being an actor (i.e., influencing changes in scholarly culture and thereby influencing cultural behaviors) and being acted upon (i.e., being influenced by scholarly and other cultures and thereby reflecting cultural behaviors).
Finally, open scholarship is seen as a practical and effective means for achieving scholarly aims that are socially valuable. Such aims might range from ideological values (as mentioned above) to a variety of others including reduced cost of delivery, improved efficiency, greater accuracy, and so forth. For instance, one argument in favor of OA journals is that “the cost savings alone are likely to be sufficient to pay for open access journal publishing or self-archiving, independent of any possible increase in returns to R&D that might arise from enhanced access” (Houghton et al., 2009, p. XIX). Similar arguments have been made about improved research efficiency in sharing data sets (Trinidad et al., 2010), increasing the reach of universities via MOOCs (Carson & Schmidt, 2012), and using SNS for research purposes (Greenhow, 2009). Considering an educational perspective, such efficiency may also have pedagogical value because as Wiley and Green (2012) argue, “Education is a matter of sharing, and ... [open practices] enable extremely efficient and affordable sharing” (p. 82). In their view, “those educators who share the most thoroughly of themselves with the greatest proportion of their students” are seen as successful (p. 82). From this perspective, openness is seen as an effective vehicle for achieving various scholarly goals like affordability, efficiency, accuracy, accessibility, sustainability, dissemination, and effective pedagogy.

**The Need for a Critical Examination of our Practices**

Empirical findings on researchers’ and instructors’ digital, networked, and open participation and practices have so far been minimal and have largely indicated that the use of participatory technologies for learning and scholarship is rife with tensions rather than realized transformative potential (Veletsianos & Kimmons, in press; Selwyn 2011a). Still, although we may have an early understanding of why individuals may not engage in open practices, we have not paused to examine potential unintended consequences of embracing activities associated with open scholarship.

A few reasons have already been proposed in the literature that may describe why scholars might not engage with digital scholarship. First, higher education faculty may be more inclined to use “traditional” technologies in their practice, such as email, than students (Roblyer, McDaniel, Webb, Herman, & Witty, 2010), and thereby may not necessarily capitalize on networked opportunities for scholarship. A second reason may be due to the relative newness of the concept of open scholarship and specialized social media tools targeting scholars, as social networking sites for academics (e.g., Mendeley and Academia.edu) have only been available since about 2007. As with every emerging technology used in education, it takes time for these tools to be evaluated, adopted, and appropriated into wide practice (Veletsianos, 2010). Finally, Zaugg, West, Tateishi, and Randall (2011, p. 32) argue that widespread use of such tools may be hindered because scholars might (a) perceive social media as an unnecessary time commitment and (b) “hesitate to openly post their developing research lest they get pre-empted by another researcher or receive public criticism for their still-evolving research.”

However, we see a pressing need for a critical examination of open scholarly practices, because the dominant educational technology narratives embraced in the field present an overwhelmingly positive picture of technology use education that we believe is detrimental to our future. The promise of technology revolutionizing education has persisted since the 1930s (Mishra, Koehler, & Kereluik, 2009), though contemporary narratives may include “Web 2.0 technology as user-generated and hence emancipatory, or of learning analytics as allegedly leading to efficient, personalised teaching and learning, or of technology as implicitly progressive” (Hall, 2011, ¶14). Selwyn (2011b) even charges that, as a field, we need to be more negative to be taken more seriously. We believe that it is through (a) critiques of technology use in education, (b) an understanding of educational technology narratives and their unfulfilled potential, and (c) an appreciation of the complex and negotiated implementation of technology use ‘on the ground’ that our field will become a site of evaluative, rather than optimistic, discourse about the relationship between technology, education, and scholarship. In the words of Hall (2011, ¶11), “in order to understand our present position, and to develop alternatives that matter, we need stories and metaphors and critiques of where we are.”

**Researcher Positionality**

Prior to explaining the challenges facing openness and open scholarship, it is important to clarify our position with respect to these issues so that the reader better understands our frame of reference and the validity of our arguments.
Both authors are actively involved in researching emerging technologies (e.g., social media), technology-enhanced scholarship, and emerging forms of learning and participation. In addition, we both believe that various degrees of openness are worthwhile for scholars and educators, and we practice openness in our own work through our own blogs, our participation in social media, our sharing of OER, our publishing in open access journals when we feel a journal is appropriate for our work, and our self-archiving of our publications in ways that allow others to access them in an open manner. We also recognize that open scholarship challenges cultural, social, publishing, and institutional norms, thereby facing institutional obstacles and contesting corporate interests. Finally, we also believe that the relationship between technology and practice is negotiated in that technology shapes practice and practice shapes the way technology is used. This belief provides part of the impetus for writing this paper as we believe that technologies shape the ways we enact openness while at the same time our beliefs, understanding, and actions pertaining to openness will shape how we use technology.

**Challenges of Openness and Open Scholarship**

In the preceding sections, we highlighted some core assumptions of the open scholarship movement. While we believe that open scholarship tackles deficiencies, injustices, and problems of the status quo, it is imperative to clarify its pitfalls and challenges so that educators, researchers, and administrators can consider and address them. We discuss these issues in detail below in the context of each assumption. Table 1 summarizes these challenges with respect to each assumption.

<table>
<thead>
<tr>
<th>Assumption #1: Ideals of Democratization, Human Rights, Equality, and Justice</th>
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<tr>
<td>Common themes and assumptions</td>
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<tr>
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<td>Challenges</td>
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<tr>
<td>Are these ideals essential components of the open scholarship movement or are they merely incidental to those who are pioneering the field?</td>
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<td>Scholars need to develop an understanding of participatory cultures and social/digital literacies in order to take full advantage of open scholarship.</td>
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<tr>
<td>Need to redesign university curricula to prepare future scholars to account for the changing nature of scholarship.</td>
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<td>Technology both shapes and is shaped by practice.</td>
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<td>Technology is not neutral, and its embedded values may advance tensions and compromises (e.g., flat relationships, homophily, filter bubbles).</td>
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<tr>
<td>Open scholarship introduces new dilemmas and needs (e.g., personal information management challenges; social stratification and exclusion).</td>
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merely incidental to those who are pioneering the field. That is, at the moment, such scholarly practices may largely reflect the values of early adopters who already engage in them, and these values may not be held as inviolate, or even important, by others who begin replicating them. For example, Cohen (2007, ¶4) presents a list of fourteen characteristics that describe “social scholars” (e.g., “a social scholar initiates or joins an online community devoted to her topic, using any of a number of social software services or tools”). Burton (2009, ¶5) describes the “Open Scholar” as someone who “makes their intellectual projects and processes digitally visible and who invites and encourages ongoing criticism of their work and secondary uses of any or all parts of it—-at any stage of its development.” In both of these descriptions, there is no clear necessity for the scholar to value democratization, human rights, equality, and so on, and we should consider the possibility that scholars engage in open scholarly practices for a variety of reasons that may not be entirely noble (Veletsianos, 2012).

While open scholarly practices may share some of these noble goals (e.g., providing access to scholars who could not otherwise afford access to recently published research), scholars and institutions need to evaluate the purposes and functions of scholarship and take part in devising systems that reflect and safeguard these values of scholarly inquiry. For instance, the development of OA journals that charge authors (and by extension their institutions) to publish their manuscripts limits the diversity of voices in the scholarly process to those able to pay for publication. As with those in any community, scholars engaging in open scholarship are susceptible to the risks of making decisions about the future of their community which may be arbitrary, prejudiced, or otherwise harmful to the community’s well-being, and, thus, scholars should be vigilant and reflective of their digital and open practices as these practices continue to emerge and develop. Such vigilance should focus both on determining who profits from such practices and who is excluded from them so as to combat both under-use by some (e.g., those lacking entry to or knowledge of useful networks) and over-use or exploitation by those with the wealth, power, and prestige necessary to effectively strip mine sources (c.f. Chander & Sunder, 2004). While solutions to these problems may not be simple, forward-thinking approaches to proactive prevention with regard to the protection of scholarly freedom, and the upholding of these early-adopted ideas are superior to post facto reparation.

To illustrate further, massive open online courses (MOOCs) were originally designed as moral imperatives and alternatives to traditional higher education, as attempts to offer free education that was co-created with learners (McAuley, Stewart, Siemens, & Cormier, 2010). In this formulation, MOOCs were flexible enough to offer self-directed learners the ability to define for themselves the types of outcomes they desired, while at the same time offering opportunities for communal learning (Rodriguez, 2012). During 2011-2012, we saw burgeoning interest in distance education by entrepreneurs, investors, and universities, and a resulting appropriation of MOOCs followed, such that the original MOOCs offered by Siemens, Downes, Cormier vis-à-vis the ones popularized by initiatives such as Coursera and Udacity share little resemblance other than the fact that they are freely available online courses. While the mass media celebrated the disruptive nature of online education and the death of higher education institutions (e.g., see McKenna, 2012 in The Atlantic, and Lewin, 2012 in the New York Times), a potential future defined by Coursera- and Udacity-type courses contrasts starkly with the narrative of MOOCs as flexible and empowering courses.

