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Undergraduate Biology Education (SCORE-UBE) Network

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Abstract

In October of 2019 the Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE) Network hosted a conference at Bates College. Participants from multiple sectors in open educational resources (OER) in biology, including librarians, instructional technologists, instructors, education researchers, funders, OER hubs, open source software developers, and college administrators were invited to be part of a discussion about sustainability in tandem with equity, and social justice. One key point was that a vibrant OER ecosystem requires moving away from being a static resource repository and into a dynamic community hub, acknowledging that OER is not just about cyberinfrastructure, it is about a community of practice. Therefore, OER work involves the often invisible labor of community organizing in addition to that of web and resource development. Financial support from a diverse set of funders is important to reap the potential rewards for student learning - both in terms of cost savings and student retention, as well as the opportunity to support emerging fields and inclusive pedagogies. However, applying a social justice lens on future financial sustainability plans needs to be on the minds of non-profit organizations.

Introduction

The Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE) Network is a National Science Foundation [NSF] Research Coordination Network for Undergraduate Biology Education [RCN-UBE] (Diaz Eaton et al., 2016; NSF, 2020). SCORE-UBE was formed as a network of networks and individuals to address the challenges of sustainability and equity in Open Educational Resources (OER) projects for undergraduate biology education. The first activity of the network was to hold a Summit at Bates College in October 2019 around OER in biology, sustainability, and social justice. Through physical and virtual attendance, 36 participants explored the promise of equity and challenges of sustainability assumed by open education resources in undergraduate biology education. The participants in the Network meeting (see Table 1) were from 16 states and 13 academic disciplines and included educators, education researchers, librarians, instructional designers, publishers, professional societies and Hubs that utilize, research, and produce OER pedagogical content in undergraduate biology and its adjacent disciplines, as well as stakeholders that support OER (e.g., foundation, business, and public research funding). The participants in the meeting represented a broad network of individuals from over 20 different OER-related initiatives and stakeholders across multiple disciplines and pedagogical communities. We also invited regional policy makers to the conference, though they were ultimately unable to attend.

In this paper, we broadly define OER to include openly-licensed learning materials including texts, ancillary materials, assignments, labs, open access publications, software, and digital platforms. OER offer many recognized benefits for higher education, such as increasing access to educational content, improving the quality of materials, reducing costs, widening participation, and establishing social scholarship (Caswell, Henson, Jensen, & Wiley, 2008; D'Antoni, 2009; Hegarty, 2015; Henderson & Ostashewski, 2018; Windle, Wharrad, McCormick, Laverty, & Taylor, 2010).

While OER is generally associated with free materials for students, it is not the sole defining characteristic of OER, or even the most important one. OER must also be accessible and allow instructors to adapt the materials to their own unique institutional contexts and reshare with the broader OER community. OER meet the standards of what are known as the 5 R permissions: Retain- the right to make, own and control copies; Revise- the right to edit and adapt; Remix- the right to combine materials; Reuse- the right to use resources publicly; Redistribute- the right to share copies with others (Wiley, 2014). Therefore, openly licensed materials allow educators to remix/reuse/adapt/share for their own personal and institutional contexts, to complete the OER lifecycle (Figure 1, (Atkins, Brown, & Hammond, 2007)) and also provide a mechanism for students to contribute as well.

Participation in the adoption and production of OER gives educators and their students access to materials and opportunities to contribute to high-quality and emerging area curriculum, but with the tension that this takes socio-technological infrastructure that requires economic/financial, social/cultural, and technological sustainability.

The organizations that participated in the Summit share OER through digital libraries and other online platforms. The institutions, journals, and online Hubs that host OER today face many of the same questions that faced digital libraries - both those spawned anew in the digital age (e.g.. NSDL) and those that transitioned from brick-and-mortar libraries. For example, these questions include how to provide free resources to users while maintaining a sustainable resource and how to stay relevant and discoverable on the internet. Unfortunately, there is currently no well-established pathway that ensures clear answers to these questions, but it is clear that a shift from "library" to "dynamic community hub"

is necessary to make progress in promoting the ongoing success of digital libraries (Chowdhury, 2014; Chowdhury, McMenemy, & Poulter, 2008; Loach, Rowley, & Griffiths, 2017) and in facilitating the evolution of the digital library from a static repository to a vibrant hub that enables communication, sharing and modification of resources, and collaboration around the use of OER. Organizations such as QUBES (Quantitative Undergraduate Biology Education and Synthesis), a virtual center that supports a community of educators at the interface of mathematics and life science, are emblematic of the shift from a repository to an OER ecosystem that enables and is driven by community interactions (e.g. (Escobar, Morgan, Makarevitch, & Robertson, 2019; Ryder et al., 2020)).

