Massachusetts PKAL Network Summer Meeting  
Fitchburg State University  
June 12, 2024

Back to the Future:  
How Lessons from the Past Can Inform New Directions

8:15-9:00: Breakfast and check-in, Hammond Main Lounge

9:00-9:10: Opening remarks, Hammond Main Lounge

Kristin Wobbe, Director, Center for Project Based Learning, Worcester Polytechnic Institute

We’re never really done perfecting our teaching but in this session, we’ll celebrate the things, big or small, that we’ve done recently to improve our students’ learning experiences. We’ll consider the common themes and review the research as to the elements that best support student learning. I’ll share some recent findings about what the long-term impacts of high quality projects are for our students. And before we go, we’ll spend some time identifying current challenges and crowd sourcing solutions. The goal is for everyone to leave with a new idea, feeling like this was time well spent.

10:25-10:35: Coffee break

10:35-11:25: Concurrent Session I

Session A. Workshop, Building Connections: The Pedagogy of Real Talk (PRT) in STEM Classrooms  
Emma Downs, Billy Samulak, Chris Cratslley, Fitchburg State University

Fitchburg State University has invested in a three-year faculty development program known as the Faculty Academy to better support diverse students across all disciplines. This project is built around pedagogical practices outlined in “The Pedagogy of Real Talk : Engaging, Teaching, and Connecting With Students At-Promise” by Dr. Paul Hernandez. The core focus of PRT is that building connections between faculty and students leads to “at promise” students having a higher chance of success in college classrooms and beyond. “At promise” students are those who have been traditionally defined as “at risk” but are better defined by their often unrecognized potential in our classrooms. As STEM faculty in this program, we have found these practices to be effective in helping us support our students. These student-faculty connections are built through “real talks” and “alternative lessons.” Presenters will define these pedagogical practices, provide background, and share examples of both “real talks” and “alternative lessons”. As part of the workshop, participants will be given a chance to explore their own ideas about real talks and consider potential themes for alternative lessons. Through this workshop participants will develop a better understanding of the goals, techniques, and implementation of PRT in the STEM classroom.

Session B. Workshop, Calculating Ecological Footprints  
Chris Picone, Fitchburg State University

An important tool in sustainable thinking is to estimate how much land area (i.e., “footprint”) is required to provide all the resources consumed by human societies. In this workshop, we will review three activities for intro classes to estimate ecological footprints. One activity has students calculate how much land area is needed to grow their personal food supply for one year. A second estimates their household water consumption. A third exercise calculates total emissions of carbon dioxide from their household, and how much forest is needed to sequester that carbon. Each exercise includes readings and questions about the most effective strategies to reduce those footprints.
Workshop participants will explore one exercise of their choice, and then we will discuss several questions: 1. How can readings and assigned questions complement these kinds of activities? 2. How can these exercises reinforce foundational skills in quantitative reasoning? 3. Are these types of exercise a waste of time, because they place the onus on the individual consumer rather than the structural changes that are far more important?

Session C. Workshop: Gendered experiences and attitudes towards lab work and group work in STEM gateway courses
Brandi Baldock and Gwyne White, Merrimack College

There is broad consensus that cross-cutting scientific skills (e.g., teamwork and communication), represent an essential competency domain for STEM students. These skills can be developed through performing experiments with lab partners and working on group projects. For a myriad of historical and interpersonal reasons, students with identities marginalized in STEM (e.g. women, BIPOC, neuro-diverse, etc.) may experience team-work as more challenging. The goal of this project was to better understand how STEM majors feel about working with lab partners and in groups, and how they would prefer such experiences to be structured.

Data was collected from a sample of STEM students with a subsample who completed a follow-up survey. Survey questions exploring student preferences and attitudes towards laboratory engagement and group work were developed. Previously validated measures of group preference, STEM identity and career plans were also utilized.

This workshop will focus on how student identity characteristics (race, gender, neurodiversity) impact their approach to lab partners and group work. Preliminary results found that female students were significantly more likely to report feeling anxious about working in groups than male students. Subsample analyses further found that female students, relative to their male peers, reported significantly lower perceptions of their STEM identity and significantly stronger preference for good work habits in their group partners. Non-White students reported stronger social motivation in their choice of group mates than their White peers. No significant differences were found between neurodiverse and neurotypical students in these domains.

Small group discussions will be used to engage the audience. Presentation attendees will consider the implications of our findings for their own work, and apply them towards designing group-work experiences to support success in a diverse range of STEM students at their own institutions.

