The International Journal of
OPEN EDUCATIONAL RESOURCES

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Mission Statement

The aim of *IJOER* is to provide a venue for the publication of quality academic research with an emphasis on representing Open Educational Resources in teaching, learning, scholarship and policy.

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Letter fom the Editor

Dear Readers of IJOER,

Allow me to introduce myself: I am Dr. Melissa Layne, Associate Vice President of Research and Innovation at American Public University System and Editor-in-Chief for the inaugural issue of the ***International Journal of Open Educational Resources.***

Aside from being *the first* academic, peer-reviewed journal dedicated to Open Educational Resources, this October issue comes with a few other delightful surprises.

First, a passion of mine has always been to reimagine and redesign academic scholarship and I think I have accomplished this by providing a website version of the journal that introduces interactivity to scholarly work. I'm not going to give too much away as you will need to see it for yourself. This marriage of "text and technology" has brought together author, reviewer, and editor to work as a collective team, rather than isolated point persons. Together we have acknowledged what the scholarly journal has *been,* re-imagined what it could *be*, and collectively are redesigning what it could be in today's technology-infused world. I think you will find it an enjoyable read.

Second, (and staying true to my nature of going-against-the-grain) we have the ***IJOER Blog***. Our blog will feature all things OER; therefore, I do not believe we will ever fall short of submissions! I am thrilled to add that two wonderful, OER-Loving Librarians (OERLLs?) from the University of Wyoming, Samantha Cook and Kristina Clement, have volunteered to lead this online version of the journal.

Third, it made perfect sense to include a section called ***IJOER Peer Review***. As a member of several OER forums, I constantly see requests for feedback by those developing OER textbooks and materials, so in each issue we will feature a near-completed or in-progress OER where our readers have the opportunity to provide constructive feedback to the author. I can't think of a better peer review system.

Fourth, I've included a section called *3 Questions for an OER Leader* (an idea I stole from National Geographic). For our inaugural issue, I had the pleasure of posing 3 questions on OER to the lovely Sharon Leu, the U.S. Department of Education's Senior Advisor for Higher Education Innovation in the Office of Educational Technology. Her strategic initiatives aim to increase access, lower costs, and improve student outcomes in higher education. I couldn't think of a better person to interview for our first issue—she is inspirational.

Fifth, we have OER News and Events, where we showcase what's happening in the world of OER and include little interesting tidbits of information on OER scholarly authoring and publishing.

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Lastly, we have very talented and world-renowned authors who are passionate about the ways in which open educational resources have the potential to transform teaching and learning. Their contributions are phenomenal and their fervor for OER is unwaning. They too are very inspirational. I thoroughly enjoyed our collaborative efforts to create this little gift of thoughts, questions, words, images, interactions, and expertise so that we can share it with everyone.

I would like to thank those who have supported me throughout this swift journal start-up, and there are many. While I could have shared the trials and tribulations of starting up a journal (and there are many), I was too wrapped up in how I was going to show how "text and technology" were going to work together to provide readers of the journal with a researcher's "story" rather than a typical study.

Whether publishing a journal, or publishing an OER, publishing is about trust and partnership. Undoubtedly, we at *IJOER* will always keep you informed on the latest in OER, but we will always *strive* to keep you engaged and wanting more. Because in the end, you, our readers, have the freedom to either "accept" or "reject" us, and we would very much like for you to accept us—even if it's "with revisions."

Did I mention we are the ***first*** academic, peer-reviewed journal dedicated to Open Educational Resources?

Stay with us—and expect more.

Melissa Layne, Ed.D.

Editor-in-Chief, *International Journal of Open Educational Resources*

3 Questions for an OER Leader | Featuring Sharon Leu

Photograph by the Ofice of Educational Technology, U.S. Department of Education Staff

Sharon leads the Office of Educational Technology's higher education innovation initiatives. These include the recent Higher Ed Ecosystem Challenge, the EQUIP Experimental Sites Initiative, and the Higher Ed National Educational Technology Plan.

Sharon works with offices across the Department and with stakeholders to think about implementing programs and technology-enabled solutions that broaden access to postsecondary education to all students, especially those traditionally underserved populations.

Prior to joining OET, Sharon oversaw the design and implementation of the Department of Labor's $2 billion Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant program, the largest federal investment in postsecondary innovation and systematic infrastructure change.

Sharon can often be found leaping from boulder to boulder with a heavy backpack and dreams of becoming a park ranger when she grows up.

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1 ***Melissa:*** With any of the Open Education or OER projects you have been involved with in the past, or currently, what seem to be "common denominator" barriers? How have you overcome those barriers?

Sharon: A transition to any new technology or a new way of doing things is difficult and transitioning to OER is no different. Without being blind to the potential challenges, I typically prefer to focus on the new opportunities that continue to present themselves at each new horizon, rather than the barriers to proceeding forward.

For example, with OER, there is the opportunity to make large-scale changes in how to deliver education, structure of education system, and make learning experiences available to a broader audience. But the very first and most tangible impact is the way that open textbooks have created greater access to "information" by dramatically reducing the cost to own learning resources. There is an abundance of data that shows how this has decreased cost and made postsecondary education possible for so many students, especially those traditionally underserved

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by the system. But, it is much more than that.

With open resources, there is the next horizon of opportunity—the ability to completely change the way that education in a classroom is delivered, how and when students experience learning, and how they contribute to it. To fully realize these requires instructors, administrators, content creators, retailers, and policymakers to reflect on their current operations and what it would take to change. In that reflection, there is always inertia around change and uncertainty from lack of information. That is one of the biggest barriers, but one that can be overcome when partnerships and collaboration form at all levels and across traditional bureaucratic silos, focused on the goal of serving students better.

In the context of OER policy that I've worked on specifically, it has been exciting to walk with people through various stages of this transition—first, understanding the goals of open policy, learning more about the technical requirements for implementation, and finally realizing the benefits for themselves and the impact they are able to have with their stakeholders. In the OER community, there is tremendous support and engagement, with practitioners of all skill levels eager to share about their process, the results they have seen, and the resources they have created. Both the Departments of Labor and Education have benefited and continue to learn from the insights, research, and resources of this community.

2 Melissa: What projects or initiatives in Open Education and/or OER are you currently working on for the Department? (Tell us a little bit more about what you are working on ...)

Sharon: I am excited about the work that the Department has done in open education. There are three main areas of work that OET either leads or supports. First, OET is leading the implementation of the open licensing requirement for competitive grant programs. Beginning in October 2017, most new competitive grants from ED came with a requirement that the educational resources created with grant dollars would have to be openly licensed and disseminated widely. This allows us to enable the public to access and benefit from these investments. We are spending significant time supporting individual program offices to implement this rule, helping their grantees who are unfamiliar with open licenses to think about how—beyond compliance—open licenses might allow more people to benefit from their hard work. We already have great examples from many of our grantees that have been openly licensing their resources for years—for example, Benetech has applied an open content license to materials created through their DIAGRAM Center and an open source license to their software so that anyone can access tools for helping visually impaired students enjoy educational resources.

My colleague in OET, Sara Tretin, leads our #GoOpen initiative, that encourages K-12 schools and districts

to transition to openly licensed educational resources to improve student outcomes. To date, there are 20 states and 119 school districts and that have committed to this systematic approach to open resources.

Finally, our colleagues in the Office of Postsecondary Education are leading an Open Textbook Pilot Program that will make some funding available for the creation of open textbooks in higher education.

3 ***Melissa:*** How can open education/OER fuel innovation? How does it fit into the ecosystem of various technological innovations such as Blockchain, AI, etc. that are popular topics in ed. tech?

Sharon: As I mentioned earlier, open licenses have already fueled innovation in classrooms and in how students access and interact with their learning experiences. Just by reducing cost alone, so many students are now able to have access to the resources they need to succeed in their courses.

Open licenses also have the potential to accelerate innovation across all of education, far beyond one classroom or institution. Thinking just of a few examples. We have already seen an adjustment in the traditional publishing and learning resource market. As resources become more freely available and modularized, and as learning systems and algorithms become more sophisticated, this will certainly become an opportunity to truly personalize learning to the needs of students.

Following that even further, as materials become increasingly exchangeable across platforms and as learning outcomes and competency standards become more transparent, we can imagine enabling students to acquire specific learning resources and to document their skills mastery over their lifetime. This puts open resources at the center of a pretty radical new way of experiencing education—with the student at the center, rebundling their learning experience to fit their needs and owning their own data. If that data on learning supported by a secure, decentralized system, then it would really enable the student to readily exchange their skills for further education or employment opportunities. **Ω**

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3 preguntas para una líder OER | presentando a Sharon Leu

Sharon es líder de las iniciativas de innovación de educación superior de la Office of Educational Technology. Estas incluyen el reciente Higher Ed Ecosystem Challenge, el EQUIP Experimental Sites Initiative, y el Higher Ed National Educational Technology Plan.

Sharon trabaja con oficinas en todo el Departamento y con partes interesadas para pensar en implementar programas y soluciones basadas en tecnología que amplíen el acceso a la educación postsecundaria a todos los estudiantes, especialmente a las poblaciones tradicionalmente marginadas.

Antes de unirse a OET, Sharon supervisó el diseño y la implementación del programa de becas de capacitación comunitaria para el comercio y asistencia para el ajuste comercial de $ 2 mil millones del Departamento de Trabajo, la mayor inversión federal en innovación postsecundaria y cambio sistemático de infraestructura.

A Sharon se le puede encontrar a menudo saltando de roca en roca con una mochila pesada y sueños de ser una guardabosques cuando crezca.

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1 ***Melissa:*** En los proyectos de Educación Abierta o OER con los que ha estado involucrada en el pasado, o en la actualidad, ¿cuáles parecen ser las barreras del "denominador común"? ¿Cómo ha superado esas barreras?

Sharon: Una transición a una nueva tecnología o a una nueva forma de hacer las cosas es difícil y una transición a OER no es diferente. Sin ser ciega a los desafíos potenciales, normalmente prefiero enfocarme en las nuevas oportunidades que continúan presentándose en cada nuevo horizonte y no en las barreras para seguir adelante.

Por ejemplo, con OER, existe la oportunidad de realizar cambios a gran escala en la forma de brindar educación, la estructura del sistema educativo y hacer que las experiencias de aprendizaje estén disponibles para una audiencia más amplia. Pero el primer y más tangible impacto es la forma en que los libros de texto abiertos han creado un mayor acceso a la "información" al reducir dramáticamente el costo de los recursos de aprendizaje propios. Hay una gran cantidad de datos que muestran cómo esto ha reducido el costo y ha hecho posible la educación postsecundaria a muchos estudiantes, especialmente aquellos que tradicionalmente no reciben servicios del sistema. Pero es mucho más que eso. Con los recursos abiertos, está el siguiente horizonte de oportunidad: la capacidad de cambiar completamente la forma en que se imparte la educación en el aula, cómo y cuándo experimentan el aprendizaje los alumnos y cómo contribuyen a ello. Para cumplir plenamente con estos requisitos, los instructores, administradores, creadores de contenido, minoristas y formuladores de políticas deben reflexionar sobre sus operaciones actuales y lo que se necesitaría para cambiar. En esa reflexión, siempre hay inercia en torno al cambio y la incertidumbre por falta de información. Esa es una de las barreras más grandes, pero se puede superar cuando las asociaciones y la colaboración se forman en todos los niveles y en todos los silos burocráticos tradicionales, enfocados en la meta de servir mejor a los estudiantes.

En el contexto de la política de OER en la que he trabajado específicamente, ha sido emocionante ir con las personas a través de varias etapas de esta transición: primero, comprender los objetivos de la política abierta, aprender más sobre los requisitos técnicos para la implementación y finalmente darse cuenta de los beneficios para sí mismos y el impacto que pueden tener con sus partes interesadas. En la comunidad de OER, hay un gran apoyo y compromiso, con profesionales de todos los niveles de habilidad ansiosos por compartir su proceso, los resultados que han visto y los recursos que han creado. Tanto el Departamento de Trabajo como de Educación se han beneficiado y continúan aprendiendo de las ideas, investigaciones y recursos de esta comunidad.

2 ***Melissa:*** ¿En qué proyectos o iniciativas dentro de la Educación Abierta y/o OER está trabajando ahora para el Departamento? (Cuéntenos un poco más acerca de lo que está haciendo ...)

Sharon: Me emociona el trabajo que el Departamento ha hecho en el área de la educación abierta. Hay tres áreas principales de trabajo que el OET encabeza o apoya. Primero, OET está liderando la implementación del requisito de licencia abierta para programas de subvenciones competitivas. Empezando en octubre de 2017, la mayoría de las subvenciones competitivas de ED vienen con un requisito que los recursos educativos creados con dólares de las subvenciones tendrían que tener licencia abierta y ser diseminados ampliamente. Esto nos permitiría habilitar el acceso al público y beneficiarnos de estas inversiones. Estamos dedicando mucho tiempo a apoyar las oficinas de programas individuales para implementar esta regla, ayudando a sus beneficiarios que no están familiarizados con las licencias abiertas a pensar cómo, más allá del cumplimiento, las licencias abiertas pueden permitir que más personas se beneficien de su arduo trabajo. Ya tenemos excelentes ejemplos de muchos de nuestros beneficiarios que han estado licenciando abiertamente sus recursos durante años; por ejemplo, Benetech ha aplicado una licencia de contenido abierto a los materiales creados a través de su DIAGRAM Center y una licencia de código abierto a su software para que cualquiera pueda acceder a herramientas para ayudar a los estudiantes con discapacidad visual a disfrutar de los recursos educativos. Mi colega en OET, Sara Trettin, dirige nuestra iniciativa #GoOpen, que anima a las escuelas y distritos de kínder a bachillerato a la transición a recursos educativos con licencia abierta para mejorar los resultados de los estudiantes. Hasta la fecha, hay 20 estados y 119 distritos escolares que se han comprometido con este enfoque sistemático de recursos abiertos.

Finalmente, nuestros colegas de la Oficina de educación postsecundaria están liderando un Open Textbook Pilot Program que pondrá a disposición algunos fondos para la creación de libros de texto abiertos en la educación superior.

3 ***Melissa:*** ¿Cómo puede la educación abierta / OER impulsar la innovación? ¿Cómo encaja en el ecosistema de diversas innovaciones tecnológicas, como Blockchain, AI, etc., que son temas populares en la tecnología educativa?

Sharon: Como lo mencioné antes, las licencias abiertas ya han fomentado la innovación en salones de clase y en la forma en que los estudiantes acceden a la educación e interactúan con sus experiencias de aprendizaje. Tan solo por reducir el costo, muchos estudiantes ahora tienen acceso a los recursos que necesitan para tener éxito en sus clases.

Las licencias abiertas también tienen el potencial de acelerar la innovación en la totalidad de la educación, mucho más allá de un salón de clase o institución. Pienso en unos pocos ejemplos. Ya hemos visto un ajuste en el mercado tradicional de recursos de publicación y aprendizaje. A medida que los recursos se vuelven más libremente disponibles y modularizados, y los sistemas y algoritmos de aprendizaje se vuelven más sofisticados, esto sin duda se convertirá en una oportunidad para personalizar verdaderamente el aprendizaje de acuerdo con las necesidades de los estudiantes.

Siguiendo esto aún más, a medida que los materiales se vuelven cada vez más intercambiables en las plataformas y los resultados de aprendizaje y los estándares de competencia se vuelven más transparentes, podemos imaginar que los estudiantes pueden adquirir recursos de aprendizaje específicos y documentar su dominio de las habilidades a lo largo de su vida. Esto pone a los recursos abiertos en el centro de una nueva forma bastante radical de experimentar la educación: con el estudiante en el centro, reagrupando su experiencia de aprendizaje para que se ajuste a sus necesidades y poseyendo sus propios datos. Si esos datos sobre el aprendizaje están respaldados por un sistema seguro y descentralizado, entonces realmente permitirían al estudiante intercambiar fácilmente sus habilidades para obtener más educación u oportunidades de empleo. **Ω**

对**OER**领袖的三个提问/专题人物**Sharon Leu**

Sharon是教育技术办公室（ Office of Educational Technology，OET）高等教育创新提议的领导人。该提议包括近期的高等教育生态系统挑战（ Higher Ed Ecosystem Challenge）、EQUIP 试点倡议, 以及高等教育国家教育技术计划。

Sharon和该部门各办公室以及利益相关者共事，一同思考实施计划和技术性措施，以期扩大高等教育面向一切学生的机会，尤其是那些传统意义上无法享有足够服务的人群。

在加入教育技术办公室之前，Sharon负责劳动部20亿美元的贸易调整协助社区大学和事业培训资助项目（(TAACCCT）的设计和实施。该项目是联邦政府对高等教育创新和系统性结构变化的最大投资。

Sharon经常背着沉重的背包，穿梭在户外岩石之间。她小时总梦想成为一名公园护林员。

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1 Melissa： 就您之前或现在所接触到的开放教育资源项目（OER）中，都存在哪些“共性”障碍？您是如何克服这些障碍的？

Sharon： 转变到任意一种新技术或新的做事方式都是困难的，OER也不例外。我意识到潜在挑战，因此选择聚焦于那些能继续呈现新高度的新机遇，而不是关注那些一直存在的障碍。

以OER为例，在如何传递教育、教育体系结构、以及将学习经历带给更多人这件事上做出大幅度改变是可能的。然而首先最能感受到的影响则是，开放图书以通过大幅降低成本到自身学习资源这一途径，从而创造了更多接触“信息”的机会。大量数据表明，开放式图书如何降低成本并让更多学生享有高等教育，尤其是那些在传统意义上无法享有足够服务的人群。然而，开放式图书的影响远不止如此。有了开放资源，就有新一轮机遇——即完全有能力改变课堂教育方式、学生如何学习、何时学习、以及如何互动。为完全实现这些目标，需要指导者、管理者、内容创建者、零售商、以及政策制定者反思其当前的做法和为做出改变所需的付出。就这一想法而言，一直存在一种因缺乏信息而产生的有关改变和不确定性的惰性。这种惰性是最大的障碍之一，但它也能被克服——当所有层面的伙伴关系和协作一起努力跨越传统官僚壁垒，并聚焦于为学生提供更好服务为目标时。

在我所特别研究的OER政策过程中，我很兴奋能与合作伙伴一同经历不同转变阶段——首先，了解开放政策目标，学习更多有关实行开放政策的技术性要求，最后实现利益和与对利益相关者造成的（积极）影响。在OER社区中，大量从业人员支持并参与分享各自在这一过程中的经历、结果和创造的资源。劳动部和教育部都从中受益，并继续从开放社区中学习看法、研究和资源。

2 Melissa： 您当前正在为教育部研究OER中的哪些项目或倡议？（告诉大家一些您当前的工作进展）

Sharon： 我对教育部在开放教育上所做的努力感到兴奋。OET领导或支持的工作主要有三种。首先，OET正为竞争性补助项目指导开放许可的实行。始于2017年10月，教育部大多数新竞争性补助都要求接受资金赞助的教育资源必须开放许可且被广泛传播。

此举将允许公众接触教育投资并从中获益。我们花费大量时间支持个人项目办公室实行此法，帮助不熟悉开放许可的受助人思考其如何能帮助更多人从中受益。在众多受助人中已有杰出代表在这几年间一直实行开放许可资源，例如Benetech已对其DIAGRAM 中心的资料采用开放内容许可，同时对其工作室软件采用开放资源许可，以便所有人能获取相关工具帮助视力受损的学生使用教育资源。我的OET同事Sara Trettin负责 #GoOpen倡议，该倡议鼓励K-12学校和区域完成开放许可教育资源这一转变，以提高学生成绩。截至目前，已有20个州和119所学校区域承诺实现开放资源这一系统性举措。

最后，高等教育办公室的同事们正在领导一项开放图书试点计划，该计划将提供一些资金补助用于在高等教育中创办开放图书。

3 **Melissa：** OER将如何推动创新？它将如何适应不同技术创新（例如 Blockchain, AI这类在教育技术中流行的话题）所组成的生态系统？

Sharon： 正如我之前所提到的，开放许可已经推动了课堂创新、推动了学生如何获取资源并完成学习互动。仅仅减少成本这一优势，便让许多学生现如今能获取其所需的课堂资源。开放许可同时还有潜力在一切教育中加速创新，远不止一间教室或机构。考虑几个例子。传统出版市场和学习资源市场中已出现了调整。当资源变得越来越能被自由获取和被模块化，同时学习系统和算法变得越来越精密复杂时，这一定会成为一种真正实现学生学习需求个人化的机遇。进一步扩展这一想法，当资料在平台间变得日益可交换，当学习结果和能力标准变得日益透明化，我们则能想象学生获取特定学习资源，并在其生涯中记录其能力掌握度。此举将开放资源置于相当全新的教育体验中心——以学生为中心，免费将学习体验匹配到其需求，让其拥有个人数据。如果该学习数据受到一个安全的去中心化系统的支持，则能真正使学生随时交换个人技能，为今后教育或就业机会做准备。

The Infrastructure of Openness: Results from a Multi-Institutional Survey on OER Platforms

by Rob Nyland, Boise State University, USA

Abstract

The purpose of this study is to understand how higher education institutions are selecting and using technology platforms for the creation and delivery of open educational resources (OER). A survey about OER technology was sent to various higher education institutions, resulting in 33 responses. The results suggest that institutions are most commonly using existing tools like the learning management system to deliver OER; however, third-party courseware also has a strong presence. The results also suggest that there is little evidence that institutions engage in structured evaluations when selecting OER technologies, but rather the selection process is most often driven by faculty preference. Institutions were also asked about their level of satisfaction with their platform's ability to support the 5Rs of openness. Respondents were most satisfied with the ability to retain, but least satisfied with the ability to remix content.

Keywords: open educational resource, evaluation, platforms, technology

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La infraestructura de lo abierto: resultados de una encuesta institucional acerca de las plataformas OER

Resumen

El propósito de este estudio es comprender cómo las instituciones de educación superior están utilizando plataformas de tecnología para la creación y publicación de recursos educativos abiertos (OER). Una encesta acerca de la tecnología OER se envió a varias instituciones de educación superior, lo que result en 33 respuestas. Los resultados sugieren que las instituciones utilizan con mayor frecuencia las herramientas existentes, como el sistema de gestión del aprendizaje para publicar OER Sin embargo, los cursos de terceros también tienen una fuerte presencia. Los resultados también sugieren que hay poca evidencia de que las instituciones se involucren en evaluaciones estructuradas cuando seleccionan tecnologías REA, sino que el proceso de selección suele estar impulsado por la preferencia de los profesores. También se les preguntó a las instituciones cuál es su nivel de satisfacción con la habilidad de la plataforma para apoyar la 5 Rs de la apertura. Los participantes están más que todo satisfechos con la habilidad de retener, pero no del todo satisfechos con la habilidad para mezclar contenido.

Palabras clave: recurso educativo abierto, plataformas de evaluación, tecnología

开放的基础设施：OER平台多机构调查结果

摘要

本研究目的在于了解高等教育机构是如何选择和运用技术平台来创建和提供开放教育资源的(OER)。笔者向各大高等教育机构发送了一份关于OER技术的调查报告，得到了33份答复。研究结果表明，各大机构通常用学习管理系统等现有工具来提供OER；然而，第三方课件也有很强的存在感。该结果还表明，几乎没有证据显示机构在选择OER技术时参与了结构化的评价，但更确切地说，选择过程往往是由教师偏好

所决定的。笔者还询问了各大机构对其平台支持开放5R模式的满意程度。受访者最满意保留内容的能力，但对内容重组的能力最不满意。

关键词：开放教育资源，评估，平台，技术

The Infrastructure of Openness

For the past decade, higher education has seen increases in the awareness and adoption of open educational resources (OER), which are defined as

> ... 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. (Hewlett Foundation, n.d.)

