

Introduction to the NC State University Data Science Academy NSF Postdoctoral Program

Dr. Rachel Levy (Ray, she/her)
Executive Director of the Data Science Academy
Professor of Mathematics

January 2023

Grant No. 2222148 STEM Ed PRF: Mentoring a Diverse Cohort of Postdoctoral
Scholars in Data Science Education Research.

Webinar goals

- Introduce applicants to the NC State Data Science Academy
- Share the goals of the NSF funded postdoctoral program
- Introduce DSA courses and curricula (Stokes)
- Introduce DSA teaching and learning model and education research program (Byun)
- Provide information to support the application process
- Answer your questions

What are NC State Academies?

- The Data Science Academy was the first academy, founded in Fall 2021.
- Academies are an initiative of the Provost's office and are part of the Office of University Interdisciplinary Programs.
- Academies are tasked with sparking, building and supporting interdisciplinary work across the whole university in teaching, research, and outreach.

The goal of the DSA is to operationalize the idea that

Understanding the NOAA Acoustic Trawl Survey Methodology

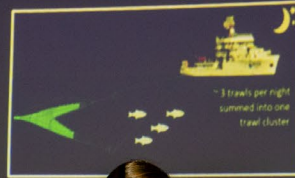
(1) Collect acoustic data



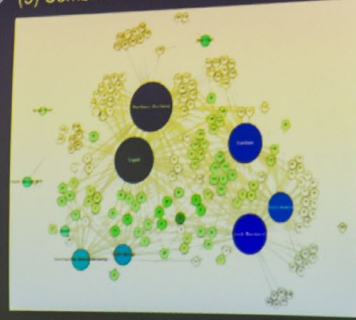
Acoustic Intervals Sea Surface Temperature



(2) Trawl for coastal pelagic species



(3) Combine and estimate species biomass



Data Science is for everyone.

In our first 1.5 years, we have built

- **ADAPT courses** and associated research
- **Research enablement** including seed grants and proposal ideation
- **Collaborative consulting** in collaboration with NC State Libraries, companies and research groups.
- **K-12** Teacher education and student engagement
- **Career connections** through All-campus Career Expo and Internship for Social Impact program
- **Interdisciplinary networking** including workshops, datathons, data jams and networking sessions

In year one the Data Science Academy brought in \$1.42M through external gifts and grants

data.org

\$110K to become part of the Capacity Accelerator Network to build workforce capacity in data science through **internships for social good**. Delivered in collaboration with the School of Public and International Affairs.



\$60K to DSA and The Science House for a **Data Explorers program** to build K-12 teacher and student leadership in data science. Partnering with Friday Institute, and Hi-RISE team (College of Ed), and the NC School of Science and Mathematics.



ALFRED P. SLOAN
FOUNDATION

\$50K to run a national **conference on best practices for collaborative consulting** in academic institutions. Partnering with the NC State Libraries and the Academic Data Science



\$1.2M to recruit and mentor a **diverse cohort of four 2-year postdocs** who will study our All-Campus Data Science Accessible Project-Based Teaching and Learning model (ADAPT model).



DSA Educational Goals

- Build equitable, inclusive, accessible, high-quality project-based teaching and learning experiences.
- Reach students across all NC State programs of study.
- Offer work-based courses through continuing education.
- Develop a scalable and adaptable course model that serves students with diverse interests, identities and previous levels of experience.
- Create learning experiences that help students want to learn more in the future.
- Become an international leader in data science education.

Questions we ask ourselves...

- Do DSA courses attract, serve and support students from all the colleges and programs of study? Who benefits the most? Who are we missing and why? Who are we not serving well?
- Do DSA courses work for students from different prior learning experiences with different identities and goals?
- Is our ADAPT course model effective? (More on this model in a bit.) How is the model enacted in our courses? What is its impact on learners? How can DSA best orient and support instructors and students?

Postdoctoral Program Overview

- Our goal is to be transparent to help you with your application and get you excited about the program.
- You will need to be familiar with DSA, especially the course model and its goals to write your applications.
- I will share the Postdoc program logic model, program evaluation questions and list of mentors.
- Then David Stokes will review the DSA instructional model and Sunghwan Byun will review the DSA research program.

