The Computational and Data Science Exchange (CDS-Exchange): A Model for Building Faculty Capacity in Computational and Data Science Education

Katharine Cahill
New Jersey Institute of Technology
kate.cahill@njit.edu

Karen Rios-Soto
University of Puerto Rico Mayaguez
karen.rios3@upr.edu

Tandabany Dinadayalane
Clark Atlanta University
dtandabany@clark.edu

Rachel Vincent-Finley
Southern University Baton Rouge
rachel.finley@sus.edu

Linda Akli
Texas Advanced Computing Center
lakli@tacc.utexas.edu

Ahlam Tannouri
Morgan State University
ahlam.tannouri@morgan.edu

Zhuoying Wang
Texas Advanced Computing Center
zwang@tacc.utexas.edu

Lisa Garbrecht
Texas Advanced Computing Center
lgarbrecht@tacc.utexas.edu

ABSTRACT

Small and lesser-resourced institutions often face challenges launching or expanding undergraduate Computational and Data Science (CDS) course offerings. CDS-Exchange addresses this challenge by building a faculty community of practice across institutions. Core components of the project include: webinar series, regional workshops, fellows program, and annual symposium. Diverse activities result in broad outcomes, such as multi-institution participation, strong repeat engagement, and positive self-reported gains in understanding and teaching relevance.

KEYWORDS

Computational and Data Science Education, Faculty Community of Practice, Collective Impact, Capacity Building

1 INTRODUCTION

The demand for workforce expertise in Computational and Data Sciences (CDS) continues to grow rapidly [2, 3, 5, 6]. However, institutions with limited local capacity often struggle to develop and implement related curricula, such as new minors or certificates. Because CDS inherently requires the integration of mathematics, computer science, and domain-specific science and engineering, creating comprehensive academic programs poses significant logistical challenges. Universities are traditionally organized into discipline-oriented departments with siloed budget models, creating a structural obstacle to rapid interdisciplinary implementation. Furthermore, existing curriculum structures exacerbate this issue: upper-level courses are typically tailored for discipline majors and restricted by numerous prerequisites, while introductory courses frequently lack computational modules and remain slow to adapt. Consequently, newly established CDS programs face substantial hurdles in recruiting students due to rigid schedule constraints and complex prerequisite pathways.

To address these pervasive challenges, the CDS-Exchange was established as a National Science Foundation (NSF)-supported initiative aimed at expanding access to CDS education through shared instructional resources and collaborative faculty development. Led by the New Jersey Institute of Technology (NJIT) in partnership with the Texas Advanced Computing Center (TACC), the Univer-sity of Puerto Rico at Mayagüez (UPRM), Clark Atlanta Univer-sity (CAU), Morgan State University, and Southern University, the project leverages inter-institutional cooperation to build capacity where local resources are constrained. This paper provides a con-cise overview of the CDS-Exchange model and details its major activities during the first two project years. By highlighting emerg-ing evidence of the project's early impact, this work emphasizes practical lessons and effective strategies that are highly relevant to the broader high-performance computing (HPC) and computational education communities.

2 PROJECT MODEL

CDS-Exchange is a faculty-focused project that uses several modes of engagement to connect faculty to a broader community of CDS educators. By encouraging development and sharing of the CDS curriculum to add to existing courses, we intend to have a greater impact on students' exposure to these topics. Rather than relying solely on the creation of entirely new, resource-intensive academic programs, the model encourages the collaborative development and sharing of CDS curriculum modules that can be integrated into existing courses, thereby maximizing student exposure to these topics. This approach evolved from the initial C^{2}Exchange pilot project (2018–2022), where a foundational group of project members successfully collaborated to share materials and expertise [1].

A critical insight gained from the pilot program is the diverse utility of shared resources and the importance of professional community support. Exchange materials proved highly adaptable, successfully utilized as independent study projects, integrated as specific modules within existing classes, or adopted entirely as new courses in department catalogs. Furthermore, the pilot highlighted

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page, along with the DOI information below. To copy otherwise, republish, post on servers or redistribute to lists requires prior specific permission from the first author.

