

The impact of OER on teaching and learning practice

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Abstract

The OER Research Hub has been investigating the impact of OER, using eleven hypotheses, and a mixed methods approach to establish an evidence base. This paper explores the findings relating to teaching and learning. The findings reveal a set of direct impacts, including an increase in factors relating to student performance, increased reflection on the part of educators, and the use of OER to trial and supplement formal study. There are also indirect impacts, whose benefits will be seen after several iterations. These include the wide scale reporting of adaptation, and the increase in sharing and open practice that results from OER usage.

Keywords: Open education; OER; Open textbook; impact

Introduction

Open Educational Resources have been part of the educational landscape since 2001 with the announcement of MIT's OpenCourseWare project, and longer if the Learning Objects movement is viewed as a precursor to OERs (Weller, 2014). There are several definitions of OERs, but with a good deal of overlap. The William and Flora Hewlett Foundation, who funded the MIT project, define OER as:

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. (Hewlett Foundation n.d.)

This is a broad definition that covers whole courses (MOOCs) as well as individual resources, textbooks and software. A key element to it is the stress on the license that permits free use and re-purposing. In order to satisfy the Hewlett definition it is not enough to simply be free, it has to be reusable also. There are other definitions of OERs available [see Creative Commons (2013) for a comparison of these] but even if they do not explicitly mandate an open license, they all emphasise the right to reuse content.

Following on from the MIT announcement, an OER movement began, with many other universities following suit. These projects were often funded by foundations such as the William and Flora Hewlett foundation, or national initiatives such as the Joint Information Systems Committee (JISC) in the UK.

Similar initiatives were founded in most regions around the globe, with considerable funding from national governments. It is worth considering the motivations for these numerous OER initiatives. A JISC review of the various OER programmes in the UK identified five major motivations (McGill, Falconer, Dempster, Littlejohn & Beetham, 2013):

- building reputation of individuals or institutions or communities
- improving efficiency, cost and quality of production

- opening access to knowledge
- enhancing pedagogy and the students' learning experience
- building technological momentum

As the authors point out, these motivations are not exclusive and often overlap. Similarly, the Hewlett Foundation (2013) state five motivations for why they fund the OER field:

- Radically reduce costs
- Deliver greater learning efficiency
- Promote continuous improvement of instruction and personalized learning
- Encourage translation and localization of content
- Offer equal access to knowledge for all

These are often stated as beliefs about what OER will, or can achieve. In the early phases of a movement, there is often a lack of evidence, as the development projects are required to generate the data. It is also the case that with OER projects many are focused on developing and releasing OER content rather than researching its impact, and so reliable data is often absent. However, the field is now reaching a level of maturity, and one of the stated goals is for it to become mainstream practice (Hewlett Foundation, 2013). In order to realize this, reliable evidence regarding the nuanced impact and effectiveness of OERs is required.

The OER Research Hub is a project at the UK Open University which was funded by the Hewlett Foundation to address this perceived need to develop a more robust evidence base for the impact of OERs. Drawing on previous research and in dialogue with the Hewlett Foundation, the project developed eleven hypotheses which represented some commonly stated beliefs and motivations regarding OERs. These were derived from previous experience, consultation with Hewlett Foundation and stakeholders, and analysis of common claims in OER literature. The full set of hypotheses is:

- A - Performance: Use of OER leads to improvement in student performance and satisfaction
- B - Openness: The Open Aspect of OER creates different usage and adoption patterns than other online resources
- C - Access: Open Education models lead to more equitable access to education, serving a broader base of learners than traditional education
- D - Retention: Use of OER is an effective method for improving retention for at-risk students
- E - Reflection: Use of OER leads to critical reflection by educators, with evidence of improvement in their practice
- F - Finance: OER adoption at an institutional level leads to financial benefits for students and/or institutions
- G - Indicators: Informal learners use a variety of indicators when selecting OER
- H - Support: Informal learners adopt a variety of techniques to compensate for the lack of formal support, which can be supported in open courses
- I - Transition: Open education acts as a bridge to formal education, and is complementary, not competitive, with it
- J - Policy: Participation in OER pilots and programs leads to policy change at an institutional level
- K - Assessment: Informal means of assessment are motivators to learning with OER

In this paper the most significant hypotheses relating to teaching and learning will be examined, namely hypotheses A-F. An analysis of all hypotheses can be found in de los Arcos, Farrow, Perryman, Pitt and Weller (2014).