While OER can take on many forms, one of the most common forms of OER in higher education is textbooks. These textbooks have been seen as a potential solution for higher education in at least two major ways. First, they are available free of charge and are seen as a way to drive down the cost of education. Second, because these materials are published with an open license, they allow faculty member to engage in 5R activities. These include the ability to *retain*, *reuse*, *revise*, *remix*, and *redistribute* (Wiley, 2014)—meaning that faculty members can adapt the content to more closely meet the needs of their course. Some institutional stakeholders may have concerns that this alternative model of content production may result in lower quality or outcomes; however, a wealth of research has shown that students perceive the quality of OER as being comparable to commercially published materials (Bliss, Hilton, Wiley, & Thanos, 2013; Hilton, Gaudet, Clark, Robinson, & Wiley, 2013; Ozdemir & Hendricks, 2017) and that outcomes are similar, if not better (Grewe & Davis, 2017; Lovett, Meyer, & Thille, 2008; Robinson, Fischer, Wiley, & Hilton, 2014).

In 2017, Cengage made a splash in the world of OER when they announced their OpenNOW product. OpenNOW includes OER from OpenStax and other sources, aligned to learning outcomes, and delivered in one of Cengage's courseware platforms (McKenzie, 2017). For access to an OpenNOW course, students pay a 25-dollar course fee. Cengage argues that this course fee is not for the OER content, which is still free and open, but for the technology and services that help deliver the content. Other companies, such as Lumen Learning and Barnes & Noble LoudCloud, work on a similar course fee model.

While some critics have argued that Cengage's approach is not a good

approach to the stewardship of OER—placing open content in a locked down, proprietary platform—it brings up an important opportunity to differentiate between OER content and the platforms or technologies by which it is delivered. What values should OER platforms hold? How should institutions of higher education select platforms for the delivery of OER? How can they be strategic about the use of those platforms?

In order to determine best practices for platforms and OER, we first need to understand how institutions are currently using technology in the creation and delivery of OER content. To facilitate this, we surveyed higher education institutions to understand what tools are currently being used to deliver OER, how these tools are selected and evaluated, and perceptions regarding how these technologies help to support processes surrounding the creation, revision, and use of OER. This descriptive study is intended as an initial step in starting a wider dialogue regarding how institutions make decisions about the technology that they use for OER.

Literature Review

The literature review covers two areas: (1) research related to OER and technology platforms and (2) research involving the evaluation of educational technology.

OER and Platforms

While studies examining OER platform use across multiple institutions were sparse, several studies exploring technological infrastructures used to support individual OER initiatives were discovered. Khanna and Basak (2013) recommend an overall architectural framework proposed for an OER system to support distance education in India. Their framework is composed of six character dimensions: (1) Pedagogical; (2) technological; (3) managerial; (4) academic; (5) financial; and (6) ethical. In addition, the architecture contains five key component areas and support services: (1) IT infrastructure; (2) management support systems; (3) open content development and maintenance; (4) open teaching and learning; and (5) learner assessment and evaluation.

Kanjilal (2013) describes eGyanKosh, an OER repository that was built by the Indira Gandhi National Open University using DSpace. Stankovic et al. (2014) describe a node-based architecture that aggregates OER published at six universities in Eastern Europe. The authors emphasized the importance in defining an appropriate metadata scheme, so that the resources can be appropriately shared among the institutions. Abeywardena, Chan, and Tham (2013) describe their OERScout technology framework, which utilizes text-mining methodologies to make OER repositories more discoverable.

Cohen, Omollo, and Malicke (2014) describe the infrastructure of the Open.Michigan platform—where materials from University of Michigan courses are made available as OER. The platform itself is built upon Drupal, the open-source content management tool.

The authors emphasized the importance of being able to collect data from an OER platform arguing that it can act as evidence to support the effort and expense that is often put into the creation of OER. Showing faculty data surrounding the use of their course materials can tangibly demonstrate the impact of sharing those resources in the open. To facilitate the collection of analytics, the platform was instrumented in such a way that it could collect data via Google Analytics.

While the aforementioned research looked at the architecture of OER platforms in individual contexts, only one study examined the use of OER platforms across multiple contexts. Amiel and Soares (2016) conducted a survey of OER leaders in Latin America countries, asking them what the most important OER repositories were in their country. Once repository information had been collected, the authors did a content analysis of the repositories to examine the infrastructure used for the repository and how well licensing information was displayed within the repository. Four types of repositories were identified:

- *Exclusive:* The sponsoring organization/institution is the sole owner of the content.
- *Linked:* A referatory, where content is linked to the original hosting location.
- *Aggregated:* The resource did not riginate from the sponsoring organization/institution, but the content is hosted there.
- *Contributed:* User submissions are welcomed and encouraged.

After examining the 50 repositories that were reviewed as a part of the study, 50% of the repositories were identified as *exclusive*, 14% *linked*, 10% *aggregated*, and 2% *contributed*. The researchers also explored the repositories to determine what technologies they were built upon. The most common architectures included: Joomla (n = 10), repositories built from scratch (n = 10), undefined (meaning the platform could not be determined (n = 6), Wordpress (n = 5), Drupal (n = 4), DSpace (n = 3), and Blogger (n = 2).

After further examination of the platforms, the researchers discovered some additional interesting findings. Seventy percent of the repositories had nonexistent metadata. Despite being OER repositories, only 44% of the sites had copyright disclaimers on their landing pages; and 46% showed some kind of misalignment in between the permissions of the content and how the licensing was displayed to the end user.

Albeit limited in scope, Amiel and Soares' (2016) research nonetheless represents an important effort in critically examining the technology that institutions are using to deliver OER. Importantly, their research points out misalignment between the goals of OER (as easy to find and use) and technology used to deliver it. In the current research study, the goal is to look critically at the technologies that institutions of higher education are using to deliver OER to their students.

While looking at the architectures supporting these technologies is appealing, the evaluation process (and respective criteria indicators) used to select these platforms is also of interest.

Evaluation of Educational Technology

Prior to the adoption of any educational technology, educational institutions are typically required to preface adoption with some form of evaluation. While one can never be certain that a technology is adopted using a full evaluation process, there are nonetheless several models for how these types of technologies can be evaluated. Bates and Poole (2003) suggest the ACTIONS model, whereby several criteria have been established for evaluating the technology including:

- **A**ccess—how accessible is the technology for learners?
- **C**osts—what does the technology cost, per learner?
- **T**eaching and learning—how does the technology support the teaching and learning process?
- **I**nteractivity and user-friendliness—how intuitive is the technology to use?
- **O**rganizational issues—what organizational requirements exist for the technology?
- **N**ovelty—how new is the technology?
- **S**peed—how quickly can the organization?

The authors also recommend an overall decision process to use in the evaluation of the technology. First, they suggest using a framework (such as the ACTIONS model) to ensure that all of the main factors have been identified. Second, analyze the technology against the framework factors by using a set of guiding questions. Third, collect and review responses from reviewers to these questions. Fourth, make an assessment of the resources available. Finally, make an intuitive or subjective decision. The authors note that while you should gather as much evaluative evidence as you need, you'll ultimately need to make an intuitive decision in the end.

Another evaluation model comes from a meta-analysis of studies involving the evaluation of educational technologies. Van Melle, Cimellaro, and Shulha (2003) identified five essential elements that should be a part of any implementation of technology used for teaching and learning: (1) The technology should be used to enhance student learning; (2) The technology should be an integral aspect of teaching; (3) Professional support for the technology should be ongoing; (4) Planning, budgeting, and evaluation of technologies should be key organizational activities; and (5) The implementation is supported by collaborative efforts.

A few studies looked more closely into the adoption of specific educational technologies. van Rooij (2008) focused specifically at the evaluation processes of higher education institu-

tions who adopted open-source technologies. A qualitative analysis of documents related to the evaluation revealed several key themes including: (1) Social and philosophical benefits; (2) Software development methodology benefits; (3) Security and risk management; (4) Software adoption lifecycle benefits; and (5) Total cost of ownership benefits.

Similarly, Stewart et al. (2007) provide a case study from Athabasca University regarding the adoption of the open-source learning management system (LMS), Moodle. In their study, they outline a process they used to undertake the evaluation of the new tool, including defining evaluation criteria (with specific factors identified related to *systems administration, cost, instructional design,* and *teaching and learning tools*). They then developed a survey system to gather feedback from a variety of stakeholders, and a scoring system to identify the preferred LMS of the institution. Their chosen method seems to follow closely to the evaluation method proposed by Bates and Poole (2003), showing an intentional process to select technology that supports student learning.

While the authors of the aforementioned studies examined the evaluation process of educational technologies, and even in some cases open-source educational technologies, there existed no research that focused specifically on the evaluation and implementation of technologies to support the use of OER. This is one of the major goals of the current study.

The current study was guided by the following research questions:

R1: What are the most common tools that institutions are using to create and deliver OER content?

R2: What processes are institutions using in the selection of OER platforms?

R3: How well do institutions' selected OER platforms support the 5Rs of openness?

Method

Survey Design

A survey was designed with questions aligned to address the stated research questions. An initial version of the survey instrument was distributed to a variety of OER stakeholders from inside and outside the author's institution. Once refined, the questions were placed into Qualtrics for distribution.

Participants

The goal of this research was to understand how institutions were choosing and using technologies to support the creation and distribution of OER; therefore, it was imperative to recruit participants who could credibly represent we sought to recruit respondents who their respective institution. Toward this goal, a comment in the recruitment letter was added stating "If there is someone at your institution who you feel is better aware of the technology being used for OER at your institution, please send this information to them." While we cannot guarantee that respondents had a full knowledge of OER at their institution, this was considered the best way to recruit these individuals.

The recruitment message and Qualtrics survey link were posted on the author's personal Twitter account and sent through various email lists. Email lists included WCET, the Open Textbook Network, Affordable Learning Georgia, and Washington State Board for Community and Technical Colleges (SBCTC). Overall, representatives from 33 institutions responded to the survey. Of those institutions, 60% (n = 20) were from public 4-year institutions, 27% (n = 9) were from public 2-year institutions, and 12% (n = 4) were from private not-for-profit 4-year institutions. There was no representation from for-profit institutions. All respondents were from institutions based in the United States.

In terms of the size of the institution, 42% (n = 14) represented medium-sized institutions with student enrollment between 5,000 and 20,000. Thirty-nine percent (n = 13) were from large institutions, with student enrollment exceeding 20,000, and the remaining 18% (n = 6) were from small institutions with student enrollment of less than 5,000.

Participants were also asked to estimate the current number of courses utilizing OER that were offered at their institution. While several respondents indicated that they were not sure how many courses were utilizing OER at their institution, of those that gave a number, the responses ranged from 1 course to 632 courses. The mean number of courses offered was 84, albeit with a large standard deviation of 152. The median number of courses utilizing OER in the sample was 18.

Data Analysis

Once the Qualtrics survey was closed, data were pulled into SPSS for cleaning. Incomplete responses were removed. Additionally, institutional names were checked to determine if there were any duplicate responses from a single institution. While the original plan was to combine any such cases into a single response, after examining the data, there was only one institution that was included twice. In this case, the respondent stopped part of the way through on the first response and then came back later to submit a full response. Owing to this oversight, the first incomplete response was removed. All other responses represented unique institutions.

Once the data were cleaned, descriptive statistics were generated using SPSS. Open responses were downloaded and independently coded using an open coding technique by two researchers; differences were discussed and resolved by consensus. Once the coding was applied to all of responses, descriptive statistics of the codes were calculated. Open comments could have more than one code applied; thus, the descriptive statistics represent the number and percentage of total responses that had a given code.

Results

The results of the survey are broken out in four sections: (1) Content and technology, (2) Evaluation, (3) The 5Rs, and (4) Analytics.

Content and Technology

In the first section, it was important that a solid understanding of the institution's OER infrastructure was established. For the first survey question, respondents were asked about their sources of OER content. Specifically, respondents were asked, "*Which of the following sources is your institution using for OER content?*" The results of the question are displayed in Table 1. Overall, the results suggest that most institutions select OER content from a variety of sources. The most commonly used OER was OpenStax (85%, $n = 28$), followed by original content authored by the institution's faculty and staff (79%, $n = 26$), the Open Textbook Library (73%, $n = 24$), and OER Commons (61%, $n = 20$).

Table 1. Most Commonly Used Resources for OER Content

Tool	Frequency	Percentage
OpenStax	28	84.8%
Content authored by institution's faculty and staff	26	78.8%
Open Textbook Library	24	72.7%
OER commons	20	60.6%
Other	11	33.3%
MERLOT	11	33.3%
Lumen Learning	11	33.3%
BCcampus	6	18.2%
eCampus Ontario	1	3.0%

The next survey question focused on the delivery mechanism for OER. Respondents were asked, "*Which of the following technological tools are being used to deliver OER content to students?" Meaning in what place are students reading or interacting with OER?*" Along with a selection box, the respondent was also given an open response area where they were invited to name the specific tool that is used at their institution. The results of this question, with aggregated open responses for each of the selections are shown in Table 2.

The results show that the LMS is the most popular mechanism for delivering OER content to students, with 97% of respondents ($n = 32$) indicating that they use them to deliver OER. The next most popular tools were Third-Party Courseware Tools (58%, $n = 19$), with OpenStax, Lumen, Cengage, and TopHat being listed as the most frequently chosen vendors. Forty-six percent of respondents ($n = 15$) indicated

Table 2. Technological Tools Used to Deliver OER

Tool	Frequency	Percentage	Open Responses
Learning management system	32	97.0%	Brightspace by D2L (*n* = 4), Blackboard (*n* = 3) , Canvas (*n* = 3), Other (*n* = 2)
Third-Party Courseware Tools	19	57.6%	OpenStax (*n* = 3), Lumen (*n* = 3), Cengage (*n* = 2), TopHat (*n* = 2), Other (*n* = 3)
A file system or institutional repository	15	45.5%	Google Drive (*n* = 4), BePress (*n* = 3), Equella (*n* = 1), Other (*n* = 2)
eTextbook Reading Platform	11	33.3%	Pressbooks (*n* = 5), Redshelf (*n* = 2), VitalSource (*n* = 1), iBooks (*n* = 1)
Other	9	27.3%	Wordpress (*n* = 4)
A text-based repository	4	12.1%	Github (*n* = 2)
Total	33		

that they used a file system or institutional repository (Google Drive, BePress), 33% of respondents (*n* = 11) used an eTextbook reading platform (Pressbooks, Redshelf, Vitalsource), 27% (*n* = 9) responded "Other," and 12% (*n* = 4) used a text-based repository to deliver OER.

The final set of survey questions regarding technology focused on the creation of OER materials. First, respondents were asked if faculty at their institution authored their own open textbooks. Seventy-eight percent of the respondents (*n* = 26) indicated that faculty at their institution authored their own open textbooks. These respondents were then asked to describe the tools that their faculty used to author OER materials. After coding these responses, seven different themes of authoring tools emerged (displayed in Table 3). The most common tool for authoring was standard word processing tools such as Microsoft Word and Google Docs (44%, *n* = 10). Other popular tools included the LMS (22%, *n* = 5), Pressbooks (22%, *n* = 5), and web-authoring tools like Wordpress (17%, *n* = 4).

Evaluation

The next set of survey questions was aimed at better understanding the process that the institution used to evaluate platforms to deliver OER. In the first question in this section, respondents were asked to *"Please describe the process that your institution used to select the technological tools used to deliver OER to students."*

Table 3. Categories of Tools for the Authoring of Open Textbooks

Theme	Frequency	Percentage
Word Processing (e.g. Word, Google Docs)	10	43.5%
Learning management system	5	21.7%
Pressbooks	5	21.7%
Web-authoring (e.g. Wordpress)	4	17.4%
Media (e.g. Captivate)	2	8.7%
File repository	1	4.3%
Text-based	1	4.3%

The themes that emerged from this question are displayed in Table 4. The most common theme that emerged was *faculty preference,* simply meaning the selection process was faculty-driven (54.8%, n = 17). In these instances, faculty are free to use their OER delivery tool of choice. A few responses that echo this theme include:

This is not an institutional decision. Faculty select their own.
I don't think we have a process other than letting faculty do what they want.

Another response hinted that there might be challenges associated with this faculty-driven process, noting

It varies from college to department to individual faculty member. We are in the process of organizing this process and standardizing it across institutional areas. We still have much to do in this area.

The second emerging theme, *existing tool,* was that the institution chose to use a tool that they already owned, rather than finding something specific for OER (35.5%, n = 11). The existing tool often included some sort of institutional repository or LMS. Here are some comments that illustrate the theme:

"We already had a program in place that utilized BePress for creating an institutional repository. We expanded its use for OER ... By adapting existing resources we avoided additional costs."

"We use Canvas because the faculty and students are accustomed to it and we have institutional support for it."

Other prominent themes that emerged were *recommend options* (12.9%, n = 4), wherein OER coordinators pre-select tools and recommend them to faculty who create or use OER, and *grants* (9.7%, n = 3), whereby a tool is selected because it is attached to the parameters of an OER grant.

Table 4. Processing for Selecting OER Platforms

Theme	Description	Frequency	Percentage
Faculty preference	Institution allows the faculty to pick their own tools to deliver OER	17	54.8%
Existing tool	Used tools that already existed or were adopted at the institution	11	35.5%
Recommend options	OER coordinators would make recommendations for tools	4	12.9%
Grants	Tools had grants associated with them. In order to obtain the grant, the tool needed to be used	3	9.7%
No process	No strategic process	1	3.2%
Pilot process	Piloted a tool in a limited manner	1	3.2%
Integrations with existing tools	Looked for tools which integrated with existing tools	1	3.2%
Usable process	Were primarily concerned about a usable workflow/tool for faculty	1	3.2%

Digging deeper into the evaluation process, it was important to better understand specific criteria that institutions used when selecting technology to support OER. Respondents were asked *"What evaluation criteria do you feel were the most important in your institutions decision regarding an OER platform?"* Respondents were given a list of evaluation criteria, and asked to rank the top three they felt were most important. They were also given an opportunity to select "other" which was included in their evaluation process.

In order to determine which of the criteria was most frequently cited as important, a medal count process was used to weight the different criteria. For each instance, a criterion appeared as a number one in the rankings it was given three points (#1 = 3 points), two points for being ranked number two (#2 = 2 points), and one point for being ranked number three (#3 = 1 point). The points for each criteria were then added to determine which of the criteria had the highest overall ranking. Owing to the variety of answers included in "other,"

this category was excluded from the medal count. The result of the process is shown in Table 5.

In terms of medal count total, *integration with existing institutional technologies* (39 points, $n = 17$) was the most important criteria when selecting an OER platform. Other popular criteria included the *cost of the platform* (23 points, $n = 12$), the *ability to edit/remix content* (19 points, $n = 10$), *accessibility* (18 points, $n = 9$), *availability of support and training* (11 points, $n = 7$), and *ability to easily find content* (11 points, $n = 7$).

Table 5. Evaluation Criteria of OER Platforms Ranked by Medal Count

Criteria	Frequency	Percentage	Medal Count Total
Integration with existing institutional technologies	17	51.5%	39
Cost of the platform	12	36.4%	23
Ability to edit/remix content	10	30.3%	19
Accessibility	9	27.3%	18
Availability of support and training	7	21.2%	11
Ability to easily find content	7	21.2%	11
Existing user base	4	12.1%	9
Hosting model (self-hosted/ cloud-hosted)	3	9.1%	6
Mobile access	1	3.0%	2
Reporting or analytics	1	3.0%	2
Other	8	24.2%	0

Helping with the 5Rs

Also of interest in this study were institution's levels of perceived satisfaction and engagement of their OER technology and the 5Rs (Retain, Reuse, Revise, Remix, and Redistribute). They were asked to rate their overall satisfaction (1—Extremely dissatisfied to 5—Extremely satisfied) with their OER platform's ability to allow faculty to engage in each of the 5Rs. A definition of each of the 5Rs was displayed alongside the questions. Results are displayed in Table 6.

Overall, respondents were mostly satisfied in all of the categories, but most satisfied with their platforms ability to *retain* (M = 3.72, SD = 1.1). Following retain, respondents were most satisfied about *reuse* (M = 3.65, SD = 1.1), while *revise* (M = 3.34, SD = 1.2) and *redistribute* (M = 3.34, SD = 1.43) had similar levels of satisfaction. *Remix* had the lowest level of satisfaction overall (M = 3.19, SD = 1.2).

Table 6. Satisfaction Levels of OER Platforms in Engaging in 5R Activities

	Retain	Reuse	Revise	Remix	Redistribute
Extremely dissatisfied	1 (3.1%)	1 (3.2%)	3 (9.4%)	4 (12.9%)	5 (15.6%)
Somewhat dissatisfied	3 (9.4%)	4 (12.9%)	3 (9.4%)	3 (9.7%)	3 (9.4%)
Neither satisfied nor dissatisfied	9 (28.1%)	9 (29.0%)	12 (37.5%)	12 (38.7%)	10 (31.3%)
Somewhat satisfied	10 (31.3%)	8 (25.8%)	8 (25.0%)	7 (22.6%)	4 (12.5%)
Extremely satisfied	9 (28.1%)	9 (29.0%)	6 (18.8%)	5 (16.1%)	10 (31.3%)
Mean satisfaction level (*SD*)	3.72 (1.1)	3.65 (1.1)	3.34 (1.2)	3.19 (1.2)	3.34 (1.43)

Table 7. Level of Satisfaction with Access to Data from OER Platform(s)

Level of Satisfaction	Frequency	Percent
Extremely dissatisfied	6	21.4%
Somewhat dissatisfied	2	7.1%
Neither satisfied nor dissatisfied	15	53.6%
Somewhat satisfied	3	10.7%
Extremely satisfied	2	7.1%
M = 2.89, SD = 0.956		

Analytics

In the final set of questions, understanding what kind of data were made available to an institution regarding the use of their OER was paramount. Participants were asked, *"Does your institution currently use any analytics regarding how students use OER?"* Only 15% of the respondents (N = 5) indicated that they currently used analytics, while 81% of the respondents (N = 27) indicated that they did not use analytics.

Respondents were next asked about their overall level of satisfaction with their current level of access to data from their OER platform(s). As shown by the results in Table 7, most of the respondents were neutral in their response to this question, with 54% of the respondents (n = 15) being neither satisfied nor dissatisfied, and the mean level of satisfaction being slightly lower than the midpoint (M = 2.89, SD = 0.956).

Discussion

The overarching goal of this research study was to better understand how institutions employ platforms for the creation and distribution of OER. Additionally, understanding how institutions select and evaluate these technologies and platforms was also of interest.

In terms of content, the results suggest that institutions are utilizing OER content from a variety of resources. This is not surprising given one of the main benefits of OER. Because the content is licensed in such a way that end-users can exercise 5R permissions, institutions will likely cast a wide net when selecting resources that meet the needs of their courses. The most commonly cited sources of OER content included OpenStax and the Open Textbook Library, both of which are well-vetted sources for quality open textbooks and materials. This further suggests that institutions primarily seek high-quality OER materials they can easily adopt in their courses.

