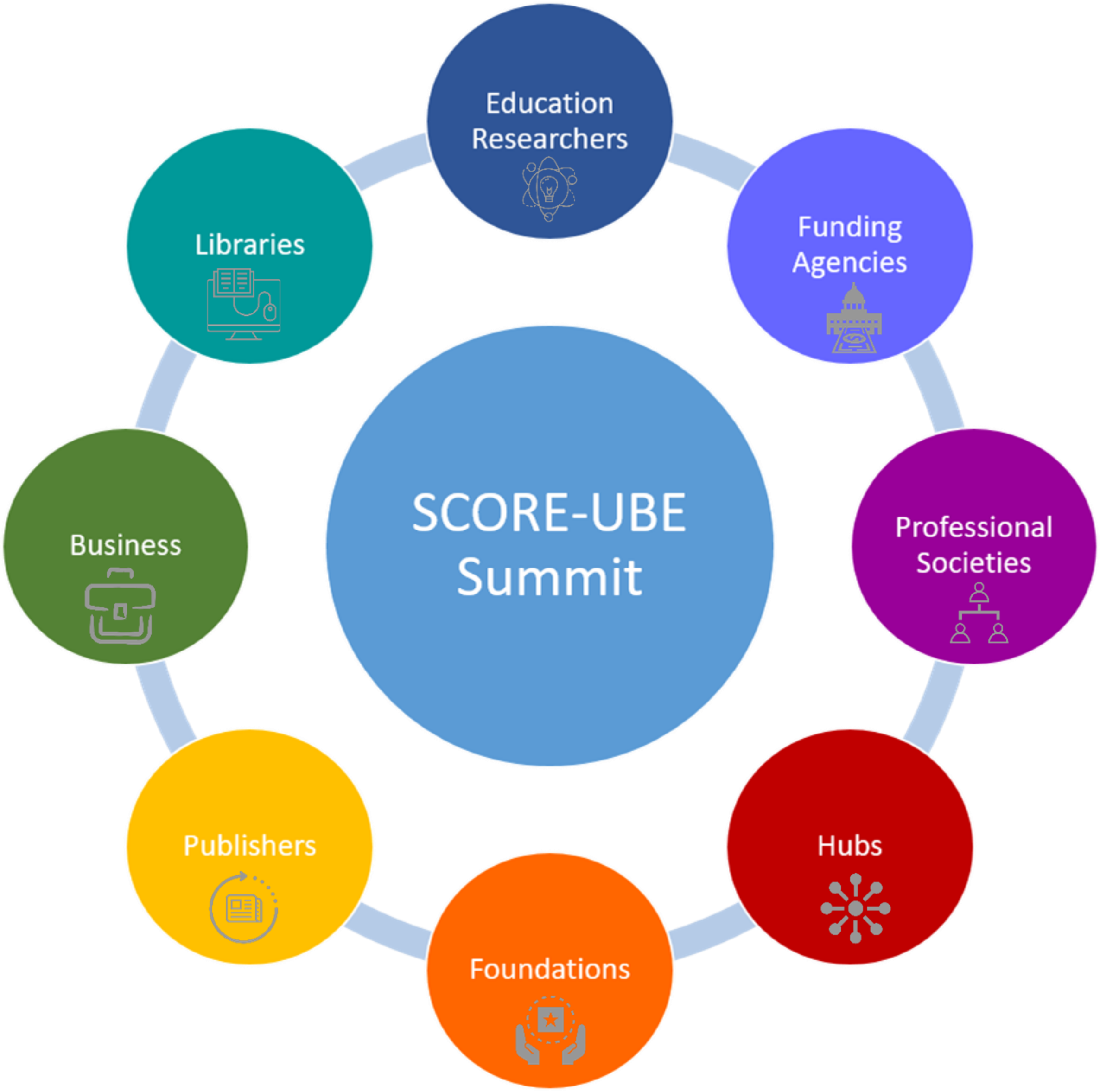

SCORE-UBE FINAL EVALUATION REPORT

2021

Prepared by Robin T. Taylor
Principal & Senior Evaluator, RTRES Consulting

Acknowledgements

The information provided within this report is summarized according to the author's understanding of data collected for evaluating the NSF RCN Incubator award (#1919879). The opinions, findings, conclusions, and/or recommendations expressed in this report are those of the author and do not necessarily reflect the view of the National Science Foundation.

Robin T. Taylor, PhD.
https://www.rtresconsulting.com

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NOMENCLATURE

AACU	Association of American Colleges and Universities
ALA	American Library Association
AASL	American Association of School Librarians
ComPADRE	Communities for Physics and Astronomy Digital Resources in Education
DEI	Diversity, Equity & Inclusion
DiG	Data Incubator Group
ESA	Ecological Society of America
iEMBER	Inclusive Environments and Metrics in Biology Education and Research
ISKME	Institute for the Study of Knowledge Management
LC	Learning Community
MERLOT	Multimedia Education Resource for learning and online teaching
MMHub	Math Modeling Hub
NF	Not funded
NIBLSE	Network for Integrating Bioinformatics into Life Sciences Education
NSDL	National Science Digital Library
OEP	Open Education Practices
OER	Open Education Resources
OPLC	Open Pedagogy Learning Community
PI	Principal Investigator
QUBES	Quantitative Undergraduate Biology Education and Synthesis
SCORE	Sustainability Challenges for Open Resources to promote an Equitable UBE
SERC	Science Education and Research Center
SGCI	Science Gateways Community Institute
SIMIODE	Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations
S-JEDI	Social Justice Equity Diversity and Inclusion
SPARC	Scholarly Publishing and Academic Resources Coalition
SPLINE	STEMed Project Leaders Inclusivity Network
TIEE	Teaching Issues and Experiments in Ecology
UBE	Undergraduate Biology Education

INTRODUCTION

An NSF RCN-Incubator grant (#1919879) was awarded to Bates College in August 2019 to support a network focused on Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE). Bates College hosted the SCORE-UBE Summit from October 17th through October 19th, 2019. A group page for network members was created within QUBES Hub, providing a virtual platform for members to form a community of practice aimed to support the following objectives:

- Bring together a group of people interested in creating, developing, disseminating, and utilizing OER across disciplines and institutions.
- Build community among network members interested in OER sustainability.
- Develop a common language for sustainability and OER centered around diversity, equity, and inclusion.
- Share experiences and create collaborations within the network to foster new ideas for sustainability.
- Discuss concepts of social justice, equity, diversity, and inclusion in the context of OER and develop strategies to incorporate these ideas into OER.

The onset of the national health pandemic resulted in uncertainty for supporting additional grant activities, thus, the team requested a no-cost extension from NSF. During this time, members of the SCORE Network worked on a meeting report that has been submitted to CBE Life Science Journal, formed stronger joint collaborations, and submitted proposals to further SCORE and collaboration opportunities. In addition, two working groups convened during summer 2021 to address issues of 1) finding and tagging of inclusive teaching resources, and 2) how equity and inclusivity can be integrated into the emerging data science curricula.

EVALUATION METHODS

Dr. Robin Taylor, Principal and Senior Evaluator of RTRES Consulting, was contracted by Dr. Diaz Eaton (PI) at Bates College to conduct an evaluation and social network analysis of the SCORE-UBE Network project. All network participants who attended the SCORE Summit in 2019 were administered pre- and post-summit surveys. An initial follow-up survey was administered during February 2020. Prior survey findings were summarized for the leadership team and data summary reports are publicly available on QUBES Hub[1].

---

[1] Taylor, R. (2020). NSF RCN-UBE SCORE Mid-Survey Findings. Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE), QUBES Educational Resources. doi:10.25334/R0VC-N068

Taylor, R. (2019). Evaluation of NSF RCN-UBE SCORE Summit. Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE), QUBES Educational Resources. doi:10.25334/RJDM-SM61

Taylor, R. (2020). NSF RCN-UBE SCORE Pre-Data Summary Report. Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE), QUBES Educational Resources. doi:10.25334/PC2Z-8346

The SCORE Network continued to grow through additional funded initiatives and collaboration opportunities. A final follow-up survey was administered in June 2021 to all SCORE-QUBES Network members (i.e., all members of SCORE who had actively joined the group within the QUBES Hub platform either from the summit or other funded activities). Additional data used to understand the SCORE Network include participation in team meetings, QUBES users and groups data, and attendance records.

EVALUATION RESULTS

SCORE Participants

A total of 35 individuals representing more than 17 OER organizations participated in the SCORE Summit in 2019. Of those 35 members, 30 joined the SCORE Network group within the QUBES Hub platform. The growth of the SCORE-QUBES Network continued to grow through additional participation across new initiatives sponsored by additional funding grants and OER collaborations – see Appendix A for a brief summary of these additional activities. A total of 140 individuals have participated in at least one activity that has been directly or indirectly sponsored by the SCORE Network, and 72 individuals are currently members of the SCORE-QUBES group. Figure 1 provides a visual illustration for the growth of activities related to the SCORE Network and includes products SCORE members reported as a result of their participation within these activities.

Table 1 is provided to demonstrate membership across each of the associated SCORE activities. The table shows SCORE activities in the rows and columns and each cell in the table shows the number of individuals within both groups. The main diagonal shows the total number of members participating within an activity. Counts are not included within the bottom part of the matrix as these values replicate the information provided in the top part of the matrix.

The primary institution of each member indicates participants represented at least 67 different organizations/institutions – including 65 academic/higher ed institutions, non-profits focused on open education, funding agencies/foundations, consulting firms, community of practice networks, professional societies, museums, research lab, and museum. In surveys administered to SCORE Network (e.g., the pre-survey and final survey administered with new SCORE members), members have reported involvement with numerous open education communities – Figure 2. In addition, SCORE-QUBES Community members have also been involved with 386 groups/communities utilizing the QUBES platform. Figure 3 shows the involvement with 77 QUBES groups/ communities in which more than 5 members were involved. Descriptions of these QUBES groups are provided in Appendix B.

Finally, SCORE-QUBES members are geographically located across 28 states and India. A geographic representation of SCORE membership across the United States is shown in Figure 4 for SCORE summit and SCORE-QUBES members.