© 2026 Journal of Computational Science Education
https://doi.org/10.22369/issn.2153-4136/17/2/1

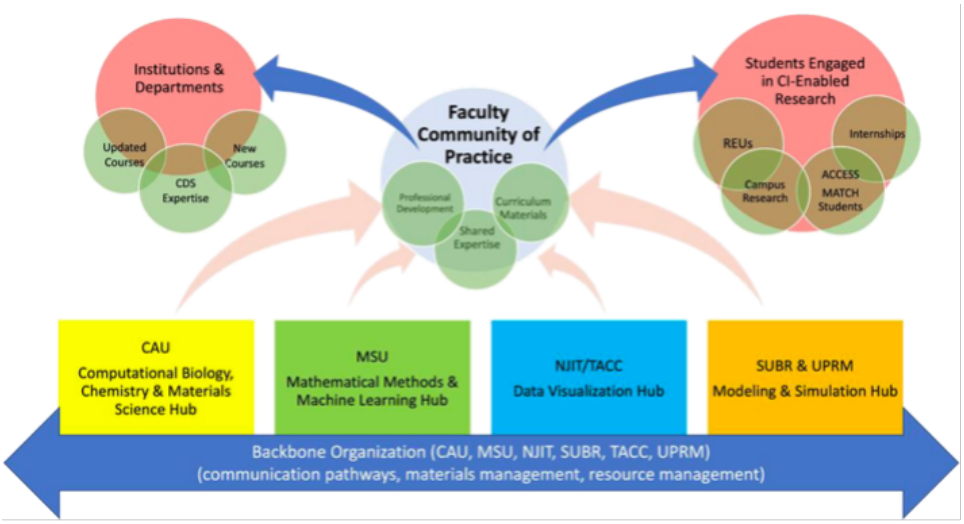


Figure 1: Structure and goals of the CDS-Exchange Project based on the Collective Impact model

Table 1: List of Regional Workshops

Institution	Date	Topic
UPRM	December 2024	Modeling & Simulation
UPRM	May 2025	Statistical Techniques
UPRM	December 2025	Chemistry & Biology
SUBR	June 2025	Modeling & Simulation
Morgan State	May 2026	Modules for Pre-Calculus

that isolated faculty members–who are often the sole computationally focused instructors in their departments–greatly benefit from the professional development and peer network that the exchange provides. Ultimately, this cross-institutional sharing model accelerates the implementation of CDS curricula, strengthens university partnerships, and ensures faculty are well-supported in preparing a larger cohort of students for a workforce where these specialized skills are in high demand.

2.1 Goals

Goals of CDS-Exchange:

- Share existing courses and modules with a larger faculty community
- Create new materials that fill gaps in CDS curriculum and are relevant to this community
- Facilitate course or module development by the community
- Provide opportunities for professional development and networking for faculty in CDS
- Encourage faculty research collaboration

The goals of the CDS-Exchange project were designed in accord with the National Science Foundation's (NSF) model of collective impact, which focuses on building "collaborative infrastructure" to achieve systemic change [4]. These goals work collectively to enhance Computational and Data Sciences (CDS) education through shared vision, partnerships, leadership, and scalability. Specifically, the goals of sharing existing courses and creating new materials to fill curriculum gaps provide a platform for collaborative action, effectively engaging a larger faculty community in a shared vision for CDS education. Furthermore, providing continuous opportunities for professional development and networking naturally fosters distributed leadership and increases communication among CDS educators. Ultimately, our focus on facilitating ongoing, community-driven course and module development establishes the necessary capacity for the expansion, sustainability, and scale of CDS curricula across participating institutions.