Methodology

The project adopted a mixed methods approach. As well as gathering existing evidence onto an evidence map (oermap.org), the project worked with 15 different collaborations, across four sectors: K12, Community College, Higher Education and Informal Learning. Interviews, case studies, and quantitative data were gathered, but this paper mainly reports on responses to surveys. A set of survey questions was created, addressing the 11 hypotheses. Although slight variations were permitted depending on context, the same pool of questions was used across a wide range of respondents. These included students in formal education, informal learners, educators at K12, Community College and Higher Education level and librarians. In total 21 surveys were conducted, with nearly 7,500 responses.

The collaborations were as follows:

1. The Flipped Learning Network (FLN) – a community of teachers whose mission is ‘to provide educators with the knowledge, skills and resources to successfully implement flipped learning’ (Flipped Learning Network, n.d.).
2. Vital Signs – a citizen-science programme for middle-school children run by the Gulf of Maine Research Institute. The aim is for 7th and 8th grade kids to learn science by doing science ‘using inquiry, peer review and scientific tools to investigate genuine research questions about invasive species’. (Vital Signs, n.d.)
3. Community College Consortium for OER (CCCOER) – a coalition of more than 240 colleges across 11 states in the USA, who are starting to use OER.
4. Open Course Library (OCL) – a collection of shareable learning materials, including syllabi, course activities, readings, and assessments designed by teams experts in the Washington area.
5. OpenLearn – the OU’s web-based platform for OER. It hosts hundreds of online courses and videos and is accessed by over 3 million users a year.
6. TESS-India – a project developing OERs for teacher training in India.
7. Bridge to Success – a project that developed and piloted whole course OER in math and learning/personal development skills (*Succeed with Math* and *Learning to Learn*, respectively).
8. OpenStax CNX (formerly Connexions) – a repository of OER, which have been shared and peer-reviewed by educators. The OpenStax CNX platform also enables users to remix and create their own resources. OpenStax College are providers of a range of open textbooks.
9. School of Open – an initiative of Creative Commons and Peer to Peer University (P2PU) which provides facilitated and non-facilitated open courses on different aspects of “openness” (e.g. copyright and licensing, OER, Wikipedia etc.).
10. BCCampus Open Textbook Project – this aims to create 40 open textbooks for use in HE institutions in British Columbia, Canada.
11. MERLOT – an OER repository and community.
12. ROER4D – a project investigating the impact of OER in the Global South.
13. The Saylor Academy – a non-profit organization offering free courses.
14. Siyavula – math and science open textbook providers based in South Africa
15. Project Co-PILOT (Community of Practice for Information Literacy Online Teaching) – this project promotes OER on digital and information literacy in the Higher Education sector.

Each of the collaborations had a researcher from the Research Hub assigned to work with them. Three or more of the 11 hypotheses were also allocated to each collaboration, with hypotheses A

(performance) and B (openness) being relevant to all. In addition one fellow from each collaboration visited the Open University to focus on a specific area of research.

Supplementary to the evidence acquired from these targeted collaborations the project also incorporated evidence from the OER community and published research which was added to the evidence map. The team adopted an agile methodology adapted from software development. This is focused around week-long sprints which targeted particular hypotheses. One such sprint has focused on populating the evidence map from research repositories and through regular review of academic journals.

The overall survey data was gathered across the collaborations, with 7498 respondents in total, and the frequencies analysis of this data constitutes the main evidence basis for this paper. The breakdown of respondents from each of the collaborations was as follows:

Flipped Learning Network (n=118); CCCOER (n=128); Saylor (n=3213); OpenLearn (n=1668); OU iTunesU (n=1114); Siyavula (n=89); Librarians (n=218); General Survey (n=147); School of Open (n=129); BCCampus (n=85); Open Stax (n=400) and OU YouTube (n=189).

Hypotheses Analysis

This section will provide a breakdown of results according to each of the first five hypotheses, which represent the main focus on teaching and learning.