Many contemporary MOOCs can be more appropriately described as commodified education, rather than the type of open education initiatives suggested by their acronym. A clear example of this commoditization can be found in the rapid adoption of business-oriented models of distance education. While the intention of distance education enthusiasts and scholars from the inception of the field was to devise approaches to provide learning opportunities to individuals who could not otherwise physically attend educational institutions, such as learners who live in remote geographical areas (Davis, 2000), distance education is increasingly characterized as a product to be packaged and reused for efficient delivery to massive numbers of students (c.f. Noble, 2002; Wilson, Parrish, & Veletsianos, 2008). While Coursera, Udacity, and EdX allow access to educational opportunities, this argument conceals the fact that (a) the type of education offered by these initiatives appears to be reserved for students who are intrinsically motivated, self-directed, and have the necessary prior knowledge to succeed; and (b) education has goals broader than effectiveness and efficiency, namely engagement and social justice (Wilson, Parrish, & Veletsianos, 2008). In the words of Stewart (2012, ¶22), “the problem with EdX is that, scale and cost aside, it IS essentially a traditional learning model revamped for a new business era.”
Given these dichotomies, we should consider whether current implementations of open scholarship and open education (e.g., in the form of MOOCs) hold true to the ideals of democratization, equality, and justice or whether organizations might be appropriating the garb of open education without necessarily embracing the ideals of its founders.

**Assumption #2: Emphases on Digital Participation for Enhanced Outcomes**

While technological advances may enable scholars efficient access to up-to-date information, networks of colleagues, and the potential to connect and network with diverse audiences, scholars need to develop an understanding of participatory cultures in order to take full advantage of open scholarship. For example, scholars need to develop an understanding of the affordances of the participatory web for scholarship and consider the implications of online identity and digital participation (c.f. Coiro, Knobel, Lankshear, & Leu, 2008).

To participate productively in scholarly networks online, scholars not only need to understand the participatory nature of the Web, they also need to develop the social and digital literacies and skills essential for effective engagement with such networks. Unequal access to technology and/or lack of digital literacies is referred to as the participation gap (c.f. Jenkins et al., 2006). In the context of open scholarship, the participation gap may refer to those scholars and learners who participate in networked spaces and are able to take advantage of digital literacies to advance their learning, teaching, research, and career (e.g., learning new teaching approaches, bringing their research to the attention of broad audiences, organizing colleagues to tackle important professional issues) vis-à-vis those who have had no exposure to participatory cultures or who do not have the essential literacies to engage in such activities online. Rheingold (2010) convinced that individuals need literacies affording them to decode and encode digital information. These literacies relate to attention, participation, collaboration, network awareness, and critical consumption (Rheingold). Without access to these literacies, contemporary scholars and learners will be ineffective participants in online spaces. Subscribing, following, and commenting on other scholars’ blogs, for example, will at some point become too much of a time commitment. Nevertheless, scholars who are literate in digital matters are capable of devising ways to manage participation. For instance, the use of web services to alert scholars of newly published information relating to their research interests (e.g., through the use of Google Alerts) allows scholars to effortlessly remain current in developments in their field.

These issues introduce a need to redesign university curricula preparing future scholars to account for the changing nature of scholarship. In such curricula, we envision the teaching of tools to manage scholarly participation online and engagement with issues such as participatory cultures, open access publishing, information management, digital literacies, community-engaged scholarship, and scholarship evaluation metrics. In addition, we envision the development of learners’ skills in situ, where their learning occurs in scholarly communities of practice, enabling scholars-in-training to understand both the content and the digital culture of open scholarship. For instance, digitally conscious scholars might employ the services of text-mining technologies (e.g., Google Alerts) to track mentions of their name or their publications such that they can take an active role in managing how they are represented online. These issues become increasingly important because, given the amount of information that exists online, including the publication of journals in digital form, the presence of university profiles, and the use of social media services for personal reasons, it is highly likely that scholars are already searchable and findable online.

**Assumption #3: Co-Evolutionary Relationship between Technology and Culture**

Technological innovations present opportunities for advancing how education and knowledge are negotiated and enacted, but we must recognize that technology, and social media in particular, are not neutral. Importantly, while contemporary discourse suggests that technology can transform and disrupt current educational and knowledge-creation processes (e.g., Mazoue’, 2012), such discussion is largely guided by techno-enthusiasm and techno-determinism, focusing on viewing technology as a solution for cultural, systemic, and economic problems. However, technologies have embedded values and norms that may be in conflict with the values and norms of higher education cultures, advancing tensions and compromises.
For example, social media tools currently structure relationships and power structures in relatively flat and non-
hierarchical manners (e.g., all connections are “friends,” or all connections are “followers”), and such a stance may be
incompatible with how relationships are structured in educational settings and other contexts offline (Veletsianos &
Kimmons, in press). At the same time, while participation in social media offers opportunities for connectedness and
sharing of knowledge, we need to remain vigilant of the potential that social media might reinforce existing structures
and norms. The tendency to connect with similar or like-minded individuals online as offline, what Thelwall (2009) calls
homophily, means that social media may not foster diverse spaces for knowledge exchange and negotiation, leading
instead to “echo chambers,” a situation in which we share knowledge and perspectives with individuals who already
share the same views as ourselves. At the same time, social media may shape the information that scholars access
online via algorithms that are intended to support personalization but have the side effect of blinding users to diversity
and encouraging uniformity. Pariser (2011) describes this phenomenon as the “filter bubble” and presents a convincing
array of examples in which Internet tools have limited users’ exposure to diverse information because web algorithms
are designed to retrieve information that they deem relevant to the user (i.e., that which confirms prior behavior).

Given the fact that various technologies are negotiated spaces with embedded values, we should recognize that
practices developing in conjunction with emergent technologies (e.g., Facebook, Twitter, Google) will be influenced by
the embedded values of those technologies and that not all of these influences may be positive. For example, though
Google Search may give scholars quick access to a wide array of open resources, the presentation of such resources
might be biased to support the researcher’s opinions, thereby hiding conflicting evidence. Additionally, though Twitter
might allow researchers to follow one another and discuss topics of interest, such discussions may go unchallenged if
participants are only followed by those who have similar educational training and beliefs.

Assumption #4: Practicality and Effectiveness for Achieving Scholarly Aims

Though open scholarship may offer some clear benefits to improve scholarly efficiency and to practically address
perennial problems in scholarly institutions (e.g., data sharing, research dissemination), such practices may also open
the door to new dilemmas and make some aspects of current practice less efficient. For example, authors argue that
the volume of information online has skyrocketed (Aro & Olkinuora, 2007) and that the information age has produced a
data “deluge” (Baker, 2008) or “explosion” (Delen & Al-Hawamdeh, 2009). Though information overload is hardly a new
concept (Rosenberg, 2003), due to the increasing availability of scholarly publications online, the data trails left behind
by scholars when participating in social media, and the ease with which scholars can access resources from a diverse
range of sources (e.g., from YouTube, to the New York Times, to this journal), scholars may come to face a personal
information management challenge that entails (a) keeping up-to-date with newly published information, (b) filtering
information, (c) rapidly differentiating between helpful and irrelevant information, and (d) saving helpful information for
future retrieval. In other words, though open practices may make some aspects of scholarly practice more efficient (e.g.,
information sharing), such efficiency may create bottlenecks for other aspects of scholarly endeavor (e.g.,
differentiating between important and peripheral information).

To overcome this challenge, scholars need to develop skills, devise methods, and use technologies to manage (e.g.,
efficiently collect, categorize, and retrieve) digital information pertinent to their work and their digital participation. RSS
readers and aggregators for example are viable solutions to information management challenges. RSS readers are
applications that individuals can use to subscribe to feeds (e.g., blogs). These applications monitor feeds and download
new content when it becomes available. Because RSS feeds download content to a central location as it becomes
available, the user no longer needs to visit sites in search of content that is of interest to him/her. Scholars can use
such applications to efficiently retrieve and archive digital information relevant to their professional interests via blogs,
twitter feeds, journal feeds, and other sources of continuously updated information.

However, merely developing digital literacies, effectively using technologies, and participating in online scholarly
communities does not mean that scholars will necessarily become efficient or equal participants in online spaces.
Social stratification and exclusion in online environments and networks is possible, especially if scholars do not
understand the cultural norms of networked participation. While digital literacies and an understanding of social
technologies may enable scholars to engage in open scholarship, it does not necessarily follow that participation will not be without perils or inequities. Where there is freedom to share and collaborate, there is often also freedom to abuse and exploit, so we should be careful not to indulge in idealized notions of participation, sharing, and openness that may be misguided. As Chander and Sunder (2004, p. 1332) point out when discussing what they term the romance of the public domain:

> contemporary scholarship extolling the public domain presumes a landscape where each person can reap the riches found in the commons [equally] ... but, in practice, differing circumstances - including knowledge, wealth, power, and ability - render some better able than others to exploit a commons.

Thus, in the case of open scholarship, issues surrounding the provision of MOOCs, use of open access journals, accessibility and use of OER, participation in scholarly networks, and use of social media by diverse audiences will arise and should be a matter of concern for participants when considering who profits from, and can efficiently and practically use, their collaborative or shared work. As a simple example of this issue, while we can advocate that individuals should publish in OA journals or that they should use social media in their professional practice, we must recognize that if we engage professionally with these practices ourselves, our advocacy comes from a position of power and we might be better positioned to benefit from these practices than others whose individual circumstances prevent them from fully adopting such practices.

**Conclusion**

In this paper, we identified a number of assumptions of the open scholarship movement and highlighted challenges associated with the aspirations of broadening access to education and knowledge through openness. We noted that even though openness and open scholarship have generated positive outcomes for those who enact and participate in such practices, individuals in the field infrequently critique their assumptions. The assumptions we identified suggest that open scholarship

- is rooted in an ethical pursuit of democratization, human rights, equality, and justice;
- highlights the importance of digital participation;
- is treated as co-evolutionary with technological advances;
- is considered as an approach capable of achieving socially valuable scholarly aims.