2.2 Activities

These are the project's four core mechanisms:

- Webinars: Building Bridges in CDS Curriculum Webinar series 2024 & 2025 recurring online sessions on topics such as computational thinking, data visualization, modeling and simulation, computational chemistry, computational biology and bioinformatics, and data storytelling.
- Regional workshops: in-person, hands-on events tailored to local communities such as Puerto Rico and Southern University campuses.
- Community Development Fellows: a cohort model supporting faculty curriculum development, with the first cohort focused on data visualization integration. The second cohort is focused on scientific computing tools.
- Annual symposium: a national convening that connects webinar participants, fellows, and regional workshop attendees around curriculum development, educational tools, and institutional implementation.

Table 1 provides an overview of the regional workshops offered so far. We have completed one full year of the fellows program, and are in the middle of the second fellows year with a new cohort. We've hosted two symposia held at Clark Atlanta University, the 1st symposium in May 2025 had 25 registered participants, and the 2nd symposium in April 2026 had 53 registered participants.

2.3 Infrastructure and Community Building

To ensure long-term sustainability and foster continuous collaboration, the CDS-Exchange project relies on a robust project infrastructure designed to transform individual activities into a cohesive, ongoing community. This infrastructure integrates a centralized website, active mailing lists, and shared repositories that allow faculty to seamlessly access, utilize, and contribute curriculum materials. Additionally, archived webinar recordings provide asynchronous professional development, while regional information networks facilitate localized support and peer engagement. By maintaining these interconnected communication and resource platforms, the project successfully moves away from a model of isolated events, instead providing a persistent digital and professional ecosystem that supports CDS educators year-round.

3 EMERGING OUTCOMES

3.1 Reach

ar series included 75 participants from 41 institutions, including HBCUs, high-Hispanic-enrollment institutions, a Tribal university, a community college, and a non-U.S. institution. In the second reporting year, webinar participation remained strong, with 57 attendees across the year, 18 non-R1 institutions represented, 16 R1 institutions represented, and continued engagement from nonprofit academic organizations and industry.

3.2 Engagement

The evaluation data demonstrates that the CDS-Exchange project model operates effectively as a community-building strategy by fostering repeat participation and cross-event movement among faculty. Between October 2024 and May 2025, a series of five targeted webinars accumulated a total of 91 participants while maintaining a steady 44% average evaluation survey response rate. Highlighting this community traction, 62 percent of webinar participants in the first year attended more than one session, a trend of repeat engagement that persisted into the second year alongside notable cross-event progression as several workshop participants subsequently attended the annual symposium. These patterns reinforce a key project insight: truly sustained faculty development requires multiple, interconnected modes of engagement rather than fragmented, one-off events.

This multi-layered engagement strategy has successfully cultivated deep cohort dedication and a robust pipeline for future participation. Within the program, fellowship cohort members demonstrated high ongoing involvement, with 91% of respondents agreeing or strongly agreeing (36% agree, 55% strongly agree) that they actively engaged in most of the project's scheduled activities throughout the year. Simultaneously, the project's regional training workshops generated a strong demand pipeline for the formal Fellows program, capturing the interest of 100% of Winter UPRM attendees, 82% of Spring UPRM attendees, and 100% of Summer SUBR attendees. This strong "community of practice pull" is further evidenced by a widespread desire to remain embedded in the project's broader ecosystem, with 100% of all regional workshop participants and 88% of webinar respondents expressing explicit interest in active, long-term participation within the wider CDS-Exchange network.