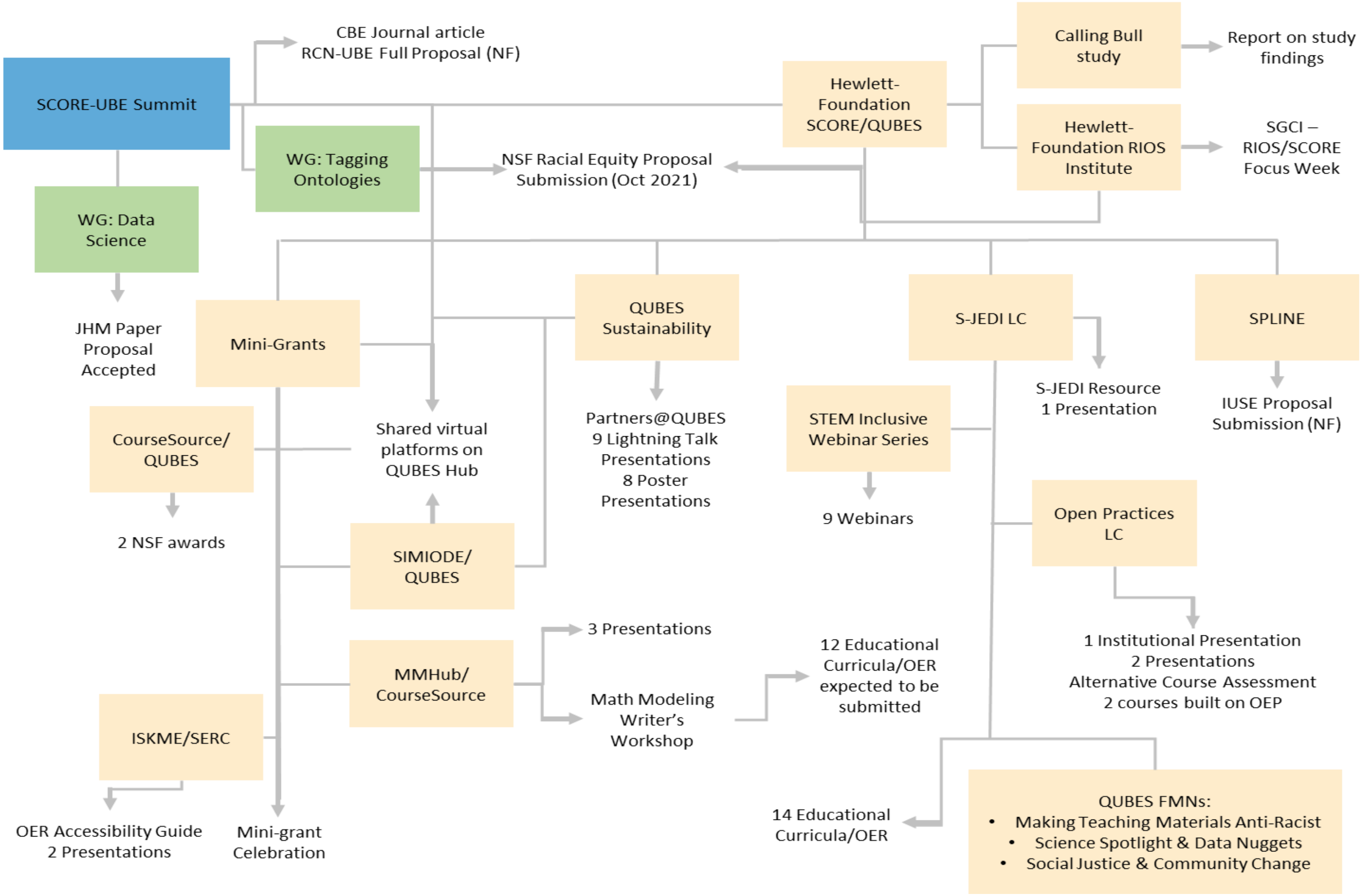

SCORE-UBE Summit
CBE Journal article
RCN-UBE Full Proposal (NF)
WG: Data Science
JHM Paper Proposal Accepted
WG: Tagging Ontologies
NSF Racial Equity Proposal Submission (Oct 2021)
Hewlett-Foundation SCORE/QUBES
Calling Bull study
Report on study findings
Hewlett-Foundation RIOS Institute
SGCI – RIOS/SCORE Focus Week
Mini-Grants
CourseSource/ QUBES
2 NSF awards
Shared virtual platforms on QUBES Hub
SIMIODE/ QUBES
QUBES Sustainability
Partners@QUBES
9 Lightning Talk Presentations
8 Poster Presentations
S-JEDI LC
S-JEDI Resource
1 Presentation
SPLINE
IUSE Proposal Submission (NF)
STEM Inclusive Webinar Series
9 Webinars
Open Practices LC
1 Institutional Presentation
2 Presentations
Alternative Course Assessment
2 courses built on OEP
MMHub/ CourseSource
3 Presentations
Math Modeling Writer's Workshop
12 Educational Curricula/OER expected to be submitted
ISKME/SERC
OER Accessibility Guide
2 Presentations
Mini-grant Celebration
14 Educational Curricula/OER
QUBES FMNs:
Making Teaching Materials Anti-Racist
Science Spotlight & Data Nuggets
Social Justice & Community Change

Figure 1. Influence of SCORE Network Across Direct and Indirect Supported Activities
🟦 NSF RCN-SCORE-UBE funded activities, 🟨 Hewlett-Foundation funded activities, and 🟩 Joint funded activities (i.e., funding from NSF and other sources). Products and outputs which emerged from project activities are indicated with →

Table 1. Participation numbers across associated SCORE Network activities

Group	*N*	SCORE-Summit	SCORE - QUBES	SPLINE - QUBES	Mini-Grant	S-JEDI LC	OPLC	WG: Tagging	WG: Data Sci.	FMN: AR	FMN: SJ	FMN: Sci. Spot
SCORE- Summit	**35**	**35**	30	7	8	8	5	6	1	2	1	2
SCORE - QUBES	**72**		**72**	14	13	14	19	10	1	3	1	2
SPLINE - QUBES	**28**			**28**	7	7	5	8	1	4	1	2
Mini-Grant	**18**				**18**	5	3	7	1	0	0	1
S-JEDI LC	**16**					**16**	6	5	1	2	1	2
Open Pedagogy LC	**23**						**23**	4	0	0	0	1
WG: Tagging Ont.	**17**							**17**	1	1	1	2
WG: Data Sci.	**5**								**5**	0	0	0
FMN: Anti-Racism	**10**									**10**	3	3
FMN: Soc. Justice	**17**										**17**	5
FMN: Sci. Spotlight	**20**											**20**

Note. See appendix A for descriptions of additional SCORE activities supported through additional grant funding.