Additionally, nearly 80% of the institutions surveyed were using OER content authored by the faculty and staff of the institution. This suggests that overall institutions are engaging in the process of either creating new OER or exercising permission to modify existing OER to meet their needs. This prompts possible further questions for exploration such as *where* is the content being created, authored, and distributed?

Participants were asked about the mechanisms that they used to deliver OER content to students. Nearly all of the respondents said that content was delivered to students via the LMS. While there may be some confusion regarding the wording of this question, respondents may have interpreted this choice as meaning "delivery via a tool integrated with the LMS", institutions should still take head. OER content authored in the LMS may suffer from a lack of discoverability from other users at the institution, and if this is the case, institutions may want to more carefully think about their strategy regarding

technology to support the distribution of OER content.

Another noticeable point regarding technology for delivery is that slightly over half of the institutions were using some form of third-party courseware to deliver at least some of the content, being split between several different vendors. Using third-party courseware in this fashion will be of interest to monitor, especially as publishers are eager to deliver OER on their proprietary courseware platforms.

Also examined in this study was the evaluation processes institution's use when selecting technology to support OER. While there was not a process that was consistent across institutions, survey participants reported that faculty were largely the decision-drivers in terms of selecting a tool. While this is likely in line with goals to preserve academic freedom, possible repercussions should be noted. As the use of OER scales across the institution, it is quite possible that students may have a fragmented learning experiences with the different ways that the content is delivered. For example, a student may find that the content is delivered via PDF in one course, while it may be offered via courseware in another. While this is not necessarily problematic, it may diminish student recognizability of OER. A single platform experience could make the student experience with OER more cohesive, and as a result help students understand when OER is being used in their course.

After assessing the results, there is little evidence in this sample to support the idea that institutions engage in a rigorous evaluation process regarding OER platforms. Notwithstanding, the criteria institutions found most important in selecting technology for OER was informative. The most frequently selected criteria w *integration with existing institutional technologies*, signaling that it is important for OER technology to integrate with existing learning technologies like the LMS. Institutions also prioritized the cost of the platform. This is important because one of the goals of OER is to lower the cost of resources for the students, and oftentimes, OER initiatives are funded directly by either the institution or via via external grants. Institutions are likely to seek low-cost technologies because those costs are not recouped in the traditional sense, where the return on investment is instead measured on total student savings. Even in newer cases where we are seeing a student or institutional pay model for OER courseware (e.g. Cengage or Lumen), costs still need to remain low in order to demonstrate that the *overall* cost of materials are being lowered.

Other notable evaluation criteria include *ability to edit/remix content*, showing that institutions want technology that will allow them to exercise 5R permissions, and *accessibility* which is becoming an increasingly must-have for institutions around the world.

Also important to understand in this research study was how technology for OER assisted institutional engagement in the 5Rs. Overall, institutions were slightly satisfied with their ability to engage in each of the 5Rs. The highest rated among respon-

dents, *retain* and *reuse*, which focus on the ability to store and consume the content comes as no surprise as these are clearly traits of OER that are inherently favorable.

Lower levels of satisfaction were in *revise* and *remix,* or the ability of individuals at the institution to make changes to the content. This suggests that the platforms that the institutions are using may not be friendly to the revision process. This finding seems to be in line with some of the challenges that could be associated with the common ways that some institutions are storing OER content. Not all third-party courseware allows the institution to make edits or revisions to the content and file repositories often contain read-only PDF versions of OER. If institutions are unsatisfied with their ability to engage in revision and remix practices, they need to make sure that they choose technology appropriately that will support these workflows.

Lastly, it was important to understand to what extent institutions were using analytics from their technology to deliver OER. Analytics are a strong force in continuous improvement with OER (Bodily, Nyland, & Wiley, 2017). Surprisingly, only 15% of institutions were currently using analytics regarding OER usage. When asked about their satisfaction regarding access to data from their OER platform, over half of the respondents were neutral, while 20% of the respondents were extremely dissatisfied. The neutrality likely reflects the fact that most institutions were not taking advantage of the information that analytics could provide from their OER platform. It is also possible that those who were dissatisfied with the current analytics capabilities of their platforms are those that are hopeful they will eventually engage in the process of using analytics more frequently.

It is suggested that institutions need to become more critical on how the data from their OER platform are being used, especially when third-party vendors are involved. Full evaluations are needed to ensure that data meet the privacy and security requirements of the institutions. Meinke (2018) emphasizes the need for institutions to be more critical regarding how textbook publishers use student data from their courseware tools.

Conclusion

This study was intended as a starting point for a conversation regarding the use and selection of technology for OER. As such, it has many limitations and potential areas for further investigation. The biggest limitation is the size of the study (n = 33); therefore, to glean a better understanding of institutional OER technology, a larger sample size will strengthen future studies. Additionally, because the source of the data is self-reported from a single institutional representative, it is difficult to determine if the data is completely accurate. To validate the data, additional follow-up studies are needed. Additional qualitative research could probe deeper into the evaluation process of individual institutions regarding OER technology. This might allow for the establishment of cases out-

lining how an institution could evaluate OER technologies.

That being said, this study serves as a firm starting point for beginning to understand the current landscape of technology being used to support OER in higher education, and how institutions are making decisions regarding the adoption of that technology. According to the results of the study, there seems to be a wide variety of technologies being utilized to deliver OER, with little evidence that institutions are engaging in rigorous evaluation processes to determine which technologies are most appropriate to meet the needs of their institutions. Rather, institutions report using existing and default tools such as the LMS to deliver content, and Word and Google Docs to create content. This may be because much of the decision is left up to the discretion of individual faculty members who are creating and delivering OER. While this is not necessarily problematic for students in the courses who are benefitting from the use of OER, it may cause challenges for the discovery and recognizability of OER across an institution.

This study also found evidence that a growing number of institutions are turning to third-party courseware (e.g. Lumen, Cengage, Tophat) to create and host OER courses for their students. While students of these courses will likely benefit from the cost-savings that come from the use of OER in these courses, institutions should also engage in evaluation processes to ensure that these platforms align with the institutional values for OER—this may include things such as accessibility, how the platform handles student data and privacy, whether analytics from the platform are available to the institution, and how easily the platform allows OER content to be modified to meet the needs of the faculty and the institution. Institutions should be willing to ask these tough questions of vendors to ensure that their chosen technology will really support the success of their students.

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Credentials for Open Learning: Scalability and Validity

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Abstract

The authors of this study advocate separating credentialing from the learning process as a path to greater scalability and better measurement of what independent learners learn from OER. They address the challenge of matching/aligning OER offerings with standardized examinations as a way for independent learners to access academic credit, and explore ways to achieve consensus among educational institutions about what academic credit means and which types of evidence to accept in terms of learning that occurred outside a particular institution. The study begins with an overview of credit by examination, contrasting the standardized testing approach with the classroom teaching approach to academic credit. The processes for creating examinations and the accompanying materials that make clear to potential test-takers what the learning objectives, are briefly described. Next, a methodology is developed for building the bridge between OER and the examination. Finally, policy issues around examination acceptance-for-credit are discussed in addition to accepting examinations for credit and

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envisioning a future in which learners can receive transferable credentials in a cost-effective, efficient, and valid manner.

Keywords: credentials, open learning, scalability, validity, open educational resources, OER, credit, transfer credit

Credenciales para el aprendizaje abierto: escalabilidad y validez

Resumen

Los autores de este estudio abogan por la separación de la credencialización del proceso de aprendizaje como una manera para tener más escalabilidad y medir mejor lo que los aprendices independientes aprenden de OER. Abordan el desafío de hacer coincidir / alinear las ofertas de OER con los exámenes estandarizados como una forma para que los estudiantes independientes accedan al crédito académico, y exploran formas de lograr consenso entre las instituciones educativas sobre qué significa el crédito académico y qué tipos de evidencia aceptar en términos de aprendizaje que ocurrió fuera de una institución particular. El estudio comienza con una descripción general del crédito mediante el examen, que contrasta el enfoque de las pruebas estandarizadas con el enfoque de la enseñanza en el aula para el crédito académico. Se describen brevemente los procesos para crear exámenes y los materiales correspondientes que dejan en claro a los posibles examinados cuáles son los objetivos de aprendizaje. A continuación, se desarrolla una metodología para construir el puente entre la OER y el examen. Finalmente, se discuten los problemas de políticas en torno a la aceptación de crédito de los exámenes, además de aceptar los exámenes de crédito y prever un futuro en el que los estudiantes puedan recibir credenciales transferibles de manera rentable, eficiente y válida.

Palabras clave: credenciales, aprendizaje abierto, escalabilidad, validez, recursos educativos abiertos, OER, crédito transferido

美国伊克塞希尔学院

摘要

本项研究的诸位作者主张将认证与学习过程分离，以此途径来更好地衡量独立学习者能从OER中学到什么。他们通过匹配OER课程与标准化考核帮助独立学习者获得学分来应对挑战，并探讨如何在教育机构间就学分意义以及机构外开展的学习活动能够接受的认证方式达成共识。本研究从考试学分制的概述入手，将标准化考试法与课堂教学学分制相比较。首先，笔者简要描述了创建考试的过程以及向考生说明学习目标的相关材料。其次，笔者提出了一种方法论以在OER与考试之间建立联系。最后，除了接受学分考试之外，笔者还讨论了关于考试学分制验收的政策问题，并展望了学习者以经济、高效和有效的方式获得可转让证书的未来。

关键词：认证，开放式学习，灵活性，有效性，开放教育资源，OER，学分，转学分

OER and Academic Credit

The growth of Open Educational Resources (OERs) has sparked an interesting and productive discussion about how OER might be used to expand learners' options for earning academic credit without traditional instruction (see, for example, Camilleri & Tannhäuser, 2012; Conrad & McGreal, 2012). The discussions tend to begin with OER and examine how best to grant credit for learning based on that OER. This paper examines the issue from the other direction: for learners planning to sit for an existing examination for credit, how can those learners best find OER that covers the material they need to master the subject of the examination? As a corollary, how can higher education institutions (HEIs) encourage the validation of independent learning through scalable examinations to take advantage of the scalability of OER?

What is known in the US as standardized examinations (that is, examinations produced for use across multiple institutions) have long served as vehicles for academic credit in the U.S. They are scalable, flexibly-scheduled, and cost-effective—but they exist outside of any context of formal classroom instruction and are not tied to a specific HEI, so learners are left to choose their methods of attaining knowledge independently, and may sometimes fail to

recognize that their studies have been incomplete. In addition, debate continues in many US HEIs and other organizations that look for a university credential over how and whether to accept particular types of evidence of learning that occurred outside a particular institution. The authors come from the perspective of a US institution that has been at the forefront of prior learning assessment and adult degree completion for more than 40 years. Three main issues are addressed: (1) the concept of what academic credit means, (2) the mechanisms by which OER-based independent learning can fit into a system of large-scale examinations, and (3) the need for a common understanding and standard guidelines for accepting and awarding credit by examination in recognition of independent learning.

The Meaning of Academic Credit

Credit by examination as practiced in the U.S. has grown in a different direction from the assessment practices of the U.K. and many European countries, where sitting for a comprehensive examination represents a milestone in one's degree program. Two primary approaches to academic credit have bifurcated in the U.S.: one focused on testing detached from specific HEIs, and one focused on teaching, which is predominant on traditional campuses.

The testing approach seeks to make rigorous examinations more scalable and reliable than individually-rated program-specific examinations can be. Robust standardized examinations are built to measure the desired outcomes (usually in chunks corresponding to what would normally be expected in a one-semester course), regardless of how the student learned the material. All candidates for a similar qualification sit for the same examination, so that their learning of, for example, a term's worth of calculus can be compared on some objective basis. Although many in the U.S. decry the current (over) use of standardized tests in the primary and secondary education, standardized subject tests are rooted in American traditions of accessibility, equality, and mass production, and evolved in the mid-nineteenth century as a way to promote equality and fairness in compulsory education (US Congress, Office of Technology Assessment, 1992). US examples of the use of standardized examinations in higher education date to the middle of the twentieth century, and include the College Level Examination Program (CLEP), the UExcel and Excelsior College Examinations programs, and the DANTES Subject Standardized Tests (DSST).

All of these examinations are designed to be used for academic credit in lieu of participation in a university course, and have undergone a review by national agencies similar to, but exclusive from, the regional accrediting bodies that certify colleges and universities, and are widely used for that purpose in the U.S. Note that these are not the same as examinations designed by one institution's faculty for use in determining course placement at that institution;

the standardized examinations are designed by testing specialists and psychometricians along with subject-matter experts for use at any institution. Hundreds of thousands of students in the U.S. earn at least some of the credit they need for a degree using such examinations every year, saving money on tuition fees and earning credit on their own schedule (Council for Adult and Experiential Learning, 2010).

The teaching approach relies on ensuring that the academic content is well taught, with a path to greater scalability and better measurement of what independent learners learn.

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Introduction to Open Education: Toward a Human Rights Theory

By Patrick Blessinger, St. John's University, USA
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Abstract

Education is recognized as a fundamental human right. Yet, many people throughout the world do not have access to important educational opportunities. Open education, which began in earnest in the late 1960s with the establishment of open universities and gained momentum in the first part of this century through open educational resources and open technologies, is part of a wider effort to democratize education. Designed for access, agency, ownership, participation, and experience, open education has the potential to become a great global equalizer, providing the opportunity for people throughout the world to exercise this basic human right.

Keywords: open education, human rights, theory, spatial, temporal, process dimensions, open educational resources, blockchain

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Introducción a la educación abierta: hacia una teoría de Derechos Humanos

Resumen

La educación es reconocida como un derecho humano fundamental. Sin embargo, mucha gente en todo el mundo no tiene acceso a oportunidades importantes de educación. La educación abierta, que comenzó en serio a finales de la década de 1960 con el establecimiento de universidades abiertas y ganó impulso en la primera parte de este siglo a través de recursos educativos abiertos y tecnologías abiertas, es parte de un esfuerzo más amplio para democratizar la educación. Diseñada para el acceso, la agencia, la propiedad, la participación y la experiencia, la educación abierta tiene el potencial de convertirse en un gran ecualizador global, brindando a las personas de todo el mundo la oportunidad de ejercer este derecho humano básico.

Palabras clave: educación abierta, derechos humanos, teoría, espacial, temporal, dimensiones de proceso, recursos educativos abiertos, blockchain

开放教育导论：走向人权理论

摘要

教育是一项基本人权。然而，全世界有许多人无法获得重要的教育机会。开放教育最早始于20世纪60年代末。随着开放大学的创建，开放教育通过其资源和技术在本世纪上半叶获得迅猛发展。它是在更广范围内努力实现教育民主化的一环。开放教育为获取、代理、所有权、参与和体验而设计，它有潜力成为全球平等的伟大力量，帮助全世界人民获得行使这一基本人权的机会。

关键词：开放教育，人权，理论，空间，时间，流程维度，开放教育资源，区块链

Introduction

What does it mean to be open, as opposed to closed? As with any word, several meanings can be attached to it. Perhaps, it is best to first discuss the more general meaning of the term and then explore the more specific meanings as we develop an analysis of open education. The word open, broadly speaking, means to be flexible, free, and welcoming, and relative to closed, it means nonprejudiced, nonrestricted, and unfettered. Of course, there are different degrees and types of openness as well as different goals and outcomes that are sought in open education. Common themes that tend to cut across all these aspects of open education are the ability to cultivate personal agency, self-determination, and self-regulated lifelong (every life stage) and life-wide (across all life activities) learning. In doing so, democracy is strengthened and human rights are supported.

The condition of being open has many qualities and characteristics, but these characteristics, relative to one's ability to access, participate in, and leverage the full benefits of open education, have the following dimensions: ***spatial, temporal,*** and ***process.*** Therefore, these core dimensions serve as a good starting point to explain the nature of open education.

As noted by Kahle (2008), the core underlying principles involved in open education include the following:

- design for access,
- design for agency,
- design for ownership,
- design for participation,
- design for experience.

Open education is designed for **access** because it removes the traditional barriers that people often face in obtaining knowledge, credits, and degrees—including but not limited to cost. Access is fundamental to open education and is the basic principle that has informed and driven the open education movement from its inception.

Open education goes beyond access: it is designed for the **agency** of students and teachers and affords them increased control of content and technology. As Kahle (2008, p. 35) explains: Openness "is measured by the degree to which it empowers users to take action, making technology [and content] their own, rather than imposing its own foreign and inflexible requirements and constraints." Open education pre-supposes the participation of the learner and the educator, and it seeks to amplify their agency.

Open education is also designed for **ownership** when technology and content are licensed in such a way that users can both modify and retain the resource in perpetuity. David Wiley originally defined open content using a "4 R" framework, which includes the rights to reuse, revise, redistribute, and remix creative works. But, in response to academic publishers pushing access codes and short-term leases on educational content, Wiley made explicit something he had long seen as an underlying implicit principle of open con-

tent: the right to retain, which includes the rights to make, own, and control copies of the content (Wiley, 2014).

Open education is designed for **participation** when it is well designed for access, agency, and ownership. In other words, these aspects lead to participation by learners and educators. As open education promotes these fundamental principles, students and teachers are more likely to collaborate and participate in inclusive activities. Indeed, one of the goals of open education is to move learners closer to the center of a community of practice, specifically by providing opportunities and infrastructure for participation and collaboration.

Finally, open education is designed for **experience,** or at least it can be when educators and systems focus on making content and technology appealing and user-friendly. Kahle (2008, p. 42) argues that "design for experience recognizes that all participants, particularly busy educators and students, quickly form opinions as to what resources are interesting, helpful, and worth their investment of time. Design for experience is a form of human-centered design." Insofar as creators of content and technologies recognize this important principle, open education can appeal to a broader audience than students and educators, thus amplifying access, agency, ownership, and participation to anyone with a desire to learn.

The open education movement can also be viewed as part of a wider drive to democratize tertiary education, which, in turn, can be viewed as part of the movement to establish tertiary education and lifelong learning as a human right. Since this article starts with the normative premise that open education should be used as a means to promote and facilitate lifelong learning, the next section will discuss a brief history of open education and then segue into the rationale for tertiary education and lifelong learning as a human right, which will lay the groundwork for a human rights theory of lifelong learning.

The human rights view of lifelong learning focuses not on the socioeconomic and personal benefits that education produces (albeit very important) but rather on the claim that universal education makes on others. A human right is a very broad construct from which other issues and rights flow (e.g. civil rights, social inclusion, humane treatment of people). A human right is defined as a justified claim on others (McCowan, 2013).

In addition, one of the goals of the UN Millennium Development Goals initiative is to move toward a more inclusive and quality education system that recognizes tertiary education alongside primary and secondary education. Human rights are justified because they protect humanity from the abuse of others and they defend those aspects of society (e.g. life, liberty, and security) that are considered fundamental to human life, and as such, they are the most urgent claim on others.

In the final analysis, by viewing learning and education through the lens

of human rights, universal education throughout the course of life becomes an important condition for justice in a democratic society.

Blessinger discusses this theme further this way:

> *Given the huge importance of lifelong learning to the overall well-being of society and the economy, access to and participation in meaningful lifelong educational opportunities is one of the chief human rights issues of our generation. As such, the emerging global higher education system hints at the prospect of a more inclusive global knowledge society.* (2015b)

In 2007, UNESCO and UNICEF further delineated the right to education into three areas: the right of access to education, the right to *quality* education, and the right to respect within the learning environment. Defined this way, these rights, therefore, have implications for governments, educational institutions, and nongovernmental organizations with regard to their responsibility toward how they provision educational resources and how they lead learning environments.

Concerning *access*, open education puts the responsibility and duty of care primarily on the service provider and others to ensure a ubiquitous, affordable way for people to access a wide range of educational resources. Concerning *quality*, it puts the responsibility primarily on the service provider (i.e. the educational institution) and the content creators (i.e. the faculty or other subject matter expert) to define the framework and process of who, what, when, where, why, and how the content will be created and the criteria by which to evaluate and assess the quality of the content and the effectiveness of teaching and learning. Concerning *respect*, it puts the responsibility primarily on the service provider to define the policies and rules to cultivate an environment of mutual respect and on the teachers and students, as the two primary agents in the teaching-learning process, to treat others with respect and dignity. Thus, open education will be most effective if it addresses all these components.

Brief History of Open Education

At its core, the open education movement has been about access. In the late 1960s, efforts began to remove barriers to entry for students desiring to pursue tertiary education. For example, the Open University of the United Kingdom (OU-UK, http://www.open.ac.uk) was established in 1969 with the mission to help facilitate educational opportunities and greater social justice by providing high-quality university education to anyone who has a desire to learn and realize their potential. Since the founding of the OU-UK, many other open universities have been established in countries throughout the world, ranging from Bangladesh to Canada to South Africa.

In the late 1990s, as the Internet was becoming more ubiquitous, many prestigious institutions of higher edu-

cation in the United States began looking for ways to further disseminate the educational content promulgated within their classrooms. At the same time, forward-thinking education technologists were recognizing the power of the Internet to democratize education at all levels and exponentially increase access to educational content for people across the globe. In 1998, David Wiley coined the term "open content," which he described as a creative work that others are allowed to copy, share, and modify. Wiley created a basic open license that creators could place on their works to signify these permissions.

As the idea of open content for education began to spread, Charles Vest, then President of the Massachusetts Institute of Technology (MIT), sought funding from private foundations to video-tape and post content from MIT courses on the Internet. This radical idea became the MIT project (http://ocw.mit.edu/ index.htm), which continues to publicly and freely share the content from over 2,000 MIT courses. Other universities followed MIT's example, dramatically expanding the open courseware movement over the next several years.

Recognizing the power and potential of open content to increase access to education, private philanthropic foundations, particularly the William and Flora Hewlett Foundation in California, began supporting the development and spread of open courseware and other types of open educational content. In 2002, at a UNESCO meeting of developing nations, known as the Forum on the Impact of Open Courseware for Higher Education in Developing Countries, the term "Open Educational Resources" (OER) was officially adopted to describe open content used for educational purposes. The forum agreed on the following definition of OER: the open provision of educational resources, enabled by information and communication technologies, for consultation, use, and adaptation by a community of users for noncommercial purposes (UNESCO, 2002, p. 24).

In the same year, Lawrence Lessig, Hal Abelson, and Eric Eldred received funding to establish a new nonprofit called Creative Commons, which produced flexible copyright licenses that people could use to openly license their creative works. These licenses have become the gold standard for establishing the legal aspect of OER. The Hewlett Foundation defines 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," and requires that all works created with project grant funding be licensed with a **Creative Commons Attribution** license. Many other foundations and government agencies throughout the world have adopted similar open policies, leading to a significant increase in the supply of OER.

For the first five or so years after the UNESCO meeting in Paris, most of the OER available for professors to adopt existed in piecemeal form and was most suitable as a supplement to primary course content. Starting in 2009, advocates and supporters of OER

began to recognize that for OER to enter mainstream adoption, open content would need to be produced in a format that professors would be better able to adopt as primary course material: the textbook. With support from foundations and governments, work began to produce and disseminate what has become known as "open textbooks." For example, over the past four years, OpenStax College at Rice University has produced 20 open textbooks for the highest enrolled college courses in the United States; and the state of California and the province of British Columbia have each compiled a library of open textbooks for the highest enrolled courses in their respective systems. These open textbooks have been adopted by thousands of professors, positively impacting hundreds of thousands of students. In addition, the Open Textbook Network and the Open Textbook Library at the University of Minnesota provide access to a growing list of open textbooks.