These challenges led us to engage sectors which have been particularly successful at different aspects of sustainability. For example, RCN-UBE projects are very good at building the kind of community needed for social/cultural sustainability (Diaz Eaton et al., 2016). Discipline-based education projects with federal funding support are major contributors to areas of the higher education innovation landscape, for example in interdisciplinary education (e.g. NIBLSE (Network for Integrating Bioinformatics into Life Sciences Education) (Dinsdale et al., 2015)) or in active learning (e.g. Active Calculus, National Library of Virtual Manipulatives, POGIL (Process Oriented Guided Inquiry Learning) etc.). Discipline-specific professional societies also can facilitate widespread educational change through recognition of individual efforts, meeting-related professional development, establishing learning outcome frameworks, and other outreach (Matyas, Ruedi, Engen, & Chang, 2017). OER projects which encompass multiple disciplines, such as OpenStax and Open Textbook Network, have been successful at attracting major foundation and institutional funding for core support (OpenStax) and institutional support from libraries (Ernst, 2015), respectively.

The SCORE-UBE Network's goal is to build a community to explore our sustainability challenges, innovate solutions, promote sustainable digital libraries/communities for OER, and collaborate to preserve and grow what the undergraduate biology education community has built. This goal is critical as we strive to meet the Vision & Change (AAAS, 2010) core competencies (modeling, interdisciplinarity, etc.), while promising to center, promote, and support the needs of historically marginalized students and faculty.

SCORE Summit

To make space for the kinds of discussions and possible collaborations outlined above, the SCORE Summit included a mix of predetermined speakers, panels, and discussion breakout topics suggested through initial surveys and discussion, as well as emergent topics (see Table 2). This is a style of conference (unconference) adapted from EdCamp that promotes inclusivity (EdCamp; Lauer et al., 2020). In a survey completed by participants on the last day of the conference, 100% of respondents reported that the format of the SCORE-UBE network meeting allowed them to explore topics of interest to them, and participants felt the exchange of ideas that took place during the SCORE-UBE network meeting will influence their future work (Taylor, 2019).

Sustainability of Open Education Resources in Undergraduate Biology Education - Issues and Opportunities

Although OER offer promise as a model for democratizing education and improving access to information and resources, there are considerable challenges, particularly with respect to sustainability. One of the challenges of the SCORE network in gathering such a diverse group of individuals is that we

had to set the language for sustainability and OER, in addition to the language of diversity, equity, and inclusion. To help with this process, Dr. Joseph Garcia, co-developer and co-facilitator of the SACNAS Leadership Institute discussed organizational sustainability. The discussion of issues and themes below is an adaptation of a research framework for digital library sustainability by (Chowdhury, 2014), which suggests three dimensions: economic sustainability, social sustainability, and environmental sustainability, intertwined with the infrastructure and communications technology, the user, and the data and content. In this essay, for each dimension we discuss some examples of conversations at the SCORE Summit or collaborations spurred after the Summit. In the conference survey, 90% of participants felt the SCORE-UBE network meeting made adequate progress toward finding a common language across disciplines to address OER sustainability (Taylor, 2019).

Cultural and Social Sustainability

The social sustainability of OER includes both social equity in access and usage of OER (both in openness and in compatibility with assistive technologies), as well as the cultural framework that values OER through promoting discovery, access, usage, and sharing of OER-related content (Chowdhury, 2014). The social and cultural value placed on OER is essential for the sustainability of these resources, including the perpetuation of the OER lifecycle, where instructors *Find*, *Adapt*, *Use*, *Refine*, and *Share* back the adaptations broadly (**Figure 1**, (Atkins et al., 2007)). The recognition of OER scholarship both at the institution and discipline levels, as well as the structure to interact with peers around OER, make up the cultural framework for the sustainability of the resources (Donovan et al., 2015). If there is no community surrounding the use of these resources, then the OER lifecycle fails and the resources will not be utilized to maximum impact (Orr, Rimini, & van Damme, 2015).