Challenges facing open scholarship are associated with each one of these assumptions. Examples include the misappropriation of open scholarship; the need for scholars developing social and digital literacies; the consideration that technology is neither neutral, nor a single solution to problems facing education and scholarship; and the consideration that open scholarship introduces new dilemmas relating to power, fairness, and equity.

In the introduction of our paper, we noted that Friedman (2005) argued that digital technologies and open source initiatives have contributed to the development of an even playing field between nations, groups, and individuals. Friedman however also noted that there is no guarantee that technologies will be used for the benefit of humanity, as it argues that the disempowered live in a flat world, but “don’t have the tools or the skills or the infrastructure to participate in any meaningful or sustained way” (p. 382). Open scholarship has the potential to enhance scholarly endeavors, but it requires paradigmatic shifts in the ways that we think about education, knowledge, learning, teaching, and research. It also requires shifts in the ways that we view our identity as scholars, in the ways we think about media and in the ways that we think about social stratification. Future research should examine these issues using both theoretical and empirical approaches, reporting on both the challenges individuals face when engaging with open scholarship, their successes and failures, as well as any breakthroughs developed to address the challenges we identified. In the process of creating scholarly and educational systems for the future, we, as an education community, need to remain critical of the systems we are creating and question our assumptions and practices. While such systems might arise from the inadequacies and shortcomings of the status quo, this does not make them exemplar or just.
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Royce Kimmons is an Associate Professor of Instructional Psychology and Technology at Brigham Young University where he seeks to end the effects of socioeconomic divides on educational opportunities through open education and transformative technology use. He is the founder of EdTechBooks.org, open.byu.edu, and many other sites focused on providing free, high-quality learning resources to all. More information about his work may be found at http://roycekimmons.com, and you may also dialogue with him on Twitter @roycekimmons.
The OER Dilemma

A comparison of OER with Traditional textbooks and the benefits of OER in the classroom

Melissa Cavan
If OER is free why aren’t more people using it?

- Will my students learn as much?
- How much time will I have to spend re-doing my course material?
- Why haven’t I heard of it before?
- If it’s free is the quality lower?

Actually...

- OER relies on word of mouth, making it a slower process before everyone hears about it.
- Some time will need to be spent reviewing open sources and adjusting course material, but it will be worth it in the long run for you and your students.
- Overall students do the same or better in courses with OER while saving money, making them more likely to enroll in courses and complete their educational goals.
- Research has shown that students do as well and sometimes better in classes with OER implemented.
Melissa Cavan
Utah Valley University

Melissa Cavan is the Zoology and Physiology Lab Manager at Utah Valley University and is pursuing her Ph.D. at Brigham Young University in Instructional Psychology and Technology. Melissa enjoys teaching and is always looking for ways to improve her teaching strategies. Her main focus is for students to walk away from her class having learned something that they will remember years down the road.

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Cultural Knowledge and OER

Navigating the relationship between Cultural Knowledge and OER

Theresa P. Holmes

As a Pasifika woman of Tongan and Samoan ancestry, I frame my life, work, and research with indigenous ways of knowing. To honor this I will use a Samoan analogy to guide my piece. In the Samoan culture, we often discuss relationships using the vā which refers to the space between. Through this framework, I hope to discuss the relationship between OER and cultural knowledge and how we can navigate it in a way that privileges and empowers indigenous knowledge, voices, and peoples.

Navigating the vā between cultural knowledge and OER is easier when indigenous peoples are telling their own stories. In my past job, there is a phrase we used to explain how we worked with students that perfectly encompasses this, "Nothing about us without us."

Nothing about a culture should be written, remixed, or distributed without the people of which culture the knowledge originates. This is key if we want to see diversity and inclusion represented in authorship and to ensure culturally appropriate and correct materials are being distributed. It takes time but it is worth it. Many underrepresented, marginalized and minority groups have been robbed of telling their own stories and sharing their knowledge due to oppressive systems. As OER champions we can make certain that the voices of the underrepresented are heard taking advantage of the flexibility to create, adapt and distribute resources without the barriers that traditional texts provide.

Figure 1 illustrates the concepts that help us to navigate the ocean between cultural knowledge and OER. I will explain these concepts through a project that I am currently working on where cultural knowledge is at the forefront.
The Aotearoa Kai Journey is a project I have been working on. We are designing a platform for sharing knowledge around food to support the redesigning of our food system to meet the needs of all. This is a collective, co-designed project that has been informed by over 350+ workers, researchers, and volunteers across the food system. This informal OER platform centers indigenous ways of knowing.

**Mana-enhancing**
For something to be mana-enhancing it protects, supports, strengthens, and empowers. As part of the co-design process, people shared what they wanted to see from this project. The collective wanted to ensure that the process and design of the platform is mana-enhancing (empowering), informed by indigenous wisdom, looks to our elders, and is a collective approach.

- We respected the cultural protocols of Māori and Pasifika
- Used a strengths-based approach and removed deficit narratives
- Acknowledge the skills and expertise that indigenous peoples bring
- Privileged Indigenous voices and ways of knowing
- Mutuality and trust by honoring peoples contribution from grass-roots to government
- We took the village approach where we design as a collective

**Talanoa**
We created space for talanoa, a Samoan word for discussion, to talk to the people. First, we started with the problem. We used this collective space to ignite the journey of change. We worked to find a solution together. The people who hope to be using the platform decided that an OER platform was a potential solution over the three days. Then we collectively gathered the insights and created a theory of change together on the last day of the summit to map a way to move forward. This resulted in collective ownership of the journey ahead. The theory of change acted as the foundation of the design process, an anchor for the work moving ahead. Once we decided on the way forward we engaged with the community three more times before we started the design sprint. We launched the solution and validated the idea and allowed space to talanoa and scope out initial thoughts on what the platform could become. Once we finalized the design process with tech experts we facilitated talanoa at two events with Maori, Pasifika, food system practitioners, and researchers. We scoped out the platform's content and design.

- We engaged with communities on a regular basis
- These discussions were led by Māori and Pasifika peoples
- The learnings from the talanoa were collated using a Māori and Pasifika lens
- We framed the theory of change and the journey using a Māori and Pasifika analogy

**Indigenous as experts**
Growing up in Aotearoa (New Zealand) I have experienced people talking at me about my culture and community. I was invited to research advisory groups on a local and national level. In these spaces it was evident that the government in various sectors had trusted non-indigenous peoples as experts to research our communities. Non-indigenous researchers more often than not wrote in a deficit narrative which made our communities look hopeless and awful. This is a common occurrence around the world and still occurs today. There must be a paradigm shift in order for this to occur.

One idea that was mentioned was a radical sharing of knowledge.

This radical sharing of free resources, removing the IP barrier, copyright barrier, and licensing barrier was an idea that was quite well supported by the majority of academics and practitioners we engaged with. People spoke about sharing...
educational resources with whanau/aiga (family) and the opportunities this would create for widespread knowledge sharing. As we discussed this idea further we talked about how we can ensure this process is mana-enhancing (empowering) for indigenous and Pasifika peoples, is informed by indigenous wisdom, and looks to our elders. And a word was mentioned, kaitiaki.

*Kaitiaki*

Kaitiaki is a word in Te Reo Māori for a person, group, or being that acts as a carer, guardian, protector, and conserver (Te Ara, n.d). When the precious and sacred knowledge of the whenua (land) is passed down from our kaumatua or kuia (elders) with it is passed the guardianship of that knowledge; we become the kaitiaki. To be a good kaitiaki of the indigenous knowledge gifted to you, you must protect that knowledge to ensure that it is not used or abused in a way that can harm others or our own communities.

*Indigenous Led*

As a Pasifika woman who lives in Aotearoa (New Zealand), I ask, what can I/we do to be a good kaitiaki of the knowledge that has been passed down? One of those things that were mentioned in our meetings was that indigenous cultural knowledge should only be reused, retained, revised, remixed, and redistributed by those of that particular indigenous culture. I fully support that is the mana-enhancing way to keep knowledge and ownership with the people, but can it still be OER, can it still be a public good? How do we honor the guardians, the people, and the communities from which this knowledge comes? Freeriders, will people benefit from this information i.e government organizations,
without paying for it as many like to take advantage of the volunteer contributions of indigenous communities or expect it.

Theresa P. Holmes
Brigham Young University & The Good Fale

Theresa Holmes is a Pasifika woman from Aotearoa. She is an interdisciplinary social impact designer, social entrepreneur, and graduate student of Instructional Psychology & Technology at Brigham Young University. Her research is focused on indigenous frameworks to guide the creation of online learning materials and designing OER to share cultural knowledge. Theresa co-founded The Good Fale, a social enterprise working on redesigning the food system in Aotearoa. Her work and research are contributing to the development of an informal OER platform aiming to increase food security and food sovereignty in Aotearoa.

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Make Out Like a Bandit

Royce Kimmons

This simulation is intended to teach you about the multi-armed bandit problem or bandit algorithms. Each button will give you a different random amount of fictional money but costs a fictional $5 to click. How much fictional money can you make?

You are an octopus at a casino. You want to make as much money as possible by pulling levers on 8 different slot machines. Each time you pull a lever, it costs you $5.

Click on the buttons below to pull a lever.