Most recently, an effort has begun to bring adoption of OER in higher education to scale. In 2013, Tidewater Community College established the first-degree program entirely based on OER. In June 2016, the college reform network, Achieving the Dream (http://achievingthedream.org), provided pass-through funding to nearly 40 community colleges in the United States to establish OER degrees within the next two years. These degree programs will impact many students and do much to bring OER into mainstream adoption in higher education.

On the international front, the OERu partnership (https://oeru.org) is working with over 30 partner institutions around the world to establish a fully articulated, credit-bearing first year of study based exclusively on OER that students around the world can enroll in for free.

Open education is more than just open content, of course, but the OER movement is a remarkable example of the power of openness to increasing educational access for all. The real potential of open education is to actually improve learning for all. In the next several years, open educational practice is expected to increase. It will include teaching techniques that draw on OER, open technologies, and open systems to increase the flexibility and authenticity of learner experiences (Conole & Ehlers, 2010), ultimately resulting in better learning for students and better teaching for educators globally.

Increasing educational access and improving teaching and learning around these opportunities elicits the *necessity* to conduct research. Alongside the flurry of OER activity, pockets of OER research have informed areas around perceptions, cost, usage, retention, policy, etc. Much of this research has been published in educational technology-related journals or academic journals specific to the OER subject matter (i.e. science, history, physics, etc.). In the fall of 2018, Melissa Layne, Associate Vice President of Research and Innovation for the American Public University System, developed a home for all OER-related research in

the first academic, peer-reviewed journal, the *International Journal of Open Educational Resources*. Not only was it a first for OER, but Layne also offered authors the opportunity to "Blockchain" their research–which was also another first in the world of scholarly publications. Combined, Blockchain and OER have a significant impact on the world of scholarly research and publishing in the following ways:

- The peer review process becomes more transparent and thorough.
- Post-publication reviews can be integrated easier.
- Encryption allows reviews to be validated, but stay anonymous and permanently stored.
- Data behind published results are verifiable.
- Researchers can protect their IP and prove ownership with a timestamp.
- Researchers can selectively share their work products with others in the research community, their funders, and publishers.
- Funders can monitor the progress of their researchers.
- Other researchers can reproduce experiments more easily.
- Nodes are distributed among universities, research and publishing organizations, and funders.

In essence, Blockchain allows OER researchers and those who create open educational content to issue licenses to the Blockchain ledger which records all of the digital asset's metadata and ownership information.

Open Education to Democratize Education

Open education is not a substitute for traditional higher education provisioning, nor is it intended to be. The desire-to-learn model of open education supplements the ability-to-pay model of higher education. For many people who use open education services, they provide a supplementary type of education that adds to the mix of educational offerings available. Thus, open education need not represent an "either/or" proposition and it need not compete with (nor necessarily intends to) traditional higher education, but rather it provides an additional means by which people can access knowledge and engage in lifelong learning.

In fact, some of the largest providers of OER are the traditional brick-and-mortar higher education institutions because they understand that open education is not a pure substitute for traditional place-based higher education and because it makes it easier for them to prepare materials for massive open online courses (**MOOCs**), for example (based on existing courses), and because it is easier for them to utilize existing instructional staff and institutional expertise.

The goals of students using open education and the goals of those who

undertake traditional higher education are often very different. Most students in traditional place-based higher education want to obtain a degree, whereas most in open education want to pursue learning but not necessarily obtain a degree.

In addition, many people do not have the time to devote themselves exclusively, or even part-time, to place-based education. Fixed time and place requirements are major obstacles to enrolment for many students. To ameliorate this obstacle, in some countries, university fees are kept very low and virtually nonexistent for low-income students and for students who live at home, the total cost of attendance is extremely low.

A key distinction between traditional and open education is that traditional higher education institutions provide services (e.g. accredited degrees, extensive instructional and support staff, research output) that some open education services may not, nor necessarily intend to. Thus, both systems have emerged to address different types of learners who have different goals and needs.

Most nations have gradually shifted away from an elitist system of higher education and toward a universal access model of higher education. In the universal access model, a multiplicity of institutional types (e.g. technical colleges, community colleges, liberal arts colleges, research universities) and a multiplicity of access types (e.g. online universities, open universities, open courseware, OER), as well as hybrid institutions together with further and continuing education programs are combined in unique ways to serve the varied needs of society. This shift has created a more diversified system of institutional types, access methods, and program and course offerings for every stage of life or career and is reflective of the continuing democratization of knowledge and the growing demand for higher education worldwide (Blessinger, 2015a, 2015b; Blessinger & Anchan, 2015; OECD, 2012; Trow, 1974; Yu & Delaney, 2014).

The main distinguishing features of open education are that it consists of free, unfettered, anytime, anywhere access to educational resources that are meaningful and useful to those who wish to utilize those resources. Effective open education platforms and processes center on meeting the needs and aspirations of people throughout every life stage (lifelong learning) and across all life activities (life-wide learning).

Since every person is part of the broader social structures in which they live, the most effective open education platforms are those that create opportunities for shared meaning-making, collaborative activities, and creative participation. Thus, open education should not only be a personal meaning-making experience but also a social one. As such, the open education model moves away from the knowledge scarcity model and toward a knowledge abundance model (Batson, Paharia, & Kumar, 2008; McGrath, 2008).

As such, additional models are needed to work alongside (not replace)

traditional educational structures. With the **knowledge abundance model,** knowledge is made available to anyone who wishes to consume it, regardless of their ability to pay or their ability to participate in place-based education. The emerging abundance model is reflective of the broader democratization of knowledge that is unfolding around the world. The abundance model represents an emerging paradigm shift from the knowledge that is owned and controlled by knowledge elites to the knowledge that is accessible to anyone.

As mentioned earlier, the emergence of massive open online courses, open universities, and OER represent concrete exemplars of this paradigm shift. As noted by Blessinger (2016), this is not an entirely new phenomenon because there have been revolutionary moments in human history (e.g. invention of the printing press in the fifteenth century, the spread of public libraries in the nineteenth century, the development of the Internet in the twentieth century) that have served as catalysts to de-monopolize higher learning and to open access to knowledge to wider segments of society.

Blessinger (2016) puts it this way:

> *The wide-ranging utility of the printing press laid the foundation for future political, social, economic and scientific revolutions such as the Renaissance and the Reformation, which paved the way for mass learning and the modern hyper-connected global knowledge society.*

This trend continues to this day. Thus, one can see how these events are connected, although, at the time they emerged, their future impact was often unforeseen and often shunned and even fiercely opposed by those who wanted to maintain the status quo.

Thus, as discussed by Blessinger and Anchan (2015), the underlying forces driving the development of open education are the basic human needs to learn and grow throughout every stage of life. The change model also supports a *democratic theory of higher education* postulating that the goal of university-level education is to cultivate personal agency through the development of knowledge, skills, and capacity; opportunities to learn throughout life should, therefore, be provided to all.

These *political, social, economic, scientific,* and *technological* revolutions and factors are connected and they impact each other in concrete ways. The role and purpose of tertiary education continue to expand. The importance of lifelong and life-wide learning continues to grow and it is now regarded as necessary to social and personal development and therefore as a human right. As such, the role of tertiary education has expanded to include the production of social and cultural capital, not just human and economic capital.

Lynch (2008) argues that we should not automatically equate access to information (e.g. Internet-based information) to access to education (i.e. education is a system of formal learning). This is especially true if we take a broader definition of education to in-

clude sociocultural processes which imply that education should also be about social and emotional learning, not just cognitive learning. Treating education as a social process emphasizes the point that learning is socially situated (Lave & Wenger, 1991) and that learning is also a personal meaning-making process (Kovbasyuk & Blessinger, 2013). Yet, notwithstanding the importance of these processes, effective educational systems also require the elimination of unnecessary and arbitrary barriers that may inhibit its access and participation.

Whether one uses a narrow definition of education or a broad definition, open education can be adequately described as a form of universal education available to all through freely accessible and ubiquitous knowledge bases. Although open education need not, strictly speaking, be electronic in form, electronic technology does nonetheless provide a low cost and relatively easy means for people anywhere at any time to learn in a social and personalized way, thus making the idea of "education for all" an emerging reality.

Open Education as Social Inclusion

Given higher education's history of exclusion and elitism, the emergence of *education for all* and *education as a right* is imperative (Blessinger, 2015e; Burke, 2012; McCowan, 2013; Spring, 2000; UNESCO/UNICEF, 2007; Vandenberg, 1990). Learning is a social process and formal systems of learning are necessary for social reproduction and the continual development of society.

As with all living creatures, all people are born depending on others for their survival and development. They depend on others (e.g. family, school, community) to learn the required knowledge and skills to live in society. Education is therefore social in nature and a type of learning community.

Although the ultimate purpose of education is to produce learning, education also inherently serves political, economic, social, and humanistic purposes. With globalization, humans live in an increasingly interconnected and interdependent world. The more complex the world becomes and the faster that change happens, the greater the need for lifelong and life-wide education. Different models and systems of open education help meet this need (Altbach, Gumport, & Berdahl, 2011; Barnett, 2012; Burke, 2012; Dewey, 1916; Kezar, 2014; Knapper & Cropley, 2000; Kovbasyuk & Blessinger, 2013).

In the United States, for example, higher education and lifelong learning have been marked by four broad movements (or waves) over the last 150 years. The first wave was the result of the **Morrill Act of 1862** which created a system of land-grant universities through the United States; the second wave was the creation of the community and technical college system that began at the beginning of the twentieth century and the **G.I. Bill of 1944,** both of which extended access to higher education to millions of U.S. citizens; the

third wave was the use of information and communication technologies (e.g. television, Internet) and distance education opportunities which helped create the anytime, anywhere educational movement; and the fourth wave which has been brought about by the acceleration of globalization and the internationalization of higher education resulting in the growing recognition that lifelong learning and education is a human right which further expands the democratic social contract to education to all segments of society (Blessinger, 2015c, 2015d, 2015e).

We suggest that the OE movement, and open methods as part of this, be considered a fifth wave in the history of education.

Open Education to Support Education

One of the main reasons why higher education has become so diversified (in terms of institutional types and educational delivery models) and widely available to anyone who wishes to avail her/himself of it is because a university or college degree has become the gateway to professional careers and specific job opportunities, whether they be white, pink, or blue collar.

For instance, nearly all professions such as medicine, law, education, and engineering are only available to those with advanced university degrees. Many careers that once only required a high school diploma now require a college degree.

In most countries, certification and apprenticeships are now required in most vocational fields such as medical and legal assisting, welding, electronics, cosmetology, real estate, and culinary arts. Jobs have become more complex and more demanding throughout the labor market.

Thus, it is no surprise that tertiary institutions of all types have grown in importance. Societies around the world are placing greater faith and reliance in educational systems to address a growing array of social and economic problems.

Universal education is now widely viewed as one of the basic requirements for a modern society and it serves as a chief catalyst for socio-economic and personal development. Education at all levels (i.e. primary, secondary, tertiary) is now widely considered a human right because it yields so many positive benefits at a social, economic, and personal level (Hanushek & Woessmann, 2007), because it has become so vital to the development of social reproduction (Bourdieu & Passeron, 1977) and because continual learning is so necessary to human agency and development.

Because of these factors, it would be an injustice to deny or constrain people from learning throughout the entirety of their lives (Kovbasyuk & Blessinger, 2013; Spring, 2000; Vandenberg, 1990).

MOOCs, OER, open universities, and the like therefore provide a low cost or zero cost means for anyone to access high-quality educational mate-

rials. The costs associated with producing open educational services typically come from a variety of sources such as institutional budgets, government support, and nongovernmental support (e.g. foundations).

In addition, studies have shown that costs for textbooks, for example, can be dramatically reduced using OER (Hilton, Robinson, Wiley, & Ackerman, 2014). Open education resources and platforms may be structured either as formal learning (i.e. part of a structured curriculum) or as nonformal learning (i.e. not structured as part of a curricula program leading to a certificate or degree but rather as one-off courses).

In the years following World War II (WWII), the human and civil rights movement took on a new sense of urgency. This sense of urgency was a result, in large measure, of the crimes against humanity perpetrated by some people during WWII. When the full extent of these crimes was revealed, it became clear that the civilized world community needed to intervene on a global scale. So, the United Nations, acting in their capacity as representatives of the world community, adopted ***The Universal Declaration of Human Rights*—UDHR** (United Nations, 1948) which articulated those basic human rights that applied to all nations and cultures. The UDHR states that everyone has a right to education at all levels.

To conclude, democratic societies have gradually moved away from elitist and exclusivist systems of higher education that were based on power and privilege claims in favor of open and inclusive systems of higher education based on justice and human rights claims.

This phenomenon represents a major paradigm shift in higher education. Since democratic societies are fundamentally based on principles of rights and justice, it should not come as a surprise that this transformation is occurring, albeit incrementally. Thus, the emergence of open education is a reflection of the broader democratic society in which it functions.

The UNESCO ***Universal Declaration on Democracy* (1997)** states that "A sustained state of democracy thus requires a democratic climate and culture constantly nurtured and reinforced by education and other vehicles of culture and information." Thus, lifelong education, not just basic education, is needed to nurture and strengthen democracy. It does this by creating flexible and open educational structures that allow all people to engage in lifelong and lifewide learning. Given the increasing impact of globalization and the increasing importance of continual lifelong education for all, it is clear that treating education as a human right is imperative.

In a democratic society, the right of voting has been viewed as the "great equalizer" because it allows citizens to have a voice in how their society is governed. Open education can also be viewed as a potential "great equalizer" since it allows people to continually improve their knowledge and skills throughout the course of their lives. And just like voting, it helps to extend the democratic social contract to all

and is reflective of how the democratic social contract continues to be restructured in meaningful ways. Thus, open education also has the potential to strengthen democracy and respect for human rights by creating a more educated and informed citizenry.

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Learning Design and Open Education

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Abstract

Learning Design has emerged in the last 15 years or so as a new methodology to help practitioners make more pedagogically informed design decisions that make appropriate use of digital technologies. In parallel, we have seen the rise of the open education movement; first, through the emergence of open educational resources (OER) and then through massive open online courses (MOOCs). OER and MOOCs are challenging existing educational offerings and have specific requirements in terms of their design. This paper will describe the current status of Learning Design research and will then articulate the 7Cs of Learning Design framework (and related Learning Design frameworks) and will consider how this can be used to design OER and MOOCs.

Keywords: Learning Design, open education, Open Educational Resources (OER), Massive Open Online Courses (MOOCs), Larnaca Declaration on Learning Design, 7Cs of Learning Design

Aprendiendo diseño y educación abierta

Resumen

El diseño del aprendizaje ha emergido en los últimos 15 años como una nueva tecnología para ayudar a los profesionales a tomar decisiones de diseño informadas más pedagógicamente que hagan el uso apropiado de tecnologías digitales. Paralelamente hemos visto el crecimiento del movimiento de educación abierta; primero, durante el surgimiento de recursos educativos (OER) y después a través de las clases en línea abiertas y masivas (MOOCs). OER y MOOC están desafiando ofertas existentes y tienen requisitos específicos en términos de su diseño. Este documento describirá el estado actual de la investigación de Diseño de Aprendizaje y luego articulará las 7C del marco de Diseño de Aprendizaje (y los mar-

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cos de Diseño de Aprendizaje relacionados) y considerará cómo se puede usar esto para diseñar OER y MOOC.

Palabras clave: diseño de aprendizaje, educación abierta, recursos de educación abierta (OER), clases en línea abiertas y masivas (MOOCs), Larnaca Declaration on Learning Design, 7Cs del diseño de aprendizaje

学习设计与开放教育

摘要

过去15年来学习设计作为一种新的设计方法萌芽，以帮助从业人员做出更有教学依据的设计决策以合理利用数字技术。与此同时，我们看到了开放教育运动的兴起，首先是通过开放教育资源(OER)的出现，其次是通过大规模的开放式在线课程(MOOC)。OER和MOOC正在挑战现有的教育产品，并对这些产品设计提出了具体要求。本文将描述学习设计研究的现状，阐述学习设计框架(和相关学习设计框架)的7C特点，并探讨如何将该框架用于设计OER和MOOC。

关键词：学习设计，开放教育，开放教育资源(OER)，大规模开放在线课程(MOOC)，拉纳卡学习设计宣言，学习设计框架的7C特点

Introduction

The *International Journal of Open Educational Resources* (IJOER) focuses on the following aspects/impact of open educational resources (OER):

- The efficacy of teachers and students perceptions of OER in actual practice.
- The cost and/or cost savings of OER.
- The outcomes of OER.
- The usage of OER.
- The associated OER policy and practice implications.

This article focuses mainly on the first of these in terms of teachers' and students' perceptions of OER. In

particular, it focuses on how OER and massive open online courses (MOOCs) can be more effectively designed to enhance the learner experience. The article begins by providing an overview of different pedagogical approaches. It then reviews today's Learning Design landscape, drawing in particular on the Larnaca Declaration on Learning Design (Dalziel et al., 2016). It then focuses in on a specific methodology, the 7Cs of Learning Design framework and articulates how this can be used to support and guide the design process. It concludes by considering the specific opportunities and challenges associated with designing and utilizing OER and MOOCs.

Pedagogical Approaches

Mayes and De Freitas (2004) group learning theories into three types: *associative* (learning as an activity through structured tasks), *cognitive* (learning through understanding), and *situative* (learning as social practice). Connectivism can be added as a fourth type of learning theory. Siemens developed connectivism as an approach that emphasizes the connected and networked nature within which modern learning occurs (Siemens, 2005). This includes a learning ecology model that considers the elements involved in the learning process and how they can be facilitated within a networked ecology. It emphasizes the networking affordances of technologies.

The HoTEL (n.d.) project provides a useful visualization of learning theories, mapping these to cognate disciplines, key theorists, and the central tenet of each learning theory. The report highlights the tension between academics wanting to use digital technologies effectively and the bewilderment as to the plethora of learning theories available.

Learning theory has been a contested scientific field for most of its history, with conflicting contributions from many scientific disciplines, practice, and policy positions. With the continuing and disruptive influence of technology on information, knowledge, and practice in all sectors of society, it is no wonder that innovators, drawn to the interactive potential that computers bring to learning, are challenged by the theoretical basis for their innovations.

Figure 1 shows the visualization. In the center are the cognate disciplines the theory originated from (orange), next is the key theorists (red), then the learning theory (blue/green), and finally a summary of the focus of the learning theory (white). For example, from social anthropology, Lave and Wenger (1991) developed the concept of Communities of Practice, the central tenet of this focuses around groups of people who share a concern or passion for something they do and learn how to do it better as they interact regularly.

Paniagua and Istance (2018) argue that pedagogy is at the heart of teaching and learning. While there are many different types of pedagogy, they particularly emphasize the importance of play, creativity, collaboration, and inquiry. They cite six clusters of inno-

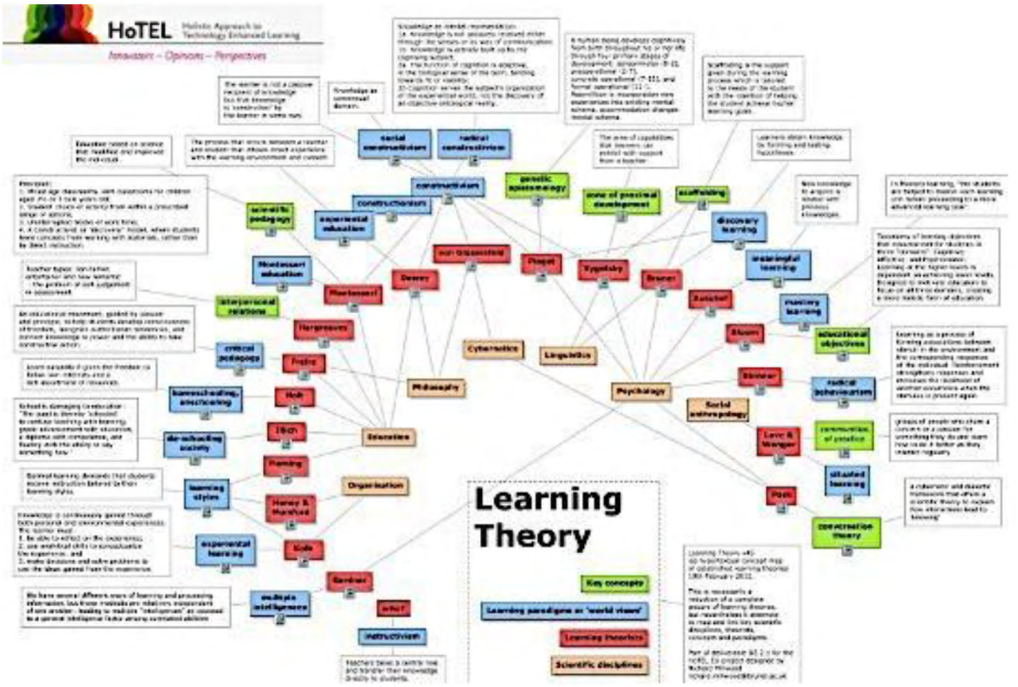

Figure 1. A Map of Learning Theories

vative pedagogies: blended learning, computational thinking, experiential learning, embodied learning, multi-literacies and discussion-based teaching, and gamification. Examples of blended learning include the flipped classroom, the lab-based model where students rotate between a school lab and the classroom, and in-class blended learning, where students rotate between online and face-to-face instruction. Computational thinking helps develop problem-solving through computer science and consists of logical reasoning, decomposition, algorithms, abstraction, and patterns. Experiential learning takes place through active experience, inquiry, and reflection, there are four aspects: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Embodied learning connects the physical, artistic, emotional, and social multi-literacies and discussion-based teaching aim to develop cultural distance and critical capacities.

Evidently, there are multitudes of learning theories that can be used to promote different pedagogical approaches, emphasizing different ways to foster communication, collaboration, and reflection, as well as the types of blended learning approaches described above. Digital technologies can be used to implement these; however, to harness the affordances of digital technologies and map them to different pedagogical approaches requires new approaches to design. The next section introduces the concept of Learning Design which has

emerged in recent years and the subsequent sections describe a number of specific Learning Design frameworks.

The Larnaca Declaration on Learning Design

The Larnaca Declaration on Learning Design provides an authoritative and up-to-date overview of Learning Design (Dalziel et al., 2016). It states that at the heart of the Learning Design methodology are three components: guiding the design process, representing/visualizing the design process, and providing mechanisms for practitioners to share and discuss Learning Designs.

Guidance covers the many ways that educators can be assisted to think through their teaching and learning decision-making, in particular, how they can understand and adopt new, effective teaching methods. The guidance prompts the practitioners to think of the design from different perspectives, to articulate the nature of the activities and resources the learners will engage with, and to constructively align learning outcomes to assessment elements, i.e. to ensure constructive alignment (Biggs, 1999). The guidance prompts the practitioner at various stages of the design process and encourages them to critically reflect on their design approach.

Visualization is a very powerful alternative to text. Before today's music notation was developed, tunes had to be passed on orally, with an inevitable loss of fidelity. Now music from hundreds of years ago cannot only be perfectly replicated in terms of the notes and tempo, but also even the emotion inherent in the piece. The aim of Learning Design is to develop an equivalent educational design language (Dalziel et al., 2016). In this respect, visualization is very persuasive, as different visualization can represent different nuances of the design. A number of visualizations have been developed. One of the earliest was the AUTC flow of activities representation, consisting of resources, tasks, and support (AUTC, 2002). Figure 2 shows that a "Learning Design Sequence" representation uses the following graphical notation:

- Squares represent Tasks.
- Triangles represent Resources.
- Circles represent Supports.