The ability to *Find, Adapt,* and *Use* open resources in undergraduate biology education has been enhanced by numerous resource developers and providers (OER Commons, MERLOT (Multimedia Education Resource for Learning and Online Teaching), CourseSource, QUBESHub, TIEE (Teaching Issues and Experiments in Ecology), etc...). The most common concern of library representatives at the Summit was how to help faculty find and adopt OER. On the other hand, OER projects connected to discipline-based communities described "instructor talk" in informal and formal settings as a critical pinch point, for example at professional development workshops, at meetings, or on listservs which help overcome the nuances of classroom implementation. Without this community support for OER, digital libraries are at risk of becoming a museum of forgotten and stale exhibits. This inherent challenge can be overcome by nurturing ecosystems of stakeholders who rely upon, benefit from, and regularly contribute to the OER environment in their common area of interest (de Langen, 2018). OER Hubs are now actively working to make socio-technological systems that can merge the social/cultural needs with the OER cyberinfrastructure. For example, SIMIODE (Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations) - a Hub for sharing materials related to teaching differential equations with modeling - allows instructors to comment directly on OER to give feedback or share ideas about how to use it in the classroom, in a style similar to that of Allrecipes (allrecipes.com) - where adopters share what they tweaked and how well it worked.

A major challenge to a vibrant OER ecosystem is completing the life cycle (i.e. *Resharing*). The barriers to completing the life cycle include: a lack of infrastructure for communicating experiences during the process of implementing and refining materials, a lack of appropriate venue for sharing adaptations, and variability in the scholarly value placed on sharing adapted materials by academic institutions. There have been examples of virtual communities promoting the use of OER and the pedagogical practices that emerge from using, remixing, revising, and creating OER. QUBES, for example, supports communities focused on the use of OER through Incubator authoring, Faculty Mentoring Networks

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(FMNs), Digital Object Identifier (DOI) for all publications, commenting features on collections and publications, and versioning and forking of publications for the resharing and attribution of any adaptations (Bonner et al., 2017).

The Summit provided an opportunity for groups like the Math Modeling Hub (MMHub), which, as a relatively new platform struggles to generate submissions of OER, to talk to organizations with successful models, such as *CourseSource,* a peer-reviewed journal of college-level life science OER materials. *CourseSource* has been able to steadily increase its submissions by supporting new authors through Writing Studios. The two groups recently collaborated on a mini-grant that supported individuals from the Math Modeling Hub to observe the *CourseSource* Writing Studio this summer. This opportunity had the added benefit of allowing MMHub to observe how another organization ran a virtual community building experience, as the Writing Studio was run online due to COVID-19. Additionally, *CourseSource* was awarded travel funds from SCORE to run a Writer's Workshop at the BioQUEST Summer Workshop - thus giving them access to a new community of practitioners who routinely author OER (though that activity has been postponed until 2021 due to COVID-19).

Lesson: OER is not just about cyberinfrastructure, but also about community - and in particular how communities can strengthen each other. Educational projects benefit from connecting with already vibrant communities to reduce the community building work that a project has to do. Beyond professional societies, there are other groups such as BioQUEST and RCN-UBE networks that cultivate these discipline-based instructor communities. Recommendation: Do not reinvent mechanisms that already exist for promoting the various stages of the OER lifecycle - but you may have to look beyond your own discipline for models that work.

Economic and Financial Sustainability
Another persistent challenge to the sustainability of OER stems from one of its fundamental virtues: free access to quality resources for students. OER's commitment to being open access presents obvious difficulties for its business model as it constrains the allowable revenue streams. Related to this, successful development of OER requires an extraordinary amount of invisible labor involved in both the cyberinfrastructure (discussed more in the section below) and in the community organizing. Open technology organizations rely heavily on volunteer labor to maintain community engagement and produce products (Dunbar-Hester, 2020). Academia as an enterprise also relies heavily on uncompensated service to govern institutions, to govern professional societies, and to maintain its publishing system - with disproportionate effects on women and Black faculty, Indigenous faculty, Latinx faculty, and other faculty of color (Hall, 2016; Hirshfield & Joseph, 2012). OER lies at the intersection of these worlds and is therefore vulnerable inequities in labor (e.g. (Golumbia, 2016)).