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<th>Pulls</th>
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How much fictional money can you make in...

- 10 pulls?
- 20 pulls?
- 50 pulls?
- 100 pulls?

**Reflection**

Which button was the most profitable?

How much money did you have to lose before you figured this out (and started to come out ahead)?

What was your strategy for balancing Exploitation (i.e., earning the most money possible from buttons that were returning high values) and Exploration (i.e., trying new buttons)? When did you move on, and when did you stay?

Are you certain that you couldn't have made more money if you had explored more? Why? (The best algorithms can net around $60 in 100 clicks.)

If you were to write instructions to systematically choose the best solution in another scenario, what process would you follow?
Royce Kimmons
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Royce Kimmons is an Associate Professor of Instructional Psychology and Technology at Brigham Young University where he seeks to end the effects of socioeconomic divides on educational opportunities through open education and transformative technology use. He is the founder of EdTechBooks.org, open.byu.edu, and many other sites focused on providing free, high-quality learning resources to all. More information about his work may be found at http://roycekimmons.com, and you may also dialogue with him on Twitter @roycekimmons.

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## Appendices

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Glossary

Copyleft
legal protections for authors of creative works (e.g., books, movies, lesson plans) that prevent them from being used by others without permission

Copyright
legal protections for authors of creative works (e.g., books, movies, lesson plans) that prevent them from being used by others without permission

Fair Use
the limited ability to use copyrighted works without permission as determined by four factors (Nature of Use, Type of Work, Amount Used, and Commercial Impact)

Open
in the context of openly licensed materials or open educational resources (OER), this means gratis and libre; gratis means that content and resources are provided at no cost, while libre means that people are free to do what they want with these resources

Open Educational Resources (OER)
materials for teaching, learning, and research that people have free access with no cost and can legally retain, reuse, revise, remix, redistribute them

Open Licenses
an license that allows users to freely use a resource without seeking permission (e.g., public domain, Creative Commons)
**Openness**

the level of license on educational resources which indicates different conditions, restrictions, or permissions users need to follow when they use or share the educational resources

**Public Domain**

in the US, a technical term referring to works that are not subject to copyright protection, such as very old works

**Royalty Free**

a variation of copyright that allows materials to be used in some limited manner (e.g., print an image up to ten times) without paying a fee

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## Keywords

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Open Science in Education Sciences

licensing

A Look at the Future of Open Educational Resources

OER

A Case for OER in SFL 223

Open

A Case for OER in SFL 223

Open Educational Resources

Open educational resources and college textbook choices

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Open Science in Education Sciences
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# Student Presentations

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A Brief Overview of Open Education

Hannah Call

Open education encompasses many ideas, but this presentation gives a brief overview of some key foundational points. This presentation aims to simply explain (1) what qualifies open educational resources (OER), (2) what impact OER can have in various settings, (3) the state of research in open education, and (4) steps needed to move open education forward.

Video Script

In this video I’ll be introducing a little bit about open education.

So to start off, what is open education? As this quote says, “Open education encompassess resources, tools and practices that are free of legal, financial and technical barriers and can by fully used, shared and adapted in the digital...
environment.” In other words, open education materials allow people to use the content however they want without any cost.

In order for something to qualify as open in the fullest sense, it must comply with what are called the 5 R’s. The first R, retain, ensures that others who use the content may continually have access. Revise allows users to change and edit the content. Remix allows users to add their own material to the original, and reuse and redistribute permit to share the content publicly and with others.

When the 5 R’s are used in education, it allow us to SHARE what we have. In our digital world, we can share content without giving it away. 2 people across the world can be reading the same book online at the same time. And in education...don’t we want to share? Education is what makes the world thrive? It can be given without giving it away.

So what can happen when we follow the 5 R’s and share what we have? Mostly, it creates a stage for possibilities. Just having a book open as opposed to privately licensed does not magically change the quality or effectiveness of the book. However, it DOES create a space for education to be made personable, more meaningful, and updated.

Open pedagogy is one of the most powerful possibilities with open education. Rather than using an outdated textbook with its outdated practice questions, open pedagogy enables instructors to customize the material to meet the needs of the students. It motivates instructors to create assignments that are non-disposable and more relevant & impactful.

What are some other benefits of open education? A major benefit is the cost savings for students. Rather than spending hundreds of dollars on textbooks every year, students are able to use the materials without cost. Quality is another benefit of OER. Open materials are also able to stay up to date since they can be easily edited. There is also the possibility for a wider range of connection in open education than other materials.

To better understand open education, research has been rapidly growing. The major questions research tries to answer in open education are: what is the cost savings? What are the outcomes of oer adoption? How is it being used? What are the perceptions of oer?

While research in this field is still young, there have been several studies conducted. The evidence from these studies suggest that students save significant money when oer is used, but this does not mean that oer is free to create. We also find that student performance with OER is equal to or better than traditional textbooks.

Moving forward with open education, here are 7 ideas from professionals in the field: Have research progress outside of the US context, focus on pedagogical benefits expand research categories, have faculty take practical steps, emphasize quality and pedagogy, promote equity, and ground everything in student learning.

In summary, open education brings with it so many possibilities for enhancing education, but there are still a lot of steps to take if it is to reach its potential. Research should continue finding answers, and users should take advantage of all that open education offers. I hope this helped you learn a bit more about open education, and I hope you’ll keep learning about it! Thanks for joining me!
Hannah Call
Brigham Young University

Hannah Call graduated from Brigham Young University with a Bachelor’s degree in Sociocultural Anthropology. She is currently a graduate student studying Instructional Psychology and Technology (IP&T) while she works as an instructional design assistant for Brigham Young University Online.

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What I Know Now About Open Education

Sara H. Tuiloma

Open education is a great way to help students have access to quality educational materials regardless of other barriers they may experience. Some of the key principles of OER include the 5 R's, understanding copyright and CC licensing, cost, open pedagogy, and assessing quality. There are many pros to shifting to open education, though there are a few cons we should consider as well. Understanding the ins and outs of OER and how it is different from traditional education can help us know how we can best move forward with it!

What challenges do we face?

CREDIBILITY

UNDERSTANDING

MOTIVATION

In this presentation, I am going to be talking about the lessons that I've learned from my open education class over the semester, and I entered this presentation around various creations that I've made as I've reflected on and tried to better understand open education for myself.
So I think to really understand open education and what it encompasses, it's important to understand the five hours for open, which are retain, revise, remix, reuse and redistribute. And if we can understand what each of these mean, I think we'll get a really good idea of exactly what open education is and what it encompasses.

It's different from other forms of education in a variety of ways, but the three primary ones that I can think of are cost. It's free for students. Secondly, there's not a stamp of approval that you would get on a normal textbook that you would buy, and so you might be unsure of quality.

And lastly, flexibility because of those five hours. So how do we make it happen? We have to educate others about open education. I think there's a lot of misconceptions around it. Secondly, I think we need to do it ourselves, perhaps through open pedagogy as an example.

And lastly, we need to create it and provide opportunities for others to use open resources. Here are just some good examples of open education, which I think are a great place to start when looking for or even wanting to create open resources and textbooks provides a great platform for people to create their own educational materials and lumen.

Learning and open stacks are two other resources I've learned about this semester that are good examples. Some challenges that we face our credibility. It's hard to know if it's good quality or not. There's a wide variety of open content.

Second, people don't understand where open is. And lastly, it's hard to motivate people to create open content. I've talked about these pros and cons a lot in the presentation already, but I think a few important things to point out a pro, it's open is usually equal or better quality than traditional materials.

And as far as it can go, I think it's important to remember free does not always equal free. There will always be a cost with open as we look forward to the future of open. I think the Qu framework is a great place to start.

We need to research what is happening in the field of open education in these areas and where the gaps are so that we can fill those gaps and create a better future for open education. And as we do that, in our effort to enact futures that are more open, I think using the rice framework would be a great place to start. As we continually improve open content to make it higher quality and more practical, more inexpensive to create and more efficient in our creations to just create good content for people. And lastly, what I want to close on is why should we choose open?
And I think we should always choose open when it is the best way to provide effective quality education to our students, which should always be the primary goal.

Sara H. Tuiloma
Brigham Young University
Sara Tuiloma is a doctoral student in the Instructional Psychology and Technology department at Brigham Young University. The focus of her studies is student engagement in online and blended learning environments, with a special emphasis on the Academic Communities of Engagement framework. She also works part-time as an instructional designer for BYU Online, where she develops trainings for instructors and TA's to be effective in teaching and assisting students in their online class.

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Take IP&T 531: A Pitch to Graduate Students

Steven Proctor

I created this video as my final project for IP&T 531: Intro to Open Education. Before taking the class, the only thing I heard from peers was that it was "a good class", which didn't tell me much. I couldn't even really grasp on the first day of class what I was about to experience. With this in mind, I wanted to pitch taking this exceptional class to IP&T students and other grad students who would benefit from it.

Video Script

What if there was a way to reduce college textbook costs to zero? While taking a course, what if you and your peers could legally add content to the textbook and share this new version? And what if I told you this same resource can help students escape the effects of intergenerational poverty?

Come experience and contribute to this impactful educational movement by taking IP&T 531: Intro to Open Education!

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First off, what does "open" in open education mean?
**Spoiler alert:** it’s a mixed bag. Most people would equate “open” with “free”, which can mean “gratis”—“no-cost”, but free can also mean “libre”—“freedom”. While an open educational resource is free of cost, “open” is more about what you can do with educational resources based on which open license an author uses. This “free-ing” aspect means you could revise, remix, and redistribute personalized content for your audience.