At about the same time, the Learning Activity Management System (LAMS) was developed, which consisted of a flow of activities and associated tools over time (Dalziel, 2003). It is a tool for designing, managing, and delivering online collaborative learning activities. It provides an interface for the designer to create a temporal sequence of tools. LAMS can be integrated with various learning management systems (LMS), such as Blackboard or Moodle.

The Open University UK developed CompendiumLD—a tool for visualizing designs (Conole, 2008). This is a flexible tool which can be used to articulate a number of different visualizations, such as the task swimlane representation (Figure 3), where the

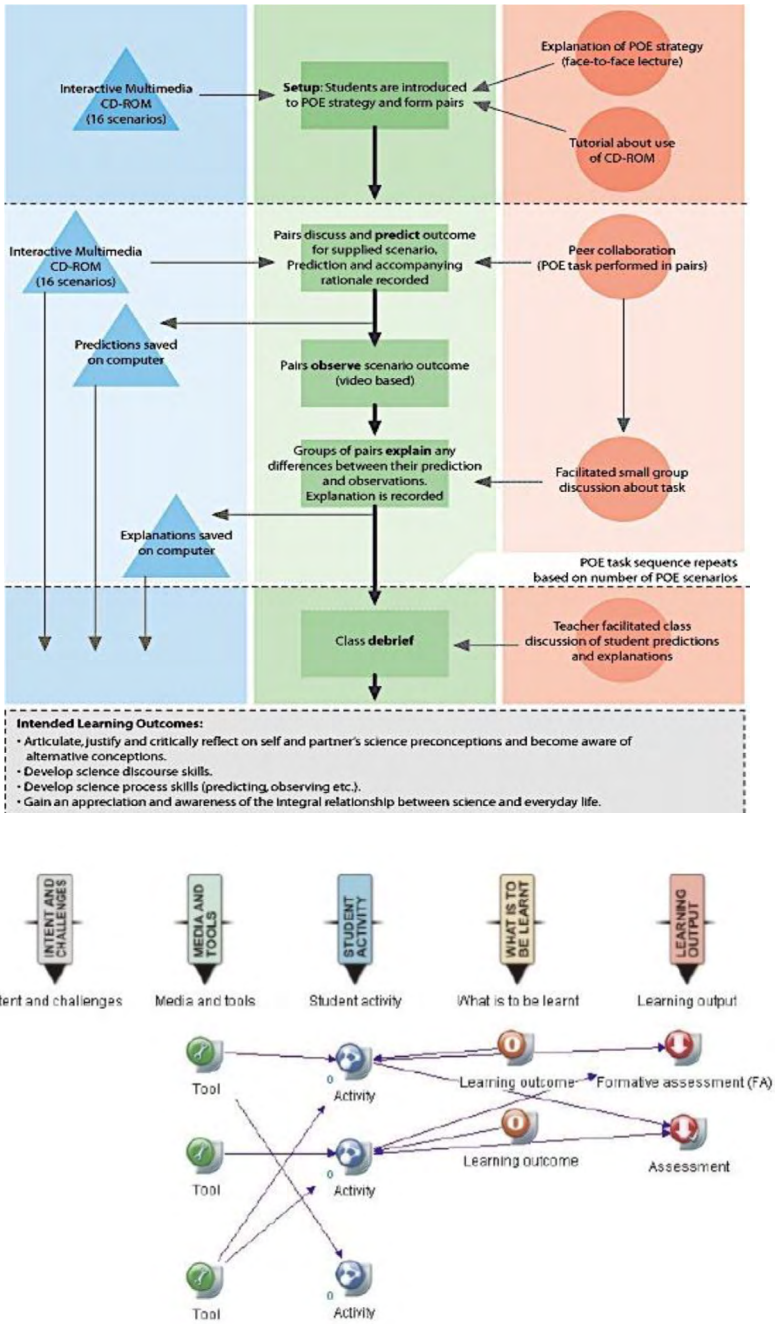

Figure 2. The AUTC Learning Design Representation

various components of the design are indicated in time-sequential columns. An alternative is an asset-focused visualization, where resources and activities are located in a central line, with associated activities for teachers and students either side.

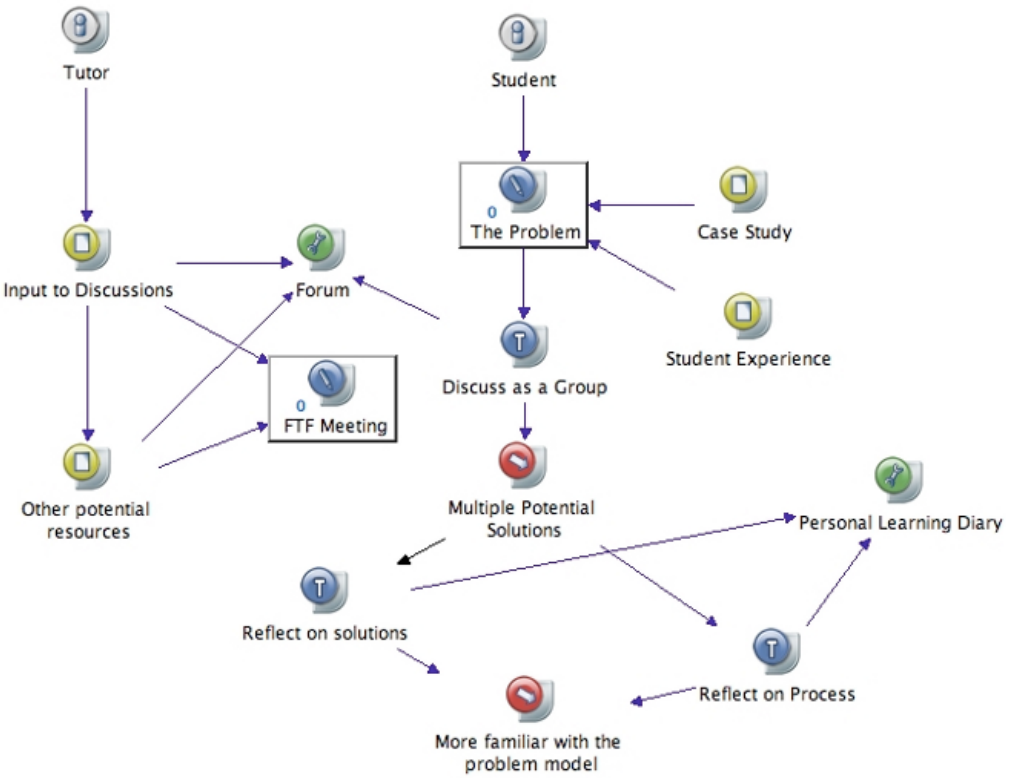

Figure 3. The Task Swim Lane Visualization

Another kind of representation is the pedagogical pattern, which begins with the problem to be addressed, followed by a structure solution, and mapping to related pedagogical patterns. Goodyear (2005) describes the concept of a pedagogical framework as a loosely coupled structured in which hierarchical relations can be made between:

- pedagogical philosophy (how we think people learn, what knowledge consists of, how we think people should be treated, etc.),
- high-level pedagogy (broad approaches such as problem-based learning, cognitive apprenticeship, collaborative knowledge building),
- pedagogical strategy (e.g. the use of an online debate),
- pedagogical tactics (the detailed methods we use to set tasks for students, encourage their participation, offer guidance and feedback, etc.).

He goes on to state that pedagogical patterns are useful in many respects:

- They provide the teacher-designer with a comprehensive set of design ideas.

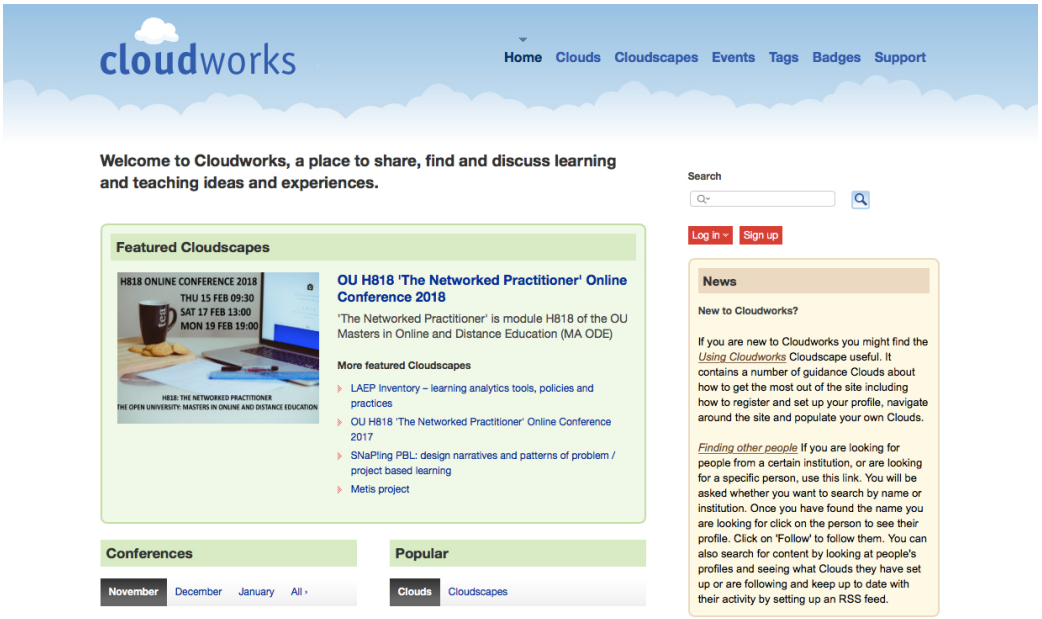

Figure 4. Cloudworks

- They provide these design ideas in a structured way—so that relations between design components (design patterns) are easy to understand.
- They combine a clear articulation of a design problem and a design solution and offering a rationale which bridges between pedagogical philosophy, research-based evidence, and experiential knowledge of design.
- They encode this knowledge in such a way that it supports an iterative, fluid, process of design, extending over hours or days.

Finally, practitioner invariably learned best from their peers, the best ideas for innovating their teaching are often through sharing and discussing designs with others. So, for example, the short "coffee room" exchange where one teacher describes how they have been using a wiki to facilitate collaboration among their students may be more useful than reading an extended case study of innovation. Facilitating sharing and discussing of ideas can be done in face-to-face contexts or through the use of social media such as Twitter or Facebook. Finally, specialized social media for sharing and discussing learning and teaching ideas have emerged such as Cloudworks[1] (Conole & Culver, 2010).

Cloudworks combines social and participatory functionality to enable multiple forms of communication, collaboration, and cross-boundary interactions among different communities of users. Figure 4 shows a screenshot of the homepage. The core object in the site is a Cloud, which can have anything to do with learning and teaching; such as a description of a learning interven-

tion, a description of a tool or resource, a question, or a discussion point. Clouds can be grouped into Cloudscapes; a Cloud can belong to more than one Cloudscape. Clouds are a combination of social and participatory functionality. Firstly, they act much like a multi-user blog; anyone can start a Cloud and others can sequentially add content to it. Secondly, they have a space for discussion. Thirdly, users can enrich the Cloud by adding embedded content, tags, links, and references. Finally, they have additional Web 2.0 functionality, such as an activity stream for the Cloud, the ability to tag, RSS feeds, and Twitter-like "follow" and "be followed" options.

The Challenges Facing Education

The Larnaca Declaration on Learning Design begins by contextualizing why Learning Design is important, and focuses on the following aspects: the challenges face educators, education, and the Government (Dalziel et al., 2016).

Firstly, education faces many challenges in the changing modern world. Learners are changing in their approaches to education—they use digital technologies, they multi-task, they collaborate, and they are becoming less patient with teacher-centric styles of education. This mirrors a recent Open Universities Australia report (OUA, 2018) on the "I want what I want when I want it" (IWWIWWIWI) generation of learners. The report states that learners are increasingly demanding and want personalized and flexible learning opportunities. This raises the question of how universities can ensure that they are meeting these needs. There is a dichotomy in that university education is becoming more expensive and at the same time, information is more ubiquitous (Portolan, 2017). Many are arguing that we do not need a degree to acquire the knowledge and creativity required to be successful and gain meaningful employment.

New initiatives are arising to address this such as "uncollege,"[2] which aims to help learners identify areas of interest and to accelerate their learning. It is a social movement that aims to change the notion that going to college is the only path to success. Furthermore, we are seeing an unbundling of education (McCowan, 2017). Learners increasingly do not want to do full three-year degrees; they want bite-sized chunks of learning. They may choose to pay for: (i) quality assured learning materials, (ii) learning support, (iii) a guided learning pathway, or (iv) accreditation. Universities need to shift from offering a specific one-time experience to providing lifelong opportunities to enable learners to acquire skills useful across multiple careers.[3] Different learners will have different needs and will, therefore, choose different components.

In addition, learners are increasingly mixing formal educational offerings with free materials and courses, available through OER and MOOCs. As a result, new forms of recognition of learning and accreditation are emerg-

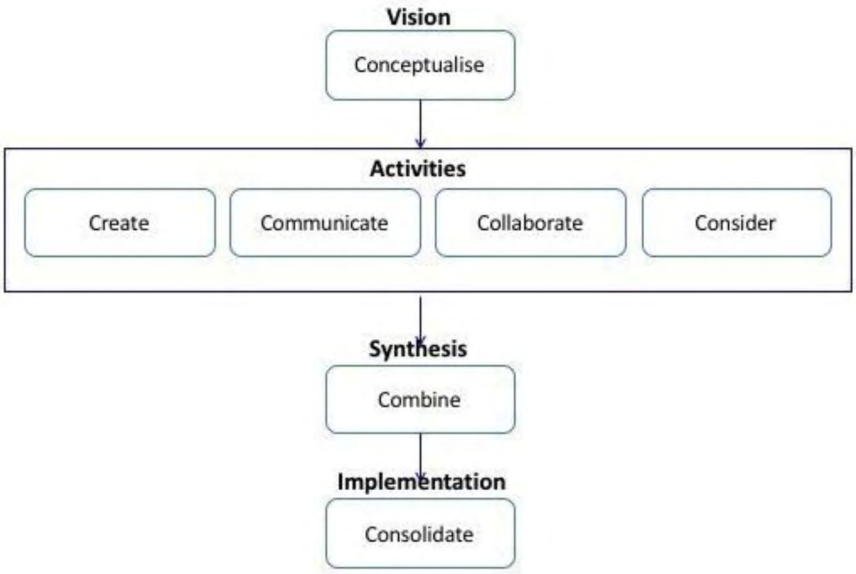

Figure 5. The 7Cs of Learning Design Framework

ing, such as digital badges, certificates of participation/completion, and Accreditation of Prior Learning. The OpenCred project provides a summary of these (Witthaus et al., 2016). It articulates a number of factors associated with nonformal learning (identity verification, supervised assessment, quality assurance, etc.).

Secondly, educators face many changes—such as expectations of adopting innovative teaching approaches, alignment of teaching to external standards, growing requirements for professional development, and difficulties in balancing a complex range of demands from different stakeholders.

Thirdly, Government and educational institutions also face many changes, such as the rise of the knowledge economy and the need for different kinds of graduates, a shift from knowledge scarcity to abundance (Weller, 2011), and the impact of technology—especially the internet via open sharing of educational resources and MOOCs.

In the context of these changes, effective teaching and learning in the classroom (and beyond) remains central. How can educators become more effective in their preparation and facilitation of teaching and learning activities? How can educators be exposed to new teaching ideas that take them beyond their traditional approaches? How can technology assist educators without undermining them? How can learners be better prepared for the world that awaits them?

All these factors suggest that more rigorous approaches to design are needed to help practitioners move beyond a concentration on content to a focus on learning activities and the learner experience. Typically, practitioners draw on their own subject ex-

pertise and their own learning experience (typically based primarily around lectures and tutorials). They need more guided support to "think outside the box" and to innovate in their design.

The 7Cs of Learning Design Framework

The 7Cs of Learning Design framework consists of a set of resources and activities to help practitioners create pedagogically informed design decisions that make appropriate use of digital technologies. Figure 5 shows the 7Cs framework, each C has associated with it a set of resources and activities to guide the design process (Conole, 2016).

When designing learning interventions, academics typically focus on content; the 7Cs framework enables them to think beyond content to the learning activities the students will engage with and the student experience. The 7Cs framework has been used now in hundreds of workshops.[4] Evaluation of the workshop is overwhelmingly positive. Participants state that the workshop helps them to be more creative and innovative in their design practice. Working in teams means that participants can build on each other's knowledge.

Other Learning Design Frameworks

Conole (forthcoming) describes a number of other frameworks for design, a flavor of these is provided here. Arguably, the most popular and useful frameworks are the ICAP framework, SAMR framework, the 8LEM model, and the TPACK framework.

Specialized Requirements for Designing OER and MOOCs

OER can be defined as

> *Teaching, learning or research materials that are in the public domain or released with an intellectual property license that allows for free use, adaptation, and distribution.* (UNESCO, 2011)

Designing OER and MOOCs offer a number of opportunities and challenges for education. When they originated, it is arguable whether or not OER were consciously designed; the focus tended to be on the content, associated copyright, and populating OER repositories. Furthermore, the inherent design was not made explicit and this made it difficult for others to use or repurpose them. This constraint is almost certainly one of the factors behind the lack of uptake of OER. The emergence of MOOCs followed a different pathway. The first MOOC was the Connectivist and Connected Knowledge MOOC in 2008. This aimed to build on Siemen's concept of connectivism (Siemens, 2005); which privileges the way in which social media can be used to support learners. In around 2011, an alternative type of MOOC emerged via organizations such as Udacity, EdX, and Coursera. These MOOCs were more

individually focused consisting mainly of videos and formative quizzes. The former is known as cMOOCs and the latter xMOOCs.

Weller (2018) suggest there are a number of principles associated with open practices, including the freedom to reuse, open access, free cost, easy use, digital/networked content, social/community-based approaches, ethical arguments for openness, and openness as an efficient model. Open education can be defined as:

> *Resources, tools, and practices that employ a framework of open sharing to improve educational access and effectiveness worldwide.*[6]

Weller (2018) and Weller, Jordan, DeVries, and Rolfe (2018) state that open education is an evolving term that covers a range of philosophies and practices aimed at widening access to education for those wishing to learn, with the current focus predominantly on practices based around reuse and sharing.

The perceived benefits of OER are that they provide a way of capturing and sharing content, that might be used or repurposed by others. Open practices have many facets and are complex, they are not new but are having an increasing impact in education as a result of new digital technologies, and in particular social media. There is a lot of rhetoric around the potential of open practices and naïve assumptions about their impact, but it is important to caution against this; they are not inherently good in themselves, but it is more to do with how they are appropriated. In other words, the nature of, and benefits of, open practices depends on the context, i.e. how they are applied and implemented.

Wiley (2007) developed the 4Rs framework for thinking about the bundle of permissions around the use of open educational resources; namely reuse, rework, remix, and redistribute. These 4Rs are the ways in which OER can be used:

- Reuse—Use the work verbatim, exactly as it was found.
- Rework—Alter or transform the work so that it better meets a particular need.
- Remix—Combine the (verbatim or altered) work with other works to better meet a particular need.
- Redistribute—Share the verbatim work, the reworked work, or the remixed work with others.

He argues that there are two criteria associated with OER: firstly, free and unfettered access to the resource, and secondly, whatever copyright permissions are necessary for users to engage in the 4R activities. He later added a 5th R: Retain—the right to make, own, and control copies of the content (Wiley, 2014).

The OpenEdu framework for higher education institutions presents ten dimensions for opening up education (Inamorato dos Santos, Punie, & Castaño-Muñoz, 2016) (Figure 6). The ten dimensions of the framework are

Figure 6. The Ten Dimensions of Openness

Source: JRC IPTS Report (2016): Opening Up Education in Europe—A Support Framework for Higher Education Institutions (OPENEDU)

divided into two categories: core dimensions and transversal dimensions. There are six core dimensions (access, content, pedagogy, recognition, collaboration, and research) and four transversal dimensions (strategy, technology, quality, and leadership). Inamorato dos Santos et al. argue that open education is often thought of as relating to content (OER) or research (open access). The framework places opening up education beyond these two aspects and introduce both content and research as core dimensions ("what" is included), which are supported by means of the four transversal dimensions ("how" it is provided).

Czerniewicz, Deacon, Fife, Small, and Walji (2015) argue that MOOCs are a flexible and open form of self-directed, online learning designed for mass participation. They argue that the affordances of MOOC technology are as follows:

- **Educator involvement**: While educators are involved in the design and production of the MOOC, their involvement during the running of the course is minimized because of the lack of formal assessment or formal academic credit.
- **Engagement**: It is possible to engage with a large number of students via discussion forums.
- **Re-watchable:** Students are able to watch and re-watch lecture videos.
- **Scale**: MOOCs are designed to reach a large number of students.
- **Assessable:** Most MOOCs include in-video, concept-check

questions, with immediate feedback, as well as peer review.

- **Customized learning experience:** Participants can learn at their own pace and choose which material they engage with.

The promise of MOOCs is that they provide free to access, cutting-edge courses that could drive down the cost of university-level education and potentially disrupt the existing models of Higher Education. Motivations for learners include: supporting lifelong learning or gaining an understanding of a particular subject, with no particular expectations for completion or achievement, for fun, entertainment, social experience and intellectual stimulation, for convenience, often in conjunction with barriers to traditional education options, and to experience or explore online education.

However, there are a number of criticisms of MOOCs. Forbes (2017) argues that three of the most pressing critiques of an open learning system are (a) lack of an effective system to measure and validate the progress of the learners, (b) how to integrate the course credits into the present system so that it counts toward a degree from a college, and (c) how do you ensure personalized guidance and mentorship.

Conclusion

This article has critiqued the relationship between open education and approaches to designing for learning. A central tenet is that OER and MOOCs have particular affordances; of significant note is the opportunity to open up practice. It has argued that new approaches to design are needed to create engaging OER and MOOCs that will enhance the learner experience. Conole and Brown (forthcoming) reflect on the impact of the open education movement on learning, teaching, and research. They outline some of the barriers and enablers associated with open education. These include the fact that despite the rhetoric, OER and MOOCs are not been used extensively by teachers and learners and the need for appropriate continuing professional development (CPD) to harness the potential of digital technologies and specifically the need for new digital literacies. They list a range of CPD possibilities that go beyond the standard fixed workshop model, which provide opportunities for colleagues to share and discuss learning and teaching ideas. They conclude by stating that OER and MOOCs are important as they get us to think about the learner experience and they challenge traditional educational offerings.

Author

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Notes

1 http: cloudworks.ac.uk

2 https://www.uncollege.org/

3 https://www.chronicle.com/interactives/store

4 The workshop outline and associated resources and activities is available online https://www.slideshare.net/GrainneConole/learning-design-workshop-2017

5 http://cetl.ulster.ac.uk/elearning/documents/About-HLM.pdf

6 https://www.oeconsortium.org/about-oec/

Expanding Access to Science Field-Based Research Techniques for Online Students through OER

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Abstract

Adoption of open educational resources (OERs) by the science, technology, engineering, and mathematics (STEM) community has yet to become an integral part of higher education classrooms. Many STEM faculty have been reluctant to develop and use OERs because the process of developing these resources is time-consuming and finding appropriate resources for higher education remains overwhelming. The team, Matias, Woo, and Whitley-Grassi at State University of New York (SUNY) developed a process to help generate OERs for topics that are generally associated with laboratory equipment or field research techniques in ecology and earth sciences, as well as general science. This project draws on the need to develop resources and expand access to scientific field-based research techniques through OERs for students learning at a distance. Engaging in undergraduate scientific virtual field experiences is an educational opportunity for students with a desire for an enriched learning experience in the sciences, particularly in ecology and earth sciences, but that cannot participate in a traditional field-based curriculum. This article discusses the current status of the use of OERs for STEM education and our approach to develop-

 doi: 10.18278/ijoer.1.1.7

ing three OERs in the areas of microscopy, geologic history interpretation, and biodiversity. The team concludes by sharing some of the challenges and lessons learned in the process.