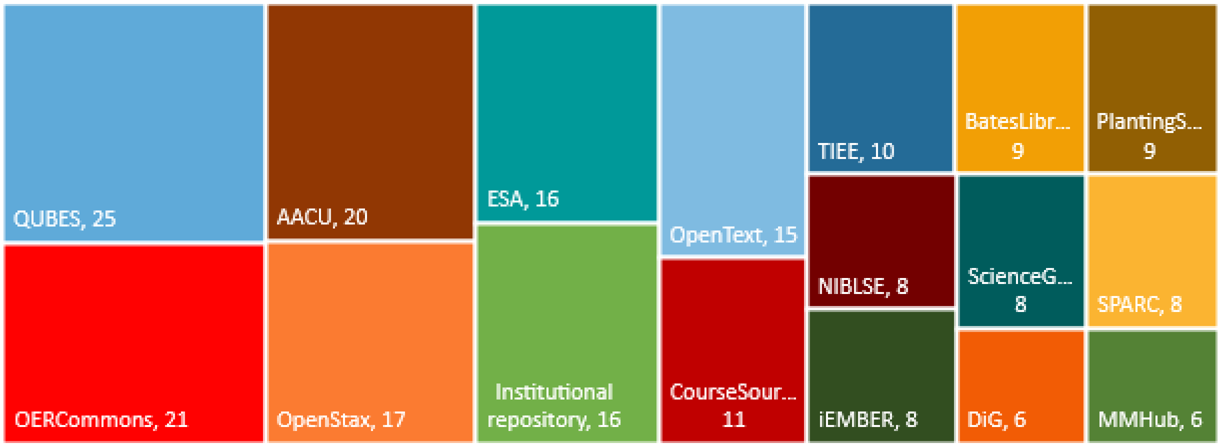


Figure 2. OER Communities of SCORE-QUBES Network Members

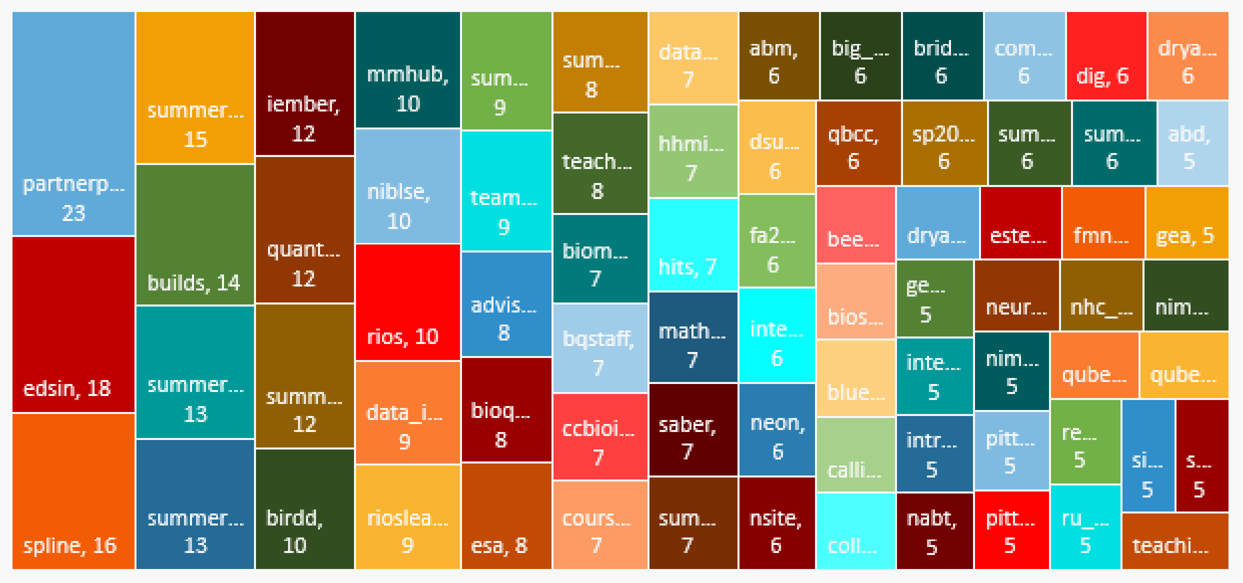


Figure 3. QUBES Groups/Communities with more than 5 SCORE-QUBES Network Members

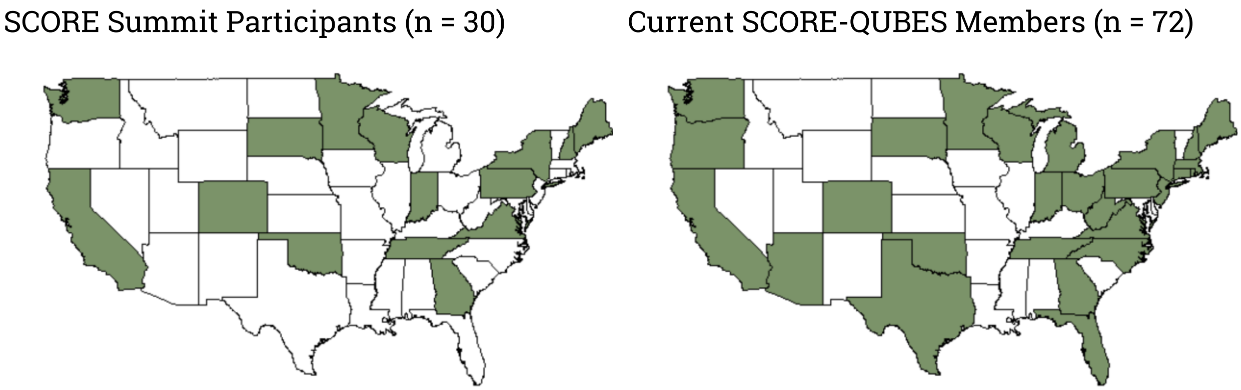

SCORE Summit Participants (n = 30)
Current SCORE-QUBES Members (n = 72)

Figure 4. Geographical representation for SCORE Network within the United States by summit participants (n = 15 states) and SCORE-QUBES (*n* = 28 states). SCORE-QUBES also had 1 international participant (India).

Network Analysis

The SCORE-UBE summit aims to expand networks of persons committed to understand and find sustainability solutions to Open Education Resources (OER) as well as Diversity, Equity and Inclusion (DEI). Participants who completed surveys prior to the summit in October, 2019, during February 2020, and/or in June 2021 were asked to indicate the nature of their relationship with all participants in the network by selecting response options which also included "I have professionally collaborated with this person." Professionally collaborated is defined as actively engaging in cooperative work with another person. Growth of the SCORE network is then assessed by examining professional collaborations across individuals in the network at each time period.

The list of network participants for the pre-survey were based on 35 individuals identified to attend the summit in October. Of these 35 participants, 3 were unable to attend any component. Three additional participants have collaborated with network participants and were added to the mid-survey. For the final survey, all SCORE-QUBES members were added to the survey network questions, while participants who did not attend the summit and were not members of SCORE-QUBES were removed from survey network. To explore network growth, the following color scheme was used to understand at what point participants joined the SCORE Network:

● PI or Co-PI ○ Individual did not participate in the summit nor joined SCORE-QUBES,

● SCORE Summit Participants, ● Did not attend summit, but member of SCORE-QUBES

The mid-network was creating using the professional collaborations indicated at pre- and for those who completed the mid-survey. The final-network was created using both pre- and mid-collaborations, plus collaborations indicated at the final follow-up; however the follow-up resulted in asking participants to indicate professional collaborations for an additional 32 persons whose affiliations in the network were not assessed at the first two survey administrations. Additionally, another limitation to understanding the full evolution of the SCORE Network is the lower response rates within follow-up surveys – response rates were 74% at pre, 31% in February, and 26% in June. We use an undirected network model since it is assumed that professional collaborations would be mutual. The following metrics are included to examine network growth:

- **Edge density** is defined as the ratio of extant edges to the number of potential edges, and demonstrates the proportion of professional collaborations within a network across all potential collaborations.
- **Cliques** indicates the number of subgroups (cliques) in a network and indicates clusters of professional collaborations among SCORE participants.

Figure 5 show the network graph based on information provided by participants prior to attending the SCORE Summit in October 2019. In addition, Figure 6 is provided to demonstrate the number of clusters present with respect to professional collaborations across SCORE Network members. The network density is .203 and 5 cliques were identified in the network – 4 clusters within professional connections and then individuals without professional collaborations.

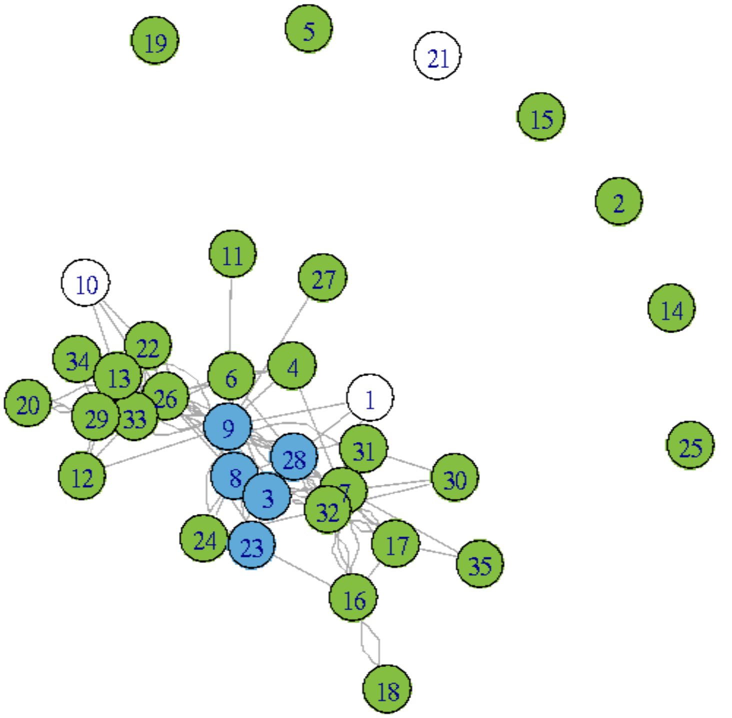


Figure 5. Network graph showing professional collaborations across summit participants prior to SCORE Summit.

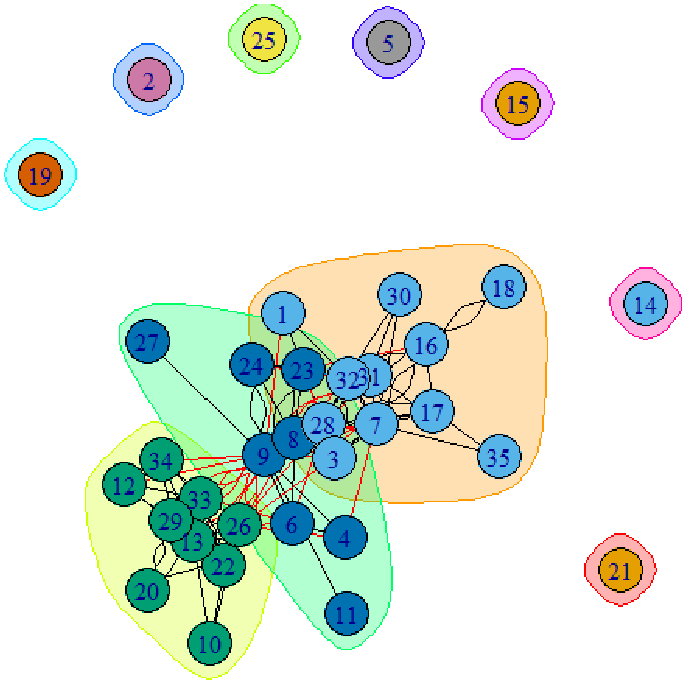


Figure 6. Network graph showing clusters for professional collaborations across summit participants prior to SCORE Summit.

Figure 7 show the network graph based on information provided by SCORE Network participants in February 2020. In addition, Figure 8 is provided to demonstrate the number of clusters present with respect to professional collaborations across SCORE Network members. The network density is .216 and 6 cliques were identified in the network – 5 clusters within professional connections and then individuals without professional collaborations.

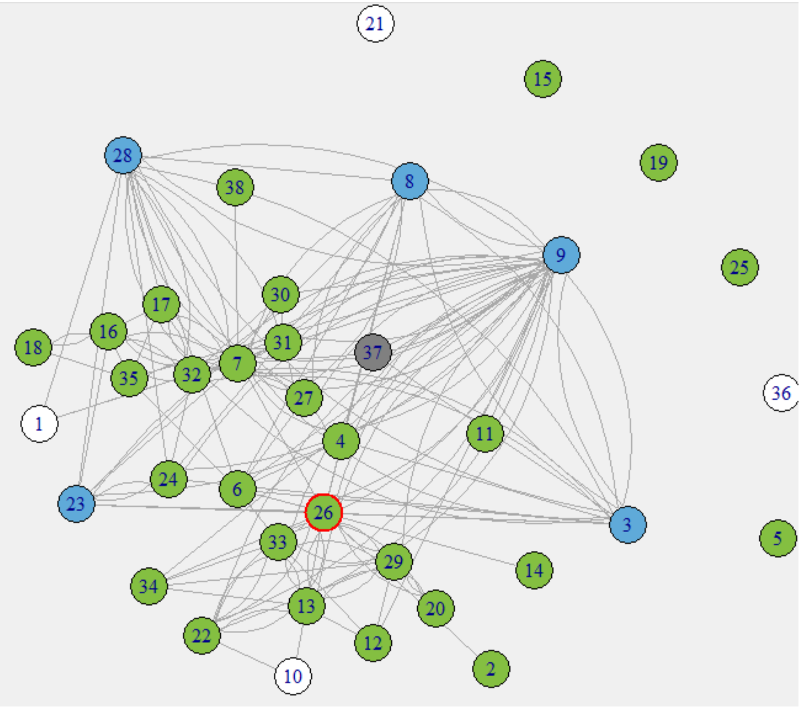


Figure 7. Network graph showing professional collaborations across SCORE Network members in February 2020.

