The (NC) State of Open
An Overview of Open Research, Scholarship, Teaching and Learning

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9/17/19

Purpose

Executive Summary

Open Data

Open Research and Scholarship
  Articles
  Repositories
  Journals
  Projects

Open Education
  Open Science Training
  Open Pedagogy
  Open Textbooks
  Alt-Textbook grants

Open Infrastructure

Open Community

Conclusion

Readings and Resources
Purpose

This document is meant to highlight and feature some of the broad work happening across NC State University that fits under the banner of open research and scholarship. Openness in principle and in practice is affirmed as the near horizon for higher education in various reports, statements, initiatives, and policies. It encompasses a range of activities from open lab notebooks and open source software to pre-print publishing in open repositories and sharing data, protocols, and methods on open documentation platforms. The compilation of this report provides a foundation for understanding what open looks like at NC State, while also giving a base from which to build, advancing open research and scholarship through community building, training in skills, tools, and issues, and adapting policies and establishing standard operating procedures.

Executive Summary

Open is a global movement toward equity of access, diversity of thought, and inclusion of voices. The National Academies of Sciences, Engineering, and Medicine 2018 report Open Science by Design: Realizing a Vision for 21st Century Research offers that “Openness increases transparency and reliability, facilitates more effective collaboration, accelerates the pace of discovery, and fosters broader and more equitable access to scientific knowledge and to the research process itself (15).” Building on momentum from federal funders public access policies, open access to scholarly publications and data is a default for much sponsored research and research compliance. Recent movements in Europe toward a strengthened infrastructure and policy framework for open sharing of research has prompted a global conversation about how best to shift the culture and processes of evaluating research impact, all while accounting for the continually lowering technical barriers of information sharing.

The national tenor is hinging on a bold action by the Universities of California system, which with the support of faculty governance, university administration, and library leadership, cancelled its contract with Elsevier after failed negotiations for including open access in their journal subscription deal. This, following on the 2017 acquisition of the bepress repository platform by Elsevier, solidified the need for a sustained and collective discussion amongst research institutions and their libraries specifically about a community-owned, principles-governed “open infrastructure” for the distribution of scholarship. While early, the open infrastructure movement is defining its parameters as the “sets of services, protocols, standards and software that can empower communities to collectively build the systems and infrastructures that deliver new improved collective benefits without restrictions, and for a healthy global interrelated infrastructure system.” Long term growth in the digital humanities,

1 https://www.nap.edu/catalog/25116/open-science-by-design-realizing-a-vision-for-21st-century
2 https://osc.universityofcalifornia.edu/open-access-at-uc/publisher-negotiations/uc-and-elsevier/
3 https://investinopen.org/docs/statement0.2
4 https://dh.chass.ncsu.edu/
cultural heritage digitization and open licensing, and social science research methods are all coalescing into a national recognition of a more open, digital, public research ecosystem.

NC State has invested in open research and scholarship significantly, albeit surreptitiously. The Chancellor's Faculty Excellence Program, which established a system of interdisciplinary clusters, created an environment for campus-wide collaboration, bringing to the fore the open principles of transparency, participation, sharing, and inclusivity. Particularly, the Leadership in Public Science, Geospatial Analytics, and Visual Narratives clusters represent complementary elements of an open landscape - publicly-engaged citizen science, open source software training and development, and new forms of scholarly work. The long-standing, respected, and field-shifting work of the Alt-Textbook program has created an affordable learning environment for students, and also altered pedagogical aims and outputs for the teaching professoriate.\(^5\) The Libraries’ sustained investment in innovative digital research projects, modularized research software environments, extensive catalog of workshops, and workforce development, including the world’s first Open Knowledge Librarian, have played no small role in contributing to NC State University’s leadership into the open.