Keywords: open educational resources, science, technology, engineering, and mathematics (STEM), microscopy field-based curriculum, virtual field experience

Ampliación del acceso a las técnicas de investigación basadas en el campo de la ciencia para estudiantes en línea a través de OER

Resumen

La adopción de recursos educativos abiertos (OERs) por parte de la comunidad de ciencias, ingeniería y matemáticas (STEM) todavía tiene que convertirse en parte integral de las aulas de clase de la educación superior. Muchos profesores de STEM se han mostrado reacios a desarrollar y utilizar los OERs porque el proceso de desarrollo de estos recursos requiere mucho tiempo y la búsqueda de recursos adecuados para la educación superior sigue siendo abrumadora. El equipo, Matias, Woo y Whitley-Grassi en la Universidad Estatal de Nueva York (SUNY) desarrollaron un proceso para ayudar a generar OER para temas que generalmente están asociados con equipos de laboratorio o técnicas de investigación de campo en ecología y ciencias de la tierra, así como la ciencia en general. Este proyecto se basa en la necesidad de desarrollar recursos y ampliar el acceso a técnicas de investigación basadas en campos científicos a través de OER para estudiantes que aprenden a distancia. Participar en experiencias científicas virtuales de campo es una oportunidad educativa para estudiantes con el deseo de una experiencia de aprendizaje enriquecida en ciencias, especialmente en ecología y ciencias de la tierra, pero que no puedan participar en un currículo tradicional basado en el campo. Este artículo analiza el estado actual del uso de OER para la educación STEM y nuestro enfoque para desarrollar tres OER en las áreas de microscopía, interpretación de historia geológica y biodiversidad. El equipo concluye al compartir algunos de los desafíos y lecciones aprendidas durante el proceso.

Palabras clave: recursos educativos abiertos, ciencia, tecnología, ingeniería y matemáticas (STEM), currículo basado en el campo de la microscopía, experiencia de campo virtual

通过OER扩大在线学生获取科学实地研究技术的机会

摘要

科学、技术、工程和数学(STEM)社区采用开放教育资源(OER) 尚未成为高等教育课堂的组成部分。许多STEM社区教师不愿开发使用OER，因为开发这些资源极为耗时，而为高等教育寻找合适资源任务艰巨。纽约州立大学(SUNY)的Matias、Woo和WhitleyGrassi团队开发了一个OER生成程序，通常用于与生态学和地球科学以及一般科学中的实验室设备或实地研究技术相关的主题。该项目利用开发资源的需求，并通过OER扩大了学生在远程学习中获取科学实地研究技术的机会。参与本科科学虚拟实地体验，对于渴望丰富科学领域学习经验，尤其是生态学和地球科学领域的学生来说，是一个教育机会。但该体验不能融入传统实地课程。本文探讨了OER在STEM教育中的应用现状，以及如何在显微镜、地质历史解释和生物多样性等领域开发三种OER的方法。该小组最后分享了这一研究过程中遇到的一些挑战和取得的经验教训。

关键词：开放教育资源，科学、技术、工程与数学教育(STEM)，显微镜实地课程，虚拟实地体验

Introduction

Research shows that incorporating hands-on, field experiences with lectures has the potential to create a problem-based learning environment that engages learners in authentic scientific inquiry (Orion, 1993; Simmons, Wu, Knight, & Lopez, 2008). However, due to the distributed environment and online-enriched educational model that many institutions are now facing, opportunities for students to engage in scientific field experiences are often minimal in the curriculum.

Engaging in undergraduate scientific virtual field experiences is an educational opportunity for students with a desire for an enriched learning experience in the sciences, particularly in ecology and earth sciences, but who cannot participate in a traditional field-based curriculum.

The team firmly believe that motivated students in science, technology, engineering, and mathematics (STEM) concentrations with demanding schedules or other barriers to access should have the opportunity to learn about scientific field research while they acquire professional development. Thus, they developed three OERs and a process to help generate skills and knowledge for topics generally associated with laboratory equipment or field techniques. Phase 1 of the project included OERs that aim to teach students about: the basic functionality of microscopes (Introduction to Microscopy); the geologic history interpretation of rocks exposed at the surface (Geologic Outcrop Analysis and Relative Dating of Rocks); and the identification of invertebrates (Biodiversity Sampling of Invertebrates). The project draws on the need to develop resources and expand access to scientific field-based research techniques for students learning at a distance or with other barriers to access.

The value of this project lies in increasing access and portability to scientific techniques while supporting an instructional model that allows for further refinement, development, growth, and use across and beyond the institution. In this article, the team discusses the current status of the use of OERs for STEM education and our approach to developing OERs as well as the challenges and lessons learned in the process.

Status of OERs in STEM

The concept of OERs is nothing new to the STEM community. If you have searched for educational resources online, you have probably noticed that there is no shortage of STEM resources for teaching. Major government-funded institutions in the United States such as the National Aeronautics and Space Agency (NASA), for instance, provide powerful free to use teaching tools. Additionally, as recent research has demonstrated, the OER movement continues to gain traction across campuses globally (Johnson, Adams Becker, Estrada, & Freeman, 2015). Why, then, do educators at colleges and universities not embrace the plethora of open digital educational libraries and repositories in STEM?

Unfortunately, the vast majority of openly available resources are targeted toward primary and secondary education rather than higher education. In recent years, more and more professional associations and institutions have embraced the OER movement by encouraging faculty and researchers to share educational materials (e.g. lesson plans) openly on their sites. Table 1 shows some examples of sites that adhere to the openly available principle of OER access for STEM subject areas as well as sites that serve as search engines to a wide range of resources.

Table 1. Examples of Repertoires Specifically for STEM OERs (Higher Education Included) and Websites that Search Across Platforms

	STEM Area	**URL**
American Association for Physics Teachers (AAPT) comPADRE Network	Physics and astronomy	www.compadre.org
Digital Library for Earth System Education (DLESE)	Earth science, geology, and environmental science	www.dlese.org
Chemical Education Digital Library (ChemEd DL)	Chemistry	www.chemeddl.org
Applied Math and Science Education Repository (AMSER)	Wide range of STEM fields, built specifically for use by those in community and technical colleges	amser.org
Science Education Research Center (SERC) of Carleton College	Geosciences	serc.carleton.edu
The National Science Digital Library (NSDL)	All STEM fields, both formal and informal educational resources	nsdl.oercommons.org
OER Commons	Wide range of areas including science and mathematics	www.oercommons.org
Multimedia Educational Resource for Learning and Online Teaching (MERLOT)	Wide range of areas including STEM	www.merlot.org
TEMOA	Wide range of resources, including for STEM fields compiled by the Tecnológio de Monterrey, Mexico	www.temoa.info
European Union Open Science Research Project	Wide range of STEM areas	www.opensciencesources.eu

Perhaps, one of the most important issues affecting the creation and adoption of STEM OERs is the culture of STEM education itself. Departmental and institutional cultures often do not adequately value, support, and reward effective pedagogy. Teaching excellence is rarely a deciding factor for tenure in many STEM departments, particularly at research-oriented institutions. Consequently, many STEM faculty are left with the decision to prioritize scholarship over teaching effectiveness. Furthermore, even when educators know about the existence of OERs, most of the repertoires remain disconnected from each other and one must invest a lot of time and energy searching for materials adequate for the different subjects and academic levels. STEM educators are not the only ones suffering from this difficulty. In 2014, an in-depth exploration of OERs in higher education by the Babson Research Group revealed that half of the over 2,000 member strong faculty surveyed were deterred from using OERs due to the lack of a comprehensive catalog of materials (Allen & Seaman, 2014). According to their report, faculty perception of the time and effort required to find and evaluate OERs remains a significant barrier to their adoption.

Another important issue is the lack of standards and quality control between repertories. A standard categorization or curating method might help faculty, especially faculty in STEM fields, in their adoption of OERs. Porcello and Hsi (2013) discuss the use of crowdsourcing as an option to improve the quality of STEM OERs. They present four components essential to the success of OERs, emphasizing application to STEM: (1) convergence toward common metadata; (2) balancing expert and community definitions of quality; (3) community input; and (4) interoperability. Efforts by programs like the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) of the California State University System (US), where communities engage in building OERs based on evaluation standards, leverage the STEM OER community to develop quality content that is easy to use and have the potential to be effective teaching tools.

The Approach

The development of OERs is growing in popularity as more faculty and administrators realize the collective power they can attain by sharing resources in higher education (Cannell, Macintyre, & Hewitt, 2015; Clements, Pawloeski, & Manouselis, 2015; Johnson et al., 2015; Porcello & Hsi, 2013). But, the process of developing these resources can be time-consuming and often requires the use of additional assets. Thus, many faculty continue to be reluctant to develop OERs. This is particularly noticeable in STEM areas where fieldwork is essential for learners' training, such as ecology and geology, where most of the available OERs are for pre-college education or do not have the rigor expected by many higher education instructors. For instance, the field setting provides the ability to see the interconnections among different components of the Earth system.

In nature, students have the opportunity to learn from nature and about science. This important learning experience is difficult to replicate in the online environment; hence, the learning environment could be enhanced with field-based OERs. Based on the necessity to infuse their online and blended courses with hands-on field experience, a process was developed to help generate stand-alone OERs for topics that are generally associated with laboratory equipment or field techniques in the areas of ecology and earth sciences, as well as general science. Drawing on that process, a series of OERs were designed.

The Project

The OER project builds on a blended summer course with a three-day face-to-face meeting at the State University of New York (SUNY) Oneonta's Biological Field Station and Upland Interpretive Center in Cooperstown, New York. This unique project leverages resources utilized during the summer course to create a series of OERs. For example, both facilities visited during the face-to-face component are adjacent to Ostego Lake, which provided us with the opportunity to showcase general ecology, earth science, and scientific inquiry activities. Dynamic OERs were developed based on field experiences at these facilities incorporating scientific equipment as well as mobile devices, which could be adapted for a broad audience and/or science subject.

The goal of the project is to provide students with the research skills they need to increase their competency in scientific research after graduation by engaging them in common field-based research techniques and methods for data collection and analysis through a series of interactive online activities. Field-based learning helps students strengthen their ability to reason spatially, to integrate information, and to critique the quality of data. Educators can help students make these connections by fostering pathways from observation to interpretation. Through the application of current technological tools, SUNY engaged in an innovative approach to STEM learning and the application of the scientific method by developing OERs on: Introduction to Microscopy (basic principles of using a microscope), Geologic Outcrop Analysis and Relative Dating of Rocks (geologic history interpretation of rocks exposed at the surface), and Biodiversity Sampling of Invertebrates (identification of invertebrates). With the creation of these OER, SUNY would like to engage students virtually in activities that typically involve a field trip.

The Process

The process of developing the OER fell to two people, the "Content Developer" and the "Instructional Designer" (Figure 1). Each of these individuals worked both collaboratively and independently. Figure 1 shows both roles and their respective tasks during the development process. The two primary responsibilities of the content developer were to envision the incorporation of the field-

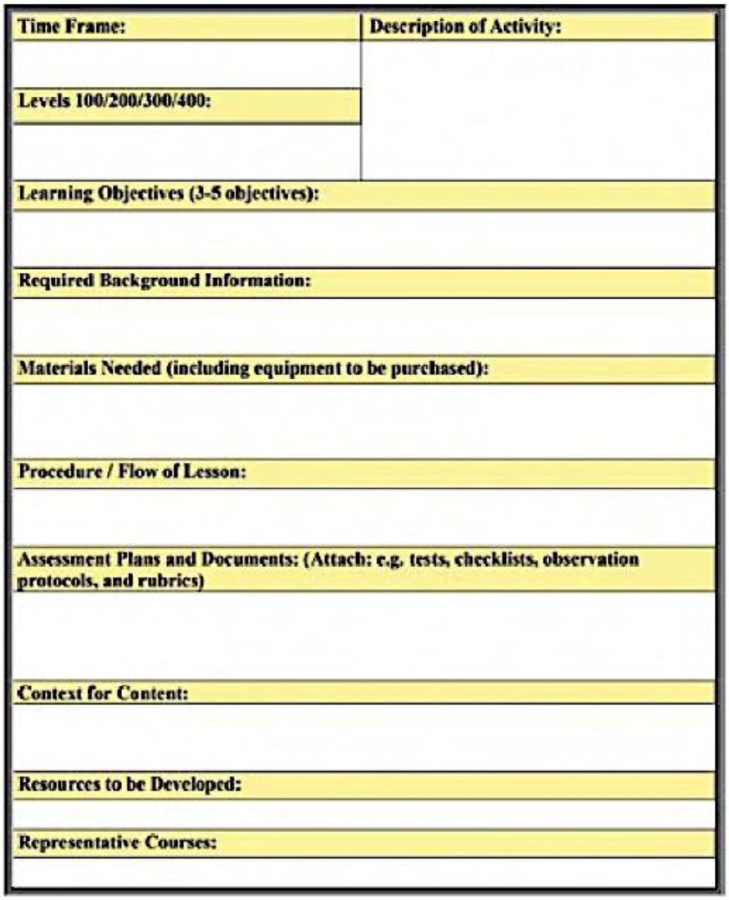
or laboratory-based experience within the OER and to provide the subject matter content. The instructional designer's main responsibilities included creating the digital objects and keeping the project moving. As such, the team worked actively together at the beginning and end of the process (tasks shown as dark grey in Figure 1), and independently during the rest of the development period (tasks shown as light grey in Figure 1).

Zoom in Original (jpeg, 142k)

Figure 1. Visual of Roles in the OER Design Process. The Content Developer and Instructional Designer Worked Collaboratively During Tasks Shown in Dark Grey, and Independently (but Simultaneously) During Tasks Shown in Light Grey

The collaboration with the instructional designer at the beginning enabled the content developer to better frame the OER in what could and should be done technically and pedagogically. Selecting the appropriate approach to convey the subject matter and to provide experiential learning that normally occurs outdoors proved to be an overwhelming task in both scope and complexity. Thus, progress was often halted by the amount of time required from the content developer and the unrealistic expectations of the available resources. During the initial stages, the instructional designer also completed a content inventory on the particular subject of the OER. The content inventory included a list of all materials needed in order to create the OER as envisioned by the developer, such as multimedia elements, images, video clips, and written content.

The process thus came to evolve into a parallel but extensive consultative process from the curriculum developer with an instructional designer used to frame the goals and outcomes of the specific OER. This was done through the use of a lesson plan template that was developed (see Figure 2). The template allows the content developer to conceptualize the learning objectives, identify the necessary resources, background information, and the learning that should happen for the learner to meet the objectives. At the same time, the instructional designer collected the necessary resources to achieve the objectives and decided on different interactive approaches to present the content. For example, the microscopy OER uses a simple approach using pop-ups to show the basic functionality of the microscope. On the other hand, the Geologic Outcrop OER utilizes videos and animations to convey how geologists interpret rock formations in the field.



Time Frame:	Description of Activity:
Levels 100/200/300/400:	
Learning Objectives (3-5 objectives):	
Required Background Information:	
Materials Needed (including equipment to be purchased):	
Procedure / Flow of Lesson:	
Assessment Plans and Documents: (Attach: e.g. tests, checklists, observation protocols, and rubrics)	
Context for Content:	
Resources to be Developed:	
Representative Courses:	

Zoom in Original (jpeg, 283k)

Figure 2. Template Form Used by Content Developers to Provide the Pedagogical Goals of the OER to the Instructional Designer

An important aspect of utilizing the OER pre-development form (Figure 2) is that it focuses on the pedagogical aspects rather than the technology. It was imperative to have clear learning objectives and outcomes before developing any content and/or pieces of the OER. After the lesson plan was completed and resources (e.g. photographs and/or videos in the field) were collected, the developer focused on the production of content materials and the instructional designer began to map the content for the OER. The usefulness of concept maps was quickly learned when mapping the different content aspects of the OER. Figure 3 shows an example of the organizational concept map for the microscopy OER. In this example, two main types of microscopes and their components are presented in the OER through the use of images, text, and audio.

The next step in the process involved the use of a storyboard approach by the instructional designer to create

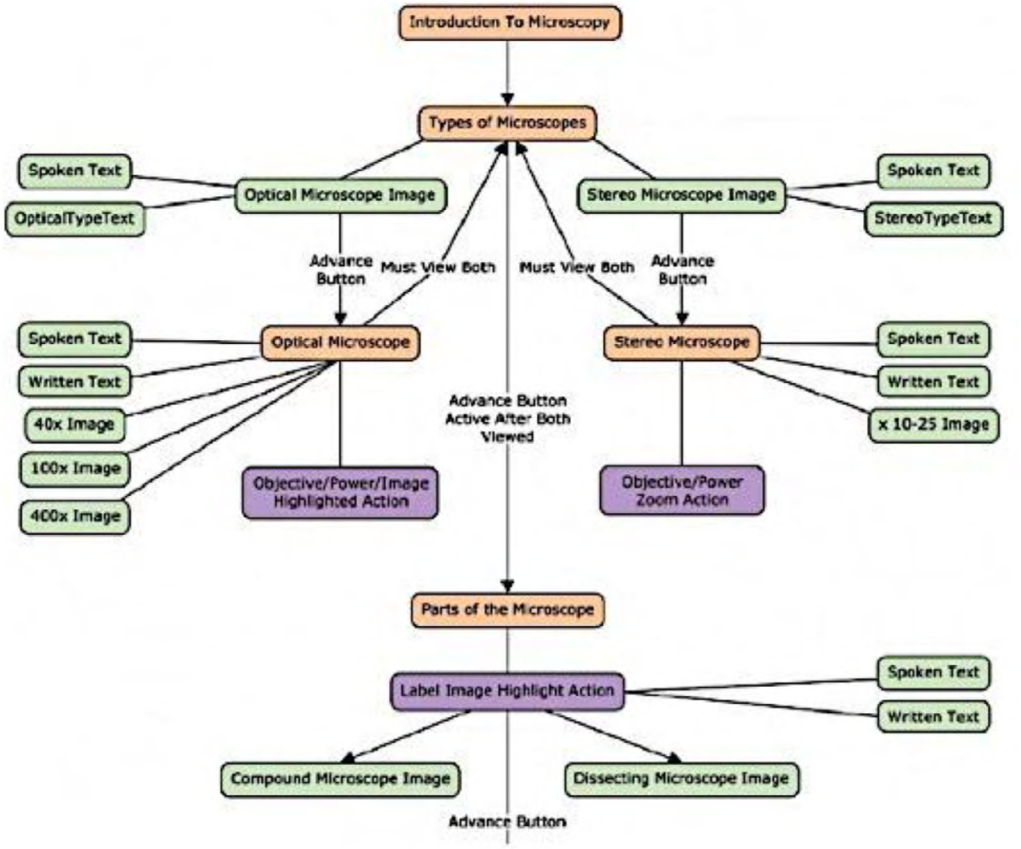


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Figure 3. Example of a Concept Map Drawn by the Instructional Designer Based on the Consultation with the Content Developer Previous to the Development of the Storyboard

a mock-up of the components of OER. The storyboard document specified the visual elements, text elements, audio elements, interactions, and branching of every screen in the OER. After both team members agree on the design presented in the storyboard, the content developer role is to provide with the content material for the demonstration and/or activity that meet the objectives originally proposed. Probably, the most time-consuming and arguably difficult part of the process was the content development. It was essential to share tasks in order to create content in a timely manner. Photographs and videos were taken in the field in parallel to the content development.

As the pieces of content came together, the instructional designer developed a mock-up or sample of all of the parts of the OER (see Figure 4). The storyboard and eLearning content for the OERs was created in HTML 5 using the authoring tool Adobe Captivate®. This tool creates interactivity that is accessible through multiple devices (e.g.

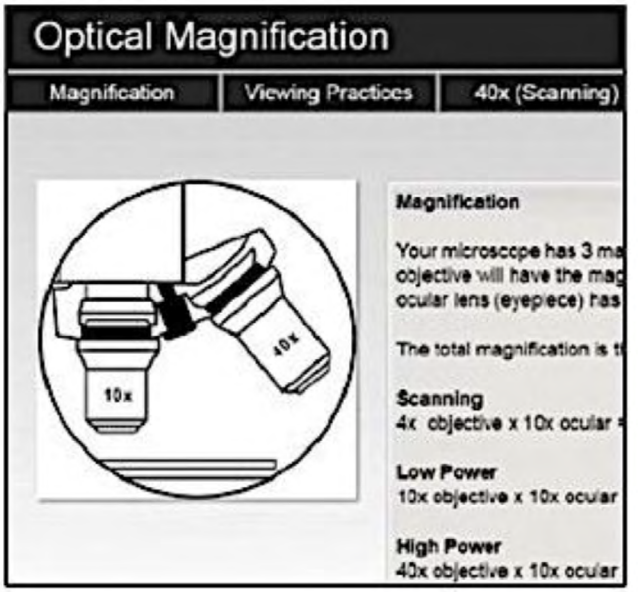
computer and mobile). An important advantage to using this particular tool over others currently available (e.g. Articulate Storyline) is the ability to move seamlessly from the storyboarding step into a mock-up and final learning object. After the team reviewed each mock-up, revisions and corrections to the design and layout were made. For instance, the mock-up for the Geologic Outcrop Analysis and Relative Dating of Rocks OER revealed the need for more contextual information for the activity where students are asked to identify rocks for a specific section from a photograph. Completing the lesson plan document (Figure 2) at the beginning of the development process was of great help when trying to figure out what was missing from the activity. Hence, the team was able to isolate the skills needed to simulate the field experience virtually into the OER Inevitable, sometimes drastic changes were needed based on input from one or both the instructional designer and curriculum developer.

The process did not end with the final production of the interactive learning object. Each final object was checked for Americans with Disabilities Act (ADA) compliance and attributions using the Creative Commons added. In the United States, and as a public institution of the New York State, SUNY is required to adhere to the Federal Section 508 Accessibility Program (http://section508/gov). In order to ensure that OERs were in compliance during development, the team followed the guidelines provided by the U.S. Board Standard for Electronic and Information Technology (EIT). The team particularly focused on providing the following: textual alternatives to non-text context such as photographs; appropriate document structure, such as headings, to allow for clear meaning and facilitate navigation; and, captions and/or transcripts for videos and narrations (see Figure 5). Additionally, OERs were created using HTML 5 output as opposed to Flash to allow for access through multiple platforms, including mobile devices.

In the end, SUNY aims to create OERs that are both technologically functional and pedagogically sound to meet the needs of their learners. In the near future, SUNY would like to expand the process to also include the revision and redesign of the OERs based on feedback from students. The OERs developed during the first phase of this project will be shared with the community through the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) and any appropriate OER repository.

