Board 398: Sustaining and Scaling the Impact of the MIDFIELD Project at the American Society for Engineering Education (Year 2)

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Hayaam Osman is a Ph.D. candidate in Engineering Education at Purdue University. She earned her M.S. in Electrical and Computer Engineering Technology from Purdue University and her Bachelor's degree in Electrical Engineering from United Arab Emirates University. Hayaam's research focuses on investigating student success in Engineering programs, employing quantitative methods. She utilizes multi-institutional datasets to explore engineering students' longitudinal development and trajectories.

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Joseph Roy has over 15 years of data science and higher education expertise. He currently directs three national annual data collections at the ASEE of colleges of engineering and engineering technology that gather detailed enrollment, degrees awarded, research expenditures, faculty headcounts, faculty salary and retention data for the engineering community. He is PI of a NSF Advanced Technological Education funded grant to build a national data collection for engineering-oriented technician degree and certificate programs at 2-year institutions. Prior to joining the ASEE, he was the senior researcher at the American Association of University Professor and directed their national Faculty Salary Survey. He also developed a technical curriculum to train analysts for a national survey of languages in Ecuador while he was at the University of Illinois as a linguistic data analytics manager and member of their graduate faculty. He has a B.S. in Computer Science & Mathematics, a M.S. in Statistics from the University of Texas at San Antonio and a Ph.D. in Linguistics from the University of Ottawa.

Sustaining and scaling the impact of the MIDFIELD project at the American Society for Engineering Education (Year 2)

Abstract

The Multiple Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD) has been developed over many years with substantial investment by the National Science Foundation through Engineering Education and Centers in the Engineering Directorate and the Division of Undergraduate Education in the Education and Human Resources Directorate. This project is focused on transitioning MIDFIELD to the American Society for Engineering Education (ASEE). The current team of MIDFIELD researchers continues to support this project including helping others learn to use the database. We have developed detailed tutorials in R that introduce MIDFIELD, key metrics, and example scenarios. We have also designed and facilitated workshops. In year 2, we offered the MIDFIELD Institute, an online three-day workshop to help researchers learn about and use MIDFIELD effectively. Attendees included graduate students, early career faculty, senior faculty, and an NSF program officer. Results from the 2023 offering of the MIDFIELD Institute are described in this paper. Dissemination and products are also summarized.

Transitioning MIDFIELD to ASEE

Archiving and maintaining the data collection at ASEE ensures that the current dataset will be preserved and grow to include a larger and more diverse set of institutions. This will enable insights from this rich resource to continue to be discovered and, through ASEE's national platform, influence multiple national stakeholders. For more information, including how to access the data, see https://midfield.asee.org/.

Expanding the Network of Researchers: MIDFIELD Institute

The current team of MIDFIELD researchers continues to support this project, including helping others learn to use the database. This has involved developing tutorials and designing and facilitating the MIDFIELD Institute, an online three-day workshop to help researchers learn about and use MIDFIELD effectively.

We have developed detailed tutorials in R that introduce MIDFIELD, key metrics, and example scenarios. We have created an R data package, *midfielddata*, that provides a stratified sample of MIDFIELD data as a publicly available practice data set [1]. The practice data can be accessed and manipulated using *midfieldr*, an R package that provides tools for studying MIDFIELD student unit record data [2].

The third MIDFIELD Institute was held July 12-14, 2023 with an optional help session on July 11, 2023. Based on a successful offering in 2022 online, we decided to host this workshop online using Zoom. We met for 4 hours per day from 1 pm to 5 pm Eastern Time with breaks approximately once per hour. The institute attracted 13 participants who registered and attended at least one day with nine attending all three days. Participants came from nine institutions. Attendees included graduate students, early career faculty, senior faculty, and an NSF program officer. One notable feature is that a MIDFIELD Institute participant from 2022 returned to

share some of her experiences and findings with MIDFIELD with the 2023 participants. The agenda included:

Day 1: Wednesday July 12 1 pm–5 pm

1:00–1:50 Introduction of Facilitators, MIDFIELD, and Objectives of the Institute

1:50–2:00 Break

2:00–3:00 Exploring data structures using Student Examples

3:00–5:00 Guided Practice: Self-paced case study using midfieldr and midfielddata. Real-time help. Check in with facilitators before leaving.

Day 2: Thursday July 13 1 pm–5 pm

1:00–1:30 Metaphors and Metrics

1:30–1:40 Break

1:40–2:30 Guided Practice (Case Study: Results)

2:30–3:20 Data Visualization 1

3:20–3:30 Break

3:30–5:00 Drafting a Research Question. Define a problem in the data that interests you with facilitators' assistance, form small groups. Report out research questions and discussion. Check in with facilitators before leaving.