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Now is a good time to ask: what am I getting into by taking this course?

Weekly assignments consist of assigned readings, reflection, creating, sharing, rinse and repeat. In a few more words, instead of buying a textbook (hooray- no-cost!), you’ll read online articles on topics such as open licenses, open educational resources, known as OERs, improving perceptions of OERs, OER-enabled pedagogy, evaluating impact, and so on. Then you’ll write a brief reflection on the readings in a blog post. You’ll also create one or multiple open educational resources of your choice. And finally, you’ll share a link to your blog posts and creations on Twitter.

Then in-class, you’ll meet with Dr. Kimmons and your peers to get clarity on key issues. The ensuing discussion is engaging, question-driven, and thought-provoking. Occasionally, guest lecturers are invited to attend on Zoom to share how they use OER in their unique professional contexts. Personally, my favorite in-class moments were the small group projects and discussions where we created solutions to the barriers of adopting OER in formal classroom settings.

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That may sound like a lot each week, but it’s not as time consuming as it sounds. In this class, there are no throw-away assignments or busy work because you actively contribute to the open educational community. And it’s fun!

Go ahead, add IP&T 531 to your program of study today. “Learn by study” why open education is a game changer for everyone, “and also by faith” by contributing to open education. Thank you!
Falling 4 OER

Theresa P. Holmes

This presentation is a collation of learning from class in partnership with a project I am working on called Aotearoa Kai Journey. This is an informal OER platform that is the infrastructure we hope to support the redesign of the Aotearoa, New Zealand food system. It is a collection of experiential learning, classroom learning, and the gaps I have found in the current Open Education Resources.

Introduction Slide

Kia ora and Tālofa, Welcome to my journey to falling for Open Ed, and hopefully, by the end of this presentation, you'll have fallen for it too.

Video Script

Introduction Slide

Kia ora and Tālofa, Welcome to my journey to falling for Open Ed, and hopefully, by the end of this presentation, you'll have fallen for it too.
To start my journey I had to understand what it truly means to be open. When I started, I thought it was free and accessible and it is both of those things, but it's more than that. And the 5Rs of OER help us understand what open educational resources truly are; They are retained or reused or revised or remixed or redistributed or it could be some or all of them.

Throughout this journey, I learned by asking questions. In regards to OER I thought, what about equity, inclusion, underrepresented voices, how indigenous knowledge relates to OER and how to apply learnings to practice, how informal OER differs from OER in educational institutions, the infrastructure that is required to create OER? How can I use my questions as research opportunities.

I had the opportunity to learn through practice this semester by building my own informal OER platform called the Aotearoa Kai Journey that is created for food systems change. This learning was integral to my experience and understanding OER looks like in real life. I gained an understanding of how it fits into the sector that I belong to which is community development and systems change. It was an amazing experience.

The platform was a space I got to apply my class learnings. I was able to learn from my mistakes and discuss with people about those mistakes and help to overcome them. But it helped me to really think like an instructional designer and see the gaps in the content and the design. But it also helped me to understand how to collectively develop OER.

One of the things that I learned during the semester was an understanding that it is all about the people. What is impactful for some communities is not impactful for all, especially indigenous communities. I created a remixed version of the COUP framework using a Pasifika analogy and what I know is important to my community.

I got to put the learning of people to practice by engaging with my community and building the platform. I had the opportunity to understand if the community really wants OER and I recommend that you ask communities that question. We asked whether they were ready for OER and also asked to understand their needs, wants, and aspirations for their community of learners.

This is a collective journey, and that's why I called this slide the village, right. We work on OER together, and I think it's important to think of it like that and develop ways we can all contribute. This is just one idea which is developing how-tos. But also just sharing and contributing and how important that is to growing sectors.

As we put those collective and equitable learnings to practice, we ensured that the underrepresented voices were heard, that we centered ourselves in indigenous ways of knowing as well as guided by indigenous wisdom. We also ensured that we treated cultural contributions as skills and knowledge and invest money into them.

During the process of designing and also my learnings from my semester, a question came up how can we guard cultural knowledge? One thing that was clear is we need to be guardians, we need to be kaitiaki, as they say in Māori.
think in order to do that, we need to protect it through licensing, ethical guidelines, understanding the vulnerabilities of communities, and the sacredness of the knowledge that we are given.

Slide 10

So what I learned this semester, is that OER works in my settings of community development and it can help support systems change. But also it's flexible and can be adapted easily, which is very important in the social sector. It allows for all contributors, not just academics. So we can learn from people at the grassroots and the private sector, in the non-profit sector as well as in government. So all in all OER is awesome.

Theresa P. Holmes

Brigham Young University & The Good Fale

Theresa Holmes is a Pasifika woman from Aotearoa. She is an interdisciplinary social impact designer, social entrepreneur, and graduate student of Instructional Psychology & Technology at Brigham Young University. Her research is focused on indigenous frameworks to guide the creation of online learning materials and designing OER to share cultural knowledge. Theresa co-founded The Good Fale, a social enterprise working on redesigning the food system in Aotearoa. Her work and research are contributing to the development of an informal OER platform aiming to increase food security and food sovereignty in Aotearoa.

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Open Education Q & A

Melissa Cavan

Abstract

Open Educational Resources (OER) can be beneficial for students, yet it is not widely used in colleges...yet. This presentation addresses the questions that someone might ask about OER and the answers that could accompany it. Each answer also has some helpful links to articles that back up what is being said.

If OER is free why aren’t more people using it?

Actually...

How much time will I have to spend re-doing my course material?

Some time will need to be spent reviewing open material, but it will be in the long run beneficial for our students.

For more information:


Transcript:

First, let’s talk about what is Open Education?

Open Educational Resources, or OER, allow for open context that is public domain and allows others to retain, revise, remix, reuse, or redistribute that content.

So, what is the difference between OER and Traditional?
Traditional content
-costs money, is under copyright restrictions, can be in digital or hard copy form, most of the information is quality because it has been reviewed several times, and is only editable over time and through the original authors.

Whereas, OER content is
-Free and accessible by anyone, so it has an open license, is mostly in digital format, still contains quality information, and can be edited by anyone instantly.

The question then becomes, if OER is so great why aren’t more people using it?

-People often ask if the content is free and can be edited by anyone does that mean the quality is lower, or how much time will instructors have to spend modifying their content to use OER

And each of these concerns can be addressed

First question might be, why haven’t I heard of OER before?

So, OER relies heavily on word of mouth and could still be considered a fairly new endeavor. However, a large portion of people who hear about and research OER find it to be beneficial and then try to spread the word themselves.

How much time will I have to spend going back through my course material?

-Initially, it will take some time to find the right sources and formulate the content the way you want it, but in the long run, it will be beneficial to the students and allow you to share only the content you want as well as instantly edit any of the content.

Will my students learn as much?

-Research has shown that overall students either do better or about the same when comparing OER to traditional content, which means, even if the students do the same they are still coming out ahead because the content was free.

Also, if it’s free and can be edited by anyone is the quality lower?

No, and as mentioned before students do better or the same, and some OER websites have designed methods for constantly improving their content based on writer reviews.

How much are the students actually saving?

-One study listed about $120 savings per college course, this does depend on location and the type, of course, being taken but added up over several courses and 4-8 years of college that is a lot of savings.

So, in conclusion

-Overall OER is beneficial to students

-However, incorporating OER on a large scale has proven to be more difficult due to teacher push back and mainly people being concerned about quality.

-A good place to start is with the following open source websites which have quality books and resources with a free and open license.
Melissa Cavan
Utah Valley University

Melissa Cavan is the Zoology and Physiology Lab Manager at Utah Valley University and is pursuing her Ph.D. at Brigham Young University in Instructional Psychology and Technology. Melissa enjoys teaching and is always looking for ways to improve her teaching strategies. Her main focus is for students to walk away from her class having learned something that they will remember years down the road.

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Observations and Learnings About OER

Yvette Arts

As editor of the seminal volume *Instructional Technology: Foundations*, Robert M. Gagné (1987) collected research to define the then new and expanding field of instructional technology, and to provide indicators of where it may go in the future. He attributed “two sets of events” that brought about the development of the discipline. The first event was the continuing advancements in technology. The second, and to Gagné—“equally essential”—was the growing number of individuals with “a dedication to the promise of human learning, and a vision of how to promote the spread of human knowledge” (p. 1). I’m interested in finding a way that the design and delivery of curriculum can better take into account the lifestyle and circumstances of the individual, especially when national and international instability have caused many of this generation to grow up in a world without structure.

According to Gagné, these individuals would research, investigate and verify “the features of communications to human learners that optimize learning, and...discover how these features may best be planned and executed with the use of the various communication media and their combinations” (p. 7). I feel I’m one of those individuals described by Gagné, who is devoted to the “promise of human learning” and am seeking a “vision of how to promote” exceptional teaching and lifelong learning. I think one of the ways to do this is to use OER as the basic infrastructure of education.
OER VALUATION
A new opportunity appears to be present for institutions in higher education to consider how to leverage OER to address completion, quality, and affordability challenges, especially those institutions that have higher percentages of Pell eligible, underserved, and/or part-time students than the institution presented in this study. See the YouTube video that discusses OER valuation. Read the blog post.