Inputs	Activities	Outputs	Short term outcomes	Long term outcomes
Diverse postdoc cohort				
ADAPT course model				
Diverse group of mentors				
DSA Teaching community				
Diversity workshops and career programs				

Inputs	Activities	Outputs	Short term outcomes	Long term outcomes
Diverse postdoc cohort	Developing research focus centered on DSA ADAPT model			
ADAPT course model	Observing, developing and teaching courses			
Diverse group of mentors	Collaborating with cohort and mentors			
DSA Teaching community	Developing workshops and webinars			
Diversity Workshops and Career Programs	Networking with leadership			

Inputs	Activities	Outputs	Short term outcomes	Long term outcomes
Diverse postdoc cohort	Developing research focus centered on DSA ADAPT model	High quality data science education scholarship		
ADAPT course model	Observing, developing and teaching courses	Evidence-based course improvement		
Diverse group of mentors	Collaborating with cohort and mentors	Scalable and replicable ADAPT model		
DSA Teaching community	Developing workshops and webinars	Postdocs with new expertise and community		
Diversity Workshops and Career Programs	Networking with leadership			

Inputs	Activities	Outputs	Short term outcomes	Long term outcomes
Diverse postdoc cohort	Developing research focus centered on DSA ADAPT model	High quality data science education scholarship	Students drawn into and persist in courses	
ADAPT course model	Observing, developing and teaching courses	Evidence-based course improvement	Increased course enrollments reflect many kinds of diversity	
Diverse group of mentors	Collaborating with cohort and mentors	Scalable and replicable ADAPT model	Instructors and students thrive in systems with built in supports	
DSA Teaching community	Developing workshops and webinars	Postdocs with new expertise and community	Courses and ADAPT model improve with input from postdoc research	
Diversity Workshops	Networking with postdoc cohort			

Inputs	Activities	Outputs	Short term outcomes	Long term outcomes
Diverse postdoc cohort	Developing research focus centered on DSA ADAPT model	High quality data science education scholarship	Students drawn into and persist in courses	Students, staff and faculty obtain data science expertise
ADAPT course model	Observing, developing and teaching courses	Evidence-based course improvement	Increased course enrollments reflect many kinds of diversity	More faculty teach project-based courses
Diverse group of mentors	Collaborating with cohort and mentors	Scalable and replicable ADAPT model	Instructors and students thrive in systems with built in supports	ADAPT model replicated across campuses
DSA Teaching community	Developing workshops and webinars	Postdocs with new expertise and community	Courses and ADAPT model improve with input from postdoc research	Data science workforce has more people attending to ethics and validity.
Diversity Workshops and Career	Networking with leadership			

Program Evaluation Questions

Recruitment and mentoring

- What strategies and activities promoted postdoctoral opportunities?
- To what extent were those strategies and activities successful in recruiting women and individuals from other groups who are underrepresented in STEM?
- How effectively did mentoring efforts support diversity, equity and inclusion among the postdoctoral cohort?
- To what extent are different STEM, STEM-Ed, and educational backgrounds represented among the cohort?

Research

- What existing research opportunities did the DSA provide for postdoctoral fellows?
- What new, independent research projects were developed by DSA postdoctoral fellows?
- What training and/or mentoring activities did the DSA provide to build competency in research methods or knowledge of the research literature?
- To what extent were training and/or mentoring successful in building competency in conducting research?

Program Evaluation Questions

Collaboration

- What opportunities did the DSA provide for postdocs to develop competency in instruction?
- What professional development opportunities did the DSA provide for postdocs to participate in scholarly communities?
- What opportunities for outreach collaborations did the DSA facilitate?
- What opportunities for internal and external presentations did DSA facilitate for the postdoctoral cohort?
- To what extent were professional development opportunities successful in building professional competencies?

Inter-institutional connections

- To what extent did the DSA successfully include MSIs, community colleges, and EPSCoR Institutions in conferences and the postdoctoral recruitment strategy?
- What teaching opportunities were available for postdoctoral fellows within MSI, community college, or EPSCoR institutions?

Mentoring and community

- Each postdoc will have a primary mentor and an secondary mentor, ideally from different fields so that they receive an interdisciplinary mentoring experience.
- We have identified 6 potential mentors, and it is possible to request that we investigate the possibility of matching postdocs with other faculty from across NC State.
- Matching will be discussed after the appointments are made, but it is fine to indicate in the application your interest in connecting with particular faculty.
- Postdocs will interact regularly with **DSA Executive Director Ray Levy, Teaching Coordinator David Stokes and the DSA Instructors** who meet regularly as a teaching and learning community.





Sunghwan Byun is an Assistant Professor of Mathematics Education in the STEM Education Department. His expertise includes applying interactional sociolinguistics to examine equity issues in STEM classrooms and identity formation processes.



Ruby Ellis is an Assistant Professor of Mathematics Education in the STEM Education Department. Her research examines professional development that supports mathematics teachers in schools with high African American, low-income student populations with integrating technology in alignment with inquiry-based instructional practices.



