

Board 362: Promoting Research-Driven Data Analytics Curriculum in High School through an NSF RET Site

Dr. Shengfan Zhang, University of Arkansas

Shengfan Zhang is an Associate Professor in the Department of Industrial Engineering at the University of Arkansas. She received her Ph.D. and M.S. in Industrial Engineering from North Carolina State University. Zhang's current research focuses on developing methodologies and solution approaches in medical decision making, especially advancing predictive and prescriptive analytics for disease prevention and treatment. Zhang teaches courses on probability and statistics, predictive analytics, stochastic processes, quality engineering and management, simulation, etc.

Dr. Eric Specking, University of Arkansas

Dr. Eric A. Specking serves as the Assistant Dean for Enrollment Management and Retention for the College of Engineering at the University of Arkansas. Specking received a B.S. in Computer Engineering, a M.S. in Industrial Engineering, and a Ph.D. in Engineering from the University of Arkansas. His research interest includes decision quality, resilient design, set-based design, engineering and project management, and engineering education. During his time at the University of Arkansas, Eric has served as Principal Investigator, Co-Principal Investigator, or Senior Personnel on over 40 research projects totaling over \$6.6 Million, which produced over 50 publications (journal articles, book chapters, conference proceedings, newsletters, and technical reports). He is an active member of the American Society for Engineering Education (ASEE) and International Council on Systems Engineering (INCOSSE) where he has served in various leadership positions.

Promoting Research-Driven Data Analytics Curriculum in High School through an NSF RET Site

Abstract

The Arkansas Data Analytics Teacher Alliance (AR-DATA) program, a Research Experience for Teachers (RET) site in Arkansas supported by the National Science Foundation, is in its second year and have twenty high school teachers participating so far. The objectives of the program are to (1) promote research-driven high school data analytics curriculum and education to reach underserved students, such as those in rural areas; (2) provide a professional development opportunity for teachers to attain new knowledge in data analytics and various engineering application; and (3) encourage a long-term collaborative partnership between the University and public school districts in the region to strength data analytics education. Currently, participating teachers have developed learning modules in mathematics, computer science, and pre-engineering. Faculty mentors across different fields in engineering and industry advisors helped the participating teachers develop modules reflecting current cutting-edge research in data analytics as well as gain a better understanding of the development needs for next-generation data analytics workforce. In this paper, we summarize key activities of the AR-DATA program, including findings from the application process, the six-week summer program, and academic year follow-up. We analyze the teachers' expectation and feedback of the program as well as the learning modules developed and piloted in the classroom. Finally, we present challenges and opportunities for sustainability of the AR-DATA program.

Introduction

The Arkansas Data Analytics Teacher Alliance (AR-DATA) program was established in 2020, funded by the National Science Foundation Research Experience for Teachers (RET) program. As the first RET site in Arkansas, AR-DATA aims to provide at least thirty 9th-12th grade mathematics, computer science, and pre-engineering teachers with transformative research experiences thematically centered on data analytics. The program seeks to introduce teachers to various engineering applications implementing data analytics and let them gain a better understanding of the next-generation workforce needs in data analytics [1]. The program is currently in its second year, and we have been working with ten teachers each year during 2020-2021 and 2021-2022 program cycles. In this paper, we present the program findings, from recruitment to product dissemination in the following sections.

Participant and Mentor Recruitment

Due to the COVID-19 pandemic, when the program started in 2020, we changed the format of the AR-DATA 2021 summer program to a virtual delivery. Because of the flexibility in the delivery mode, we opened application to the whole state, especially those in more rural areas, instead of recruiting teachers only in the Northwest Arkansas region as originally proposed. In Summer 2022, we offered a hybrid format for the summer program when local teachers participated in person and remote participants joined virtually. In these first two years of the programs, we received a total of 50 applications and selected 20 participants. These applicants came from 28 school districts and 38 schools throughout Arkansas, as shown in Figure 1, with 2021 participants demonstrated in red, 2022 participants in green, 2021 and 2022 participants in yellow, and the remaining applicants in blue. It can be seen from the figure that most applications came from schools in Northwest or Central Arkansas. We gave priority to teachers from Northwest Arkansas since that was the grant's targeted geographic location.

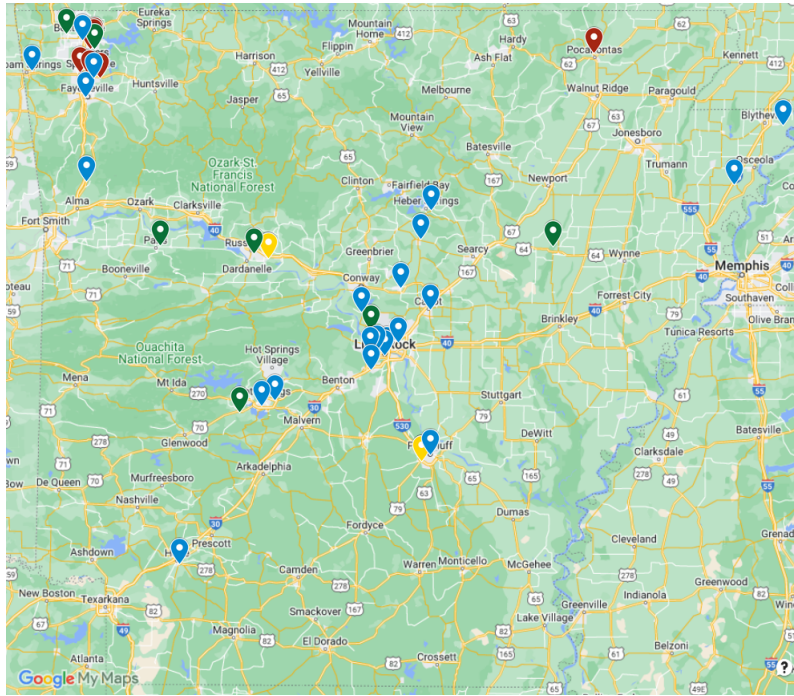


Figure 1. Location of Applicants and Participants

Table 1 shows the number of applicants' and participants' schools that received funds for the rural and low-income status (RLIS) program. Many applicants came from schools not classified as rural or low-income, but 25% of ARDATA participants came from schools who receive RLIS program funds. Fifty-four percent of the applicants self-identified as female. We saw a similar distribution for teachers who self-identified as female among selected participants. Table 2 shows the breakdown of applicants and participants by race. One applicant self-identified as Hispanic and three identified as veterans. One of the veterans was selected for the 2021 program.