SUCCESS, SCALE, SAVINGS
David Wiley details his thoughts about educational innovations (including OER) into an evaluation framework with three components: success, scale, and savings.
SUCCESS= Completion of a course with a final grade that counts towards graduation.
SCALE= The proportion of students being reached.
SAVINGS= How much money does this innovation save students?
He measures the impact in an equation that ideally would equal 7. IMPACT=4×success+2×scale+1×savings See the YouTube video that explains the equation for impact.

REPRODUCING MARGINALITY?
I was reminded by Maha Bali about mindfulness in open spaces: “It is everyone's responsibility to listen and care and support marginal voices. Whether or not they wish to speak. Whether or not they wish to be present. Whether or not they like what we do. It is everyone's responsibility to recognize their own privilege and to use it with purpose.” Maha Bali Read the blog post.

JOHN HILTON III RESEARCH
John Hilton synthesized the results of 16 studies that examined either (1) the influence of OER on student learning outcomes in higher education settings or (2) the perceptions of college students and instructors of OER. He concluded that educators may need to more carefully examine the rationale for requiring students to purchase commercial
textbooks when high-quality, free and openly-licensed textbooks are available. See the SPARK presentation that distills John’s research.

GETTING INTO THE AIR
Wiley makes the point that we now have the internet and such copyright restrictions as were in place before the internet are outmoded and outdated. Just as the possibility for flight with the airplane was squashed by the law, Wiley states that the copyrighted textbooks and other materials invisibly “shackle” our actions. Read the blog post.

STOP THE BRAIN DRAIN!
Imagine my delight when I read the article by David Wiley, *What is Open Pedagogy?* and found that others share the same sentiment about the time spent on homework that doesn’t add value, both for the students doing the assignments and for the teacher doing the grading. Let’s change ‘disposable assignments’ into activities which actually add value to the world. Let’s stop the brain drain! Read the blog post.

DAVID BOLLIER ON COMMONS
Bollier clarifies the commons in very precise language, detailing what the commons is and what it isn’t. I wanted to see if Bollier averted the tragedy of the commons in his definitions and suggested solutions. All of his structures mention accountability in some form or another…through community. He even suggests adaptations of laws, changes in culture and public policy to advance the commons. Read the blog post.

WIKI AS ULTIMATE OER
Wikipedia is called “the ultimate open education resource” in a blog post by Cassidy Villeneuve. She states: Wikipedia is one of the most important resources for public education in the world. It’s free, openly licensed, and available to anyone who has internet access worldwide. No ads, no collecting or selling of personal data, and no fake news. Read the blog post.

INFRASTRUCTURE
David Wiley and Nicole Allen—both propose using OER as an educational infrastructure. Said Wiley: “OER is about creating possibilities. When infrastructure is of reasonable quality and it’s available for everyone to use, then it becomes kind of an innovation platform on which you can do all kinds of stuff.” Read the blog post.

FUTURE OF OER
“[W]e contend that future directions in OER design, use, and research should not focus on openness itself but on creating futures that (a) are more generous and (b) better allow for ongoing improvement (both in sustainable ways).” (Veletsianos & Kimmons, 2012b)

For more observations and learnings, go to my blog at http://yvettearts.com/.
Yvette Arts
Brigham Young University

Yvette Arts is a lifelong learner working on a doctorate degree in Instructional Psychology and Technology. She's interested in finding a way that the design and delivery of curriculum can better take into account the lifestyle and circumstances of the individual.

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What is OER?

Layne West

Examples of OER

Mountain Height OER

EdTechBooks

OpenStax

Lumen Learning

Watch on YouTube
Layne West
Brigham Young University

Layne West is a graduate student in Instructional Psychology and Technology at Brigham Young University. She works as an instructional design assistant at BYU Online. In addition, she supervises student teachers minoring in school health. You may dialog with her on Twitter @WestLayne.

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Overview of Open Education

Jacob Rogers

Open education as a practice and theory has been gaining momentum in the education vertical for the last two decades particularly with the rise and dominance of the internet. The definition (centering around the 5Rs), use cases, rules, obstacles, and opportunities are all addressed briefly in this presentation to give the viewer an opportunity to be introduced to the subject broadly and encouraged regarding its future standing.

TRANSCRIPT:

Alright. Let's go ahead and jump into and overview of open education. So the first question to ask is what is open education Wiley decided to answer this question in a comprehensive way that has been cited abundantly by the scholars and researchers alike for the last two decades he explained this way this is content that can be reused we're going to start on the center here used in any different way you can be revised it can be adjusted modified you can change this content it's very different from traditional intellectual property right content it can be remixed but it was on the same mash it up together this content can be redistributed in any way that an educator or an individual or anyone at all desires to do so and lastly the owner of the content is to retain rights and controls the contents and the copies and
everything that goes with it so this is an overview what it is how is it different from traditional education while some of that's obvious bill will point it out there's a material costs that is less with open education because it simply doesn't cost anything or it cost very very little in terms of a token amount there's a speed of deliveries that is often quicker with open education that I can get into there's a freedom of use with open education material that it just cannot be had with traditional resources and ultimately and this is what is perhaps most exciting about open education content is that after it's been revised reused remixed becomes better and even better than traditional content so is open education APC and now this is a question that's asked and answered quite a bit the simple answer is not it is a lot of work to bring according to Dr Wiley less than 10% of our even met through so here's some of the other Roblox general sweeping themes here first we have adoption people adopting this is just difficult it's something new there's a ingrained system already in place with traditional books there's a perception with open education that's perhaps the quality is lesser there's a lot of oer options out there implementation just teaching him teachers especially to be able to use this content more quickly and to be comfortable using it and there's also the question of equity that comes into play that is equity being addressed so who's using it now right now there's only a few people using less than 20% of this number has gained tremendously the last so quick question is there a recognize the Wikipedia logo here it is very very similar and would be able to work much the same way in terms of shareability people being able to go in and edit revised for you so one quick question is do we want people do we really want people using it is actually this good and it's unavoidable really to some degree and that's great news so how do we get more people using open practices well it's a lot of work but there's a lot of factors to it and one as a student you need to be asking for as an educator you need to be provided and as a person you need to be talked about it and as all those things are followed they'll be a slow generational improvement where societies as well as individuals especially educators become more and more acquainted with and accustomed to the use of open education products

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Adopting Open Textbooks

In Higher Education

Kenzie Dinsmoor

My pitch to the Teacher Education Department in the David O. McKay School of Education here at Brigham Young University in Provo, Utah.

Watch on YouTube

Transcript

Slide 1: Title
Welcome to my pitch on Open Textbooks! First, a little about what OER is.
Slide 2: What is OER?

A working definition:

OER stands for open educational resources. That means teaching materials that are either in the public domain or released under a license that allows them to be freely used, changed and shared. OER can be a complete lesson plan or a complete online course.

Why the demand increasing:

Teachers need common core content. New digital and print material can be inexpensive plus online content is easy to share.

Should we have concerns over OER:

Standard for student data privacy may vary so you want to be heads up to that. Some districts lack training on how to choose high quality material.

Slide 3: Examples of OER

Here are some good examples of open education which I think is a great place to get started when looking for or wanting to create open resources. EdTEch books is a great platform for open textbooks.

Slide 4: 5 R’s

In order for something to qualify as open, it must comply with the 5 R’s.

Retain: Control copy of resources

Reuse: Use the new version publicly

Revise: Edit and adapt the original

Remix: Mix the original content with other material

Redistribute: Share copies with others

Slide 5: Open Licenses

An open license lets you retain ownership of your work, while allowing others to use, share, and remix it, without requesting your permission. For most open licenses, all that is required of the users is to attribute you for your work.

Slide 6: What is an open textbook?

The use of open textbooks in universities is, according to some organizations, changing the higher education landscape and is promising for the mainstream adoption of OER. Open textbooks (OT) are part of the broader open educational resources (OER) movement.

“An open textbook is a textbook licensed under an open copyright license and made available online to be freely used by students, teachers and members of the public. Many open textbooks are distributed in either print, e-book, or audio formats that may be downloaded or purchased at little or no cost.”

Slide 7: Purpose

The purpose of open textbooks is education and therefore knowledge is organized to facilitate the user’s learning but the incentives to create open textbooks go beyond making the subject matter more affordable for students.
E.g., to make the textbooks available for a broader community and to provide creators and adaptors with the ability to reuse, remix and redistribute the material in order to customize it for their courses.

**Slide 8: OER vs. Traditional**

What is the difference between OER and Traditional textbooks?

**Slide 9: Cost Savings**

Students can save hundreds of dollars every year on textbook costs with open replacements because they are able to use the materials without cost.

**Slide 10: Benefits: Learners**

Here are some benefits for learners when using open textbooks

**Slide 11: Benefits: Instructors**

Here are some benefits for instructors if they use open textbooks

**Slide 12: Future**

OER promotes a future in which instructors and students have free access to a wide range of excellent educational resources that have been generated, vetted, and shared cooperatively across institutions. a time when it is simple to modify instructional materials to fit the needs of various students and the setting of various courses. a time when the cost of creation, use, and upkeep is significantly cheaper than the escalating price of textbooks and other educational supplies today.
Kenzie Dinsmoor
Brigham Young University

Kenzie Dinsmoor is a graduate student in Brigham Young University's Instructional Psychology and Technology program. She previously earned a Bachelor's degree in Elementary Education with minors in Art History and TESOL K-12 (Teaching English to Speakers of Other Languages) from BYU. She is currently teaching a programming course at BYU for Elementary Education majors. Her interests include teaching coding at the elementary level, military instruction and design curriculum.