Emily Griffith is the Director of Consulting of the Data Science Academy and a Research Associate Professor in the Department of Statistics. Her research interests include developing best practices for teaching statistical consulting and collaboration.



Shiyan Jiang is an Assistant Professor of Learning Design and Technology in the College of Education at NC State. She has expertise in technology-enhanced data science learning environments and supporting career exploration in interdisciplinary learning environments



Daniela Jones is an Assistant Professor in the Biological and Agricultural Engineering Department at NC State University and holds a joint-faculty appointment with Idaho National Laboratory. She serves as the DSA Director for Agricultural Analytics and administers the graduate certificate in Agricultural Analytics at NC State.



Hollylynne Lee is a Distinguished Professor of Mathematics and Statistics Education in the STEM Education department at NC State. Her research expertise focuses on teaching and learning of probability, statistics, and data science in grades 4-14¹⁹

DSA Website Resources

- Postdoc program page – slides and recording will be here
- Description of ADAPT course model and course descriptions
- DSA Impact report from year 1
- Other news, programs and events.

datascienceacademy.ncsu.edu

Courses and Curricula at the Data Science Academy

David Stokes
Teaching Coordinator
NC State Data Science Academy

This portion will include:

- Information about DSA courses & curricula
 - Postdoc teaching
- DSA teaching & learning community
- Current developments in DSA courses & curricula

Post Doc Teaching

You will have the opportunity to teach one DSC course per semester

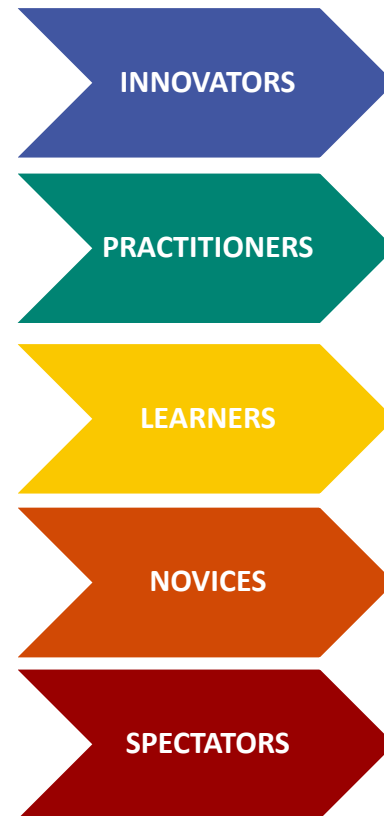
- May choose or want to observe for the initial semester

Goals for DSA courses & curricula:

- Include expanding entryways and pathways into data science through a range of multidisciplinary data science courses

Who are DSA Courses for? (Hint: Everyone)

- Students from all disciplines & backgrounds
 - Undergrads
 - Graduate Students
- Faculty
- Agricultural Extension Agents
- Alumni
- University Staff
- Industry Partners
- Farmers
- Community Members
- PreK-12 Students, Teachers, Parents, and Administrators
- And more...



**Enter at
Any Level &
Make Your
Way upward**

Question to consider...

Who would you like to participate in Data Science?

Our Course Model

We expand data science access through our course model:

- Each course follows the **All Campus Data Science through Accessible Project-based Teaching and Learning (ADAPT)** model.
 - Project-Based Learning
 - Identity-conscious choices
 - 10 common learning elements

Notable Course Features

- Project-based learning that emphasizes contextual data science applications as course outcomes
- Career-oriented perspectives that give students the opportunity to present their work and gain experience in effectively communicating data science ideas
- Active student participation built-in to the classroom structure

Question to consider...

What course features would you add to improve the ADAPT model and to make data science for everyone?

Three Course Levels

One-credit courses that allow us to meet students where they are:

- **Level one** courses do not require prerequisites and students aren't expected to come in with data science knowledge.
- **Level two** courses have skill-based prerequisites (e.g., knowledge of data types and programming methods, like loops, or experience with regression and classification).
- **Level three (graduate)** courses are known as research ready, where students can bring their own data or algorithm.

Level 1 courses (DSC-295)**No prerequisites**

- Data science for policy
- Data science for social good
- Data science for sustainability
- Data visualization: tools and techniques
- Design thinking for data science
- Intro R/Python for data science
- Intro R for social sciences
- Social media: data ethics and theory

Level 2 courses (DSC-495)**Skill-based prerequisites**

- Epidemiology: data and disparities
- Exploratory data analysis for big data
- Data science for cybersecurity
- Machine learning for practitioners
- Natural Language processing
- Reproducibility, containers and the cloud
- Web scraping and data wrangling

Level 3 courses (DSC-595)**Research readiness**

- Text analysis using intermediate python

How are DSC courses built?