Day 3: Friday July 14 1 pm–5 pm

1:00–2:00 Data Visualization 2: Expanding your graphical repertoire

2:00–2:10 Guest Speaker "Sankey diagram" by Erica Ives (MIDFIELD 2022 Participant)

2:10–3:30 Work on your research question (consulting with the MIDFIELD team)

3:30–4:30 Progress Report to the Group. Discussion

4:30–4:45 Wrap-up

Evaluation

At the conclusion of the workshop, participants were invited to complete a Likert-style survey. Eight participants responded. All of them reported that they had installed R, R studio, and *midfieldr* prior to the start of the workshop. Seven of the eight had also installed *midfielddata*. By the end of the workshop, six participants reported having finished the practice modules on R basics, R chart basics, R data basics, Case Study: Data, and Case Study: Results. Two participants did not finish the Case Study: Results.

Participants were asked several questions and the distribution of their responses is shown in Figure 1. The top scale assists counting total agreement; the bottom scale assists counting total disagreement. The chart illustrates that respondents had a high level of agreement on all questions with only one "disagree" on each of three questions and no "strongly disagree" at all.

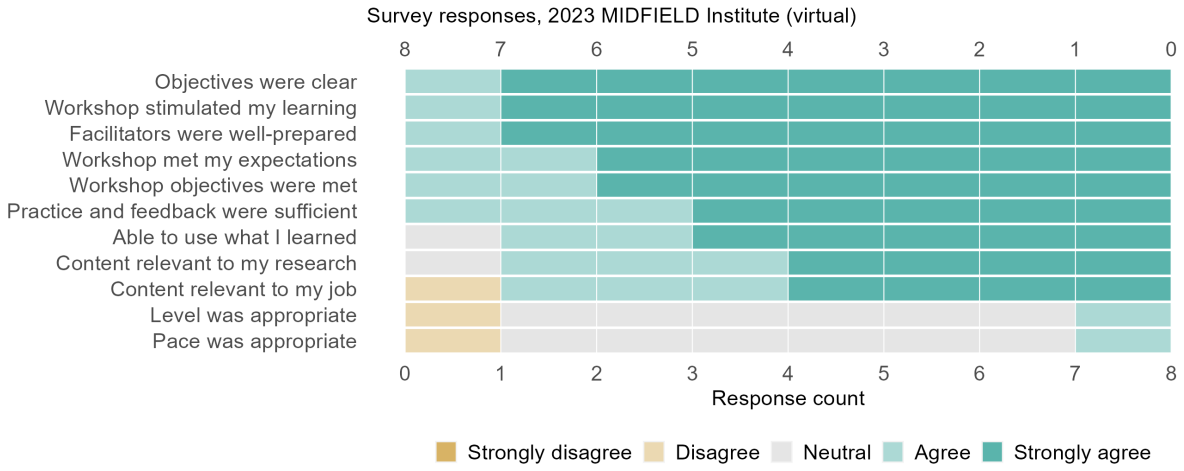

Figure 1. Post-workshop survey result from 2023 MIDFIELD Institute.

When asked what was most valuable about the workshop, participants were enthusiastic about working the MIDFIELD data. They shared

- getting to work with the data
- time to play with the data!
- I appreciated getting to share space with such knowledgeable folks, and being able to ask so many questions about the data
- shared resources
- Everything was great. I had minimal knowledge of the database and R, and I walked away with a solid plan to create some meaningful research and a start on writing the code to analyze the data. Being able to ask questions to experts in real-time was invaluable, and I appreciated that a prior participant came to share her experience!
- Talking about the ins and outs of the data set.

In response to what was the least valuable part of the workshop, six participants had no response or said "nothing." Others said

- I felt everything was fairly valuable. Again, I have minimal R experience, so the data visualization presentations felt a little abstract. I would have appreciated more of a walkthrough on how to create each of the different charts (although maybe that's in the resources page and I haven't found it yet ;))
- Too much information about display design. Giving a short overview with resources would be better.

Participants provided several ideas for improving the workshop with many of these specific to their own needs. For this offering, no logistical items such as scheduled breaks or more time for R before the workshop so it could focus on MIDFIELD were mentioned. We had intentionally included these in response to previous feedback. Two participants had no suggestions. Others suggested:

- I think sharing some broad papers as suggested reading before the meeting would be helpful. I would have liked to see the types of questions that had already been looked at and answered before "diving in"
- There was some of this but I would take less time presenting the results of the past studies and more time on the progression of those studies from initial to final analysis
- I think the hard part is that there wasn't a lot of time to dig deep into our projects (but I also just had a million questions about mine...)
- additional small groups rounds of sharing or feedback. Themed sets of vignettes.
- As someone who came in with minimal R programming knowledge, I didn't feel like I had enough solo work time to make significant progress on the research question I chose. A more thorough walkthrough of the vignettes section may have helped me track down the specific resources which would have helped. Also, linking directly to the vignettes page on the Institute webpage would be helpful because I had a hard time finding it!
- I would like the facilitators to give us a question to answer with the practice data set. Something different from the case study. Then put us in groups to try to answer it. Jumping straight from the case study to our own research question was very overwhelming.