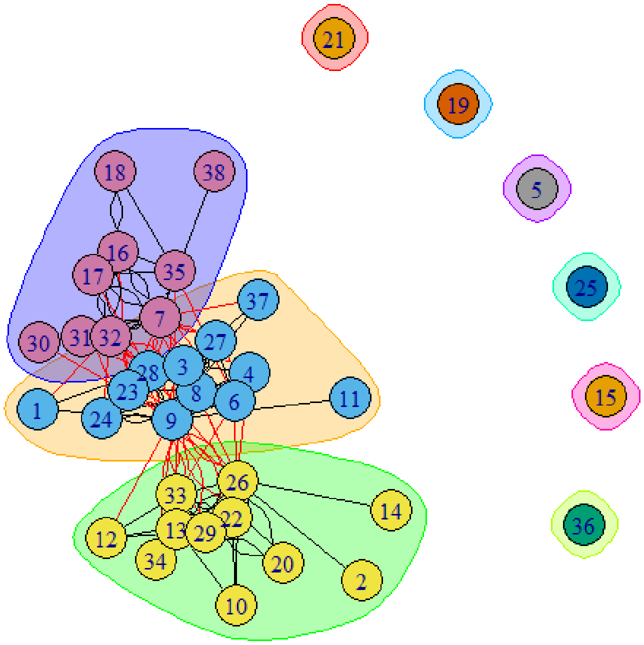


Figure 8. Network graph showing clusters for professional collaborations across SCORE Network members in February 2020.

Figure 9 show the network graph based on information provided by SCORE Network participants in June 2021. A visualization of clusters for the final network graph could not be computed. The network density is .108 and 8 cliques were identified in the network – 7 clusters within professional connections and then individuals without professional collaborations.

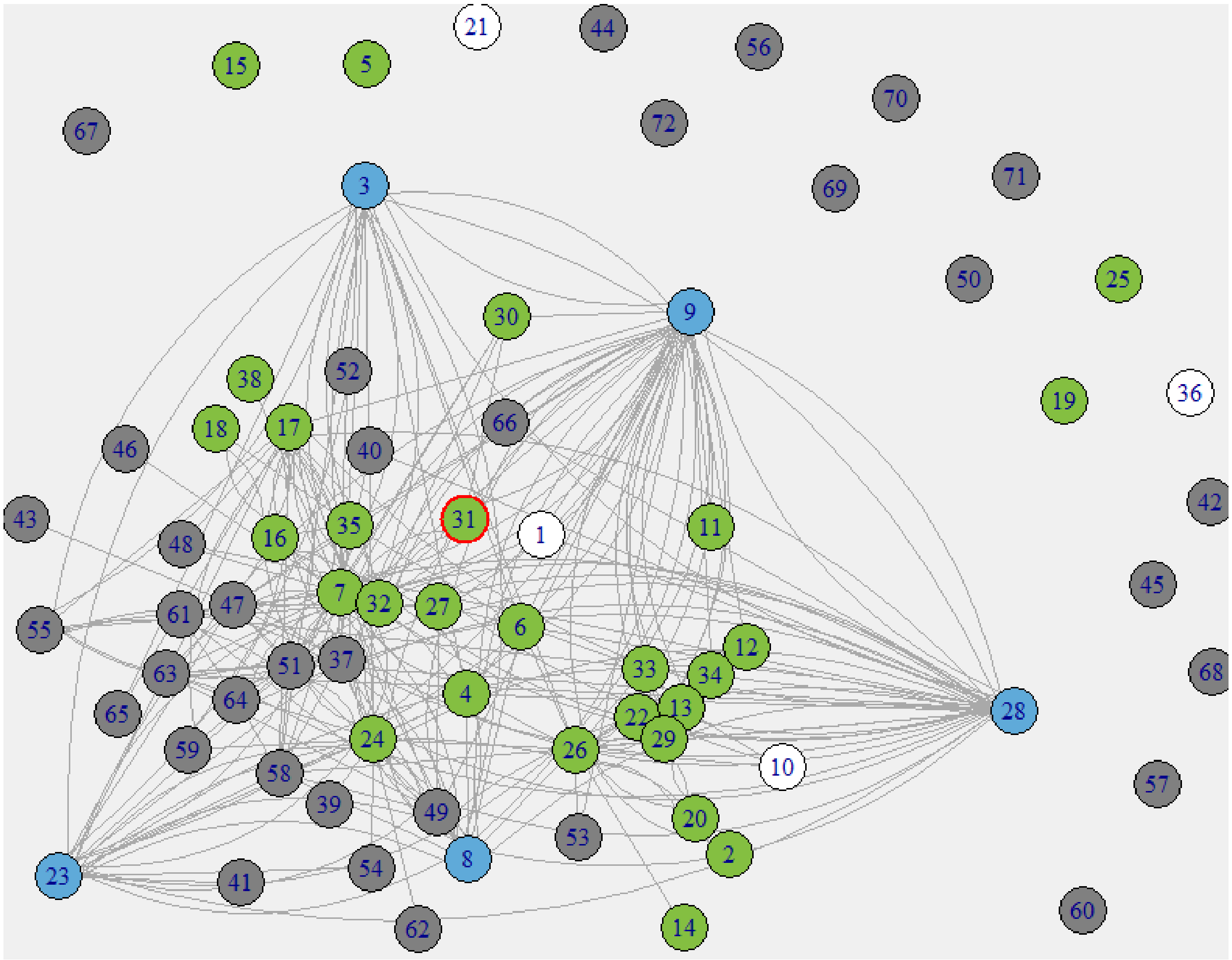


Figure 9. Network graph showing professional collaborations across SCORE Network members in June 2021.

The number of cliques in the network increased from 4 to 7 indicating an increased presence of subgroups with professional collaborations. Edge density slightly increased from pre to mid; then decreased when the additional SCORE Network members were added to the Network. However, the increased number of edges (lines connecting nodes/SCORE members) demonstrates an increase in professional collaborations even if the portion of actual connections over potential connections decreased with the addition of new members.

Survey Results

In June 2021, a final follow-up survey was sent to the 72 individuals registered as SCORE Network members on the QUBES Hub platform. A data summary report for survey findings is provided in Appendix C. Nineteen (26%) members completed the survey and feedback was highly favorable for the network influencing their work as 16 out of 19 indicated '*yes*' and the remaining 3 indicated '*maybe/not sure at the time*' as they had just recently joined the network.

Participants were also asked to select up to 9 ways they believed the SCORE Network may have benefited their work. All participants selected at least one response with a median of 6 responses selected as benefits. The benefits most highly selected include 1) provides access to expertise, collaborative partners, information, resources, and opportunities for turning ideas into action and/or solving problems (n =18); and 2) provides relevant information that helps me understand the challenges I face at work with the sustainability, cyberinfrastructure, and/or community building (n = 17). Open-ended feedback included:

> “ The SCORE Network has provided me the opportunity to join a new community with a shared interest in promoting educational access and equity. I regularly reference the resources (including discussions) I was introduced to at meetings such as S-JEDI last summer.

> “ The information, feedback, and support from SCORE has provided me with tools and resources to develop OERs of my own and be an advocate at my own institution.

Findings from previous surveys of SCORE Network members are publicly available through the QUBES Hub[1].

Products/Outputs

Members of the SCORE Network were asked to indicate any products or publications that have resulted as a result of their participation in the network. At the time of this report, SCORE Network members have reported 5 journal articles, book chapters or other manuscripts; 38 presentations; 11 proposal submissions; 26 educational aids/curricula; 6 media products; 12 meetings/workshops; and 7 other products – see Figure 10. Appendix D provides full citations and details for products reported by SCORE Network members.

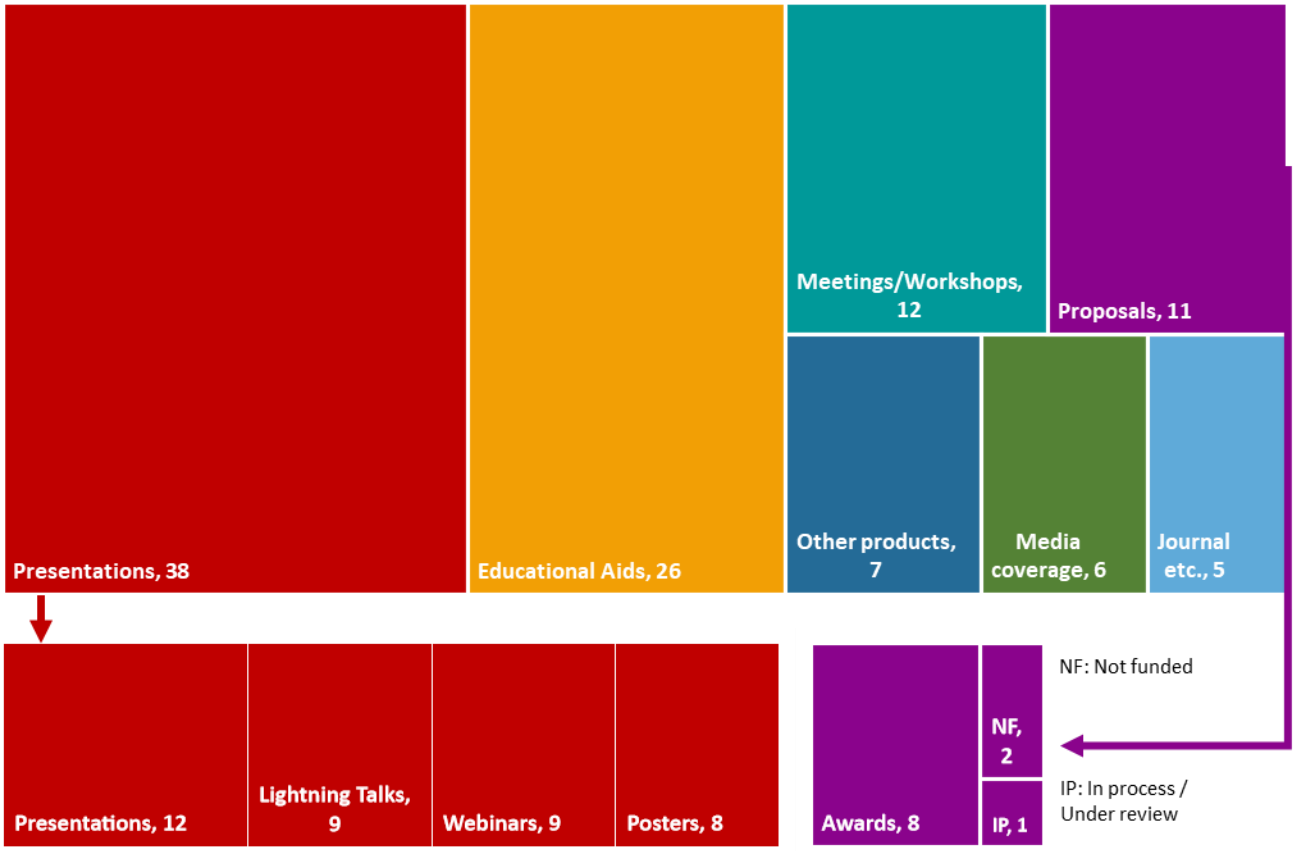


Figure 10. Count of products and publications resulted from participation in the SCORE Network

EVALUATION FINDINGS

The SCORE Network was created through initial NSF funding, and the summit provided a platform for members to tackle shared issues in sustaining OER and OEP. The growth of the network continued to grow through continued collaborations across SCORE members, the pursuit and receipt of initially funded initiatives, offerings of two working groups to tackle aims of the NSF RCN-SCORE-UBE project, and multiple learning opportunities created through additional funding and helped grow the SCORE Network community. Overall findings for the NSF RCN-SCORE-UBE Network are grouped by project objectives.