The open turn in academia is happening, at field/discipline, national, and global levels. Local factors and realities have created an ideal environment for growth, and for a deepend and visible integration of NC State’s open research, scholarship, teaching and learning with far-reaching trends. Quoting the Director of the Natural Resource Library, Dr. Rob Olandorf, “While the general trend toward openness in academic research is a good thing, the culture and practices around open research are still developing.”\(^6\) Capitalizing on our unique regional character, the confluence of inspired and innovative people, and the shifting tides offers an overwhelming opportunity for NC State to make a mark.

\(^5\) [https://www.lib.ncsu.edu/alttextbook](https://www.lib.ncsu.edu/alttextbook)

Open Data

The White House Office of Science and Technology Policy memo, *Expanding Public Access to the Results of Federally Funded Research*, set the stage for open sharing of data in a codified way. Below are a few examples of open data shared by NC State researchers.

- A. Penick, Clint; Halawani, Omar; Pearson, Bria; Mathews, Stephanie; M. López-Uribe, Margarita; R. Dunn, Robert; et al. (2018): Supplementary material from "External immunity in ant societies: sociality and colony size do not predict investment in antimicrobials". The Royal Society Collection. [https://doi.org/10.6084/m9.figshare.c.3982623.v2](https://doi.org/10.6084/m9.figshare.c.3982623.v2)
- Fyfe, Paul; Ge, Qian, 2018, "Replication Data for "Image Analytics and the Nineteenth-Century Illustrated Newspaper"", [https://doi.org/10.7910/DVN/U5HTNJ](https://doi.org/10.7910/DVN/U5HTNJ), Harvard Dataverse, V1

Open Research and Scholarship

The outputs of scholarly pursuits are more often than not textual works, peer reviewed and published in academic journals, monographs, or conference proceedings. Recent years have seen the rise of “scholarly sharing,” the act of releasing a research output into the public aside from, before, and/or in spite of “Publishing.” Scholarly sharing is often accomplished by utilizing a platform (e.g. Zenodo, PsyArxiv, figshare, Humanities Commons), scholarly social network (e.g. Academia, ResearchGate), or a documentation tool (e.g. Open Science Framework, github, wiki). Below are examples of published works, shared works, campus-based journals, and unclassifiable research projects that make scholarly ideas public in various ways.

Articles

Featured articles


Designing Healthy and Resilient Societies
• Insights into the Human Virome Using CRISPR Spacers from Microbiomes. Hidalgo-Cantabrana, C., Sanozky-Dawes, R., & Barrangou, R. Viruses, 10(9), 479. MDPI AG. Retrieved from http://dx.doi.org/10.3390/v10090479

Harnessing Data for Decision Making

Enriching the Human Experience
• The Making of a Forest: Landscape Change at the Argentine-Brazilian border, 1953-2017. Frederico Freitas, Emily McNamar, Juliana Quist. https://arcg.is/uquTq

Creating Safe, Secure and Intelligent Systems
• Knowing Bass: Accounting for Information Environments in Designing Online Public Outreach. Pigg, S., & Reading, B. J. OPEN LIBRARY OF HUMANITIES, 4(2). https://doi.org/10.16995/olh.377

Driving Food, Water and Energy Solutions

Repositories

Repositories are established platforms through which research is made public, often prior to publication. Physics, mathematics, and statistics have relied on the arxiv repository as a primary source of knowledge for nearly 20 years; in the past 3 years multiple disciplinary repositories have launched with increasing use, utility, and impact on open access to scholarly literature.


Journals

Complementing repositories, open access journals published by NC State colleges, departments, or units are representative of the intellectual and labor investment in moving academic knowledge more fully and efficiently into the public sphere.

- Education in the Health Professions, a publication of North Carolina State University College of Veterinary Medicine, is a peer-reviewed print and online quarterly journal. http://www.ehpjournal.com/
● **The Journal of Textile and Apparel, Technology and Management** seeks to establish a high quality forum relevant to the needs of global industry and higher education that will provide leadership in the timely dissemination of information dealing with all aspects of textile and apparel, technology and management. 
https://ojs.cnr.ncsu.edu/index.php/JTATM

● **BioResources**, from the College of Natural Resources, is a peer-reviewed online journal devoted to the science and engineering of lignocellulosic materials, chemicals, and their applications for new uses and new capabilities. 