Hypothesis A - Performance

Use of OER leads to improvement in student performance and satisfaction

This was an overarching hypothesis for the project in that it was addressed in all collaborations; it can also be seen as an overarching belief for the OER movement in general. The additional element of satisfaction has been added to performance, as many observers suggested that OER based courses may not lead to improved performance, but that students preferred them due to variety and quality of resources.

On the impact of OER on student satisfaction, 62.1% (n=524) of educators agreed or strongly agreed that OER increased student satisfaction with the learning experience, an opinion shared by 60.7% of formal students (n=707). On the subject of performance understood in terms of improved grades, only 44.1% (n=372) of educators believed that OER use resulted in better test scores for students, a percentage that decreased to 38.9% (n=453) for the responses of formal students.

There is stronger belief for OER improving non-grade related aspects of performance, with a majority of educators (59.6%, n=503) agreeing that OER improved student engagement with lesson content and increased students' experimentation with new ways of learning (60.3%, n=501); 59.5% (n=505) that students are more independent and self-reliant as a result of using OER, and 60.8% (n=524) that students become more interested in the subjects taught. The impact for learners can be dramatic as this quote demonstrates:

*"I went from being horrible in AP Biology to actually reading these and went from a D 66% up to a A 90% so far."
(Open Stax student)*

There is strong evidence that OERs benefit learners' engagement, as formal learners rank 'increased interest in the subjects taught' as the biggest impact that OER have on their learning (61.9%, n=720), followed by 'increased enthusiasm for future study' (60.4%, n=702); and 'becoming interested in a wider range of subjects than before I used these resources' (54.7%, n=637). Looking at users of Saylor resources in particular, more than half of learners believed that they grew more confident,

became interested in a wider range of subjects, their learning experiences became more satisfactory and their interest in formal studies increased.

Hypothesis B - Openness

The Open Aspect of OER creates different usage and adoption patterns than other online resources

Hypothesis B was intended to guide exploration of whether the open licensing of open educational resources is a contributory factor to their being used differently from non-open online resources. To what extent does *openness* (which in this case we interpreted as openly licensed resources) make a difference over their simply being online and free? Disentangling the influence of these elements is problematic, as the contribution of all factors will influence the use of a resource.

One indicator of the influence of openness is the degree to which resources are adapted. The OER Research Hub found a comparatively high level of adaptation amongst all types of users (77.7%, n=1890), regardless of being educators (79.8%, n=674), formal learners (77.3%, n=338) or informal learners (84.7%, n=792). What constitutes adaptation varies for these users, and is an area that requires further investigation. This is in contrast to other research which found previously low levels of adaptation (Wiley 2009). However, what constitutes adaptation may vary. For some users it means using the resources as inspiration for creating their own material, as this quote illustrates:

“What I do is I look at a lot of free resources but I don’t usually give them directly to my students because I usually don’t like them as much as something I would create, so what I do is I get a lot of ideas.”
Math Teacher, Grade 11

While this is an important use of OER (and perhaps under-reported), it arises principally as a result of their online availability rather than open licence. However the freedom to reuse ideas is encouraged with an open licence and users feel encouraged to do so. For other users, adaptation is more direct, editing or reversioning the original, or aggregating elements from different sources to create a more relevant one, as this quote demonstrates:

“The problem where I teach now is that we have no money; my textbooks, my Science textbooks are 20 years old, they’re so out-dated, they don’t relate to kids (. . .) so I pick and pull from a lot of different places to base my units; they’re all based on the Common Core; for me to get my kids to meet the standards that are now being asked of them, I have no choice, I have to have like recent material and stuff they can use that’ll help them when they get assessed on the standardised test.”
Math & Science Teacher, Grades 7–8

And for others, adaptation may be taking an existing resource and placing it in a different context within their own material, for example:

“I will maybe look and find an instructional video that’s maybe 2 or 3 minutes long that gets to the point better than I could, and I would use it, or I will look for lessons and if they are for Grade 5 or Grade 3 I don’t use all of it, I just adapt it, I take out what I don’t want and rearrange it.”
Math teacher, Grade 2

What this suggests is that one impact of openness is that it allows a continuum of adaptation to develop, ranging from adapting ideas for teachers’ own material to full reversioning of content.