The financial obstacles to sustainability could be reduced if OER communities—and the nonprofits who support them—work together to develop common technology and synergistic activities, thus improving the overall efficiency of the OER enterprise. Sustainability of digital OER libraries is an innovation landscape and therefore may require innovative financial sustainability solutions. This may include tapping into new funding streams - encouraging discipline-based projects to seek philanthropic foundation funding (as our Summit panel discussed, **Table 2**) and connecting textbook level OER projects to discipline-based communities and research funding.

In a session on nonprofit organizational life cycles, Dr. Joseph Garcia helped participants understand how their sustainability challenges are part of an established nonprofit life cycle framework and discussed ways to mitigate and address these issues - staying true to your organizational mission, renewing your organizational functions periodically, and staying committed to seeking new funding

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sources (not taking continuing funding support for granted) (**Figure 2**). This was followed by a panel discussion which showcased SCORE-UBE Network members at a variety of life cycle stages (Table 2).

As a result of Dr. Garcia's talk, *CourseSource* began talking to business faculty at Rollins College and Cornell University. Librarian Krystie Wilfong was also able to help *CourseSource* connect with librarians. Deborah Prosser, who is the Director of the Olin Library at Rollins College has been instrumental in helping the journal think through sustainability plans and she is now a member of the *CourseSource* advisory board. *CourseSource* is also looking at combining infrastructure with QUBES to further reduce costs. We suggest that discipline-based education projects should think more broadly about collaboration partners, which have the potential to make a significant contribution to financial sustainability.

Lesson: Financial and economic sustainability is particularly challenging due to the amount of invisible and behind the scenes labor that is part of both the cyberinfrastructure and the community organizing required by OER. Collaborative work to build both cyberinfrastructure, community organizing, revenue streams, and OER practices might reduce "reinvention" labor and cost. Recommendation: Project directors could benefit from professional development related to managing non-profit organizations and should be thinking about how to adjust their work based on where they are in their organizational life cycle.

Technological and Environmental Sustainability
The need for continual innovation is also a significant issue in technological sustainability. For example, consider the computational resources needed to support recent shifts in the way scholars and educators in biology are interacting with technology in the conduct of research, teaching, and learning (Chen, Scott, & Stevens, 2018; Thistlewaite & Daniels, 2016). Increasingly, faculty and students expect to—or at least desire to—access information and resources immediately through online searches (Biddix, Chung, & Park, 2015). Furthermore, scientists are now more inclined to treat resources as dynamic entities that emphasize interaction between humans and technology, as well as among the human practitioners. The ability to adapt and customize instructional materials and computational tools to new environments has become a critical characteristic for evaluating the usefulness of resources in the practice of modern science.

Open Educational Resources are both a product of the evolving educational technology landscape and a potential solution to the needs of the communities which operate within it (Butcher & S, 2012). The OER movement emphasizes open access to and adaptability of quality academic resources. Development and dissemination of these materials is, by nature, an iterative process requiring the interaction of a community of practitioners. Much as local brick-and-mortar libraries have been converted from warehouses for housing books and media to venues for cultural interaction, the digital library is being transformed from an information repository to a dynamic community space (Loach et al., 2017). QUBES facilitates human interaction in the digital resource environment, both for its own OER-related activities as well as for its partners (Akman, Diaz Eaton, Hrozencik, Jenkins, & Thompson, 2020; Donovan et al., 2015; Ryder et al., 2020). QUBES uses HubZero as its base cyberinfrastructure and benefits from its technological developments. However, to serve educator communities more specifically, QUBES also employs a full time user-experience/web-developer as well as staff that focus on the OER infrastructure and experience. The virtual nature of the website hides a significant amount of invisible labor that is crucial to the cyber infrastructure part of the ecosystem (and there are additional staff required to support the community building portion!).