● **Mashriq & Mahjar: Journal of Middle East and North African Migration Studies** is a bi-annual electronic publication devoted to disseminating original research on migration from, to, and within the Middle East and North Africa. It is published by the Moise A. Khayrallah Center for Lebanese Diaspora Studies at North Carolina State University. 
https://lebanesestudies.ojs.chass.ncsu.edu/index.php/mashrig/about

● Founded at North Carolina State University in 2016, **Dialogues** was conceived as an open-access, peer-reviewed journal for researchers and practitioners to exchange current scholarship and practice related to English language teaching and learning. The journal publishes research in/across fields like applied linguistics, second language writing, elementary and secondary education, and TESOL. 
https://dialogues.ojs.chass.ncsu.edu/index.php/dialogues/index

Projects

Often, the work of research and scholarship is larger than the sum of its outputs. Highlighted here are several projects that represent incredible intellectual investment, but are not systematically recognizable as works of scholarship. Questions of infrastructure, sustainability, and technological innovation all rise to the fore in works like these.

● **SPeech Across Dialects of English (SPADE)** aims to develop and apply user-friendly software for large-scale speech analysis of existing public and private English speech datasets, and to understand how English speech has changed over time and space. The project is a collaboration of five British and North American institutions and funded by the Transatlantic Platform (T-AP) Digging into Data Challenge via contributions from the ESRC (UK), AHRC (UK), SSHRC/CRSH (Canada), NSERC/CRSNG (Canada) and the NSF (USA).  

● The **Urban Panorama Project** is developing a method to assess urban change by introducing two novel elements in the craft of digital historians: 1) the use of historical images of streetscapes as primary sources; 2) the use of computer vision and machine learning in the geolocation and analysis of these images. It is a project of the Visual Narratives cluster.

● **Immersive Scholar** is a project exploring and developing extensible models and programs for the creation and sharing of digital scholarship in large-scale and immersive visualization environments, focused on and led by the NC State University Libraries.
● **Sound Around Town** is a citizen scientist driven study of urban soundscapes and how individuals are impacted by them. This project is led by Dr. Caren Cooper, Associate Professor in Forestry and Environmental Resources at North Carolina State University.

● **Bodies and Structures** is a platform for researching and teaching spatial histories of Japan, its empire, and the larger worlds of which they were a part. This project utilizes the Scalar product to “publish” learning modules interconnected through a rich ecosystem of conceptual maps, developed through the collaborative curatorial and analytical effort of the site’s contributors and editors.

● **Virtual MLK** is an expansive digital experience of Dr. Martin Luther King Jr.’s “Fill up the jails” speech given at White Rock Baptist Church in Durham, NC. It features elements of audio, video, virtual reality, image, pedagogy, and digital humanities research methods.

### Open Education

The pace of change in open teaching and learning is far surpassing research and scholarship, driven often by the focus on student success, affordability, and social justice.

### Open Science Training

- Dr. Ross Wheten’s **Deep Sequencing Data Analysis** course focuses on training and skill development using some open source research tools, and is also published on the ReadTheDocs documentation platform, connected to github, making the course design editable and reusable.

- Dr. Vaclav Petras, a post-doctoral candidate in the Center for Geospatial Analytics, offers a course on **Tools for Open Geospatial Science**, which covers the emerging field of open science and will deal with reproducibility and replicability challenges of computational research.

### Open Pedagogy

Open pedagogy is the practice of engaging with students as creators of information rather than simply consumers of it. It's a form of experiential learning in which students demonstrate understanding through the act of creation.