Objective 1. Bring together a group of people interested in creating, developing, disseminating, and utilizing OER across disciplines and institutions.

> The NSF RCN-SCORE-UBE Summit was hosted by Bates College on October 17th through 19th. The summit provided a space for participants with various OE affiliations to network, learn and address issues related to sustainability of open education and centering values of social justice, equity, diversity, and inclusion within OE.

Objective 2. Build community among network members interested in OER sustainability.

> The SCORE-QUBES group page was created to facilitate community building among SCORE network members. Additional funding through the William & Flora Hewlett Foundation provided opportunities to expand the network and offer additional SCORE activities committed to sustainability of open education and social justice, diversity, equity, and inclusion. Multiple opportunities were provided for members to learn and engage with different OE organizations across the network (e.g., Partners@QUBES, and mini-grant celebrations).

Objective 3. Develop a common language for sustainability and OER centered around diversity, equity, and inclusion.

> "*Sustainability and Justice: Challenges and Opportunities for an Open STEM Education*" has been accepted and is currently being revised for publication in the CBE Life Science Education journal. The paper addresses findings from the SCORE Summit and outlines frameworks of digital sustainability and social justice within STEM educational reform.
>
> During the second year of the NSF grant, members of a Tagging Ontologies working group were supported to address issues in findability of inclusive teaching resources, especially through the lens for how these resources are tagged by authors.

Objective 4. Share experiences and create collaborations within the network to foster new ideas for sustainability.

> A key outcome of the SCORE Network are the collaborations of CourseSource (an open-access peer-reviewed journal) and SIMIODE (open community of practice aimed to support instruction and learning of modeling within differential equations) to migrate the content of their OER into the QUBES Hub platform. These collaborative opportunities have allowed the groups to combine resources and reduce overall financial costs for sustaining the OE communities.

Objective 5. Discuss concepts of social justice, equity, diversity, and inclusion in the context of OER and develop strategies to incorporate these ideas into OER.

> The summit allowed members of the SCORE Network to discuss S-JEDI within the context of open pedagogy, and during year 2, an additional working group met to explore emerging issues of S-JEDI within the rapidly growing field of data science. Additional grant funding also supported discussions of S-JEDI within new learning communities such as SPLINE, S-JEDI LC, OPLC, STEM Inclusive Teaching Practices Webinar Series and QUBES FMNs.

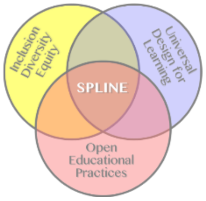
APPENDIX A: SCORE ASSOCIATED ACTIVITIES

Hewlett-Foundation Supported SCORE Activities

QUBES Infrastructure. The QUBES leadership team continued to develop collaborations to support the sustainability of the QUBES Hub infrastructure and support partner organizations and research projects. A Partners@QUBES summit was held in December 2020 and allowed partnership projects to present lightning talks and share posters of their work. Funding from the Hewlett award supported 1) QUBES infrastructure, 2) mini-grants to four partnerships, 3) the STEMed Project Leaders Inclusivity Network (SPLINE) program, and 4) a learning community focused on examining social justice, equity, diversity, and inclusion within OER (S-JEDI LC).

Mini-grants. The mini-grants program was used to catalyze collaboration within the SCORE Network as members share common interests for supporting OER, OEP, social justice, and equity. Four mini-grants were awarded funding to support partnership efforts. A description of the remaining four mini-grants follow:

> ***Piloting an Evaluation Framework for Accessible STEM OER.*** The Institute for the Study of Knowledge Management (ISKME) partnered with the Science Education Resource Center (SERC) at Carleton College to pilot test an evaluation framework previously developed by ISKME and the Center for Applied Special Technologies (CAST) to help determine the accessibility of multimedia OER based on varying learner needs.
>
> ***SIMIODE to QUBES: Gaining Efficiency and Expanding Visibility.*** The Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations (SIMIODE) collaborated with QUBES Hub to integrate the SIMIODE platform within the QUBES infrastructure.
>
> ***Creation of a Sustainable Platform that Benefits CourseSource and QUBES Hub.*** CourseSource, an open-access journal of peer-reviewed teaching resources for undergraduate biological sciences collaborated with QUBES to begin integration of the CourseSource journal within the QUBES hub platform.
>
> ***Math Modeling Writer's Workshop.*** The Mathematical Modeling Hub (MMHub) aims to facilitate integration of mathematical modeling into classroom teaching and collaborated with CourseSource to adapt their writing workshop model to support submission of OER content.


Inclusion Diversity Equity
Universal Design for Learning
SPLINE
Open Educational Practices

SPLINE. The STEM education Project Leaders Inclusivity NEtwork (SPLINE) program was a faculty mentoring network (FMN) to support instructors, curricular developers, and other OER stakeholders with assimilating the Universal Design for Learning (UDL) framework, inclusivity teaching practices, and OER within their projects. SPLINE was facilitated by Dr. Jeremy Wojdak, Professor of Biology at Radford University and QUBES Professional Development Director. Meetings were led by six mentors with personal experience and professional expertise in or UDL, DEI, and OER. An evaluation report with findings from the SPLINE program is publicly available on QUBES Hub.

S-JEDI Learning Community. Participants from the SCORE Network participated in weekly readings, discussions, and reflections to increase awareness of issues in social justice, equity, diversity, and inclusion (S-JEDI) within teaching methods, research, programs, and organizations. The QUBES Community platform for SCORE was used as a forum for posting weekly assignments and allowed for continual communication across group members. The learning communities were facilitated by. Dr. Pat Marsteller and Jasmine Roberts. An evaluation report with findings for the S-JEDI learning community is publicly available on QUBES Hub.

Open Practices Learning Community (OPLC). Dr. Karen Cangialosi facilitated a six-week learning community from April 07, 2021 through May 12, 2021. The OPLC explored different components of open-practices A total of 23 SCORE Network members participated in the learning community. An evaluation report with findings for the OPLC is publicly available on QUBES Hub.

RIOS Institute. The Hewlett-Foundation provided a second grant award to Bates College and members of the SCORE Network to establish the Institute for a Racially Just, Inclusive, and Open STEM Education.

SGCI - RIOS/SCORE Focus Week. RIOS collaborated with SGCI to offer a virtual two-week workshop, *Building Just and Sustainable OER*, for open education organizations and project leaders. The workshop was an adaptation of SGCI's sustainability focus week program aimed to center values of social justice, equity, and inclusion as teams engaged in exploring sustainability solutions for their projects.

Calling Bull Study. A study to understand students' perceptions towards OER, efficacy, and achievement and how these relationships held across different student characteristics. Study findings are available on QUBES Hub.

Additional activities of SCORE Network members include:

STEM Inclusive Teaching Practices Webinar Series. A webinar series entitled “Inclusive Teaching Practices in STEM Education” has been sponsored by SCORE-UBE, EDSIN, B(ui)LDS, BLUE, iDigBio, QUBES, and BioQUEST Curriculum Consortium. The webinar series was intended to initiate discussion on topics related to inclusive teaching practices and to build community among a diversity of STEM disciplines interested in catalyzing more inclusive learning environments for undergraduate students.

QUBES Faculty Mentoring Networks. Faculty Mentoring Networks (FMNs) are community-based professional development opportunities for faculty. The following FMNs were created after participation within the S-JEDI LC:

Making Teaching Materials Anti-Racist.
A FMN aimed to 1) make educational materials for biology courses anti-racist, and 2) implementing new materials for your course.

Science Spotlights & Data Nuggets.
A FMN aimed to 1) feature diverse scientists and their data, and 2) create new course materials which feature diverse scientists.

Social Justice and Community Change.
A FMN with the goals to 1) develop course-based undergraduate research experiences (CUREs) that increase students’ understanding of Environmental Justice/Social Justice issues using data driven learning and authentic research experiences; 2) use case studies to introduce progressive CUREs for environmental science, biology and other STEM courses; and 3) examine how social and economic factors have created disparities in environmental condition of urban communities.