While some conversations focused on shared practices and metadata, the Summit also percolated

many direct exploratory conversations between organizations about platform sharing in order to reduce expenses and benefit from each others' cyberinfrastructure development and maintenance expenditures. For example, SIMIODE, *CourseSource*, and DiverseBookFinder are all in the process of piloting a full cyberinfrastructure move to QUBES. This is mutually beneficial for all partners. For example, *CourseSource* is excited to help support QUBES, but in addition will benefit from OER cyberinfrastructure, so that users will be able to version and fork materials, enhancing the vibrancy of materials shared. QUBES will benefit from DiverseBookFinder's extensive work on culturally relevant tagging for books and from SIMIODE's OER commenting features. In addition, QUBES is working with CyVerse to see how it might outsource some of its cloud computation needs. Each of these projects will require extensive conversation about shared infrastructure, metadata, and user experience - in particular around maintaining existing branding and communities - but this process should provide guidance to other groups interested in combining infrastructure.

Lesson: The technological landscape of OER is rapidly shifting, both in response to advancing research and teaching needs for computation in biology, but also in response to the need for community interaction to occur around OER. All of this work adds additional cost, labor, and need for innovation. Recommendation: Shared infrastructure discussions should lead to both reduced costs as well as provide benefits from shared communities and shared practices.

Sustainability in the context of social justice and open and accessible education philosophies
OER has shown extraordinary potential to improve undergraduate biology education and student learning within a social justice framework. As redistributive justice, OER save institutions and students money and increase student success (Jenkins et al., 2020; Lambert, 2018). As recognitive justice, OER can enable faculty to tailor instructional materials that better represent the diversity of contributions to biology (Lambert, 2018). As representational justice, OER, when combined with open educational practices (see below) enable students to participate in knowledge creation (Lambert, 2018).

Cost savings to institutions is probably the most talked-about benefit of OER. The replacement of commercial learning materials with OER has saved students millions of dollars nationally (Griffiths et al., 2018), and data from SPARC (Scholarly Publishing and Academic Resources Coalition) (Allen, 2018) show that the OER movement has saved students, parents, schools and governments at least $1 billion dollars worldwide. Additionally, students using OER perform better on course throughput, have improved end-of-course grades, and have decreased drop-fail-withdrawal rates. This is particularly true for Pell recipient students (Colvard, Watson, & Park, 2018; J. Hilton; J. L. Hilton, III, Fischer, Wiley, & William, 2016).

Furthermore, use of OER can be leveraged to support Open Educational Practices (OEP) (See Figure 3). OEP emphasize participatory classrooms in which OER is not just about allowing access to knowledge, but also to knowledge creation. When a diversity of students and faculty are invited to participate in the practices of remixing and revising content, they can make these materials more representative and inclusive of a wide variety of people and perspectives (Lambert, 2018). If instructors can create their own narratives in their own instructional materials, write materials that are aligned with universal design for learning practices, or adapt an OER text and add diverse scientists' biographies and citations to the text, they are part of building a new narrative for higher education. This instructional flexibility of OER is already being leveraged by OER authors in emerging areas (active learning, interdisciplinarity, etc.) in which traditional texts are slow to respond to changes in the field. However creating an anti-racist, anti-bigoted, anti-sexist, anti-ableist, decolonized STEM curricula is an equally compelling area in which traditional texts have been slow to respond and OER could be leveraged.

OEP extends beyond just the use of OER in the classroom to open pedagogical approaches that emphasize student agency and ownership of learning. Students can create and openly license content and therefore move from a model of information download to one that is participatory in which students contribute their own ideas to a public knowledge commons (DeRosa & Robison, 2017). Providing opportunities for students, especially the marginalized, to construct and share knowledge is an especially potent way to empower those whose voices are often ignored (Hodgkinson-Williams & Arinto, 2017; Jhangiani & DeRosa, 2017).

As we looked to expansively discuss OEP, the Summit invited individuals involved in policy, open-source software, and open data. We also discussed how open science practices might align with OEP in biology classrooms. However, as we embrace these open practices, we should also keep in mind the inherent tensions of open work, such as student authorship crediting and labor, Indigenous data sovereignty as it pertains to open data (we refer readers to (Rainie et al., 2019)), and privacy issues in digital environments.

