

Expanding Access to and Participation in MIDFIELD (Year 5)

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Susan M. Lord received a B.S. from Cornell University in Materials Science and Electrical Engineering (EE) and the M.S. and Ph.D. in EE from Stanford University. She is currently Professor and Chair of Integrated Engineering at the University of San Diego. Her research focuses on the study and promotion of diversity in engineering including student pathways and inclusive teaching. She is Co-Director of the National Effective Teaching Institute (NETI). Her research has been sponsored by the National Science Foundation (NSF). Dr. Lord is among the first to study Latinos in engineering and coauthored *The Borderlands of Education: Latinas in Engineering*. Dr. Lord is a Fellow of the IEEE and ASEE and is active in the engineering education community including serving as General Co-Chair of the Frontiers in Education Conference, President of the IEEE Education Society, and Associate Editor of the IEEE Transactions on Education (ToE) and the Journal of Engineering Education (JEE). She and her coauthors received the 2011 Wickenden Award for the best paper in JEE and the 2011 and 2015 Best Paper Awards for the IEEE ToE. In Spring 2012, Dr. Lord spent a sabbatical at Southeast University in Nanjing, China teaching and doing research. She is on the USD team implementing "Developing Changemaking Engineers", an NSF-sponsored Revolutionizing Engineering Education (RED) project. Dr. Lord is the 2018 recipient of the IEEE Undergraduate Teaching Award.

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Catherine E. Brawner is President of Research Triangle Educational Consultants. She received her Ph.D. in Educational Research and Policy Analysis from NC State University in 1996. She also has an MBA from Indiana University (Bloomington) and a bachelor's degree from Duke University. She specializes in evaluation and research in engineering education, computer science education, and technology education. Dr. Brawner is a founding member and former treasurer of Research Triangle Park Evaluators, an American Evaluation Association affiliate organization and is a member of the American Educational Research Association and American Evaluation Association, in addition to ASEE. Dr. Brawner is also an Extension Services Consultant for the National Center for Women in Information Technology (NCWIT) and, in that role, advises computer science and engineering departments on diversifying their undergraduate student population. She remains an active researcher, including studying academic policies, gender and ethnicity issues, transfers, and matriculation models with MIDFIELD as well as student veterans in engineering. Her evaluation work includes evaluating teamwork models, broadening participation initiatives, and S-STEM and LSAMP programs.

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Russell Long, M.Ed. was the Director of Project Assessment at the Purdue University School of Engineering Education (retired) and is Managing Director of The Multiple-Institution Database for Investigating Engineering Longitudinal Development (MIDFIELD). He has extensive experience in performance funding, large data set analysis, program review, assessment and student services in higher education. One of his greatest strengths lies in analyzing data related to student learning outcomes and, therefore, to improving institutional effectiveness. His work with MIDFIELD includes research on obstacles students face that interfere with degree completion and, as well, how institutional policies affect degree programs. His group's work on transfer students, grade inflation, and issues faced across gender and ethnicity have caused institutions to change policies so that they may improve. Awards and publications may be found at <https://engineering.purdue.edu/people/russell.a.long.1>.

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Richard A. Layton is Professor Emeritus of Mechanical Engineering at Rose-Hulman Institute of Technology. He received a B.S. from California State University, Northridge, and an M.S. and Ph.D. from the University of Washington. He is a founding developer of the CATME system and a co-author of the Engineering Communication Manual. Now retired from teaching, he devotes his time to data visualization consulting, woodworking, and songwriting.

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Executive Summary

This National Science Foundation (NSF)-sponsored project aims to expand the number of institutions participating in the Multiple-Institution Database for Investigating Longitudinal Development (MIDFIELD) and increase the number of researchers using the dataset for research. MIDFIELD is a resource enabling the study of students that includes longitudinal, whole population data for multiple institutions. More details about the dataset are available in [1]. Information about the MIDFIELD team and research conducted using MIDFIELD is available on the MIDFIELD website [2].

Expanding Participation

This project aims to expand MIDFIELD database from 11 to approximately 100 institutions containing over 10 million student records and representing over 50% of the U.S. engineering undergraduate degrees awarded. The expanded dataset also increases the diversity of institutions in the dataset to include public and private institutions, additional minority-serving institutions (MSIs), and institutions from a range of Carnegie classifications. The scope of MIDFIELD will enable significant improvements in research in higher education. It will enable the development of research capacity to examine student characteristics (race/ethnicity/sex/prior achievement) and curricular pathways (including coursework) by institution and over time. Because the dataset contains students records of all students matriculating at these institutions over a period of time, researchers can study students across all disciplines, not just engineering. Due to the broad nature of the disciplines represented by MIDFIELD, this project has cross-Directorate support from the Directorates of Engineering, Math and Physical Sciences (MPS), and Education and Human Resources (EHR) as well as the Office of Integrative Activities (OIA). Within the MPS Directorate, this work is supported by Astronomy and Physics; within EHR, this work is supported by the EHR Core Research (ECR) program.