This extensive adaptation of OERs is in contrast with the use of open licences for sharing content. Only 14.8% (n=125) of educators (N=845) shared resources with a Creative Commons license, although a majority (70.4%, n=285) considered open licensing important and were familiar with the Creative Commons logo (41.1%, n=171). This is however consistent with the fact that only 28.2%

(n=281) of educators were concerned with not knowing whether they have permission to use or change a resource. There is a disparity between consumption and sharing practice, for instance for Flipped Learning educators, 82.5% (n=90) say that they adapted OER, 43.3% (n=42) created resources and shared them publicly online, but only 5.1% (n=5) published them under a CC license.

An open licence is not the most significant factor for many users when selecting an OER, with relevance and reputation being most salient. The significance of an open licence varies across users however, depending on purpose. For users of Saylor content who are primarily independent learners, only 17.7% (n=483) said that CC licensing was an important factor for them when choosing OER, whereas for Community College educators and learners, this rises to 51%.

Openly licensed content also allows for experimentation and innovation, in allowing educators to adapt, alter and share content. This ability to experiment is possibly one of the most significant factors of OERs for educators. For instance, high percentages of both OpenStax College (64.4%) and Siyavula (78%) educators reported that using these OERs increased learners' experimentation with new ways of learning. A majority of OpenStax respondents (80%) reported that they were more likely to discuss using OER with college administrators having used it once.

There is some evidence for the 'openness as virus' hypothesis, that once users have been 'exposed' to open resources they seek them out elsewhere. For example, high numbers of both OpenStax College using educators and Siyavula educator survey respondents report being "more likely" to use other free educational resources/open educational resources for their teaching as a result of using Siyavula/OpenStax (Siyavula: 90.2%, n=55 and OpenStax: 79.5%, n=58). The following quotes also indicate a similar trend and what appears to be an increased sense of community around the use, creation and sharing of OER:

"I tend to share my materials more freely than before. I like for people to use my materials since I benefit so much from other people's free sharing"
Siyavula teacher

Elsewhere over 50% of Siyavula educator respondents reported that they collaborated more with colleagues as a result of using OER (51.7% "strongly agree" or "agree" n=31) and over 70% reported that they more frequently compared their own teaching with others (72.1% "strongly agree" or "agree" n=44).

Hypothesis C - Access

Open Education models lead to more equitable access to education, serving a broader base of learners than traditional education

Based on evidence from our research with collaborations there is a mixed picture as to whether open education models lead to more equitable access to education. There is some negative evidence in the demographics of the informal learners, 57% of whom already have an undergraduate or postgraduate degree. This is in line with similar findings for MOOCs (Meinel, Willems, Renz & Staubitz, 2014).

However, one use of OER that was evident was either to support formal students studying already or for trialling a subject before committing to formal study. For example, 41% of learners (n=398) used OERs to try university-level content before signing up for a paid-for course. The Open University reported a 10% conversion rate of learners using OpenLearn OER materials, and then going on to the formal sign up page of a relevant course (Perryman, Law & Law, 2013). There is evidence to show that OER enables students to develop an interest in their subjects as this quote demonstrates:

"It has allowed for me to develop knowledge easily in areas that I thought would be difficult to learn in due to the inability to buy an in-depth textbook."

Saylor user

Some learners are using OER as a replacement for formal education which they might not otherwise have access to. For example, 88.8% of all learner respondents (n=3657) indicated that the opportunity to study at no cost was significant, and for Saylor users 26% of the formal students said they used Saylor as a replacement for HE, perhaps to indulge an interest in a subject they don't feel they can afford to study institutionally. Amongst OER users who were already in higher education, 52.7% indicated that they were using OER to supplement their formal studies.

A longitudinal study would be required to determine if this trialling of formal content prior to, or supplementing formal study has any effect on student retention. Given the increasing cost to students of entering higher education, this function of OER in supporting their choice and also allowing diversity in their study is under-represented in the literature, and may represent a growing role for OER in the sector.