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Community Members Should Create OER

Melanie Jensen

*Ordinary community members should contribute to Open Educational Resources.*
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Open textbooks for MSED faculty

Jennifer Ramsey

A presentation on open textbooks to help BYU’s McKay School of Education faculty revamp their courses with creating content in EdTech Books. Topics presented include descriptions of OER and open textbooks, the drawbacks of open textbooks, and the strengths and solutions of open textbooks.

Watch on YouTube

Google Slides Presentation

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Consider OER
Erin Measom

Presentation to online faculty to consider adopting open educational in their online course.

We are excited to have you work with BYU Online to develop your online course. This presentation is to give you a very brief overview of the benefits of using OER to you and your students.

Open Educational Resources (OER) are learning, teaching and research materials in any format and medium that reside in the public domain or are under copyright that have been released under an open license.

One important component of OER is what is called the 5 R’s. OER allows you to Retain Revise Remix Reuse and Redistribute.

As we talk about some important components of OER we will use the COUP framework to illustrate some of the impacts that the adoption of OER has in higher education. Coup stands for Cost Outcomes Usage and Perceptions,
Cost is one of the most impactful and easily recognized benefits of OER. Here are just a few stats about high textbook cost.

We know it is important than you know how student outcomes compare when using OER. Multiple studies have shown that the use of OER improves or does not decrease student learning.

We know it is important for educators to understand how students are experiencing their online class. The use of OER can help provide more information on how resources are being utilized.

Do you want to know how other faculty and students perceive open resources and Here are just a few finding:

Decreasing cost to underserved students, improving usability and increasing the voice of the marginalized are a few ways that OER improves equity

Have you heard about open pedagogy. Using this approach in teaching allows students to help create materials, they can also remix and reuse existing materials in a course.

We recognize that there are challenges in adopting OER. We can help you find a starting point that is right for you and help you let your department know about the value of this practice.

We have given you a small idea of some of the research around OER, we would also like to encourage you to consider adding to that research.

Thank you for considering OER for your course Please let us now if you would like more resources

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**Erin Measom**

Brigham Young University

Erin is currently working as the Academic Manager for online classes at Brigham Young University. In this position she supervises over 500 teaching assistant. She loves creating programs and processes to help student’s succeed and she is passionate about growing and expanding the peer support model. She is a Ph.D. candidate in the Instructional Psychology and Technology program also at BYU.
A Pitch for Open Textbook Adoption

Bobbie Sandberg

Here is my presentation about why BYU-Hawaii should consider adopting open textbooks.
Bobbie Sandberg
Brigham Young University

Bobbie Sandberg is a graduate student in Brigham Young University's Instructional Psychology and Technology program. She previously earned a bachelor's degree in Linguistics and a Master's Certificate in TESOL (Teaching English to Speakers of Other Languages) from BYU. She taught writing courses for second language learners preparing for college admission. Her research interests include creating learning communities and student engagement in online environments.

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The Case for Open Textbooks in SFL

Rebecca Stull Zundel

This presentation addresses why BYU's School of Family Life Professors should adopt open textbooks.
A Call To Action for Instructors

Jana Hansen
Expanding the use of open education in the BYU Marriott School of Business
A CALL TO ACTION
LEADERSHIP

Jana Hansen

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Lessons Learned

The Powers and Pitfalls of Open

Rachel Wadham

An overview of the lessons learned during a semester long study of the philosophy and context of open educational resources and projects to create two resources.

Today I would like to share with you some lessons learned during my semester long study of the philosophy and context of open educational resources and projects to create two resources.

The projects I worked on included work on the structure for an open access textbook for one of my courses as well as work on open access lesson plans and a structure to disseminate them.
In strategizing on how to make these projects happen I encountered a number of challenges, and through these challenges I learned a few things that I would like to share with you.

I first had to look for existing resources and I quickly learned that finding open resources can be challenging. With no one cleaning house it was a lot of work to really explore the landscape.

Even when I found some similar content I found the quality of open really varies. Particularly with open lesson plans some were really great and others where poorly constructed and thought out.

Because quality varied, I came to realize just how important remixing is. Lesser quality items did have some useful elements so the ability to remix was essential.

I soon found the amount of work ahead was too much for me alone. So I began the complex process of creating collaborative partnerships to really make my open resources stronger.

But not everyone really understood the concept of open and to cement my partnerships I had to do a lot of educating about the purposes and values of open.

With more collaborators deep strategic planning about the scope and context of the project and strategies for dividing the work resulted in numerous conversations and compromises.

In planning content we constantly came up against copyright. How much can you really quote from copyrighted texts? How can you remix and use copyrighted material? All are tricky questions.

I’ve laid a lot of groundwork but still have a long way to go. I’ve come to appreciate just how essential things like planning and collaboration are to making open resources successful.

So I’m going to keep working on making these resources a reality and now the future of my open resources will be all the better because of the lessons learned.

Rachel Wadham
Brigham Young University
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Access it online or download it at https://edtechbooks.org/open_education/lessons_learned.
A Pitch for K-12 Teachers and Their Students to Create O.E.R

Nathan Standing

The purpose of this presentation is to provide K-12 teachers with an explanation of open education and to encourage them to create O.E.R. with their students.
Why did you choose to become a teacher? It is very probable that your response would include that you want to bless the lives of children. You may want to bless the lives of as many children as possible.

Today, I am going to discuss ways that you can expand your influence to bless children even those outside of your classroom. Open education is one way to do this. I will discuss simple ways to use open education.

First off, open education is a way of carrying out education that is free meaning both free of cost (gratis) and free to use without limitation (libre). Openness often involves the creation of open education resources which are materials that are not restrained by copyright and are open.

The person who coined the term, open education, was David Wiley. He also came up with the five R's that he argues must be present in order for something to be considered open. Understanding these five R's helps you gain a more complete understanding of open.

The first R is retain, meaning people can own and make copies of the materials. Then there is reuse, meaning people are free to use the material. Revise refers to the freedom people have to also change the material to fit their own needs.

Remix refers to the ability to combine the resource with other resources in order to form something new. Lastly, redistribute means that people are allowed to share the content they create with whoever they wish.

As a teacher, you have limited time. I am going to suggest only two things that you can implement in order to participate in open education. 1) Create open education resources 2) Involve your students in creating open educational resources.

Open education resources or O.E.R. are instructional resources that have at least 4 of the five R’s. O.E.R. is not restricted by copyright.

As a teacher, you can actually license the things that you are already making with an open license called a creative commons license. Doing this will essentially allow people anywhere in the world to use your material. There are many types of creative licenses. Click on the link to learn more.

Secondly, you can involve your students in open pedagogy. This isn’t just teaching your students about open education, but allowing them to create O.E.R. themselves. For example, you could have students create educational videos and then assign them a creative license.

There are many examples of teachers doing this successfully. Some teachers have their students create O.E.R. textbooks. There is actually an online high school called Mountain Heights Academy whose curriculum is based on O.E.R and regularly involves their students in creating O.E.R.

In closing, thank you for listening to me today. I am no expert, but if you have any questions feel free to reach out. Thank you.

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This short presentation prevents three reasons as to why the BYU SFL 223 faculty should consider switching their traditional textbook to an open format. These reasons includes better achieving the mission of BYU, helping increase student wellbeing, and being able to more easily improve students learning now and throughout their lives.
### The Case for OER in SFL 223

| 1 | Think Celestial | “The people began to be distinguished by...their chances for learning...” | “They had all things common among them...and partakers of the heavenly gift.” |
| 2 | Student Wellbeing | 40% of college students experience food insecurity | Students focusing on learning and improving academically |
| 3 | Ability to Improve | Must wait to update, difficulty accessing, stagnant content, etc. | Update continually, instant access, interactive content, collect data, etc. |

### Sources


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OER in English Language Teaching

Karina Jackson

This is a pitch to the Linguistics Faculty at BYU that teach the TESOL courses. The English Language Center at BYU exists to support the TESOL students by providing a place to practice applying their learning and research. The ELC has implemented OER, but we are still hoping to encourage more faculty to get involved in creating, sharing, and using these resources.

Thanks for coming to this presentation today about Open Educational Resources that we're using at the English language center, and how we'd like to get the TESOL faculty more involved in the creation and sharing of those resources.

Now, open educational resources are materials that are copyrightable, but they are shared in the public domain, or with the license that allows them to be free and used unrestricted.
And that means: retaining, revising, remixing, reusing, and redistributing. We can talk about that in more detail later, but it's just basically the idea that these materials are shared so others can use them as needed.

And at the ELC, we have in our mission statement the idea that we share our scholarship for the benefit of others, which is really this idea of openness and sharing what we know with others.

Now we have the most incredible students and teachers at the English Language Center that are very creative and enthusiastic about teaching and learning, and we want to share that with others.

Some of our current projects are listening and speaking books, writing textbooks, and even positive psychology in ESL classroom. And these are all great things that our students have been working on.

In the last year, we've had undergraduates, graduate students, community teachers, full time administrators. Some working with me and some with Ben on positive psychology work.

And the benefit for this is that they get to apply what they're learning in the TESOL classes both the content and pedagogical knowledge, and they get to then pilot in their actual classrooms to see how it works.

They also gain a publication and a resource that they can continue using, no matter where in the world they go after graduation, which is all very exciting.

The benefits for the TESOL program is that this brings more recognition to our program for our contributions to the field. Recently, Ben Mcmurray and I gave a presentation at TESOL about this very topic.