As of March 2, 2021, there are 33 institutions in MIDFIELD. A map of the current MIDFIELD institutions across the USA and their status is shown in Figure 1 and an interactive map is also available at <https://engineering.purdue.edu/MIDFIELD/Institutions%20Map.html>.

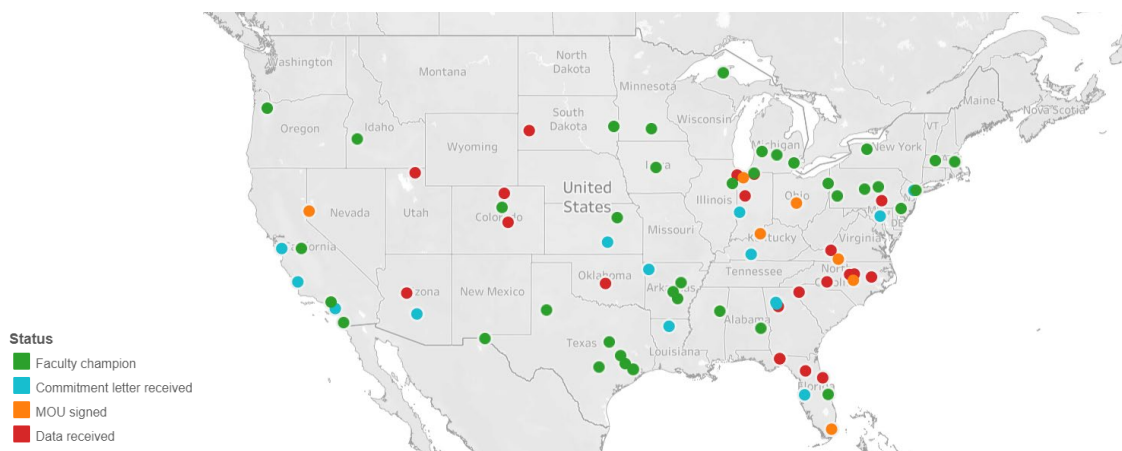


Figure 1 Map of MIDFIELD partners as of February 21, 2021.

Changes in Implementation – Data Collection

A number of institutions that had provided commitment letters promising to join the partnership have not followed through on those commitments. Some have provided reasons for the change of plans such as personnel changes. Others have been less communicative. Given the remaining project timeline, this has resulted in a strategic shift to make progress toward our objectives by reaching out to entire university systems about joining the partnership – particularly university systems where one or more institutions have already provided commitment letters or shared data with the project.

Changes in Implementation - Archiving

We have revised our implementation strategy to help us achieve our goal of expanding institutional participation. We received NSF approval to reallocate funds from our unallocated subcontract budget – that part of our budget used to support institutions as they compile data to contribute to MIDFIELD. We have moved some of these funds to support a partnership with the American Society for Engineering Education (ASEE) that has yielded a plan to make ASEE the archivist instead of the Interinstitutional Consortium for Political and Social Research (ICPSR). Although ICPSR is better known as an archivist, ASEE is certainly better known among engineering education researchers. When the data are available from ASEE, we (and ASEE) can publicize the availability of the dataset outside the engineering education community so that researchers in Sociology, Education, and other fields can use it for research. ASEE has worked with their data management service to develop a plan for this process. As a result of the planning process, it is clear that ASEE cannot complete the transition during the timeframe of this award due to both the timing and scope of the work required.

The partnership is expected to benefit from the support of the ASEE Deans Council in encouraging institutional participation in MIDFIELD and ASEE's support in publicizing MIDFIELD. This will also allow the generation of DataBytes for publication in ASEE's PRISM magazine using MIDFIELD data – some in partnership with MIDFIELD researchers. We also expect to develop feedback mechanisms and a community forum to support researchers using MIDFIELD (through ASEE or another avenue).

We believe that this partnership will set MIDFIELD on a path to reduce the cost of adding new institutions and make MIDFIELD more visible and accessible to researchers.