APPENDIX B: TABLE OF SCORE-QUBES MEMBERSHIP ACROSS QUBES

QUBES Group	Description of QUBES Group	# SCORE
partnerprojectsupport	QUBES Support Community for Partner Projects	23
edsin	EDSIN: Environmental Data Science Inclusion Network	18
spline	SPLINE - STEMed Project Leaders Inclusivity NEtwork	16
summer2019	Evolution of Data in the Classroom: From Data to Data Science (SW 2019)	15
builds	B(ui)LDS: Biological, Universal, and Inclusive Learning in Data Science Community	14
summer2020	2021 Biology and Mathematics Educators (BIOME) Institute	13
summer2021	Cultivating Scientific Curiosity	13
iember	Inclusive Environments and Metrics in Biology Education and Research (iEMBER)	12
quant_bio_online	Lowering the Activation Energy: Making Quantitative Biology more Accessible (SW 2016)	12
summer2016	Teaching Quantitative Biology Online	12
birdd	Beagle Investigations Return with Darwinian Data	10
mmhub	Math Modeling Hub	10
niblse	Network for Integrating Bioinformatics into Life Sciences Education	10
rios	RIOS Institute	10
data_incubator	Data Incubator Group	9
riosleadershipteam	Making Meaning through Modeling: Problem solving in Biology (SW 2017)	9
summer2017	Quantitative Biology at Community Colleges	9
teamqubes	QUBES Leadership Team	9
advisoryboard	RIOS Leadership	9
bioquest	BioQUEST Curriculum Consortium	8
esa	Ecological Society of America	8
summer2018	QUBES Advisory Board	8
teaching_r	QUBES Community Group: Using R in the classroom	8
biomaap	Wicked Problems: Investigating real world problems in the biology classroom (SW 2018)	8
bqstaff	BIOMAAP: Biology Student Math Attitudes and Anxiety Program	7
ccbioinsites	BioQUEST Staff & Volunteers	7
coursesource	CC Bio INSITES	7
datadiscovery	CourseSource	7
hhmibiointeractive	ESA Data Discovery FMN (2016)	7
hits	HHMI BioInteractive	7
mathattitudes	HITS	7
saber	Math Attitudes FMN (2016)	7
summit	Quantitative Biology Education Summit	7
abm	SABER	7
big_data_is_big_fun	Agent-Based and Individual-Based Modeling	6
bridge	Big data is big fun	6
community	BioQUEST / HHMI / CaseNet Summer Workshop 2015	6

dig	BioQUEST / QUBES Summer Institute 2016 Planning	6
dryadlabnetwork	Data Science in Undergraduate Biology Education (DS-UBE)	6
dsube	DIG into Data FMN (2017)	6
fa2019mentors	DryadLab FMN (2016)	6
integrate	Fall 2019 FMN Mentors	6
neon	InTeGrate	6
nsite	NEON - National Ecological Observatory Network	6
qbcc	Networking STEM Initiatives to Enhance (NSITE) Adoption of Evidence-Based Practices	6
sp2021mentors	QUBES Bridge FMN (2017)	6
summer2015	QUBES Support Group: Building Community	6
summer2016planning	Spring 2021 Faculty Mentoring Network Mentors!	6
abd	2015 Quantitative Biology Summit QUBES Advisory Board Meeting	5
beer2015	BEER FMN (2015)	5
biosigmaa	BIO SIGMAA	5
blue_data	Biodiversity Literacy in Undergraduate Education	5
callingbull	Calling Bull - a resource sharing and teaching community	5
collections	DryadLab Superclass	5
dryadlabclass	ESTEEM	5
esteem	FMN demo group	5
fmndemo	Genomics Education Alliance	5
gea	Genomics Education Partnership	5
gettingstarted	InTeGrate FMN (2016)	5
integratefmn	Introductory Genetics Probability and Chi-squared	5
introgenetics	National Association of Biology Teachers	5
nabt	National Institute for Mathematical and Biological Synthesis (NIMBioS)	5
neurocasenet	Natural History Education Portal	5
nhc_fmn	NeuroCaseNet	5
nimbios	NIMBioS Working Group: Unpacking the Black Box	5
nimbios_wg_ teachingquantbio	Pitt QUBES spring 2015	5
pittqubes	Pitt QUBES summer 2015	5
pittsummergroup	QUBES Community Group: Using NetLogo in the Classroom	5
qubes_advisory_board	QUBES Support Group: Getting Started	5
qubessupport	QUBES Support Team	5
remnet	Radford FMN (2015)	5
ru_fmn	Research Experiences in Microbiomes Network - REMNet	5
si16_beast	Resources for Collections-Based Undergraduate Education	5
sp2019mentors	SI 2016 Working Group - Biodiversity to Explore Applied Statistical Techniques (BEAST)	5
teaching_with_netlogo	Spring 2019 FMN Mentors	5
21century	The Analysis of Biological Data	5

APPENDIX C: SCORE-UBE FINAL SURVEY FINDINGS

All SCORE Network members who attended the Summit as well as members who joined the network through the QUBES platform were administered a final follow-up survey to understand their experience with SCORE. A total of 19 out of 72 participants completed the final survey. The findings from their responses are provided.

16 out of 19 Respondents indicated the SCORE Network had influenced their work.

3 out of 19 Respondents indicated uncertainty at the time of the survey for the SCORE Network influencing their work.

Open-ended Feedback: YES, SCORE Network has influenced their work

- Definitely! I was not necessarily thinking of CourseSource as an OER prior to our involvement in the SCORE Network. It has also opened up so many possibilities for partnership and collaboration with others in the SCORE network.
- SCORE has particularly influenced the way we approach sustainability and DEI in our organization's efforts. Some of our programming has been developed in direct collaboration with SCORE members, including a writers workshop that was partially funded by a mini-grant from the Hewlett Foundation.
- Connecting with new colleagues has been great. Allowed me to make many valuable connections
- CourseSource now collaborates with QUBES Hub. We got one NSF grant and it looks like we might get a second.
- Participation helped me develop ideas that I am not extending to FMNs for Social Justice and to my work with ASCN
- The SCORE Network has provided me the opportunity to join a new community with a shared interest in promoting educational access and equity. I regularly reference the resources (including discussions) I was introduced to at meetings such as S-JEDI last summer.
- Working with the network on intersections in STEM, OER, and DEI, including accessibility and UDL, across disciplines has strengthened our work.
- I am now more active in OER and vocal about it. I enjoyed meeting with the group and learning about different practices and resources.
- It was helped me consider more systemic ideas pertaining to educational materials
- The information, feedback, and support from SCORE has provided me with tools and resources to develop OERs of my own and be an advocate at my own institution.
- I felt being a part of the SCORE Network was transformative for my teaching.
- I have definitely formed new collaborations and learned more about OER.
- I have made amazing new collaborations that have lead to impactful work.
- Just knowing that other people are using open resources Empowers me to do more.
- It has connected me with expertise that I did not have access to before. :: It brought me back into touch with the OER Commons community and informed the development of QUBES.

Open-ended Feedback: Maybe/Not sure at this time for SCORE Network influenced their work

> “ I am just getting started with the OER and the SCORE network.

> “ I have attended a couple of the learning communities. That said, I'm not sure that I understand what SCORE is.

> “ I have not used it as much as had planned due to stresses teaching during COVID and providing PD to other educators but I plan to in the future.

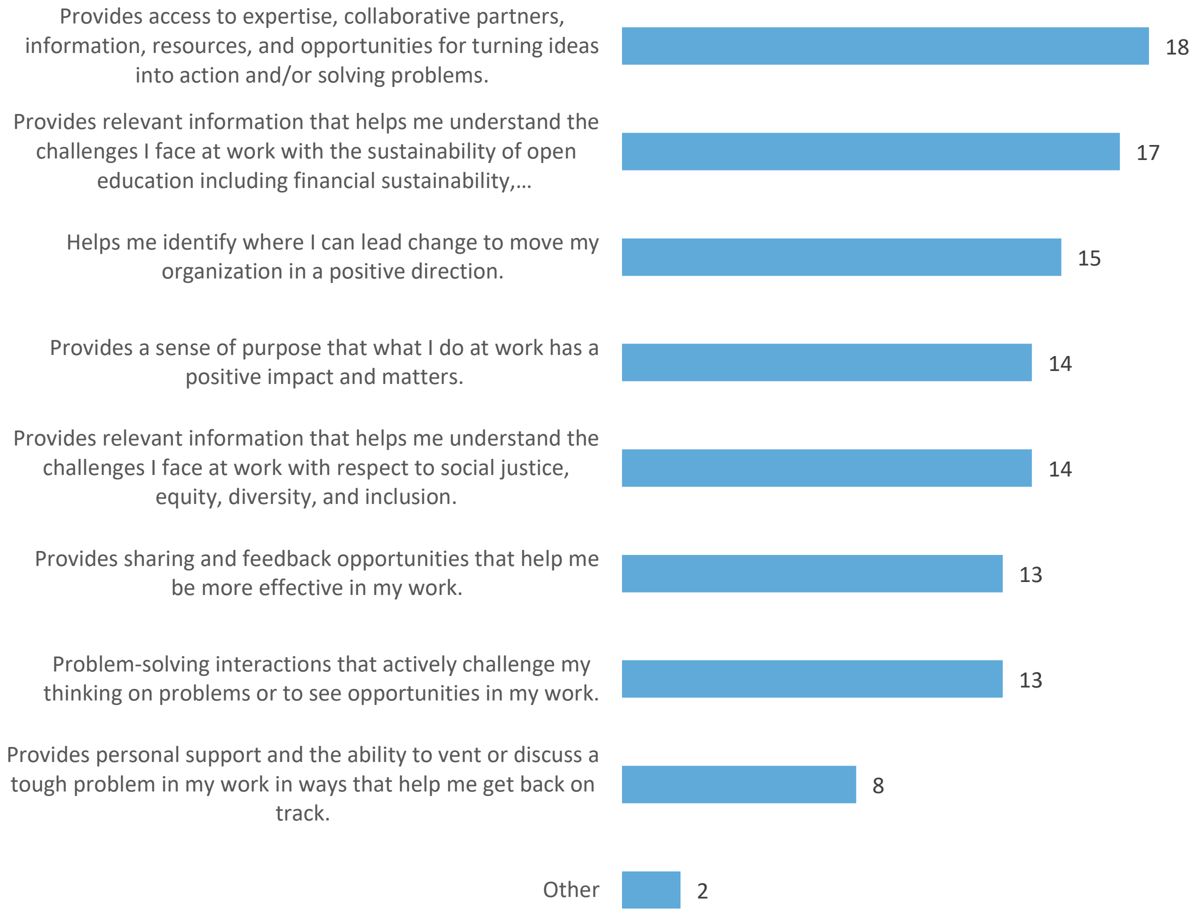
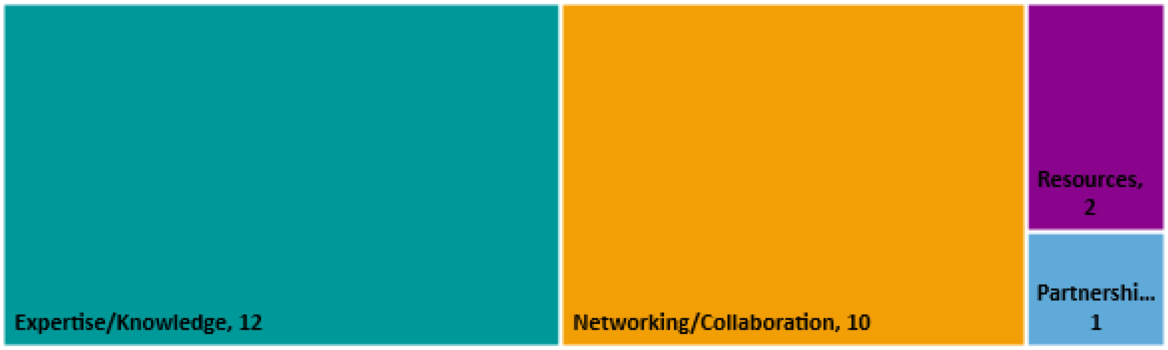


Figure 11. Frequency of responses for indicating how the SCORE Network has benefited or supported members’ work. 100% of survey respondents indicated at least one benefit while the median number of benefits selected was 6.