Hypothesis D - Retention

Use of OER is an effective method for improving retention for at-risk students

Educators (N=576) were asked to agree or disagree on a 5-point Likert scale with the statement 'OER use increases the likelihood of students at risk of withdrawing, continuing with their studies'. A majority (51%) were undecided and while the percentage of those in favour was 36.6%, the proportion of those who disagreed or completely disagreed was lower at 12.3%. As one educator commented

"Many at risk students . . . have more complicated extrinsic factors impacting their lives, which may require more intensive contact from the instructor to keep them involved in the course. OER is not going to be a make or break issue of retention. It is not a panacea for at-risk students."

A small number of educators (N=100) were queried about the aspects of OER that help improve retention for students at risk of dropping out of their course of study (Table 1). Cost and access can be identified as the most important factors influencing retention.

Table 1: Aspects of OER affecting retention

	EDUCATORS N=100
	%
Reduced cost of study materials	85
Greater range of learning methods	53
Materials can be used flexibly	66
Materials can be accessed at any time	80
Materials can be adapted to suit student needs	49
Use of resources for improving study skills	50
Materials can be used for improving non-native language skills	28
Materials are available in different languages	16
Availability of culturally-relevant materials	25

The view from formal learners who were using OER was more confident, with 46.9% (n=546) stating that OER have a positive impact in helping them complete their course of study.

There is some overlap here with Hypothesis C, as the usage there could lead to increased retention, and Hypothesis F which examines financial impact of OER. The free aspect of OER attracted most attention with this hypothesis, and a more longitudinal study would be required to determine whether other aspects of openness have an effect, such as the ability to adapt content to suit learners, or to provide a range resources which might suit different learner's needs.

Hypothesis E - Reflection

Use of OER leads to critical reflection by educators, with evidence of improvement in their practice

There was strong evidence that use of OER tends to lead to reflection on their own practice by educators. This could be a result of exposure to other teaching approaches, of raising awareness of issues that had not been considered before, or through the process of adaptation.

The question here asked educators their views on the impact of OER use on their own teaching practices: 64.3% (n=620) said that they used a broader range of teaching and learning methods; 59.4% (n=558) agreed that they reflected more on the way that they teach; 44.5% (n=416) that they more frequently compared their own teaching with others; 40.3% (n=262) that they now used OER to develop their teaching. Data from other questions in the surveys also revealed that 32.8% (n=363) of educators say they have written a blog post in the last year, 14.3% (n=121) have added comments to a repository suggesting ways of using a resource, and 23.8% (n=201) commented on the quality of a resource.

As reported earlier educators often use OER to draw inspiration. For example most educators using Saylor content said they did so to get new ideas for teaching (73%); prepare for teaching (53%); to learn about new topics (55%) and to supplement lessons (51%). While overall 37.3% of educators felt that using OER encouraged them to collaborate more with colleagues, in some cases this was more marked: 78% of Community College respondents felt this was the case.

Exposure to OER tends to lead to educators incorporating a wider range of content, which itself leads to reflection; for instance, with Siyavula educators, 92.2% of respondents reported that they "strongly agree" or "agree" that they use a broader range of teaching and learning methods as a result of using OER (n=59) whilst over half of all educator respondents indicated that they "strongly agreed" that OER had broadened their coverage of the curriculum (n=34).

Hypothesis F - Finance

OER adoption at an institutional level leads to financial benefits for students and/or institutions

Where open textbooks are used to replace costly purchased ones, there is an obvious saving for students, or if purchase occurs at an institutional or regional level the savings can be more considerable. This represents a major advocacy point for the adoption of OER, and one area of OER impact that has seen considerable research [eg. Bliss, Hilton III, Wiley & Thanos (2013) and Wiley, Hilton III, Ellington & Hall (2012)].

Unsurprisingly a majority of educators (73.1%, n=264) believed that using OER saves students money; a smaller percentage of students (60.9%, n=196) agreed with educators, however librarians were mainly undecided (51.2%, n=83).

Quantifying these savings can be problematic as such calculations often rely on the assumption of 100% purchase by students. However, more precise calculation of student savings is possible. For example, the student savings of over \$1 million at De Anza College were calculated as follows:

“Students never paid more than \$50 for the books, at the bookstore, new. We estimated based on how many students had used the book and at \$50 about three quarters of them would buy it new. I started surveying the students to see buying it new, buying it from their friend, buying it used. . . So we estimated that \$50 with about three quarters of the students who were using the book, buying it new” (Interview with Barbara Illowsky, November 2013)

Just under 80% of OpenStax College textbook-using students (both informal and formal) believed that they had saved money by using the OpenStax textbooks (79.6%, n=39) with a conservative average saving estimate of \$208 per student (n=24).