- In collaboration with instructors from private and government industries, as well as faculty within academia.
- Prospective instructors and/or collaborators...
 - Create a course title and a short course description,
 - 5 or so student learning outcomes, and
 - An idea for a project that will be integral to the course.
 - Those who propose a course sometimes have other instructors in mind
- Innovative and exciting ideas are being presented all the time.

Example Course Description

Introduction to R/Python for Data Science

- Students will develop introductory skills in R and Python needed for data science. Topics include data types, data structures, control structures, good coding practices, and reproducible coding. Students will become acquainted with basic data science algorithms and their implementations in R and Python. Skills acquired in this course serve as a foundation for many of the Data Science Academy classes that suggest some experience with R or Python.

Example Course Objectives

By the end of this course, students will be able to:

- Identify components of a data science methodology and be able to identify where tasks might belong within these components.
- Create transparent and reproducible code through comments.
- Communicate analyses and results supported by data science methodologies.

Question to consider...

This postdoc is an opportunity to bring your perspective to the DSA and impact data science education...

What do you envision for data science, and how would you add to DSA courses and curricula?

Teaching & Learning Community

Instructor Meetings

As a member of the DSA teaching community, you will participate in bi-weekly meetings with other instructors:

- Professional development
- Research updates
- Support group
- Technical support (Ex. google chat group)

Course Collaboration Leaders

Course Collaboration Leaders are:

- Undergraduate students who have taken at least one DSC course
 - Offer peer to peer support with general programming questions
 - Offer instructional support with review session support

Current Developments in DSA Courses & Curricula

Spring 2023

- Working on permanent course numbers for courses previously taught as experimental/special topics.
- Collaboratively developing 12 credit undergraduate certificates on a variety of topics
 - 6 DSA credits (breadth, from the 1-credit structure)
 - 6 credits from a department/program (focus, from in-depth 3-credit courses)

Certificate: 6 DSA categories (example course)

1. Data Communication (e.g., Data Visualization)
2. Ethics, Policy & Privacy (e.g., Data Science for Social Good)
3. Data Management and Analysis (Data Wrangling & Web Scraping)
4. Machine Learning and AI (Machine Learning for Computer Vision)
5. Electives
6. Capstone (Example Next)

Example Capstone Course

Data Internships for Social Good



- Career preparation oriented
 - Applying learned skills
 - Gaining experience in real world settings

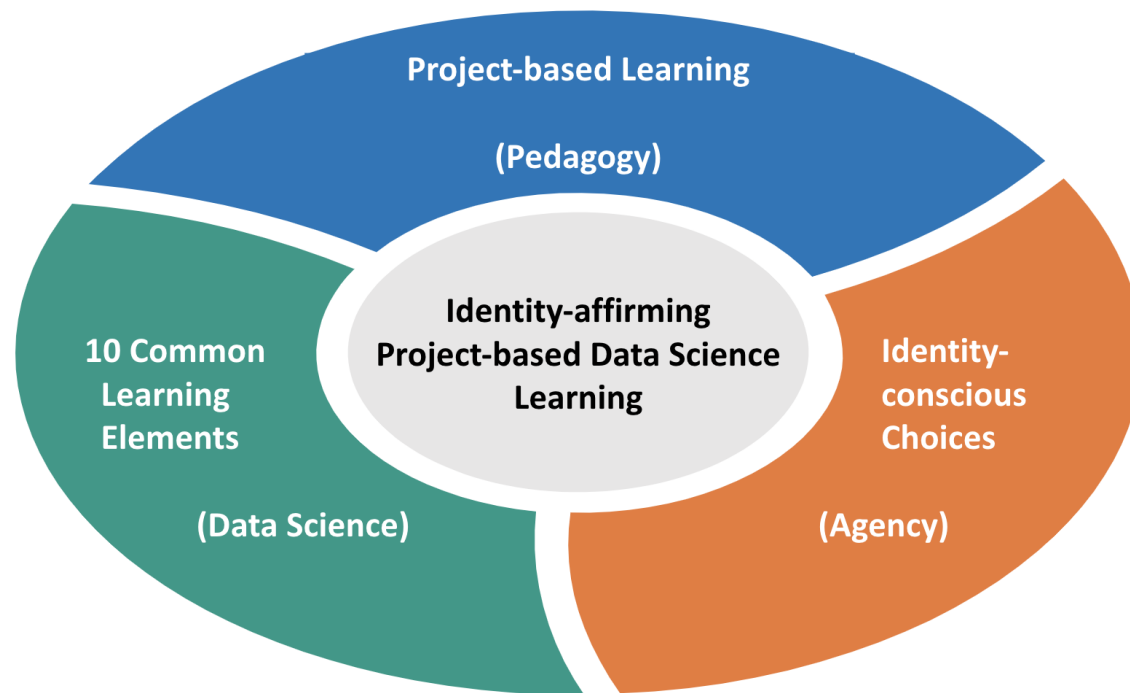
Educational Research at the Data Science Academy