Figure 12. Thematic responses: Most useful aspect of SCORE Network



Open-ended Feedback: Most useful aspect of SCORE Network:

“ Getting to work and collaborate with QUBES! It is because of this network that we are now partners and will be moving the CS website to QUBES.

“ Access to expertise from far afield - library, OER experts, etc. that I wouldn't ordinarily interact with

“ Getting to know what other groups are tackling similar problems and how bringing leaders together from each group can bring synergy to the collective tackling of important OER-related issues.

“ The expertise within the community was very valuable.

“ Discussions around resources, tools, and practices.

“ The Open Pedagogy PMN was especially valuable to me.

“ The open pedagogy learning community was amazing.

“ Most of all, SCORE has served as a venue for conversations and idea/resource-sharing on issues related to sustainable OER and open pedagogy. I now feel like I have a deeper understanding of these issues as well as a team of collaborators to facilitate implementation of forward-thinking practices.

“ Colleagues and learning

“ Collaborating with STEM experts around OER practices and processes and how they might be effectively integrated into current workflows and how they might be improved to become more inclusive.

“ The best aspect is the community of fellow faculty and their honest evaluation of various OER sites and sources.

“ The introduction and admittance into a new community of folks with a shared interested in promoting educational access and equity. While I'm still learning a lot, I greatly appreciate the efforts of the leaders within the Network to provide many opportunities to meet and discuss important topics.

“ The network and learning ideas from each other.

“ Making valuable connections with colleagues to work on projects together :: Connecting to colleagues and working on projects together

“ Collaboration

“ The community from the meetings was fantastic.

“ Meeting people outside of my field and learning about various topics outside of my discipline!

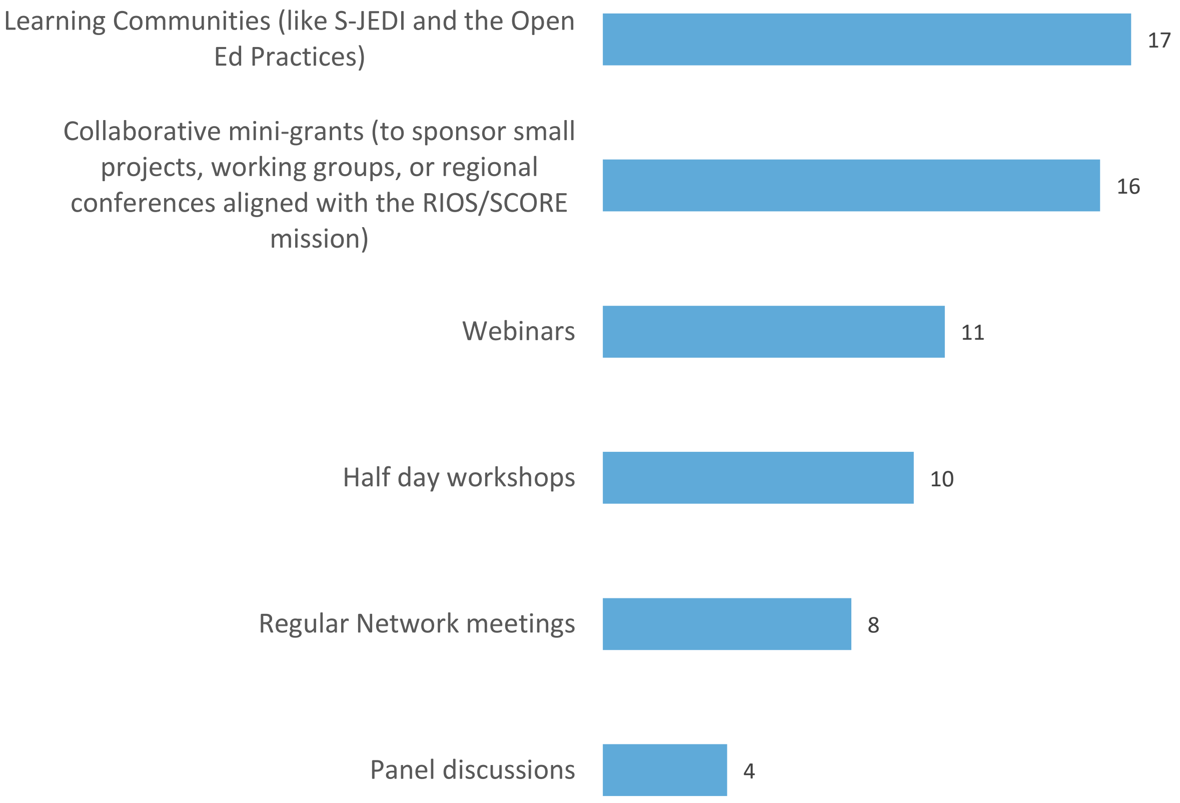


Figure 13. Types of collaborative opportunities SCORE participants indicated interest

APPENDIX D: SCORE-UBE PRODUCT CITATIONS

Journal articles, book chapters or other manuscripts

Bakermans, M. (2021). *Climate lessons: Environmental, social, local.* (M. Bakermans, & P. Pfeifer, Eds.) CC BY-NC-SA 2.0. Retrieved from https://www.oercommons.org/courses/climate-lessons-environmental-social-local/view

Diaz Eaton, C., Bonner, K., Cangialosi, K., Dewsbury, B., Diamond-Stanic, M., Douma, J., . . . Wilfong, K. (In Press). Sustainability and Justice: Challenges and Opportunites for an Open STEM Education. *CBE-Life Sciences Education*.

Diaz Eaton, C. R.-S. (2020). *S-JEDI Learning Group Resource. Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE).* doi:10.25334/XXGX-8192

Jimes, C. E. (2021). *STEM OER Accessibility Framework and Guidebook.* QUBES Educational Resources. doi:10.25334/ERXF-AH09

Taylor, R. (2021). Study Findings to Understand Students' Perceptions of OEP/OER. Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education (SCORE-UBE), QUBES Educational Resources. doi:10.25334/H424-PE53

Presentations

Bakermans, M. (2021, June 17). Project based learning to produce OER. Institute for Project Based Learning; Worcester Polytechnic Institute. Worcester, MA.

Cangialosi, K., Diaz Eaton, C., Roberts, J., & Bonner, K. (2021 May). Reimagining STEM education: Strengthening networks, centering social justics, and leveraging the open ecosystem. Northeast OER Summit. Virtual conference. Retrieved from UMASS Amherst

Douma, J. (2021, January). The Math Modeling Hub: A space for community, collaboration, and resource sharing. SIAM Minisymposium on Supporting Workforce Preparation with Mathematical Modeling. Joint Mathematics Meeting.

Galluzzo, B., Peters, S., Zbiek, R. M., & White, S. (2021, May). Math Modeling Teacher Education: Lessons Learned from a retrospective study of modeling teachers. Pennsylvania Association of Mathematics Teacher Educators (PAMTE).

Godwin, A. E., & Jimes, C. (2021, February). Accessibility Issues - What to know, look for, offer, and learn about. SIMIODE Expo 2021. Retrieved from https://www.simiode.org/resources/8289

Godwin, A. E. (2021). Open Ed Week Public Webinar.

Goller, C. C. (2021, July). Using open education to precipitate gold nuggets of wisdom: An open pedagogy model for crowdsourcing notes and citizen science research using

web-annotation. Open Education Southern Symposium. Retrieved from https://openedss.uark.edu/schedule.php

Greene, M. R. (2021). Disposing with the disposable assignment. Vision Sciences Society Teaching Satellite.

Taylor, R. T. (2021, February). Evaluation as a tool for assessing the effectiveness of teaching interventions. SIMIODE Expo 2021.

Zbiek, R. M., Galluzzo, B., Peters, S., & White, S. (October 2021). Retrospective study of teachers' experiences that contribute to their development as modelers and teachers of modeling. 43rd Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (PME-NA 43). Philadelphia, PA.