In commercial and non-profit systems either the submitter or the consumer typically pays for the costs of the publishing infrastructure. If having OER remaining freely accessible for both the producers and consumers of OER preserves equity, then who pays for these costs? What are the implications for our vision of an open and accessible 21st educational experience? What are the potential benefits for students in an educational model that embraces OER as well as broader open educational practices and pedagogies? How might we expand to include new partnerships with academic libraries and foundations? In order to answer these questions, we find that we need to focus on WHY we are "open" and for whom (Adam, Bali, Hodgkinson-Williams, & Morgan, 2019; Hodgkinson-Williams & Trotter, 2018). We need to ensure that Open Educational resources, practices and communities not only address economic inequities, but are culturally sensitive and inclusive of diverse perspectives (Adam et al., 2019). This led to a discussion in which Summit participants were asked to grapple with the role of social justice, equity, diversity, and inclusion (something the Summit affectionately termed "S-JEDI" practices). What is their organizational commitment to S-JEDI, and how does that affect their orientation to solutions for financial sustainability, who has access as a producer or consumer, and whether their potential for transformative and liberating pedagogy/classroom experience is being met? As one participant described in response how the Summit would influence their future work, "[The] Economic lens has changed my perspective on how to absorb challenges in sustaining OER and also using a lens pertaining to social justice regarding access to OERs by URMs" (Taylor, 2019).

We also identified the need for organizational mission statements to be more clearly linked to equity and inclusion. As a first pass or attempt at this work, a breakout room developed a draft of the SCORE mission statement. Our current agreed upon draft is here:

"The mission of the SCORE-UBE Network is to help our Network participants achieve their sustainability and broader impact goals by working together to amplify the value and reach of open education in STEM and to align our resources and practices with the principles of anti-racism, equity, social justice, and inclusion. In particular, we see open education as an approach and mindset to transform teaching and learning to center the needs of underrepresented and marginalized learners and instructors who have been systematically excluded from the benefits of traditional educational systems."

After the Summit, SERC (Science Education Resource Center) and ISKME (Institute for the Study of Knowledge Management in Education) collaborated on a joint effort to create a toolkit to help faculty understand and use proper accessibility tagging for their OER. SCORE has also launched a learning

community on S-JEDI practices for all of its members to offer a space to talk about race and racism in higher education, but more specifically what this means for OER and organizational practice. The goal is to meet participants' interest in re-examining their organizational missions in light of S-JEDI. We also challenged all groups to think about their financial sustainability plans in light of this commitment. Many of our projects have previously been encouraged to develop financial sustainability plans based on placing the burden of cost on instructor submitters/users or students. However, this approach privileges those who have access to resources for publication/educational material costs. However, an alternative in which OER is free to all users, while seemingly ideal, becomes a system based in volunteer labor, which may disproportionately burden instructors of color and women (Hall, 2016; Hirshfield & Joseph, 2012).

Lesson: OER and OEP have extraordinary potential to make a difference in a more equitable and socially just undergraduate education, but only if organizations, authors, and users are actively applying a social justice lens to this work. Education cannot move forward if we do not recognize and reward the labor of OER work, including cyberinfrastructure, community organizing, and publishing. Recommendation: Equity and social justice are intertwined with every aspect of the sustainability framework presented and discussed above, and so should be on everyone's minds as policy makers, open data and software developers, education researchers, organizational leaders, library and instructional technology staff, and instructors.

What is next for SCORE?

To summarize, the emergent and immediate challenge areas identified from the SCORE-UBE Summit are:

- Bridging synergies between OER and opportunities for social justice, equity, diversity, and inclusion;

- Growing, strengthening, supporting, and transforming [discipline-based] communities around OER;

- Leveraging institutional and philanthropic foundation support for development and implementation of OER;

- Funding for technological and personnel infrastructure that is often invisible to others;

- Maintenance and sharing of common cyberinfrastructure; and

- Promoting broader dissemination of OER through education research and faculty development.

Collaboration and networking were highly emphasized, and in the post-conference survey 70% of participants indicated they developed plans for collaborative research with other participants with whom they had not previously collaborated (Taylor, 2019). In a Spring SCORE Network survey, 85% of those that responded reported sharing information from the SCORE-UBE Summit with others from their organization. Approximately 92% indicated the ideas exchanged at the Summit had an impact or influence on their organization, with comments related to increased understanding of the OER ecosystem, new collaborations, and awareness of equity, diversity, and inclusion (Taylor, 2020).