In response to the question ‘Do you think that your institution benefits financially by using OER?’ respondents tended to agree positively but it was in the ranks of the educators where the highest percentage of No answers occurred. Amongst librarians over 40% reported that they didn’t know whether savings had been made through the use of OER and just over half of all librarian respondents said they didn’t know whether students had saved money by using OER. Similar confusion was seen with Community College respondents, of whom 44% thought that OER had saved money, but 37% didn’t know (and 19% thought they hadn’t). This perhaps indicates an issue around transparency regarding any institutional savings made from OER adoption. The qualitative data throws some light onto the issue, which indicates that savings may not be as direct as assumed:

“Indirectly. Making college more affordable allows our students to stay at our university.”
Community College educator

Discussion

The findings of the OER Research Hub reveal a complex picture of OER use in teaching and learning, and a range of impacts that could be usefully explored for the next wave of OER implementation. OER has a positive impact on student’s attitudes and perceptions of learning, even if comparative data of score improvement is difficult to obtain. There was no evidence that OER use negatively influenced student’s performance, but acquiring robust pre and post implementation score data is problematic as there are usually confounding variables. In the absence of such data however, the attitudinal response that OER improves factors relating to student performance, such as enthusiasm, engagement and confidence represent a strong case for their adoption on a purely pragmatic grounds for education institutions.

Beyond this the data also reveals several other benefits of OERs, which are under-reported in much of the OER literature. Firstly, there is a positive benefit in the reflection on practice by educators that accompanies OER adoption. Secondly, the use of OERs by students to supplement or trial formal education has benefits for both learners and institutions, as it has the potential to improve retention, performance and recruitment, although detailed longitudinal study would be required to measure if these impacts are seen. Lastly, the financial benefits, which is one aspect that has been well researched, were in evidence in our findings also. There were other advantages of free resources beyond just the cost saving: many students reported that having access to the material immediately was important, as the practice was often to wait until a course had commenced to evaluate whether a costly textbook was worth buying. For educators, being able to assume that all students had access to the resource was also reported as beneficial.

These findings represent direct impacts of OERs, that is ones that have immediate impact for learners, educators and institutions. Taken as a whole they make a compelling case for high quality, free resources being released. However, most of these benefits emphasise the free, online, digital nature of OERs, and not the openly licensed aspect. Separating out the influence of these factors has proven problematic for the OER community, but the OER Research Hub evidence suggests

one way of viewing them. While the primary impacts arise from free cost and access, there are a range of indirect, longer term impacts that emerge from this open aspect. For example, the finding that the majority of users adapt OER materials in some manner is influenced by open licensing. This type of use will have an impact indirectly, in that learners may benefit from improved course design, resources or teaching. Similarly, the manner in which OER use encouraged sharing and collaboration between educators will have its influence felt at one or two degrees removed.

What the findings of the OER Research Hub identify are areas of OER research that can now be pursued to find detailed evidence of impact. They also demonstrate how complex the impact of movements such as OER can be to detail. For instance, gathering quantitative, comparative data on performance is difficult because of concerns around data protection and also the inexact manner of the intervention. Combine this difficulty with the nebulous nature of OER adaptation, and it is perhaps not surprising that the depth of research evidence has not yet emerged for how OER adaptation improves performance. However, the OER Research Hub evidence now highlights where this adaptation is occurring and what type of benefits are being seen with different users.

By considering these direct and indirect impacts, research can be focused appropriately to examine them in further detail. For example, now that the continuum of adaptation has been observed, specific research can focus on the impact of these different types of adaptation, by taking a longitudinal approach to assess the impact over time. Similarly, tracking students who have used OER prior to study and then go onto register for formal study is a proposal to demonstrate that type of impact.

The OER community has been around for over a decade, but compared to many fields it is still in its relative infancy. Now that sufficient implementation projects have been established, the type of research required to find the impact of OER can be undertaken. The findings in this paper help map the OER usage landscape, and reveal a complex picture of different type of usage, with a range of positive benefits.

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