Challenges and Lessons Learned

In the long term, OERs will likely experience the same kinds of challenges that many virtual learning environments may encounter, such as the sustainability of the project (e.g. typically through funding availability or maintenance of material and interface), evaluation and feedback, computing infrastructure, and inequity of access to the materials depending on country or socioeconomic status (Atkins, Brown, & Hammond, 2007). It seems clear that



Zoom in Original (jpeg, 69k)

Figure 4. Screenshot of a Storyboard Slide Used in the Introduction to Microscopy OER

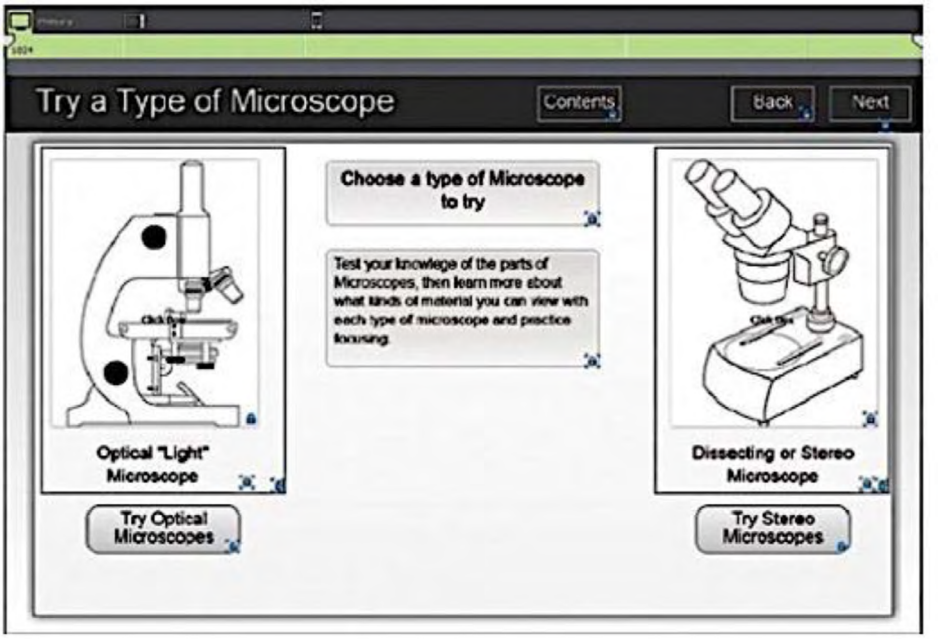


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Figure 5. Screenshot of Part of the Introduction to Microscopy OER Showing the ADA Compliant, High Contrast Responsive Design Approach Used in this Project. The Storyboard and eLearning Content for the OERs Were Created in HTML 5 Using the Authoring Tool Adobe Captivate®

sustainability is likely the most salient issue, as it encompasses the interaction of all large-scale challenges that enable the success, failure, or longevity of open educational resources (OERs), such as the virtual (e.g. software, computer-based platforms, advancement in disciplines) to the realistic (e.g. funding, staffing, maintenance, evolution of technology) (Downes, 2007). The authors realize that the sustainability of the OERs, and those they wish to create in the near future, may inherently confront the same challenges; therefore, steps need to be taken to meet the individual obstacles as they surface. Some longitudinal challenges may be difficult to proximally identify. However, in the short term, there were some clear challenges that were considered necessary to address before producing the OERs.

In building their OERs, one of the major decisions that they needed to make was to choose a specific software program in which to design their virtual content. The decision was particularly difficult as they needed to identify a platform on which it was easy to design, edit, and modify their content. Moreover, each finished project needed to be universal to all popular operating systems, and had to include the ability to function on all popular web browsers with appropriate plug-ins.

The failure of many virtual laboratories, OERs, or online supplementary materials is the inability to work on cross-platforms, and therefore selectively biases the students who may have access to the formatted software, operating system, or browser and plug-ins. The incorporation of these software and programming layers increases the complexity of the design and therefore decreases the ability for their OERs to operate on more universal or cross-platform systems. Indeed, if the OERs were inaccessible to the target population of traditional students, and as in the case with their students at SUNY Empire State College who were nontraditional, then it clearly created an additional bias for populations that were already challenged by the norms of accessible technology.

Another major challenge that was faced was to create OERs that were truly accessible for all kinds of disabilities. The OERs were designed on visual platforms with images, videos, text, and voiceovers to accommodate individuals with disabilities that made hearing and seeing difficult. However, the challenges also extended beyond sight and sound and may include the inability to manually move through each exercise because of the inability to use hands or fingers. These challenges meant that there was a need to create a version of each OER that accommodated all possible likely disabilities or create multiple versions of their virtual learning environments in which students could select the best mode of delivery.

Furthermore, consideration of the implementation of various types of assistive technology that may enable students to access material more efficiently was taken into account. For their field component, the use of more sophisticated technology, such as tablets and handheld GPS units, which

were visual, but were specifically operated by touch, was employed. It is likely that other kinds of assistive technology, such as text-to-speech, speech recognition software, augmentative communications software, mobility or positioning equipment, instructional formats created in different modes, or various input/output devices, will also need to be considered. Clearly, the available options for assistive technology are extensive, and these options should be considered for individual student needs upon course enrollment.

Finally, in terms of resources and the field-based aspect of the OERs, finding time to engage in the necessary field activities and weather conditions certainly prove to be a limiting factor. Without a clear commitment to the collaboration from the institutions, faculty acting as content developers and instructional designers may find it hard to dedicate the required amount of time.

Future Work and Final Remarks

The rationale and process for designing OERs create an innovative tool for more readily open access to an otherwise underutilized aspect of sciences. Laboratory studies are often assumed as exclusively physical and hands-on, yet this bias clearly limits its access to various students, particularly those who exemplify underserved or underrepresented populations. Thus, their OERs will allow all students to experience virtually common field techniques in ecology and earth systems without undermining the integrity of the disciplines.

In the near future, SUNY would like to extend their current work to include other common field techniques, such as mapping using global positioning system (GPS). As methods may adopt the use of more technology, it also seems practical to include the use of emerging technologies in their virtual content. Consequently, there is the need to continue to update and improve upon current versions of OERs to include the latest advances in methodology, technique, and technology. In addition to the three virtual field experiences created during the first phase of their project, the intent is to create OERs in areas such as: species identification (e.g. invertebrates and flora), mapping of species using a GPS (e.g. invasive species), and animal behavior.

Clearly, there are other kinds of experimental field techniques that could also be incorporated into virtual exercises. However, the intent is to continue to create easily replicable methods that can be adapted to a variety of science and nonscience areas. For instance, the use of GPS technology for mapping enables real-time data collection applicable to geosciences, agriculture, conservation biology, social sciences, business, and emergency management.

The creation of OERs also extends beyond mere implementation. SUNY hopes that the models serve as an initial blueprint in which others can base their OERs in terms of the platform, software, content, and organization. Ideally, the OERs can be utilized to suit the likely needs of individual

educators and their targets population of students regardless of their subject matter area. The flexibility in the design is a critical feature of OERs, such that it can serve multiple applications and that it may enable others to use the programming framework and only need to modify the content.

Furthermore, the model can be expanded beyond the focus of ecology and earth systems. There is no limitation on content, and hence, those wishing to modify the content adaptors may wish to utilize the OERs in other STEM areas (e.g. Introduction to Microscopy could also be used in genetics or cell biology courses) or to replicate the approach in other disciplines within the physical sciences of chemistry and physics. Moreover, examining STEM across the curriculum to identify courses that may benefit from the addition of OERs, either to supplement current physical or virtual components or to increase the level of accessibility for students with disabilities. Additionally, other non-STEM areas, such as the humanities and the arts, may also be able to emulate the general platform design and approach using field-based activities to create learning virtual environments with content from respective disciplines. The hope is that the process of integrating hands-on, fieldwork into the OERs to recreate the experience needed to develop important research skills is transferred and replicated in non-STEM areas that have a clear applied learning component, such as performance (e.g. theatre, dance, music) and visual arts (e.g. photography, drawing, painting, ceramics). There is already an inherent interdisciplinary interaction across disciplines, as the visual designs of the virtual interface may employ artistic aptitude, and the craft of the text may be influenced by writing and literature.

The ultimate purpose of the OERs was to be able to disseminate instructional content to audiences who seek alternative means for education or require access to learning content because of accessibility issues. At present, there is a repository for OERs and other STEM resources within the SUNY (http://navigator.suny.edu); however, the intention is to make them available beyond the institution's educational system. There is the potential for global dissemination by placing them in the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) and any appropriate OER repository. Advocacy by many international government and nonprofit groups to promote STEM education further suggests that this approach could potentially provide students around the globe with another opportunity for engagement in the sciences.

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A Solution to OER Publication Resistance: Using Blockchain Technology to Protect Scholar Copyright

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Abstract

Current higher education conversations about open educational resources (OERs) revolve around faculty or administration resistance to OER adoption (Seaman & Seaman, 2017), but fewer conversations are devoted to scholar resistance to publishing their works as OERs; the majority of the discussions are focused on why academics should *consume* OERs rather than why academics should *produce* OERs. Some scholars resist publishing OERs to share their works for several possible reasons including:

- concerns about not being attributed by web users who repost OER publications;
- concerns about web users disregarding OER's open copyright requirements and misusing the published work;
- concerns about the sustainability of OER materials; and
- inability or unwillingness to pay predatory publishers for the privilege to publish works as OERs.

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Blockchain technology, a decentralized and an almost incorruptible digital ledger that documents an accumulating list of records, could be the digital solution to address all the aforementioned problems.

Keywords: blockchain, technology, open educational resources, publication, copyright

Una solución para la resistencia a la publicación de OER: el uso de la tecnología Blockchain para proteger los derechos de autor

Resumen

Las conversaciones actuales sobre educación superior sobre recursos educativos abiertos (OER) giran en torno a la resistencia del profesorado o la administración a la adopción de OER (Seaman y Seaman, 2017), pero se dedican menos conversaciones a la resistencia de los académicos a publicar sus trabajos como OER; La mayoría de las discusiones se enfocan en por qué los académicos deberían consumir OERs y no por qué los académicos deberían producir OERs. Algunos académicos se resisten a publicar OERs para compartir sus trabajos por varias razones posibles incluyendo:

- preocupaciones sobre no ser atribuidos por usuarios de la web que vuelven a publicar publicaciones de OER;
- preocupaciones sobre los usuarios web que ignoran los requisitos de derechos de autor abiertos de la OER y hacen un mal uso del trabajo publicado;
- preocupaciones acerca de la sustentabilidad de los materiales OER e
- incapacidad o falta de voluntad para pagar a los editores depredadores por el privilegio de publicar trabajos como OERs.

Tecnología Blockchain, un libro digital descentralizado y casi incorruptible que documenta una lista acumulada de registros, podría

ser la solución digital para abordar todos los problemas mencionados anteriormente.

Palabras clave: blockchain, tecnología, recursos educativos abiertos, publicación, derechos de autor

OER出版物抵制的解决方案：利用区块链技术保护学者版权

摘要

当前高等教育机构关于开放教育资源(OER)的讨论大多围绕教师职工或行政当局对OER的抵制(Seaman&Seaman，2017)，但很少有人谈论学者抵制将他们的作品作为OER出版；大多数讨论的重点在于为什么学者应该消费OER，而不是为什么学者应该带来OER。一些学者反对出版OER来分享他们的作品，可能原因如下：

- 担心不被重新发布OER出版物的网络用户认可作者身份；
- 担心网络用户无视OER的开放版权要求，滥用已发表的作品；
- 担心OER材料的可持续性；
- 不能或不愿为出版作品的OER特权向掠夺性出版商支付费用

区块链技术作为一种几乎无法篡改的分散式数字账簿，用以记录一系列累积数据清单。它可能是解决上述所有问题的数字解决方案。

关键词：区块链，技术，开放教育资源，出版物，版权

Introduction

Sometimes called Internet 2.0 or Web 3.0 by technologists and researchers (*The Economist*, June 30, 2018), blockchain technology holds the promise of decentralizing the entire Internet where no central administrators will exist, but where all web users will keep track of all digital transactions through nodes consensus (using global users' computer networks to check data validity and reach consensus). Since the hash function of the blockchain can automatically designate unique hash values to all web transactions and record them in "blocks"—where a new block stores all of the hash values recorded in the previous block, the technology could create an almost permanent record of the entire web if used to restructure the Internet. Blockchain also democratizes information by distributing all data to web users while maintaining data copyright. Keeping data copyright is becoming ever more important as the European Parliament recently passed a globally applicable copyright law on September 12, 2018, that requires companies to observe the creators' copyright (European Parliament News, September 9, 2018).

Currently, blockchain has been applied to create currencies (bitcoin and cryptocurrencies) and apps for the finance, security, property, contracts, governance, identity, insurance, and health sectors. But, it has not been widely adopted by educational institutions (State of the Dapps, October 23, 2018). The slow adoption curve of Blockchain in academe can likely be attributed to confusion, misinformation, and/or misunderstanding around the technology itself and how its potential applications in open educational resource (OER) and education.

In terms of OER, blockchain technology has the potential to (a) decentralize and document all OER publications, (b) protect a scholar's copyright by preserving publication data in blocks, (c) help scholars publish OERs without fear of nonattribution or fear of their material being misused, (d) record and sustain OER information on a blockchain, and (e) enable scholars to form their own OER publishing networks that bypass predatory publishers. The potential benefits of applying blockchain technology to OERs will lessen scholars' resistance to publishing their works as open access.

The sections below detail each type of OER publication barrier in-depth and then solutions for overcoming these barriers using blockchain technology follow.

The OER Research Impact and Attribution Problem

Given that OERs are, by nature, hosted online and distributed widely on the web, some scholars are concerned that web users will repost OER materials but fail to give OER scholars proper attribution. A scholar's academic standing is measured by the extent of her works' research impact, which is determined by each university's set of evaluation standards (Cheng, 2018). Research impact can influence a

scholar's chance for promotion or obtaining tenure in academia. The number of citations is one of the constant variables and factors in measuring research impact. Many scholars rely on databases such as arXiv, CiteSeerX, Pubmed Central, and Google Scholar to identify the number of citations for their work, but the databases only calculate citations numbers based on references by other scholars.

Google Scholar's citation numbers, for example, are calculated based on six metrics: h-index, h-core, h-media, h5-index, h5-core, and h5-meridian (Google Scholar Website, 2018). The metrics all refer to articles published in journals or books, with "h" referring to the number of works indexed in top publications, and "h5" referring to the number of works published in the last five years. Thus, the metrics do not include web users who post a scholar's work on a website or social media. The incentive for scholars to publish their works as OERs to effect further research impact is lessened when web users may not appropriately attribute OER materials.

Although a work's research impact is currently determined by how many times other scholars cite it, the number of views or re-posts of a scholar's work could matter, in the foreseeable future, to universities who are looking to demonstrate and promote the quality of their institutional scholarship to the public. The web view count of scholarly work based on exposure to social media and the web-at-large is currently under consideration as one of the variables for measuring research impact (Ravenscroft, Liakata, Claire, & Duma, 2017). ResearchGate, Academia.edu, and other for-profit databases are keeping track of web view counts of scholars' works as some universities accept view counts as part of research impact assessment, but these databases also are controversial for capitalizing on the scholars' research efforts (Straumsheim, 2016).

The Limit of the Creative Commons License and the Problem of Tracking OERs

Publishing OERs with a Creative Commons (CC) license is the most common way to maintain open copyright and to indicate permission for use, but the CC license does not necessarily deter some web users from ignoring the CC's legal requirements; difficulty in enforcing the CC license may be one of the reasons that some scholars resist publishing OERs. To clarify, the CC nonprofit organization offers six types of licenses for copyrighting works for open access: CC Attribution (CC BY), CC Attribution-ShareAlike (CC BY-SA), CC Attribution-NoDerivs (CC BY-ND), CC Attribution-NonCommercial (CC BY-NC), CC Attribution-NonCommercial-ShareAlike (CC BY-NC-SA), and CC Attribution-NonCommercial-NoDerivs (CC-BY-NC-ND). The most open license out of the six types is CC-BY-SA, which allows others to "remix, tweak, and build upon [the author's] work even for commercial purposes, as long as they credit [the author] and license their new creations under the identical terms" (Creative

Commons, 2018). And, the least open license is CC-BY-NC-ND, which only allows others to share one's work with attribution, but no changes can be made to the work. Despite each type of CC license requirement, some web users ignore the license requirements, such as the requirement to provide attribution to a work's author, or to avoid modifying and remixing the work.

Furthermore, the CC organization only offers the digital licenses to be appended to the web interface of online publications and does not provide technology to track the online location, or the Internet protocol (IP) location, of the referenced licensed materials. This means that individual authors who append CC licenses to their online works can only hope that web users will observe the licensing requirements, with no way of tracking where the online work resides (other than manually making repeated Google searches in the hope of tracking down the materials) or monitoring how the online work is being used.

The Problem of the Sustainability of OERs

Another method for publishing open copyright materials is through OER providers, some of which are nonprofit organizations that may have nonpermanent presence due to lack of funding, technological, and content issues (Downes, 2007). Although multiple databases such as the Directory for Open Access Journals (DOAJ), Scholarly Publishing and Academic Resources Coalition (SPARC), Wikibooks, OER Commons, and MERLOT index the links to OER materials, the links can disappear from all the databases when the providers no longer exist. Self-published OERs face the same sustainability problem when websites or social media that host the OER materials are removed. This problem presents another significant hindrance to OER publication and adoption.

The Problem of Capitalizing on OER Publications

Many advocates believe that OER is the solution to the commercialization and marketization of academic publications, but do not recognize how OERs can still promote commercialization and marketization of scholarly research. In the traditional publisher paradigm, scholars pay a fee to the publisher for the prestige and readership, while the publisher makes a profit from, and obtains copyright over a scholar's work.

Advocates believe that publishing works as OERs will protect a scholar's copyright, stop predatory journals and publishers from profiting from scholarly work, and allow the publications to reach a wider audience. However, most scholars, for academic promotion and tenure purposes, still need to publish with traditional publishers valued in respective fields; therefore, self-publishing OER materials may not meet the university's requirements for distributing research.

Traditional publishers now seize these OER movement opportunities by offering to publish open access ar-

ticles for an extensive article processing charge (APC), leading to a backlash by academics. In 2016, academics threatened to boycott Elsevier's open access APC, which ranges from $400 to $1,800, depending on the journal under Elsevier's ownership (Hu, 2016). Since November 2016, more than 2,700 academics worldwide have signed an online petition to boycott Elsevier's open access APC cost that has grown to €4,000 (No Deal No Review, 2017). This reaction by Finnish researchers is particularly notable because it demonstrates the European influence and stronghold over research journal pricing structures while suggesting a much larger move to a universal open access model.

The controversy continued to 2017, where 100 German universities and research institutions canceled their subscriptions to Elsevier (Kwon, 2017). Adding fuel to the fire, in 2018, five German scientists resigned from Elsevier's journals to protest Elsevier for refusing to adopt a fair, open access model (Enago Academy, May 21, 2018). Beyond Elsevier, for example, PNAS' website lists a $2,200 fee for publishing science articles with a CC-BY license (PNAS Website, 2018), which allows users to re-post, modify, and remix the material as long as they provide attribution to the author. The inflated prices further emphasize that the current publishing model is unsustainable and unaffordable to scholars, who, even with institutional support, would have difficulty in paying the APC and sharing their works widely with the research community.

The commodification of OER demonstrates how capitalism continues to hinder the discoverability of academic research. Macintyre (2015) argues that open educational practices (OEP) and OER are products of neoliberalism, in which commercial publishers have co-opted OER publications, and scholars have become the producers and the consumers of OERs simultaneously. To indeed expand the OER movement, scholars must be able to publish their works without being punished by exorbitant APC fees.

How Blockchain Technology Can Mitigate Scholars' Resistance to Publishing OERs

This article addresses the possible reasons that scholars resist publishing OERs, such as concerns around (a) how to track research impact and citations of OERs, (b) how to track the location of re-posted OERs and how to ensure that the user is observing CC license requirements, (c) how to sustain OERs when providers disappear, and (d) how to stop predatory publishing practices of charging exorbitant APC fees to publish open access materials.

Blockchain technology has the potential to solve the problems if scholars and institutions employ the technology to create their own OER blockchain publishing network. A network refers to a group of decentralized computers (nodes) dispersed throughout the world being used to track all transactions made in a blockchain. Ideally, the network has the potential to do the following:

1. ***Records of OERs will be secured and permanent.*** The blockchain can assign a hash value to every OER record, meaning that the publication date, location, and authorship of every OER will be recorded on the blockchain. Any change (transaction) made to any OER record will generate a new hash value, and the change can only be completed with network consensus (meaning that every node (computer) that is on the OER blockchain publishing network must accept the modification for the record to be received). Since every new OER record on the blockchain carries the hash values of all OER records that came before it (and its respective author), the author will always be attributed when her record is referenced.
2. ***OER files will always include attribution to the author in their metadata, regardless of where the files are re-posted on the web.*** Files that are associated with a block on the blockchain can also carry the hash value assigned by the block. For example, the metadata of a scholarly article can carry the hash value assigned by the associated block on the blockchain, meaning that both the block and the academic article carry identical hash values. If anyone attempts to re-post or remix the article, the resulting material will carry the hash value in its metadata, thus establishing its original identity regardless of any tampering.

   Another appropriate analogy would be the "Do Not Copy" watermark that is added to every page of a contract. The metadata would not be the visible watermark, but the hidden embedded data that accompanies the file everywhere that it is shared. Furthermore, no matter how many copies are made of a file, every copy of the file will still carry the hash value to indicate ownership. Files that are hosted on other websites can be easily traced by the hash values hidden in their metadata.
3. ***There will be less resistance to allowing users to remix OER materials.*** Since OER files will always carry the hash values of the associated blocks, establishing the scholars' authorship, the scholars will be less resistant to allowing others to remix their works. All remixed works will still carry the hash value in their metadata.
4. ***OER records will be permanent regardless of provider changes.*** Even if a provider of an OER disappears, the blockchain will always have a record of that OER, and hopefully, the OER itself is saved in other decentralized and peer-to-peer networks associated with the blockchain.
5. ***OER publishing networks can be created and moderated by scholars themselves.*** Scholars from different universities from anywhere in the world can form their own OER publishing blockchain to ensure the rigor of the OER materials being released, as scholars can moderate each others' works on the blockchain. It is possible for scholars to publish and share their own work

on the blockchain and with the public, bypassing predatory publishers. All scholarly work (on the network) will become more transparent.

6. ***OER records will be almost incorruptible.*** Since every block in the blockchain carries the hash values of the previous block, it would be almost impossible to hack the blockchain and destroy OER records. This is assuming that many scholars and their computers (perhaps in the thousands) are part of a single blockchain, and that their computers (nodes) are constantly verifying every transaction made on the blockchain.

More OER and Blockchain Applications

The above examples are potential scenarios in which blockchain technology can be used to store OER materials, maintain authors' attribution on the OER materials they develop, keep track of the location of the OER based on hash values, enable scholars to create their own publishing networks, and secure the records from corruption and hacking.

Puscar and Mehra (2018) propose that an OER blockchain network can further authenticate the content on the ledger—and through smart contract technology, sell published works directly from blockchain. In other words, scholars would have the opportunity to sell their work directly to the public, if they choose.

As academia becomes more open to blockchain technology, there is a potential for institutions to use blockchain to document and distribute other types of records in higher education, such as transcripts, student records, badges, letters of recommendation, and more. The potential for other types of OER and educational record distribution will be discussed in upcoming articles.