We'd love for these types of classes to get more involved because the students are learning this great material, and they could actually learn by creating things to share openly.

And you can see in this graphic that the things that we have already created and shared openly, are being used worldwide, really showing that we're building global leaders in TESOL. Thank you!
Introduction to Open Education

Gloria Mora

*Here is my presentation with answers to some questions frequently asked about Open Educational Resources.*
Gloria Mora

Gloria Mora is a first-generation Latina Ph.D. student in BYU's Instructional Psychology and Technology Department. Her work centers on understanding learners’ experiences and how they interact with their environment. She is committed to researching and designing culturally relevant learning experiences. In her spare time, Gloria practices yoga and meditation. She also enjoys traveling and learning more about different cultures.

This content is provided to you freely by EdTech Books.

Access it online or download it at https://edtechbooks.org/open_education/introduction_to_open.
This presentation is about open pedagogy and why it should be used in current classrooms.

Open refers to things made accessible, collaborative, and free in both senses of the word. Open pedagogy is using OER to support learning and improve teaching practices -- overall improving the education experience.

I will talk about the inputs, the process and the outputs.

The first input is OER. That is the lesson plans that are being used and created or modified. Textbooks, past student work, or even inviting current students to create OER (student creation flows into the process). There's also the input of the time and effort teachers are putting in to their creations. This is going to increase as they create resources that are specifically customized to their class. For this to happen, teachers are going to need to be paid a little bit more. They already don't get paid enough despite their education; so to ask them to do more without an increase in pay is challenging.
The process is all about collaboration. Collaboration among teachers includes sharing lesson plans, best practices, and helping each other adapt to the needs. This will result in innovation. Think about how many times Pluto has changed between a dwarf planet and regular planet. Open pedagogy will allow students and teachers to update those textbooks. And lastly, students are involved in that collaboration as well. Just like real life, they share with each other and they learn from each other.

Because students are involved in the learning process, the first output is more prepared students. This is a result of the improved curriculum. Students are more prepared to enter the real world after whatever level of education. They are also more excited about learning. Learning should be fun and exciting. Being a part of that creation process makes it that way.

This is a new territory. It’s going to take time for open pedagogy to get to where we want it to be. So start being an advocate now and be willing to adjust as we go on.

My experience this semester was really exciting. I created resources that were used by 130 ExDM students at BYU. The OER I was creating was being used in real time to help students succeed.

I hope that you enjoy using OER and open pedagogy in your classroom soon.

Kirsten Buer

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https://edtechbooks.org/open_education/what_is_open_pedagogD.
Dear Colleagues,

If I were to ask each of you to consider which qualities or competencies make a person an excellent educator, I imagine there would be a few salient replies, and I am confident that among the most repeated responses would be a person’s ability to understand, connect with, and engage an audience of learners. It is an ability that most teachers strive to develop because we have seen the positive impact on learning outcomes. As an educator speaking to educators, I am here to offer a viable means of amplifying these positive effects: integrating Open Educational Resources (OER) into teaching practices empowers us in our efforts to connect with and engage learners.

The affordances of OER give us the ability to leverage our understanding of specific learning audiences in increasingly dynamic ways. Allow me to illustrate this with a simple example. Sam and Cindy both teach World History in a public high school in the Southwestern United States. Both are excellent teachers who invest time and energy towards knowing their students’ interests, personalities and cultural backgrounds. Sam teaches the course using the traditional textbook that has been used at the school for the past five years. He finds some of it to be out of date, or inaccessible
to his students, but he makes it work. Cindy teaches the same class using various resources from the OER Commons’ World History Textbooks Collection. These resources are openly licensed, so Cindy can revise and remix them. She compiles resources from several different OER texts, picking the ones that she knows will be the most relevant, engaging and accessible for her learning audience. If she finds that a key perspective is missing, she adds it to the resource before distributing it. Although Sam and Cindy are both excellent educators who work hard to meet the needs of their classes, Cindy's ability to do this is amplified by the affordances of OER.

Integrating OER into instruction will not make us better educators. OER are simply tools. What it can do is aid excellent educators in engaging learners by offering them more freedom to design instruction with specific learner audiences in mind.

Sincerely,

Christan Hatch-Garcia

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Pitch to BYU Online

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Transcript
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A Brief Overview of Open Education

Breanna Slaugh

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Open Textbooks in the NDFS department pitch

Kayla Keiser
ADVANCING EDUCATION THROUGH OPEN TEXTBOOKS IN THE NDFS DEPARTMENT

By: Kayla Keiser

Watch on YouTube
ADVANCING EDUCATION THROUGH OPEN TEXTBOOKS IN THE NDFS DEPARTMENT

By: Kayla Keiser

COST OF TEXTBOOKS

• In August 2016 the U.S. Bureau of Labor Statistics reported that the price of college textbooks has increased 88% since 2006
COST OF TEXTBOOKS

- A Florida survey found that 64% of students reported not purchasing a required textbook because of its high cost

FOOD INSECURITY

- Around 40% of BYU students experience food insecurity
FOOD INSECURITY

• College students are more susceptible because of balancing the large cost of tuition, fees, books, housing and recently rising food prices.
CONSEQUENCES OF FOOD INSECURITY

- Increased depression and other kinds of psychological distress.
- Lower academic performance

HEALTH OUTCOMES

- Food insecurity can lead to Type 2 diabetes, high blood pressure, heart disease, and obesity.
OPEN TEXTBOOKS IS A POSSIBLE SOLUTION

ONE-THIRD STATED THAT THEY HAD EARNED A POOR GRADE IN A SUBJECT BECAUSE THEY COULD NOT AFFORD TO BUY THE TEXTBOOK
BENEFITS OF OPEN TEXTBOOKS

- Removable and tailored to class
- Have the opportunity to impact thousands of students

NUTRITION 101

- Available for everyone
- Core principles are taught to help students understand nutrition
Hello, I will be talking about advancing education through open textbooks in the NDFS department. Here we go! The cost of textbooks has risen significantly. Statistics show that the price of textbooks has increased 88% since 2006, in 10 years. A Florida study found that 64% of students did not purchase their textbooks because of the high cost. One reason why this matters is that food insecurity is higher among college students. At BYU food insecurity is 40%. The national average is 12.5% (for the whole US population). Food insecurity affects college students more severely because they have to balance large costs and limited time. One of those large costs is textbooks. The consequences of food insecurity are increased depression and other kinds of psychological distress, along with lower academic performance. Health outcomes related to food insecurity are higher incidences of type two diabetes, high blood pressure, heart disease, and obesity. Open textbooks are a possible solution to decrease the monetary stress of a student and hopefully decrease food insecurity. 1/3 of students from Florida stated that they had earned poor grades because they could not afford to buy the textbook. The benefits of open textbooks, besides being cheaper, can be remixed and tailored to the class and have the opportunity to help thousands of students. Nutrition 101 would be an excellent course to have access to an open textbook because it can be available for any department and teaches core principles of nutrition. NDFS 310 would also be a good class to have an open textbook because it relies heavily on current research and always needs to be updated.
Open Education for Aspiring Teachers

This is a video to spark interest and appeal for Open Education in pre-service teachers. Undergraduate K-12 Education majors as the intended audience. It focuses on the benefits of Open Education in meeting the idealistic values that pre-service teachers exemplify and emphasizes that Open Education is a tool that can be as good as the educative values we bring to it.

Watch on YouTube
Open in Google Drive
Transcript:
1. Open education is a tool you will want to have as an aspiring teacher.

2. Teachers tend to have a passion for equity and social justice, they believe in education’s power for the benefit of individuals and for humanity. Open education amplifies that power.

3. Before we begin, I want to share a quick story. A wise and seasoned teacher shared his observation that new teachers tend to be overzealous to find the perfect tool, or activity or gadget. He tells them, “Don’t get caught up in finding the perfect thing. The most powerful tool you have as a teacher, and the one your students need the most, is you. Everything else is extra.”

4. This applies to Open Education too. It has exciting potential and sounds like the golden ticket to social issues. But remember, it is a tool, it can only be as good as the values we bring to it.

5. Open education is a global movement to remove existing barriers to education. Experts have identified the most potent means of removing barriers as Open Educational Resources or OER. These are materials that are free to access and are openly licensed, meaning they can be retained, re-used, revised, remixed, and redistributed.

6. This can look like in Minnesota where teachers can contribute courses and lessons they have created that align with state education standards. These sources are OER so they are free to access and can be remixed or revised. Say a teacher was asked to change grades at the last minute, they can easily access whole courses and can mix and match pieces of lessons to create a personalized approach for their unique teaching style and classroom needs. This frees up substantial time for teachers and improves the quality of the lessons.

7. Now, consider a teacher in perhaps a different state or even continent. They can access these existing and expert materials and are free to adjust pictures, stories, and analogies to align with the experiences of their students, making the learning more accessible and personalized.

8. Another example of open education is using assignments for real world purposes. For example, a medical school professor assigns his students to research common diseases and update wikipedia articles. As an open educational resource, these articles are a primary source of medical advice for the underprivileged. Students are spending their learning efforts not only preparing for a career, they are benefiting humanity across the world.

9. Open education empowers teachers and students to personalize learning, reach the underprivileged, and contribute to global knowledge. It isn’t a silver bullet, but as you learn more about it, and apply your values and passions to it, you will find it is an avenue to making education closer to what we always hoped it would be.

[*AI was consulted for wordage on a few of the sentences.]

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