Dr. Sunghwan Byun

Director of Educational Research

Assistant Professor, College of Education

All-campus Data Science Accessible Project-Based Teaching and Learning (ADAPT) Model



10 Common Learning Elements

Desired actions and dispositions - How do we do data science?

1. Examine **how data are created**, and the related assumptions and collection practices
2. Recognize **data as information, not truth**, with error, variability, and degrees of inclusion/exclusion
3. Practice **data curation, wrangling and cleaning**
4. Investigate **ethical issues** and ways to approach them
5. Assess **validity** of data, methods, results and communication
6. Employ **accessibility** practices (e.g., alt text, color choices, GUIs, sonification, visualization, commenting, captioning videos and talks, etc.)

Community and individual identity development - What does it mean to participate in data science?

7. Explain what it means to be a **data scientist and data-enabled**
8. Observe a diverse collection of data scientist **role models and careers**
9. Articulate **current issues or open questions** in data science
10. Specify **exciting discoveries or impacts** of data science

Educational Research Example 1

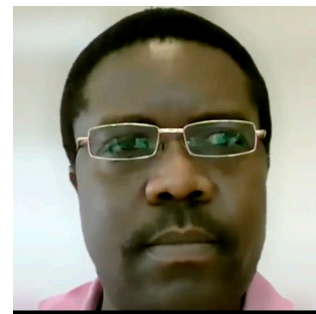
Interview/Narrative Study

Why Do Students Take
Data Science Courses?

Multiple Narratives of Data
Science Learning Pathways



Michelle Pace



Nixon Igunza

Ph.D. Students
Math and Stat Ed

Educational Research Example 2

Social Interactional Study

How do students' social identities manifest in classroom interaction, and how can instructors affirm their identities?



Hamid Sanei

Ph.D. Student
Math and Stat Ed



Jeanne McClure

Ph.D. Student
Learning Analytics

Educational Research at NC State DSA

Research Approval Process

- Which course/student/instructor will you study?
- How does your study promote the mission and goals of DSA?
- How will you support the DSA community based on your study?

Institutional Review Board (IRB)

- There is an existing IRB in place for research/evaluation purposes
- Data collection includes: student demographic data, class artifacts, interviews, and classroom video recordings.
- New IRB may need to be in place to initiate new studies

Your Application

- **Cover Letter.** In the letter, please explain how this postdoctoral position is a good fit for your research and professional goals.
- Contact Information for **References**
- **Resume/CV** that helps us connect your prior work experience with this postdoc. Please include any metrics you used to evaluate the success or impact of this prior work.
- **1-2 page research statement** describing how your past research and teaching experience and future goals are aligned with the goals of the Data Science Academy and work you could do in this postdoctoral position. Broadening participation in data science is fundamental to the Data Science Academy. Please address this in your statement.

What do you want to know?

- This fellowship program is for you to explore questions that you care about related to data science education. Examples are presented to initiate your thinking. We want to know what you want to study!
- Consider how your question(s) may contribute to achieving the three elements of the ADAPT model.
(project-based learning, 10 common learning elements, identity-conscious choices)

How will you explore the question(s)?

- This fellowship program is for you to grow and develop as a researcher/leader in data science education. What research expertise do you plan to (further) develop?
- Consider how your past experiences inform the trajectory of your development.
- Consider how specific resources at DSA (and NC State) may be useful for you to further develop as a researcher/leader in data science education (e.g., faculty mentors, DSA courses).

When can I apply and how?

- Applications will go live around January 19, 2023.
- You must apply by uploading materials through <https://jobs.ncsu.edu/> (not by email)
- You are welcome to email questions about the application process to datascienceacademy@ncsu.edu.
- We are excited to read your ideas about how you might spend this 2 years doing your individual research and participating in the cohort community.

**What questions do you have for us?
Please enter them in the chat.**

Thank you for joining us!
We look forward to reading your applications.