Author

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losophers such as Nietzsche, Spinoza, Sartre, and Lao Tzu. In 2013, she created Rhetoric and Composition: The Persuasive Power of Video Games as Paratexts MOOC to teach rhetoric studies with digital games. In 2016, Jones designed the "Survive the Ethics" mixed reality escape room game exhibit showcased in the Computer History Museum for the Intentional Play Summit, and designed Ethics AI: Don't Freeze Edition, a digital game exhibit installation. Her publications include: "Composition on a New Scale: Game Studies and Massive Open Online Composition" (2014); "Games as Logic Machines" (2016); "Designing Seamless Learning Through Role-Playing Experiences" (2017); "Life Is Strange as a Thought Experiment: Understanding Nietzsche's Eternal Recurrence Theory as Virtue Ethics Through Game-Playing (2019 pending publication)."

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Identifying Categories of Open Educational Resource Users

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Abstract

The open educational resource (OER) movement has been successful in developing a large, global community of practitioners, in releasing high-quality learning material and influencing policy. It now stands at the cusp of mainstream adoption, which will require reaching different audiences than previously. In this article, the findings of the OER ResearchHub are used to identify three categories of OER users: OER active, OER facilitator, and OER consumer. These groups have different requirements of OER and thus varying strategies would be required to meet their needs if mainstream adoption was to be realized.

Keywords: open educational resource, OER, users, categories

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Identificando categorías de usuarios de recursos educativos abiertos

Resumen

El movimiento de recursos educativos abiertos (OER) ha tenido éxito en el desarrollo de una gran comunidad global de profesionales, en la publicación de material de aprendizaje de alta calidad y en influenciar políticas. Ahora se encuentra en la cúspide de la adopción generalizada, lo que requerirá llegar a audiencias diferentes a las anteriores. En este artículo los hallazgos del OER ResearchHub se usan para identificar tres categorías de usuarios de OER: activo de OER, facilitador de OER y consumidor de OER. Estos grupos tienen diferentes requisitos de OER y, por lo tanto, se requerirían diferentes estrategias para satisfacer sus necesidades si se realizara la adopción general.

Palabras clave: recursos de educación abierta, OER, usuarios, categorías

确定开放教育资源的用户类别

摘要

开放教育资源(OER)运动已经成功地开发了一个庞大的、全球性从业者社区，发布了高质量的学习材料并影响了政策发展。目前它正处于主流采纳的尖端，这将需要接触到与以前不同的受众。在本文论述中，OER研究中心的发现被用于识别三类OER用户：OER激活者、OER促进者和OER消费者。这些群体对OER有各自不同的要求。因此，如果要实现采纳主流化，就需要采取不同的战略来满足它们的需求。

关键词：开放教育资源，OER，用户，类别

Introduction

Open educational resources (OERs) have been part of the open education movement since 2002, with the advent of MIT's OpenCourseWare project. The history of OER goes back further than this if one considers the Learning Object developments of the 1990s and emergence of openly licensed software as precursors. Their premise is a relatively simple one and has remained largely unchanged since the initial MIT project: creating educational content with an open license so it can be accessed freely and adapted. The Hewlett Foundation's definition of an OER is:

> *[...] 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 gives a clear definition of OER, but for many practitioners, this becomes blurred in practice, and overlaps with any online resource, regardless of license. Although this study focuses primarily with OER as defined here, this mixed economy is part of the practice of users, and so is reflected in some of the later discussion.

The OER movement has been something of a success story compared with many educational developments, for instance, the aforementioned learning objects, which gained a good deal of initial attention. There is a global OER movement, with repositories in most major languages. Funding has been provided by foundations such as Hewlett and national bodies such as JISC in the UK, and sustainable models that do not require external funding have begun to emerge, for example, the Open University's OpenLearn project (Perryman, Law, & Law, 2013). It is difficult to quantify OERs by time or projects, since it will vary depending on definition, but Creative Commons have estimated there are over one billion CC licensed resources (Creative Commons, 2015).

For example, should online collections from museums be included? Or more general resources such as YouTube videos, SlideShare presentations, iTunes U downloads? Even if the focus is solely on university-based OER projects then there is considerable output, with the Open Education Consortium listing over 200 institutional members, all of whom have a commitment to open education and releasing OERs (Open Education Consortium, 2015). MIT has now made over 2,000 courses freely available (MIT OCW, 2015) and the Open University's OpenLearn site has released over 10,000 hours of learning resources.

One major development in OERs over this period has been the advent of open textbooks, although these repre-

sent just one form of OER. The premise of open textbooks is relatively simple—create electronic versions of standard textbooks that are openly licensed and freely available and can be modified by users. The physical versions of such books are available at a low cost to cover printing, for as little as $5 USD (Wiley, 2011). The motivations for developing open textbooks are particularly evident in the United States, where the cost of textbooks accounts for 26% of a four-year degree program (Government Accounts Office, 2005). This creates a strong economic argument for their adoption in higher education, and a similar case can be made at the K12 level.

There are a number of projects developing open textbooks using various models of production. A good example is OpenStax, who have funding from several foundations to develop open textbooks targeting the subject areas with large national student populations, for example, "Introductory Statistics," "Concepts of Biology," "Introduction to Sociology," etc. The books are co-authored and authors are paid a fee to work on the books, which are peer-reviewed. The electronic versions are free, and print versions available at cost. The books are released under a CC BY license, and educators are encouraged to modify the textbooks to suit their own needs. In terms of adoption, the OpenStax textbooks have been downloaded over 120,000 times and 200 institutions have decided to formally adopt OpenStax materials, leading to an estimated savings of over $30 million in a little over two years (OpenStax College, 2014).

The OER movement has managed to grow substantially over the past decade. It has released a vast amount of educational material, and seen diverse implementation projects across the globe. The OER movement has gone through different phases, from startup to growth and, in places, sustainability. This has happened in parallel with a number of related developments in the open education movement, namely the success of open access publishing, particularly through national mandates (SPARC, 2015), and the more recent popular attention garnered by MOOCs. Education policy has also started to recognize the potential of OER, for example, the U.S. Department of Labor launched a $2 billion program, Trade Adjustment Assistance Community College and Career Training (TAACCCT), aimed at improving workforce and employability training. All new materials produced through these grants were mandated to release their content under a Creative Commons license (Allen, 2016). This has created a context in which the OER movement views the next phase as one of becoming mainstream in educational practice.

For example, the Hewlett Foundation White Paper (2013) on OERs states that its goal is "to pave the way towards mainstream adoption of OER in a manner that promotes greater, sustainable educational capacity," and the theme of the 2015 OER conference in the UK was "mainstreaming open education" (OER Conference, 2015).

In order for OERs to enter the mainstream of educational practice, their use by learners, educators, and policymakers would need to become common practice; the default option. The broad approach of the OER movement thus far has been to increase OER awareness and to grow the OER community. However, for mainstream adoption, it may be that other approaches are now required and what was a successful strategy in one stage of development may not be successful in another. This may not have been an overarching, or deliberate strategy, but reflects the manner in which movements develop. This study examines different forms of engagement with OER, using the research of a project based at the Open University, the OER Research Hub, as the basis for proposing three forms of engagement. By understanding these types of engagement, strategy for OER adoption can be influenced.

The OER Research Hub

The OER Research Hub (http://oerhub.net) was a project funded by the Hewlett Foundation, which commenced in 2012. The aim of the project was to create an evidence base for the OER community. Much of the initial phase of the OER movement can be characterized as being belief-driven about the potential benefits of OERs. These beliefs might be stated as obvious, undeniably true, or based on anecdote, but rarely backed up by evidence. This was because the movement had to gain sufficient momentum to have evidence to investigate whether this potential was realized. The OER movement may now have realized this critical mass of evidence needed to investigate these more fully. The OER Research Hub set out to establish this evidence base, using 11 hypotheses, which represented the commonly stated beliefs and claims in the OER community:

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 for learning with OER.

Methodology

The authors adopted a mixed methods approach. In addition to gathering existing evidence onto an evidence map (oermap.org), the project worked with 15 different collaborations, across four sectors: K12, 2 community colleges, higher education, and informal learning. Interviews, case studies, and quantitative data were gathered, but this paper largely reports on responses to surveys. Sets of survey questions were 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 distributed, with nearly 7,500 responses.

The collaborations were as follows:

- **The Flipped Learning Network (FLN)**
- **Vital Signs**
- **Community College Consortium for OER (CCCOER)**
- **Open Course Library (OCL)**
- **OpenLearn**
- **TESS-India**
- **Bridge to Success**
- **OpenStax CNX (formerly Connexions)**
- **School of Open**
- **BCcampus Open Textbook Project**
- **MERLOT**
- **ROER4D**
- **The Saylor Academy**
- **Siyavula**
- **Project Co-PILOT (Community of Practice for Information Literacy Online Teaching)**

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 was focused around weeklong sprints which targeted particular hypotheses. One such

sprint focused on populating the evidence map from research repositories and through regular review of academic journals.

The overall survey data were gathered across the collaborations, with 7,498 respondents in total, and the frequencies analysis of this data constitutes the main evidence basis for this chapter. The breakdown of respondents from each of the collaborations was as follows:

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

A detailed analysis of the evidence is given for the following: each hypothesis (Weller, de los Arcos, Farrow, Pitt, & McAndrew, 2015); open textbook use (Pitt, 2015); K12 teacher adoption (de los Arcos, Farrow, Pitt, Weller, & McAndrew, 2016); informal learners (Farrow, de los Arcos, Pitt, & Weller, 2015). The aim of this contribution is to use this data to identify different types of OER users, which can be classified by different forms of engagement with OERs. This analysis focuses on identifying categories of OER engagement that will inform the intention of making OER use mainstream practice, and is based on the authors' interpretation of the OER data set.

Types of OER Users

Open education in general, and OERs specifically, form a basis from which many other general teaching practices benefit, but often practitioners in those areas are unaware of OERs explicitly. The focus in the OER community thus far has largely been to expand this group of "OER aware" users, but mainstream adoption will see OER usage by new audiences. Analyzing the findings of the OER Research Hub reveals three main categories of OER users: OER active, OER as a facilitator, and OER consumer. The categories include users from different sectors, including educators, formal and informal learners, higher education, and K12. However, some categories may see higher representations of some user types, for instance, the OER active category may have a higher proportion of educators than learners, since it is focused on engagement with the OER movement, but it will not be exclusive to educators.

OER Active

This category of user is aware of OER issues, in that the term itself will have meaning for them, they are engaged with issues around open education, are aware of open licenses,

and are often advocates for OERs. This group has often been the focus of OER funding, conferences, and research, with the aim of growing the size of this audience. 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.

Much of the OER Research Hub work focused on this group, and the findings highlight the positive benefits for this community, for instance, increased confidence from learners, reflection by educators, and cost savings. However, the findings also highlight the difficulties in expanding this group, for instance, in terms of their awareness of OER and the significance of licenses.

With regard to the positive aspects, there is a strong claim concerning the benefits of OERs for both learners and educators, for example, 62.1% of educators and 60.7% of formal learners reported that using OER improved student satisfaction, and 44.1% of educators and 38.9% of formal learners agreed that OER use resulted in better test scores. It must be remembered, however, that these results are self-reported and may not accord with actual performance.

However, the research also revealed that knowing where to find resources is one of the biggest challenges to using OER and that awareness of well-established OER repositories, such as MERLOT, is low compared with free resource sites such as the Khan Academy and TED. There was also a disparity in belief and practice that suggests that there may be practical barriers in expanding this group of users. For example, only 14% of informal learners (i.e. those learners not currently enrolled in a formal study program) selected OER with an open license allowing adaptation, despite the fact that 84% of all informal learners said they adapted the resources they found to fit their needs (although what "adaptation" means here may vary, as discussed in the next category). Similarly, only 14.8% of educators created resources and published them with a Creative Commons license despite the fact that a majority of educators (70.4%) considered open licensing important and 58.9% were familiar with the Creative Commons logo.

While the OER active group has continued to expand and has established a successful community, it is unrealistic to assume that every educator will become interested and active in the OER movement. It may not be necessary for every educator to engage with OER for it to be considered mainstream, but as with eLearning in general, it would need to impact upon the majority of educational practice. A recent survey of educators in U.S. higher education found that awareness of OER was low, but that awareness was not a requirement for adoption (Allen & Seaman, 2014). This leads to the second category of OER user.

OER as Facilitator

This group may have some awareness of OER, or open licenses, but they have a pragmatic approach toward them. OERs are of sec-

ondary interest to their primary task, which is usually teaching. OER (and openness in general) can be seen as the substratum, which allows some of their practice to flourish, but their awareness of OER issues is low. 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.

One of the collaborations on the OER Research Hub was the FLN. Flipped Learning moves the direct instruction element away from the face-to-face component and into the individual's learning space (Flipped Learning Network, 2014). The face-to-face time is then spent on dynamic, interactive group learning. The claim is that the flipped model reverses the traditional approach as class time is spent doing tasks where students exercise critical thinking and homework is used to support understanding and knowledge acquisition. In practice, this often means giving students videos and other online resources to view at home. OERs are therefore of relevance, in that they can help these educators realize their main aim, which is "flipping" their classroom. They are not absolutely necessary, however, for instance, many educators use YouTube videos without paying attention to the license it has been released under. As well as this, flipping a classroom could be achieved by using licensed materials from content providers, for example, the commercial publisher Pearson offer a course on the "Foundations of Flipped Learning" [Pearson (n.d.)], and could presumably offer all of the resources to "flip" a classroom for a subscription fee.

However, the OER Research Hub found that adaptation was a key requirement for educators, with 79.4% of all OER users adapting resources to fit their needs. As stated above, though, people's interpretation of adaptation varies. 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.*

This is particularly relevant for those in the FLN as they are seeking new ideas to teach their subject. While this is an important use of OER, it arises principally as a result of their online availability rather than openness, and so does not necessarily require OER in order to be realized. However, the freedom to reuse ideas is encouraged by an open license and users feel able to do so without fear of infringing any copyright.

For other users, adaptation is more direct, e.g. editing or re-versioning 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 outdated, 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 standardized test.*

And for others, adaptation may be taking an existing resource and placing it in a different context within their own material. The resource is not adapted, but the manner in which it is used is altered.

What this suggests is that there may be a continuum of adaptation in practice, ranging from adapting ideas for their own material to full re-versioning of content. The degree to which OER are required to realize this adaptation also increases along that continuum. At the "inspiring ideas" end, they are not required for simple reuse in a different context; the open license is useful, but many educators will ignore rights issues if their class is only accessing the material. At the full adaptation end of the continuum, open licensing is required.

It is likely that teachers will not remain static on this continuum; one of the findings of the OER Research Hub was that the more educators used OER, the more willing they were to share. 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/OERs for their teaching as a result of using Siyavula/OpenStax (Siyavula: 90.2%, n=55 and OpenStax: 79.5%, n=58). Sharing content is made much easier if there are no concerns around licenses.

In the example of Flipped Learning, then, OERs are useful for realizing a different aim, they are a related topic of interest, but not the primary one. However, the open aspect leads to developments that are not possible with resources that are merely digital and online.

Cost savings for students can also be viewed as a goal, which OER can help achieve. Much of the motivation for the open textbook movement relates to the financial burden of buying proprietary textbooks. The potential savings here are one area of OER impact that has seen rigorous, quantitative research. Hilton, Robinson, Wiley, and Ackerman (2014) found an average saving of 90.61 USD per student per course, across a wide range of community and stage college courses. In the OER Research Hub study, 79.6% of formal students (i.e. those enrolled in a program of study at a higher education institute) reported that they saved money by using OER, primarily open textbooks. Cost savings also have other positive impacts on study, for example, in student retention, and immediate access to content, as this quote demonstrates:

> *I would sure think if institution more fully made use of open*

> *educational resources that we could benefit financially: by retaining more students who otherwise have to drop out because of the high cost of textbooks; by providing higher quality and more diverse and accessible learning and teaching resources which would be a great financial benefit.*

However, 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. As with the FLN, OERs are, in this instance, one means of achieving a related objective.

OER Consumer

This group will use OER among a mix of other media and often not differentiate between them. Awareness of licenses 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. One under-reported use of OERs is by formal learners to sample study in their topic before entering the formal study, with 52.7% of formal learners accessing OER indicated that they were using OER to supplement their formal studies. Similarly, 32.4% of learners stated that their interest in using OER was a chance to try university-level content before signing up for a paid-for course.

Similarly, many learners were using OERs to supplement study while currently in formal education, with 46.9% of all formal learners in our sample stating that OER had a positive impact in helping them complete their course of study. For these users, the OERs need to be freely available, at the appropriate level of study and from a reputable institution. The open license is not a primary concern for this group, although there may be circumstances when they wish to adapt, or share them. This was reflected in the importance learners placed on the factors that influence their selection of OER, the top three of which were: relevance to their particular needs; a good description of learning objectives and outcomes; ease of download. The presence of a Creative Commons license was ranked 14th out of a possible 17 options.

A related use of OER is that for informal learners, it can function as an alternative to formal study. For these learners, the quality and zero cost were important, with our study showing that 89% of learners using OER say that the opportunity to study at no cost influenced their decision to use OER.

These learners are studying for personal interest predominantly: 86.3%

state this as the main reason over improved job opportunities or mandated requirements. For these learners, the quality of the content is of prime interest, and the lack of formal support is not seen as significant for their goals, with only 18.7% stating that not having the support of a tutor/teacher to help them was a barrier to their use of OER.

For this category of OER user, open licensing is at best an additional bonus, over the quality and usefulness of the resource. This is captured in this quote referring to the Siyavula open textbook project in South Africa:

> *OER per se does not excite learners. Good content does—free or paid, legal or pirated. Siyavula's stuff works because it is GOOD. Being CC makes it legal to download, not fun to use. There are 100's of free/CC Geogebra resources. 98% are useless to me.*

Discussion

Three categories of OER use have been identified through the work of the OER Research Hub: OER active; OER as facilitator; OER consumer. In expanding the OER community over the past 12 years, the focus has largely been on growing the first of these groups, that is, making people aware of the benefits of OER use and adaptation.

This has been a successful strategy in establishing a sufficiently large OER community globally such that OER projects can be developed, funding can be secured, and advocacy can be conducted. All of these actions are required to establish a sustainable community, and represent the necessary foundation for a movement to enter the mainstream.

However, in order for OER to become part of mainstream practice in education, additional strategies are required in order to meet the needs of the other two categories of users identified here.

Wiley (2009) has talked of "Dark Reuse," that is when reuse is happening in places that cannot be observed, analogous to dark matter, or simply it is not happening at all. Wiley challenges the OER movement about its aims:

> *If our goal is catalyzing and facilitating significant amounts of reuse and adaptation of materials, we seem to be failing. [...] If our goal is to create fantastically popular websites loaded with free content visited by millions of people each month, who find great value in the content but never adapt or remix it, then we're doing fairly well.*

Wiley contrasts creating popular websites and the reuse of content, but by considering these three perspectives of OER engagement, it is possible to see how both elements of Wiley's goals are realizable, as they represent different aims for each category. The main focus of OER initiatives has often been the OER active group. It is this group that creates open resources and advocates the movement. For example, Wild (2012) suggests three levels of engage-

ment for HE staff that progress from piecemeal to strategic to embedded use of OER. The implicit assumption is that one should encourage progression through these levels, that is, the route to success for OER is to increase the population of what we have here labeled the OER active group. Perryman and Seal (2016) expand on this model that incorporates inhibitors and enablers (such as Internet access) to account for uptake in developing nations.

While expanding the OER active group is undoubtedly a requirement for the mainstream adoption of OERs, it may not be the only approach. Another strategy may focus on increasing penetration of OER into the other categories of users identified here. As awareness of OER repositories was very low among these users, a way of improving uptake for these groups is to increase the visibility, search engine optimization, and convenience of the resources themselves, without presuming a specific knowledge of open education. This might be realized through creating a trusted brand to compete with resources such as TED. If this was desirable then the funding and ownership of such an open brand would then be a focus for development.

Similarly, a strategic aim to engage with the second two groups would influence both the formats of OER and the content. For instance, the popularity of content varied across users' groups, with educators favoring science and maths, formal learners preferring science, psychology and philosophy, and computer science, economics, and business preferred by informal learners. Video was the preferred format across all groups, but if the OER community were to target the OER consumer directly, then shorter content that is more viral in nature may be preferable. The community would then be focusing on promoting the development of these types of OER.

These categories of OER users are not exclusive, nor does an individual remain fixed within a category. Once users have encountered OER they are keen to access more of it, with 84.5% of informal learners stating that they are more likely to take another open course or study a free OER. Educators in particular often become advocates, with 95% saying they share OERs. This quote from a K12 teacher was typical of the increase in sharing practice brought about by exposure to OERs:

> *Free online resources have virtually opened up my world for sharing resources. Our district will never be able to pay, nor will I, so sharing was just a chance thing before now. Now, it is a daily occurrence most times.*

There may be some progression, therefore, from either OER consumer or OER as facilitator into the OER active category. However, it is not necessary for this progression and increased OER awareness to occur for OERs to achieve mainstream adoption. Within one project or institution, it is possible to witness all three types of user in operation. For example, Tidewater Community College embarked on the

Z-degree program (to make zero cost textbooks available to students) with two aims (DeMarte & Williams, 2015):

- to improve student success through increased access and affordability,
- to improve teaching efficiency and effectiveness through the ability to focus, analyze, augment, and evolve course materials directly aligned to course learning outcomes.

OER was seen as a facilitator of these aims, but the project required its adopters to be OER aware. As the project expands to more courses in the college, it may be that the instructors are more interested in OER as a facilitator that allows revised course design and improved retention.

Although the OER Research Hub survey represents one of the most comprehensive studies of OER usage, it has its limitations; further investigation is needed in order to validate these categories and to assess some of the finer detail within each. The first of these limitations is geographical coverage. There were 180 different countries in the respondents but a concentration in the United States (35.8%) and United Kingdom (21%). In considering the strategies to realize mainstream adoption of OER, it is likely that the needs of these three categories of users will differ by region, so more focused studies in specific areas are needed.

Similarly, the needs of users across different demographic groups within these categories are likely to vary. The respondents in the OER Research Hub surveys tended to be well qualified with a majority holding a postgraduate (34.4%) or undergraduate degree (27.5%), and a very small percentage declaring that they have no formal qualification (4.3%).

Lastly, these surveys looked at users who were already accessing OERs through one route, even if they were unaware of the term "OER." In order to gain mainstream adoption, it will be necessary to study how other, casual users can gain access to OERs.

Notwithstanding these limitations, the Research Hub survey represents the best cross-section of OER users currently available and as such, it provides a useful means of considering the next phase of OER strategy. If the intention to become part of mainstream practice is to be realized then an expansion of usage beyond the current OER active group is required. As well as attempting to grow the community that constitutes this OER active group, different approaches will be required to meet the needs of the OER as facilitator and OER consumer groups.

Conclusion

The OER movement has seen steady growth and development since its inception, and elements are now being accepted into the mainstream of educational practice. In order to achieve widespread adoption, it is likely that new strategies will be required by the OER community, whether researchers, funders, practitioners,

or policymakers. In order to inform this work, it will be necessary to develop a better understanding of how different communities use OERs and the problems OER solves for them.

The work of the OER Research Hub provides a basis for this analysis as it provides a large data set of attitudes and perceptions of OER users. The three categories outlined in this paper of OER active, OER as facilitator, and OER consumer represent an initial, but not exhaustive attempt, to rationalize these different forms of OER engagements. This analysis highlights that different strategies will be required to suit the expectations of these users, and thus a coordinated, directed vision may be necessary. This will present a challenge for a loose, open community but can be realized through open discussion and targeted funding and projects.

Authors

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