3.3 Perceived Value

Webinar respondents (88%) expressed interest in joining a community of practice, and two-thirds or more across five webinars reported increased understanding of the content. Regional workshop respondents also reported high gains in knowledge and skills for using CDS-Exchange materials, and all respondents to the 2025 fellows program and annual symposium surveys rated those experiences as valuable and/or useful. The fellows program was reported to be highly impactful among participating faculty. Every surveyed fellow reported overall satisfaction with their experience, while all concurrently affirmed that their personal investment of time and resources into the program was entirely worthwhile. This exceptional level of satisfaction is deeply rooted in the program's success in driving instructional empowerment and capacity building. Specifically, 100% of participants noted that the provided resources offered significant, direct support to their teaching (80% strongly agree, 20% agree). Furthermore, the program effectively fostered long-term educational growth by ensuring that 100% of the fellows agreed that the initiative successfully strengthened their individual instructional capacity while simultaneously elevating their home institution's core capability to deliver high-quality Computational and Data Sciences (CDS) education (70% strongly agree, 30% agree).

4 LESSONS LEARNED

Based on the first two years of survey data, we have identified several lessons learned.

- Multiple entry points matter. Webinars create a low-barrier first contact, while workshops, fellows activities, and the symposium create progressively deeper engagement.
- Regional adaptation matters. UPRM workshops show how the same project model can be tailored to local disciplinary interests and regional institutional networks, including Puerto Rico and the Caribbean context.
- Community infrastructure matters. Mailing lists, archived recordings, websites, and shared curriculum materials help convert short-term events into an ongoing educator network.
- Cross-disciplinary framing matters. Participation from mathematics, biology, chemistry, engineering, statistics, business, and public administration suggests that CDS/HPC education grows when framed as broadly applicable rather than limited to computer science alone.

5 REPRODUCIBILITY AND NEXT STEPS

The CDS-Exchange model demonstrates high reproducibility and transferability due to the exceptional clarity of its operational processes and structural design. Because its core elements are clearly defined, the framework can be systematically adapted by other academic communities or disciplines seeking to build collaborative educational networks. These structured components include recurring webinars for broad outreach, local workshop partnerships for localized faculty training, cohort-based faculty support to foster continuous mentorship, an annual national convening for community alignment, and shared online resources to ensure open access to curriculum materials. This clear, modular blueprint demystifies the complexities of cross-institutional collaboration, making it a

highly transferable strategy for expanding specialized educational capacities in resource-constrained environments.

Looking ahead, the project's next steps will focus on sustaining and expanding this structured process through continued webinars, additional regional workshops, and the recruitment of a third fellows cohort. Furthermore, the initiative plans the continued strengthening of the curriculum repository and project partnerships to deepen inter-institutional cooperation and secure long-term resource sustainability. Ultimately, the CDS-Exchange experience suggests that a layered model combining online engagement, regional faculty development, cohort-based support, and national convening can broaden participation in CDS and HPC education while building a sustainable community of practice.

REFERENCES

[1] Katharine Cahill, Linda Akli, Tandabany Dinadayalane, Ana Gonzalez, Raphael Isokpehi, Asamoah Nkwanta, Rachel Vincent-Finley, Lorna Rivera, and Ahlam Tannouri. 2022. Building a computational and data science workforce. *The Journal of Computational Science Education* 13, 1 (2022), 27–31. doi:10.22369/issn.2153-4136/13/1/5

[2] Burcin Campbell. 2026. Tracking the rise of AI academic programs: Methods, metrics, and what the data tell us. *CERP Bulletin* April 28 (2026).

[3] Andrea Danyluk and Scott Buck. 2019. Artificial intelligence competencies for data science undergraduate curricula. In *Proceedings of the AAAI Conference on Artificial Intelligence*, Vol. 33(01). 9746–9747. doi:0.1609/aaai.v33i01.33019746

[4] National Science Foundation. 2022. NSF's Eddie Bernice Johnson INCLUDES initiative. https://nsf-gov-resources.nsf.gov/files/INCLUDESOverviewOnePager-r.pdf

[5] National Center for Science and Engineering Statistics. 2021. *Women, minorities, and persons with disabilities in science and engineering: 2021.* Special Report NSF 21-321.

[6] U.S. Bureau of Labor Statistics. 2026. Occupational outlook handbook. https://www.bls.gov/ooh/