11:25-11:40: coffee break

11:40-12:40: Concurrent Session II

Session D. Developing and strengthening STEM research skills

The Power of Culminating Research Poster Project in a Challenging STEM Class
Reena Randhir, Springfield Technical Community College

The culminating research poster project in a STEM class aligns with contemporary educational reform efforts aimed at promoting active learning, teamwork, and the development of essential skills for future STEM professionals. This also embraces the Universal Design for Learning practice that can address equity and diversity in a classroom. This class project is active learning at its best, increasing student engagement that promotes retention. Students also develop their scientific thinking process which is crucial for success in STEM fields. By applying the concepts learnt to address world challenges students understand the importance of STEM innovation. Students are introduced to the research project early in the semester, selecting topics relevant to their life experiences. The faculty provides guidance on research methods, data collection, and analysis through shared google slides. This evaluation represents a capstone experience where students synthesize and present their knowledge in a comprehensive, visual format and interact with attendees at a local conference. The effectiveness of this project is evaluated by both qualitative and quantitative tools, including student feedback, academic performance, quality of the research posters and class retention. This is a high impact practice which is engaging and effective learning that can better prepare our students for the demands of the 21st-century workforce. To enhance audience engagement during the presentation, there will be a Q&A session and a student sample poster study activity. This presentation aims to inspire the attendees to apply similar projects in their own classes.
Fostering Student Authorship in Biology
Louis Roberts and Natalie Fary, Worcester Polytechnic Institute

Developing a scholarly identity by engaging in a scientific community through writing and communication is an important component for STEM retention, particularly for underrepresented individuals. Several excellent pedagogical tools have been developed to teach scientific literacy and measure competency in reading and interpreting scientific literature. However, fewer tools exist to measure learning gains with respect to writing, or that teach the more abstract processes of peer review and scientific publishing, which are essential for developing scholarly identity and publication currency. We will describe our approach to teaching scientific writing and publishing to undergraduate students within a synthetic biology course. Using gold standard practices in project-based learning, we created a writing project in which students became experts in a specific application area of synthetic biology with relevance to an important global problem or challenge. To measure learning gains associated with our learning outcomes, we adapted and expanded a concept inventory to include additional questions about the process of scientific writing, authorship, and peer review. Our results suggest the project-based approach was effective in achieving the learning objectives with respect to writing and peer reviewed publication, and resulted in high student satisfaction and student self-reported learning gains. We propose that these educational practices could contribute directly to building and developing scientific identity in undergraduate students, which may increase retention in STEM particularly for underrepresented groups. During the presentation we will guide faculty in the process of adapting our project learning outcomes and assessments to their courses. Our goal is attendees will be able to define learning outcomes for a writing project, map these onto course learning outcomes and assessment questions, and develop a strategy to deploy their project in an upcoming offering.

Targeting Success: Enhancing Retention and Achievement for Low-Income STEM Students through Faculty-Mentored Research
Eric Williams, Fitchburg State University

We endeavored to create a program that would harness the power of faculty-mentored research to improve retention, student achievement, and student satisfaction. Factors such as low income, first-generation status, and low incoming GPA are known to decrease success rates. For example, we find that 70% of incoming freshmen STEM students are retained within our program, but this rate drops to 32% for low-income students with a GPA of less than 3.0. Furthermore, only 21% of these students remain in STEM fields. An analysis of independent research courses from 2013-2017 revealed a 98.5% graduation rate for FSU students who participated in faculty-led research. However, these courses are typically taken by strong students with high retention rates. Given this data, we wanted to test if faculty-mentored research could increase student success among populations with lower retention rates. We received funding from the Moderna Charitable Foundation to create our program. We started with a cohort of 12 students. They received academic credit for their work, and also a research stipend of $1800 to reduce the number of hours they needed to work outside of school. Each student was paired with a faculty mentor, conducting research on the faculty member’s research interest. The students met once per month to share their findings, with the goal of creating a community of scholars to share progress and improve communication skills. At the end of the Spring semester, each student presented at two conferences: Fitchburg’s Undergraduate Research Conference and the University of Massachusetts Undergraduate Research Conference. We plan to evaluate the program’s success by tracking the cohort’s GPA, graduation rate, and student satisfaction rate.

Session E. Pedagogical practices that support student success in STEM courses

Transparent Learning Objectives as the Basis for an “Ungraded” Large Enrollment STEM Course
Monica Linden, Hanna Aboueid, Kimberly Mingyue Liu, Brown University

Faculty often perceive learning objectives as perfunctory texts which must appear in course syllabi. Students are rarely incentivized to deeply consider the learning objectives and how they relate to their learning. However, learning objectives can serve as a critical tool for both instructors and students. Instructors can use learning objectives as the basis for a backwards-design pedagogical approach which is conducive to more authentic assessments and learning activities. Students can use learning objectives to not only understand the content and competencies they can expect to develop in the course but use them to also help monitor their growth and progress.

