Board 429: Work in Progress: Capacity-Building for Change Through Faculty Communities Exploring Data and Sharing Their Stories

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Motivation and Project Overview

This NSF Improving Undergraduate STEM Education (IUSE: EHR) Institutional and Community Transformation (ICT) capacity-building project is designed to support faculty to collaboratively explore questions on student learning and success in introductory and gateway undergraduate STEM courses, such as early engineering courses as well as prerequisite math and science courses. The project is motivating faculty to consider evidence-based teaching strategies by including them as co-designers of learning analytics tools and storytellers inspired by the data and their reflections. Learning analytics uses data about learners and learning to draw inferences to inform actions and changes to achieve a goal, which for this project is improving student success and retention in early STEM courses [1]. Learning analytics is an emerging approach to motivating STEM faculty to implement evidence-based teaching practices.

The project also builds and strengthens faculty communities and develops a culture of inquiry and conversations that are data-informed – all to build readiness for transformation. We are exploring how a change framework for intentional capacity building by creating faculty communities with similar interests across disciplines and course-level data dashboards can establish the foundation for implementing change in their instructional practices and curriculum, with faculty members becoming change agents [2]. The setting of this project is the University of Southern Indiana, which is a public, regional, primarily undergraduate institution (PUI) in the Midwest United States. Approximately 1,000 undergraduate students enroll in STEM majors, including approximately 400 engineering majors, in the participating college, which has nearly 90 full-time faculty members in STEM. This paper describes the activities during Years 2 (2021-2022) and 3 (2022-2023) of this capacity-building project.

The project tests three assumptions, grounded in theories of change and assumptions (described in [1]), that guide this project: providing faculty with multiple ways to engage with challenges to student success and evidence-based teaching will cultivate motivation to consider change in instruction and curricular design; data alone will not drive change, but rather developing connections with data and evidence will help motivate transformation; and systems thinking establishes an effective framework to organize efforts to facilitate change [3-9]. Moreover, the activities are grounded in the idea that "significant conversations and significant networks" can influence faculty as they develop their understanding of teaching and learning [7].

The project's overall framework for engaging faculty in long-term change is summarized as:

engagement + data + community (with stories as a thread) = motivation + knowledge --> transformation.

This is operationalized through multiple activities: 1) opportunities for faculty to discuss engineering/STEM education literature and evidence-based instructional practices and related institutional data, 2) co-designing and using institutional academic data dashboards, and 3) building community within and across departments and offices. Through brief (15-20 minutes)

mini-activities once a semester and more frequent faculty community (FC) discussions, this project is increasing faculty engagement in issues related to student learning, success, and retention in STEM introductory and gateway courses, which are part of the engineering curricula. These activities, together with reflective stories about how faculty participants' perspectives and understanding of student success issues have evolved, can be used to motivate change.

While most transformation projects and use of learning analytics have been conducted at large research institutions, the findings from this project will contribute to the knowledge in engineering education change in the context of a public, regional, primarily undergraduate institution in the Midwest. This work-in-progress paper describes the grounding, planning, and implementation of these strategies to build capacity for change as well as shares the challenges encountered, strategies used, and lessons learned.

Learning Analytics Dashboard Development and Initiation

To date, a total of individual 17 faculty members have been involved one or both faculty communities (Data Tools Co-Design FC, Inquiry in STEM Success FC) since the start of the project (Spring 2021-Spring 2023), with 6 faculty participating in the Data Tools Co-design FC and 14 faculty participating in the Inquiry in STEM Success FC, with most participants continuing each semester. Faculty are recruited to join the FCs during the mini-activities at the beginning of the semester. The Inquiry in STEM Success FC focuses on exploring topics of interest related to evidence-based instructional strategies and addressing barriers to student success. The Data Tools Co-Design FC focused on guiding and testing the learning analytics dashboards, with the intent that the dashboards provide data actionable by faculty.

Phase 1 Discovery: Through the Data Tools Co-Design Faculty Community (FC) and working with the data analytics consultants and institutional research office, the project team has identified the set of available institutional data, developed an inventory of existing academic data sets and dashboards, and explored similar tools developed at other universities (e.g., Indiana University Bloomington, University of California Davis, University of Kansas).

During Year 1, over 80 Questions and “I Wonders” (QWs) were developed through the Data Tools Co-Design and Inquiry in STEM Success Faculty Communities sessions (prompted by reading papers and national reports on student success and retention in STEM) and visit to a meeting of the STEM department chairs. Members of the Data Tools Co-Design FC categorized the generated Q&Ws according to data category, when faculty would use the information, and why a faculty member might use the data.