Feedback from this evaluation will be used to improve subsequent offerings. The next offering of the MIDFIELD Institute is planned for June 11-14, 2024 with extra office hours on June 10. Information is available at https://midfieldr.github.io/2024-midfield-institute/

Dissemination and Products

Materials from the MIDFIELD Institute are available online, including the agenda, slides, and self-paced tutorials [3].

To reach audiences in engineering education, we presented at several venues during Year 2. To raise awareness of MIDFIELD, the MIDFIELD team handed out cards advertising the MIDFIELD Institute at the *ASEE Annual Conference and Exhibition* in June 2023. At this conference, we also presented a poster in the NSF Grantees Session [4] and presented a paper in the New Engineering Educators (NEE) Division [5]. This NEE paper summarized the lessons we have learned about working with longitudinal student records and provided a primer for those interested in doing such work. In October 2023, we presented a paper at the *Frontiers in Education* (FIE) conference [6]. This used the most recent version of MIDFIELD to examine student pathways among academic fields including Arts and Humanities, Business, Engineering, Other, Social Sciences, and STM (Science, Technology, and Mathematics).

The Comprehensive R Archive Network (CRAN) is the central software repository for R packages. We published the *midfieldr* R package on CRAN in July 2023. As shown in Figure 2, the package has been downloaded by 1337 users by January 2024.

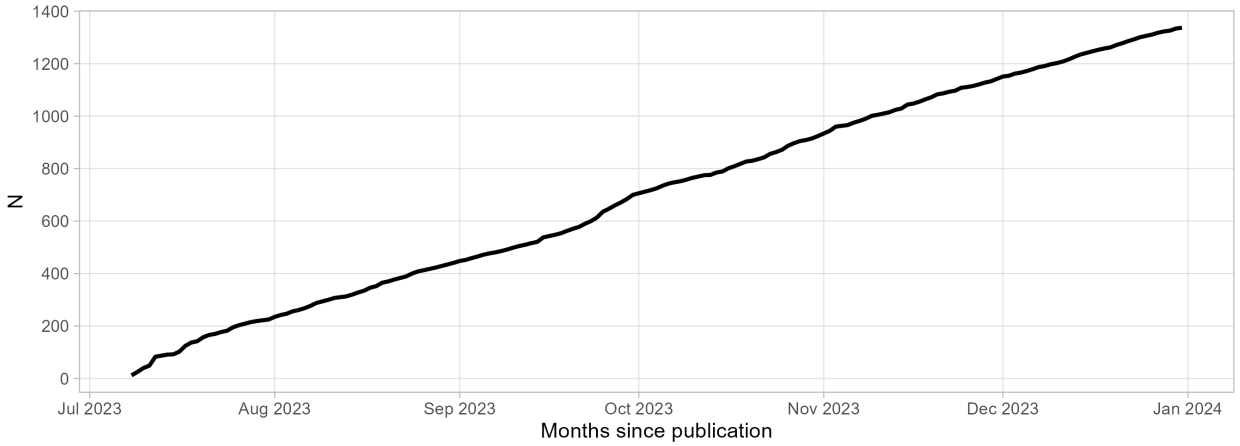

Figure 2.Cumulative number of midfieldr package downloads from CRAN.

MIDFIELD's impact on published work

The MIDFIELD team includes Matthew Ohland, Marisa Orr, Richard Layton, Catherine Brawner, Susan Lord, and Russell Long. As of February 2024, a total of one book [7], one book chapter [8], 141 journal and conference publications, and nine doctoral dissertations have utilized MIDFIELD. The context of these studies ranges from exploring success metrics [6] to diversity in engineering [9] to leveraging curricular analytics [10] and includes contexts outside of engineering [11].

The MIDFIELD team are authors on 118 journal and conference publications, such as investigating the role of MIDFIELD and how it can be used [12, 13] and has focused not only on performance among American students but also among international students [e.g., 14]. Additionally, MIDFIELD has been used by researchers beyond the MIDFIELD team with 27 publications authored exclusively by non-MIDFIELD team members. These studies range from comparing graduation timing across diverse student groups [15] to algorithm designs in education applications [16].

Conclusions and Future Work

Research with MIDFIELD has been impactful and broadly disseminated. In this project, the MIDFIELD team is focusing on transitioning MIDFIELD to the American Society for Engineering Education (ASEE). The current team of MIDFIELD researchers continues to help others learn to use MIDFIELD. We have developed tutorials that introduce MIDFIELD, key metrics, and example scenarios as well as facilitating workshops. In year 2, we offered the MIDFIELD Institute, an online three-day workshop to help researchers learn about and use MIDFIELD effectively. In the final year of the project, we plan to offer the MIDFIELD Institute in June 2024 and continue transitioning MIDFIELD to ASEE.

Acknowledgments

We are grateful for the support of the National Science Foundation through Grants 2142087 and 214903.

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