- Dr. Nora Haenn’s (Department of Sociology and Anthropology) Globalization and Migrations course in 2017 was re-designed with the NC State University Libraries support. Using an open pedagogy grant through the NCSU Libraries’ Alt-Textbook Project, Haenn collaborated with librarians to develop a new course that replaced writing a traditional term paper with making significant contributions to Wikipedia. [https://wikiedu.org/blog/2018/01/26/finding-a-voice-in-the-public-conversation/](https://wikiedu.org/blog/2018/01/26/finding-a-voice-in-the-public-conversation/)

- To help create more balanced information, the College of Natural Resources’ Dr. Yuan Yao is editing Wikipedia articles with the help of graduate students. For Yao, teaching...
this course is about more than just guiding the next communicators in science fields – it’s about reaching the global public.  

Open Textbooks

Related to the broader open education movement is the production, sharing, and reuse of openly licensed textbooks. The NC State University Libraries supports the creation and dissemination of a variety of openly licensed learning materials, including textbooks.

- Microwave and RF Design by Dr. Michael Steer, the Lampe Distinguished Professor of Electrical and Computer Engineering, is a series of five volumes published by NC State University and distributed through UNC Press. The open access textbooks are freely available digitally from the NC State University Libraries and in low-cost, print-on-demand form from UNC Press.

Alt-Textbook grants

The Alt-Textbook program empowers faculty to innovate pedagogically, enhance access for NC State students to high-quality, tailored educational materials, and reduce the financial burden of expensive textbooks. The Libraries awards grants to faculty to adopt, adapt, or create free or low-cost alternatives to expensive textbooks. Below are some example alt-textbook projects from the past few years.

EAC 703: THE PROGRAMMING PROCESS IN ADULT AND COMMUNITY COLLEGE
- For this off-campus, executive format, face-to-face doctoral course, students benefited from an alternative to the the standard textbook. Dr. Diane Chapman curated an expertly tailored collection of readings for the students that was free, relevant, and accessible. The course readings were hosted by the Libraries Course Reserves and the reading list will be made publicly available for reuse.

METAGENOMICS (BIT 477/577), HIGH-THROUGHPUT DISCOVERY 495/595, AND BIT 501 ETHICAL ISSUES IN BIOTECHNOLOGY
- Dr. Carlos Goller is working on 3 open textbooks. For Metagenomics, lecture notes will be converted into chapters which students will review outside of the classroom, leaving more time for experimentation and lab work during class time. Students in High-Throughput Discovery will collect samples from other courses and campus partners and publish their lab analyses. This new open textbook will allow us to make the data available to all participants and continue building on this dataset, with the goal of engaging more participants throughout campus. In a similar vein, the textbook for Ethical Issues in Biotechnology will be dynamically created by students. Case studies about ethics in biotechnology will be the launchpad for a collection of student analyses and finding.
HI 346: INTRODUCTION TO CIVIL WAR AND RECONSTRUCTION

- Dr. Susanna Lee wanted to create an interactive, multimedia US history alt-textbook, focused on sectionalism, the Civil War, and Reconstruction (1789 to 1898). The alt-textbook program allowed her to hire a graduate student from the History department to help create the textbook. Student feedback on the textbook was generally positive, with some students even giving unsolicited glowing commentary on how much they enjoyed having a free interactive textbook. Lee emphasized the interactivity of the book, noting that it helped cement lessons to immediately have follow-up questions about the section embedded into that interactive part. She also noted that reviews were surprisingly high for the class being taught online, which she at least partially credits to the alt-textbook.

CH226: ORGANIC CHEMISTRY I LAB

- Dr. Maria T. Gallardo-Williams wanted to improve instruction in laboratory practices to the over 3,000 students who enroll in organic chemistry labs at the university each year. The resulting product, Student-Made Audiovisuals Reinforcing Techniques (S.M.A.R.T.), is a set of short videos created by undergraduate students to supplement learning in organic chemistry labs. Each video is fully captioned and showcases a single laboratory technique. Most videos are under 2 minutes. The videos produced measurable improvements in student learning, as well as significant cost-savings for students in Chemistry courses.