SCORE/Hewlett Mini-Grant Celebration (Feb 02, 2021) – video

Partners@QUBES Leadership Summit (Dec 14, 2020)

Partners@QUBES Leadership Summit: Lightning Talks

- Molecular CaseNet - presented by Shuchismita Dutta
- HHMI BioInteractive and Data Explorer - presented by Kaitlin Bonner
- Dmitry Kondroshov (University of Chicago)
- Math Modeling Hub - presented by Jason Douma
- Math Modeling Hub - presented by Ben Galluzzo
- SENCER - presented by Eliza Reilly
- EREN-NEON - presented by Laurie Anderson
- ISKME - presented by Amee Godwin and Cynthia Jimes
- Genome Solver - presented by Anne Rosenwald

Partners@QUBES Leadership Summit: Posters

Bonner, K., Fleming-Davies, A., Grayson, K., Wu, B., & Hernandez-Pacheco, R. (2020, December). Perspectives and practices in sharing data-centric adaptations in the biology classroom: How, why, when, and where are instructors sharing these high-impact pedagogies? *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/TV22-GQ81

Buntz, J. G., Esquibel, J., Jenkins, K., Karpakakunjaram, V., Miller, J. M., Nieuwsma, C. B., . . . Starnes, J. H. (2020, December). Quantitative Biology at Community Colleges: Building a community of biology and math faculty to develop and disseminate open education resources. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/A00X-Q527

Donovan, S. S., Wojdak, J. M., Jenkins, K., & LaMar, M. D. (2020, December). QUBES: An education gateway for accelerating undergraduate biology education reform. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/570Q-HQ07

Grayson, K. (2020, December). Closing the Gap in the Open Educational Resources (OER) Life Cycle with HHMI BioInteractive Resources. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/Q46Q73

Grayson, K., Fisher-Reid, M. C., Mead, L., Coovert, H., Hernandez-Pacheco, R., Sevin, J., . . . Grant, E. (2020, December). Research and Teaching Opportunities with a Large-scale Salamander Collaboration Network (SPARCnet): TWS Poster. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/7CV0-TY57

Morgan, W. R., Kleinschmit, A., Rosenwald, A. G., Triplett, E., Pauley, M. A., & Tapprich, W. (2020, December). Collaborative Community Model for Developingm, Disseminating & Assessing Bioinformatics Learning Resources. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/QTEK-P378

Naithani, K., Jones, M. A., & Grayson, K. (2020, December). NEON Data in the Classroom: Using the QUBES Platform and Faculty Mentoring Networks to Build, Adapt, and Publish Data-Driven Teaching Resources. *Poster presented at Partners@QUBES Leadership Summit.* doi:10.25334/W83X-S558

Rook, D. L., Donovan, S., Diaz Eaton, C., Jenkins, K. P., Lamar, M. D., Wojdak, J. M., . . . Orndorf, H. (2020, December). Faculty Mentoring Networks: Community Professional Development for the Digital Age. *Poster Presented at Partners@QUBES Leadership Summit.* doi:10.25334/ZXBG-WJ66

STEM Inclusive Webinar Series. (9 recorded videos)

Andrew Osborne Hasley, Hayley Orndorf (2020). STEM Inclusive Teaching Practices Webinar Series: Universal Design for Learning. Universal Design for Learning, (Version 2.0). QUBES Educational Resources. doi:10.25334/R29S-8433

Dewsbury, Bryan. STEM Inclusive Teaching Practices Webinar Series: Episode One. Retrieved from: https://qubeshub.org/qubesresources/publications/1805/1

Wing, K. (2020). STEM Inclusive Teaching Practices Episode 3. B(ui)LDS: Biological, Universal, and Inclusive Learning in Data Science Community, QUBES Educational Resources. doi:10.25334/Z0MP-7A08

Orndorf, H., Hasley, A. O. (2020). STEM Inclusive Teaching Practices Webinar Series: Universal Design for Learning Recording. EDSIN: Environmental Data Science Inclusion Network, QUBES Educational Resources. doi:10.25334/P8DR-N510

Woods, B. (2021). STEM Inclusive Teaching Practices Webinar Series: Fixed vs Growth Mindset and Why the Biggest Challenge May be Faculty (Episode Seven). iDigBio, QUBES Educational Resources. doi:10.25334/YKKQ-Q751

Imad, M. (2020). STEM Inclusive Teaching Practices Episode 4. iDigBio, QUBES Educational Resources. doi:10.25334/685T-NE04

Dewsbury, B., Eaton, C. D., Phillips, M., Monfils, A. (2020). STEM Inclusive Teaching Practices Webinar Series: Episode One. B(ui)LDS: Biological, Universal, and Inclusive Learning in Data Science Community, QUBES Educational Resources. doi:10.25334/P7NQ-HT70

Wares, J., Torres, M., teymuroglu, z., Stadnyk, G., Hawthorne, C., Balreira, E. C. (2021). STEM Inclusive Teaching Practices Webinar Series: Socially Relevant Teaching in the Time of COVID-19. iDigBio, QUBES Educational Resources. doi:10.25334/D7QV-9710

Anderson, J., Hudson, M. (2021). STEM Inclusive Teaching Practices Webinar Series: The Biocultural Labels Initiative. iDigBio, QUBES Educational Resources. doi:10.25334/E6SC-PP18

Proposal submissions/Grants awarded

Grants Awarded

Hewlett Foundation Award to Bates College: Support Open Education Practices of SCORE and QUBES. (PIs:

Hewlett Foundation Award to Bates College: Launching The Institute for Racially Just, Inclusive, and Open STEM Education. (PIs:

Collaborative Pilot Projects through Hewlett-Foundation award to Bates College:

- Piloting an Evaluation Framework for Accessible STEM OER. (ISKME & SERC)
- SIMIODE to QUBES: Gaining Efficiency and Expanding Visibility (SIMIODE & QUBES Hub)
- Creation of a Sustainable Platform that Benefits CourseSource and QUBES Hub (CourseSource & QUBES Hub)
- Math Modeling Writer's Workshop (MMHub & CourseSource)

NSF IUSE Award #2044189: Building Adaptability for Teaching Online through Peer-Reviewed, Active-Learning Resources and Professional Development. (PI: Smith, M; Vinson, E.; Prescott, S., & Jenkins, K.)

NSF IUSE Award #2126110: Collaborative research: From Community to Practice: Evaluating How Open Educational Resources Facilitate Implementation of Vision and Change Principles Across Diverse Institutions. (PI: Smith, M.)

Proposals Submitted but not funded.

IUSE SPLINE. Submitted 2021. (PIs: Dewsbury, B., Donovan, S., Jenkins, K.)

RCN-UBE: Sustainability Challenges for Open Resources to promote an Equitable Undergraduate Biology Education. Submitted 21Jan2020. (PIs: Diaz Eaton, C. Cangialosi, K. & Bonner, K.)

Proposals in process/Under review

Collaborative Research: Racial Equity: Re-engineering the STEM OER landscape for racial justice. Submitted ##Oct2021. (PIs:)

Educational aid/curricula

Scientists Spotlights & Data Nuggets.

Yang, S., Negrete, Jr., B. (2021). Data on Dead Zones and a Scientist Spotlight Featuring Benjamin Negrete, Jr.. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/7BCE-ED43

Apple, J. (2021). Lizard cold tolerance and extreme weather events: a scientist spotlight featuring Dr. Shane Campbell-Staton. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/JP8C-JP93

Wade, J., Chang, H. (2021). Using Nanoparticles to Treat Cancer Scientist Spotlight. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/MY74-KA76

Apple, J. (2021). Urban stream invaders: a scientist spotlight featuring Dr. Piatã Santana Marques. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/PS3C-0T54

Furrow, R. E. (2021). Maintenance of Phenotypic Polymorphism and a Scientist Spotlight Featuring Dr. Swanne Gordon. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/XW84-CZ53

Panvini, D. (2021). Coyote Habituation and a Scientist Spotlight on Dr. Christopher Schell. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/2P6X-J305

Jindal, P., Vemu, S. (2021). Understanding Action Potential and Frequency Coding using Scientist Spotlight and Data Nuggets. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/0WWH-BW25

Richardson, M. R. (2021). A Scientist Spotlight Featuring Dr. Danielle Brown. Scientists Spotlights and Data Nuggets, QUBES Educational Resources. doi:10.25334/A6XN-7452

Social Justice and Community Change.

Basham, T. (2021). Assessing Socioeconomic Trends in Tree Cover and Human Health in Urban Environments. Social Justice and Community Change, QUBES Educational Resources. doi:10.25334/8CQK-SV75

Mary Mulcahy (2021). Exploring Health Inequities and Redlining. Social Justice and Community Change, (Version 1.1). QUBES Educational Resources. doi:10.25334/B5PX-3M96

Jones, a. C. (2021). Graphing and mapping patterns of air quality in Los Angeles, California through an environmental justice lens.. Social Justice and Community Change, QUBES Educational Resources. doi:10.25334/AZ2T-1Y63

Vereen, E. (2021). Exploring EnvironmenATL Justice with Data Analytics and Visualization. Social Justice and Community Change, QUBES Educational Resources. doi:10.25334/D0EN-0R77

Denise Piechnik (2021). Exploring Connections between Low Albedo, Urban Heat Islands and Social Justice. Social Justice and Community Change, (Version 2.1). QUBES Educational Resources. doi:10.25334/40CF-Q206

Cole Ekberg, M. (2021). The Legacy of Redlining in Oakland, CA. Social Justice and Community Change, QUBES Educational Resources. doi:10.25334/8YA7-MX12

Cole Ekberg, M. (2021). The Legacy of Redlining in Oakland, CA. Social Justice and Community Change, QUBES Educational Resources. doi:10.25334/8YA7-MX12

- Up to 12 high-school level OER lesson modules, currently under development through the Math Modeling Hub Writers Workshop (supported by the SCORE Collaborative Pilot Project grant).
- SPLINE network materials, findable on QUBEShub
- OER accessibility guide, professional learning workshop and research study, 2021

Media coverage

Newsletter: SCORE News Spring 2021
Newsletter: SCORE News January 2021
Newsletter: SCORE News November 2020
Newsletter: SCORE News October 2020
Newsletter: SCORE News September 2020
Blog: Welcoming CourseSource to the QUBES Platform!

Meetings/Workshops

- Open Practices Learning Community
- STEM Inclusive Webinar Series
- SPLINE
- S-JEDI Learning Community
- SGCI-RIOS/SCORE Focus Week
- MMHub Writers' Workshops Fall 2020.
- Calling Bull QUBES group
- CourseSource Faculty Mentoring Networks
- BIOME workshop/working group, July 2021/fall 2021
- QUBES FMN: Making Teaching Materials Anti-Racist
- QUBES FMN: Science Spotlight & Data Nuggets
- QUBES FMN: Social Justice & Community Change

Other products

- CourseSource on QUBES Hub:
- SIMIODE on QUBES Hub:
- Two courses built on open resources
- Changes to instructional assignments
- Online lab course materials
- Leading group at home institution for the upcoming AAC&U Institute on OER.
- Alternative assessments

APPENDIX D: ICON ATTRIBUTION

BUSINESS
Created by Gregor Cresnar from Noun Project

EDUCATION RESEARCHERS
Created by Chanut is Industries from Noun Project

FOUNDATIONS
Created by Nithinan Tatah from Noun Project

FUNDING AGENCIES
Created by Luis Prado from Noun Project

HUBS
Created by Adrien Coquet from Noun Project

LIBRARIES
Created by Creative Stall from Noun Project

PROFESSIONAL SOCIETIES
Created by Krish from Noun Project

PUBLISHERS
Created by Aneeque Ahmed from Noun Project