After the summit, the SCORE-UBE Network Steering Committee met to immediately identify activities to support next steps. We opened remaining participant funds up to the entire network to share findings at meetings, spur collaborations, and attend workshops related to financial sustainability. Unfortunately COVID-19 hit and many of these participant activities have been rescheduled to next year. A challenge for our RCN grant as well as for some of our network members' organizations is how to utilize NSF participant funds effectively when costs for virtual programming (virtual platform and staff time) tend to not fall under participant expenses, ironically highlighting our earlier points about labor.

Shortly after the Summit, SCORE Leadership also began productive discussions with the Hewlett Foundation around the emergent conference themes. In those conversations, we shared the work of the discipline-based education research community as both crucial to biology OER creation, but also helping faculty implement and adapt it at their institutions. We also shared the excitement of our SCORE Network in wanting to collaborate, but needing catalyst funds to do so, beyond what the participant funds in the incubator grant could provide. Lastly, we shared the interest of the SCORE Network in wanting to adopt practices explicitly connected to social justice, equity, diversity, and inclusion, but with the caveat that they needed additional professional development, support, and conversation space to do so.

The result of these conversation was a one-year Hewlett Award to Bates College to support the SCORE Network through three new initiatives, all of which kicked off between April and June:

1. A collaborative mini-grants program for its network members, which funded some of the post-meeting collaborative actions described above. We were able to fund five projects relating to universal design for learning and culturally responsive resources, shared infrastructure, and writing workshops for OER submission. These collaborations involve seven organizations in SCORE: Diverse Book Finder, ISKME/OER Commons, SERC, *CourseSource*, MMHub, SIMIODE, and QUBES.

2. A virtual professional development program, SPLINE (STEMed Project Leaders Inclusivity Network), to support curriculum developers in open pedagogy, inclusive teaching, and universal design for learning as it relates to curriculum development and classroom implementation. These project leaders will be implementing changes to their curriculum, and will be offered the opportunity to run QUBES Faculty Mentoring Networks in the Fall to help others implement a more inclusive and accessible curriculum.

3. A S-JEDI reading and learning community for OER organizational leaders focused on social justice, equity, anti-racism, critical studies, universal design for learning, and open pedagogy. Organizational leaders will be invited to explicitly link their organizational mission in OER with their commitment to social justice.

4. Funding for core QUBES cyber-community infrastructure as it serves as a technocrat hub for other SCORE organizations.

The goal of the Hewlett grant was to move collaborative discussions at the Summit into collaborative actions, and the timing for conversations about an S-JEDI minded OER for biology education has never been more relevant. Multiple OER organizations found themselves called to reorient and serve an increased demand in the midst of the COVID-19 crisis to meet the needs of their members, while also feeling compelled to respond to the protests in support of Black lives across the nation and the related

#ShutdownAcademia and #ShutdownSTEM movements by centering S-JEDI principles in their organizations and actions.

We are excited about the conversations we have started, but there is more critical community building work to do. The invitation to connect with other like-minded organizations and OER leaders is open and broad - just join the QUBES Hub group to become a member of the SCORE-UBE Network. We are committed to keeping this conversation open and centered on collaborations and issues of social justice, equity and inclusion, and we welcome all those who share our mission.

Acknowledgements

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Figure Legends

Figure 1. A simplified OER lifecycle model for educational resources, highlighting barrier stages (dashed circles). Percentages represent the percent of surveyed college biology instructors that engage in each step of the OER lifecycle in resource development and implementation. Lifecycle adapted from Atkins *et al.* (2007).

Figure 2. Organizational life cycle of nonprofits based on presentation by Joseph Garcia, SCORE Summit, Oct. 17, 2019). Phase 1 of the cycle involves the planning and inception of the organization. During phase 2, the organization begins to grow, focusing on expanding capacity to meet demands. Phase 3 is characterized by a shift to professional management and a slowing of growth as the organization matures. At the point, organizations must begin the cycle anew - planning for a new iteration of the organization, undergoing initial growth in this new iteration, eventually reaching maturity again – or face stagnation and decline.

Figure 3. Eight attributes of Open Educational Practices (OEP). Visual from Ontario Colleges OER Toolkit, licensed CC BY SA, and based on Bronwyn Hegarty's Eight Attributes of Open Pedagogy Podcast Transcript, from the Alberta Open Educational Resources Initiative, licensed under CC BY SA (The Learning Portal & ISKME). For more information on Open Educational Practices, see (DeRosa & Robison, 2017; OER Services, 2019).

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