- **Category** codes: student demographics, student preparation (transfer credits, prerequisites, high school scores), student performance (GPA, retention rate, repeats), student choice (major, pathway toward graduation), Class-level data (assessment scores, participation).
- **When** codes: Before/at start of semester, During the semester, Longitudinal
- **Why** codes: Course decisions for all students in class, Specific interventions for student sub-groups, Academic advising, Course sequence for a program, Other purposes

Each QW was coded by 2-3 individuals with primary and secondary codes (Table 1). The QWs coding were used by the data consultants to identify themes (Table 2) for three focus group sessions with the Data Tools Co-Design FC in Fall 2021. Informal stories that were shared during the Inquiry in STEM Success and Data Tools Co-Design FCs also contributed to these themes.

Table 1. Frequency (counts) of Primary and Secondary Codes for all QWs generated (n=81).

Category	Category1	Category2	Why	Why1	Why2
Demographics	6	5	Course	23	13
Preparation	16	12	Specific	20	11
Performance	35	17	Advising	21	16
Choice/pathway	7	6	Sequence	14	13
Class-level data	15	9	Other	3	3

Table 2. Themes from the Most Common QWs (n=35).

Theme	Count
Bottlenecks	12
Course repeats	5
DFW	9
Early alerts	2
Math	7
Learning/concepts	3
Teaching approaches	5
Student-related info	2

Common types questions that faculty thought that institutional student data could help address include:

- Student performance: repeats, DFW rates
- Student attributes and preparation
- Identifying bottlenecks in course sequences
- Customizing course; inform course/sequence redesign
- Assessing impacts of changes

These themes are similar to the questions faculty at large research-intensive institutions with learning analytics programs, such as at Indiana University, Kansas State, and University of California Davis [11, 12].

Phase 2 Iterative Tools Development**:** During Year 2, the Data Tools Co-Design FC guided and tested two learning analytics dashboards, through multiple cycles of draft dashboard pages. The project team and external data dashboard consultants met virtually with a learning analytics expert introduced by one of the project External Advisory Board members to learn about the technical and use of such dashboards with faculty.

Two similar dashboards were created for introductory courses in the Chemistry and Mathematical Sciences departments. Engineering majors are required to take and pass courses in both departments. Chemistry was selected because one of the members of the Data Tools FC is chair of this department and a willing supporter, and Math was selected because the Pre-Calculus

to Calculus sequence impacts many students across engineering programs. Both dashboards include a "Who are Your Students" page with aggregate student information at the course section level and "Course Sequence" grade distribution pages with aggregated data at the course level (aggregated across multiple sections). The Course Sequence pages shows a matrix of course grades for course pairs, such as Calculus 1 and Calculus 2, which can be filtered by student attributes (student demographics, major, number of attempts/repeats). During Year 3, the dashboard activities focused on developing use cases and guidance documents for the dashboards.

Lessons Learned and Challenges

The process for identifying and prioritizing what dashboards to develop has been long and slow. While developing these learning analytics dashboards could be a relatively straightforward project for the Institutional Research office, an intentional process that engaged faculty as co-designers to help develop buy-in and to directly incorporate faculty perspectives was taken. Testing the dashboards troubleshoot technical issues and data definitions required multiple iterations. The dashboards currently are in draft stage and will require additional iterations of testing before they are demonstrated to initial groups, such as the Inquiry in STEM Success FC and department chairs. Developing trust in the data is an important consideration. Introducing elements in the mini-activities during the college-wide meetings each semester help to introduce and start normalizing the connection between data, observations, and assumptions.

Some faculty and department chairs across the college expressed concerns on who could access the dashboards since the data was at the course or section level. It was emphasized by the dean that the dashboards were not intended for faculty evaluation but rather to provide data to inform decisions on instruction, course design, and the curriculum to support our students. Some faculty also had concerns about the potential for the dashboards to create or heighten bias or stereotypes. The project team and the Data Tools Co-Design FC are developing data definitions, guidance documents, and example use cases and exercises (from different perspectives) as part of a professional development and training that would be required before faculty could access the dashboards. This is intended to guide faculty from focusing on the exceptions and rare cases and more towards the use of aggregate data (that can be disaggregated) to identify bottlenecks, gaps, and trends that could be addressed to support student success and improve student retention. The data will also be used to explore the stories that faculty tell about their observations, in which the data might tell different stories from the assumptions that faculty might have, providing potential levers for change.

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