Documentation of Institutional Policies

In addition to collecting student record information, we are continuing to compile academic policy information for each partner institution. This involves collecting and coding catalogs from each of the partner institutions during the time period of the data collected. A team of undergraduate students has been trained in human subjects' research protection and the use of NVivo software. For each partner institution and for each year they have contributed data to the MIDFIELD database, the student research team is coding the university catalogs in these areas:

- Admissions policies for engineering students – including high school GPA, standardized test scores, transfer admissions, preferential admissions (e.g., highly qualified, sociodemographic characteristics, or of a particular faith), awareness of financial need, and policies regarding admission of international students.

- Academic progress policies for engineering students - GPA and course requirements for maintaining satisfactory progress towards a degree, and required coursework for engineering; also measures of unsatisfactory progress, including warning, probation, suspension, and expulsion and performance needed to return to good academic standing.
- Engineering matriculation model – admission to a first-year engineering program, admission to a pre-engineering status, admission to an engineering major, admission to engineering for less qualified students.
- Financial aid - for highly qualified state residents (e.g., Georgia’s HOPE scholarship), “loan free” aid policies, or for members of sociodemographic groups, standards for retaining aid.
- Grading policies – grading scale, handling of incomplete grades, course repeat, forgiveness, withdrawals.
- Disability policies, including services provided and requirements to access services.

As of March 1, 2021, policy summaries have been completed for 26 institutions and are in progress for 17 additional institutions. Summaries, the complete codebook, and the NVivo project files can be made available to researchers who wish to include institutional context with their study of MIDFIELD variables and outcomes. The COVID-19 pandemic slowed our progress substantially when our campus workplace was closed and the research team had to adjust to working remotely in addition to continuing their studies remotely. Student workers often did not have access to suitable computing and Internet resources to successfully engage with the project.

Expanding the Network of Researchers

Another important goal of this project is educating the broader research community, expanding the network of researchers capable of conducting this research, and sharing of innovative research methods in addition to the actual data. At the 2020 Frontiers in Education (FIE) conference, we held a special session that described MIDFIELD and highlighted some of the work done by attendees of the 2019 MIDFIELD Institute using MIDFIELD [3, 4, 5, 6, 7]. Despite COVID-19 and the need to conduct this session online, it was successful with enthusiastic participants. Another MIDFIELD Institute attendee has also conducted research with MIDFIELD related to students in Computer Science and published this work in several venues in 2020 and 2021 [8, 9, 10, 11]. A workshop entitled “Engaging with MIDFIELD data” was accepted for presentation at the 2020 ASEE conference but was not conducted due to COVID-19. It is planned for the 2021 ASEE Conference. The MIDFIELD research team is working on strategies for presenting this workshop and subsequent workshops in an online format. For the 2021 ASEE conference, the team will be prepared to present in-person or online depending on the global health situation.

For these workshops and the MIDFIELD Institute, we created two R packages to facilitate access to MIDFIELD data and to provide tools for processing the data. *midfielddata* is an R data package that provides a practice data set of student records for 97,640 undergraduate students from 1987 to 2016 with anonymized student and institution IDs [12]. The second R package is *midfieldr*, providing programming tools for studying MIDFIELD student records [13]. For example, one can select specific academic programs to study, group and summarize by

race/ethnicity, sex, and program, and compute and graph various persistence metrics. We chose the R software environment because it is free, open source, available on every major platform, and provides superior tools for contemporary data graphics [14]. Both packages are freely available via GitHub.

The prospective use of *midfieldr* extends beyond the workshops and the Institute, however. Because the practice data set is congruent with the larger MIDFIELD database, the tools in *midfieldr* can be also used for research by members of participating MIDFIELD institutions. The detailed tutorials at the *midfieldr* website let users take advantage of the MIDFIELD team's experience with the data, analysis, metrics, and data graphics.

Dissemination

Despite the COVID-19 worldwide pandemic, the MIDFIELD team has continued to disseminate results from research using MIDFIELD in the last year in various venues including conferences, invited talks at universities [15, 16], and as panelists [17]. At the 2020 ASEE Annual Conference, we presented a summary in the NSF Grantees session [18]. A journal paper comparing MIDFIELD and the ASEE dataset appeared in the *International Journal of Engineering Education* in 2020 [19]. Additionally, we have been invited to expand our FIE Special Session paper for inclusion in a special issue of *IEEE Transactions on Education* celebrating the 50th Anniversary of the FIE Conference.

Acknowledgments

We are grateful for the support of the National Science Foundation through Grant 1545667.

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