PRT238: DIVERSITY AND INCLUSION IN PARKS, RECREATION, AND SPORT MANAGEMENT

- PRT238 is a required course for all PRTM undergraduate students, around 340 students in multiple sections a year. Yet there was no standard textbook for this course. Further, the topics of this course change rapidly, making it difficult to find up-to-date resources. Janell Moretz wanted to offer instructors and students of this course and similar courses at other institutions a current and complete resource. This Alt-Textbook includes relevant chapters from various textbooks, innovative and interactive online simulations, current news articles, published journal articles, and video lectures from guest speakers and professors. It is an engaging set of resources, allowing students to gain hands-on experience and challenges them to think critically and solve problems.

Open Infrastructure

The systems, processes, tools, and platforms that support the opening of academic discourse are in constant development and flux. Highlighted here are a few infrastructural applications and/or references where NC State researchers are refining and defining what open infrastructure is, can do, and will change.
● Dr. Joe DeCarolis, an associate professor of environmental engineering at NC State has recently received funding from the Sloan Foundation to develop the **Open Energy Outlook model**.

● Micah Vandegrift, open knowledge librarian, produced the **Periodic Table of Open Research Tools**, as a resource for beginning to map workflows and processes through which to better understand open infrastructure for scholarly publishing.

● **Citation Index** is a bibliographic aggregator built on top of the Open Researcher and Contributor ID (ORCID) protocol. This tool allows researchers at NC State to effectively manage their CVs from a single point, feeding data to multiple publisher, funder, and research platforms.

● Dr. Colleen Doherty in the Molecular and Structural Biochemistry department is committed to open source development as often as possible. The **Time of Day Transcriptional Responses to Heat Shock** tool is a micro infrastructure utilized to advance her lab’s work on the impact of temperature on plants.

● **Pest or Pathogen Spread (POPS) model** is an open source technology delivered as an R package via github to allow decision-makers, researchers, and students create geospatial distribution models. Dr. Chris Jones in the Center for Geospatial Analytics is the project lead. This project is funded by USDA, NSF, Google, and NVIDIA.

● A collaboration between Dr. Ryan Martin, Associate Professor of Statistics, and a colleague at Rutgers, **Researchers.One** is an open-access peer review publication platform to promote academic freedom, broaden dissemination and even help improve the quality of scientific research.

**Open Community**

Establishing communities of practice is a step toward entrenching open in the social system of the university. As projects build into initiatives, and initiatives into programs, the gravity of people and activity will become more apparent.

● The **OPEN Incubator** is a research development program established by the NC State University Libraries in the summer of 2019. This program seeks to connect principles with practice through cohort-based discussion and discovery. Participants gain knowledge about implementing ‘open interventions’ in their workflows, regardless if the project is a dissertation, new software application, or teaching opportunity.

**Conclusion**

NC State is on the precipice of an open evolution. Uniquely, due to many contributing factors and in no small part due to the public-orientation of the university as a land-grant institution, open is unremarkable and commonplace, a means of excellence and as a tool for sharing the world-class ideas at NC State. While there are many opportunities for growth in community, training and development, policy and evaluation of open, public scholarship, the seeds are deeply rooted. Effective, efficient, and pragmatic resource management will guide the next phases of the State of Open.
Readings and Resources


Invest in Open Infrastructure: A Concept 0.2. (n.d.). Retrieved September 17, 2019, from Invest in Open Infrastructure website: https://investinopen.org/docs/statement0.2.html


“Plan S” and “cOAlition S” – Accelerating the transition to full and immediate Open Access to scientific publications. (n.d.). Retrieved September 17, 2019, from https://www.coalition-s.org/


State of Open, 2019