Table 1. Rural Status of Applicants' or Participants' School

Rural	Application	Participant	2021	2022
No	41	15	8	7
Yes	9	5	2	3

Table 2. Race Classification of Applicants and Participants

Race	Application	Participant	2021	2022
Asian	1	0	0	0
American Indian/Alaska Native	1	1	1	0
Asian, white	1	1	1	0
Black or African American	4	2	1	1
Prefer not to respond	3	0	0	0
White	40	16	7	9

For each program cycle, we sent recruitment letters to superintendents of the targeted school districts and hosted an information session in Spring 2021 for interested teachers. We also shared the program announcement via various listservs and contact lists from previous college outreach efforts. We experienced an increase in the number of applications in the second year of the program with teacher referral and broader dissemination.

We recruited ten faculty members in the College of Engineering to participate as faculty mentors. They also recruited one of their graduate students to participate as student mentors. Two faculty mentors were replaced in the second year of the program due to their unavailability. An Industry Advisory Board (IAB) was formed for the program to provide guidance and feedback on the program activities, especially those related to industry engagement, to ensure the teachers are well-informed of the workforce needs in the data analytics space, which can be reflected in their lesson plan development.

Pre-Program Activities

We designed a two-week pre-program to prepare the participants for the summer program. In the first year, the RET participants learned more about faculty mentors in the pre-program through their bios, project descriptions, short video introductions, and more. We also hosted a virtual meet-the-mentors session, where RET participants met with the mentors virtually, learned more about their research, and discussed potential project ideas. In the second year, based on the first-year evaluation feedback, we changed the pre-program to information Q&A sessions where the teachers learn about the program requirements, ask questions and share concerns, while the program team also learns more about the teachers, their subject areas, and their goals for the program.

Summer Program Activities

The six-week summer program started with an orientation week, with five full days of activities including (1) presentations from all RET faculty mentors, (2) a tutorial on data analytics, (3) panel discussion on workforce needs in data analytics, (4) facility tours of local industries, (5) module development workshop by the curriculum coach, and (6) brainstorming sessions on lesson plan ideas. By the end of the orientation week, the RET participants gained a better idea of the mentors' research projects. We successfully match all teachers with a faculty mentor based on their preferences for both program cycles. Using Google Jamboard, we had exciting and insightful brainstorming sessions where all teachers share their ideas for lessons based on each mentor's research and themed around data analytics. From external evaluation report for Summer 2021, in the entirety, the orientation week was successful, all respondents (100%) replied in the affirmative to the following items:

Did the AR-DATA orientation week programming...

1. ... provide you with a better understanding of the content of the AR-DATA program?
2. ... provide you with a better understanding of the process of the AR-DATA program?
3. ... affirm your decision to participate in the AR-DATA program?
4. ... increase your knowledge of data analytics applications?
5. ... increase your interest in data analytics?
6. Were you satisfied overall with the Orientation week program?

Ninety percent replied in the affirmative to the following item: Did the AR-DATA orientation week programming provide you with a good proportion of theoretical and practical learning? Response for Summer 2022 showed a similar result.

During Week 2 to Week 6 of the summer program, each participant worked on their module and lesson plan development, with regular meetings with their faculty and graduate student mentors. The participants met with a curriculum coach weekly, and participated in the weekly cohort meetings where teachers shared their lesson ideas and received feedback and suggestions from other teachers. Teachers also participated in industry tours to see their facilities and discuss data analytics. The summer program ended with a showcase where all teachers presented their developed learning modules and lesson plans. Mentors and teachers were able to ask questions and share ideas to help improve each module development.

Challenges and Opportunities

The pandemic posed challenges of in-class observation during academic-year follow-up, when schools are closed to outside visitors. We observed a few of the lesson delivery virtually and provided feedback to the teachers. However, we were not able to fully assess student engagement. Teachers has found it challenging to disseminate the developed lesson plans via the *TeachEngineering* website due to their template requirements not being the norm for most participants. However, we can share completed lesson plans via our website, and plan to work with the teachers for a broader dissemination.

We found teachers from the same schools can share the program work more efficiently together. Two of the teachers from a school district that has a high percentage of Hispanic students and RLIS rate were able to integrate and expand their lesson plans for a full day event on data and data analytics, which was well-received among the students. AR-DATA program team representatives attended as panelists and observed the “Data Day”. They also partnered with the university for additional panel speakers. Their lesson plans were now written to the district curriculum that will reach more students in the upcoming years.

Acknowledgement

This work is supported by the AR-DATA RET Program funded by the National Science Foundation (NSF: #1953733).

References

1. Zhang, S., Specking, E., Alimohammadi, M., Boykin, A., Bell, S., Schubert, K., Davis, S. “Establishing a Research Experience for Teachers Site to Enhance Data Analytics Curriculum in Secondary STEM Education.” In *Proceedings of the 2021 ASEE Midwest Conference*.