To facilitate greater student understanding of the learning objectives in large enrollment STEM courses, we created “transparent learning objectives” (TLOs - modeled on the Transparency in Learning and Teaching project (TILT) framework) which include paragraph-long descriptions contextualizing and motivating each objective. Course assessments were directly
linked to the TLOs, and assessment feedback required students to consult the TLOs regularly throughout the semester. The
class also utilized a standards-based “ungraded” pedagogical approach where standards were mapped to the TLOs. Here we
will present example TLOs and student responses to using them in the course. Attendees will have the opportunity to
transform one of their own course learning objectives into a TLO.

**BISC110P: Introductory Cell and Molecular Biology with targeted additional support**
Leah Okumura and Julie Roden, Wellesley College

Many students interested in STEM enter college with a weaker background in science or quantitative reasoning
compared to their peers and often struggle in or are prevented from taking even introductory courses. We have developed an
additional version of our standard Intro Cell and Molecular Biology course called BISC110P, which includes additional, built-in,
targeted support for students and requires no pre-requisites. This structured time includes two additional meetings per week,
so that the course meets five days a week, compared to the standard course schedule of two lectures, plus a lab. These
discussion and workshop meetings allow for extra practice, STEM-specific study skill building, hands-on activities designed
around students’ various learning styles, and intentional community building to improve students’ confidence and provide
additional support even outside the classroom. Enrollment is capped at half of the typical lecture size, and students are
together in a single group for all components of the course. These features allow students to build strong connections with one
another and the instructors, fostering confidence and helping students overcome the anxiety of asking for what they need in
order to be successful in the course. A majority of the students who have chosen to enroll in BISC110P in the past four years
have been from typically underrepresented groups in STEM, and in its first year of implementation, nearly all students
reported an increase in their confidence in a wide variety of skills pertaining to asking and answering scientific questions,
analyzing data, and being successful in future courses. We hope that attendees of this talk will learn ways in which they can
build community in their courses, engage their students by working with individual learning styles, and provide targeted
support to students who are nervous about introductory level STEM courses.

**Supporting STEM Scholars with the Pedagogy of Real Talk**
Nirijan Mani, Chris Cratsley, Nermin Bayazit, Fitchburg State University

At Fitchburg State University, we are embarking on year 1 of a 5 year NSF SSTEM grant, S-STEM: Building Institutional
Capacity to Support STEM Scholars Through Pedagogy of Real Talk. This project capitalizes on several pedagogical approaches
and high impact practices already underway at Fitchburg State University, that we are utilizing to best support academically
talented, low income STEM students. These approaches include the Fitchburg State University Faculty Academy, a 3 year
faculty program of faculty institutes and communities of practice implementing the Pedagogy of Real Talk. The Pedagogy of
Real Talk focuses on building authentic and meaningful connections with students from diverse backgrounds through
faculty-led “Real Talks” that explore universal themes and “alternative lessons” which more effectively connect academic
content and skills to students’ lived experiences. The “alternative lessons” will be incorporated into a STEM Seminar that builds
on the work of our First Year Experience Seminar by focusing on skill-based learning outcomes and habits of mind that support
student academic and career success. In addition, this project will incorporate “Real Talks” into both the STEM Seminar and
into Faculty and peer mentoring, developing student’s STEM identity and sense of belonging, while guiding them through
annual internship and/or student-faculty research experiences. This presentation will provide background on the ongoing work
of the Faculty Academy, FYE and efforts to promote STEM internships and student/faculty research at Fitchburg State
University as well as our plans to build on these efforts to support 2 cohorts of STEM Scholars over the next 5 years.

12:40-1:40: Lunch

1:45-2:35: Concurrent session III

**Session F. Workshop: Planning Linked-Course Communities to Increase Student Success: Lessons Learned from a
Randomized Controlled Trial**
Thomas Kling and Laura Ramsey, Bridgewater State University

Linked-course communities place students into cohorts, such that students take multiple classes with the same peers.
Bridgewater State University has conducted a randomized control trial of STEM linked-course communities where first-year
science and mathematics students took a content-rich First Year Seminar focusing on the UN Sustainable Development Goals,
the first course in their major, and their first mathematics course through the community. Students participating in the communities had higher rates compared to the control group for University retention, STEM retention, rates of A & B grades, and lower rates of D, F, and W grades. In this workshop, participants will learn steps for creating communities, map out local courses for effective communities, and identify the important local players to create effective communities. Participants will be able to explain the underlying theory of why linked-course communities may lead to increased STEM retention and know key players for effective implementation.

Session G, Workshop: “I Know I Need Help, But I Don’t Know What to Ask” – Helping Overwhelmed Students Identify Their Questions
Elizabeth Kilpatrick, Fitchburg State University

Some college students who have difficulty in STEM courses utilize resources such as office hours and tutoring at the first sign of trouble. Many, however, wait until they have reached a point where they feel so overwhelmed that they do not know how to formulate or ask their questions, which may make them even less likely to seek help. How can we structure our class time and course materials to make it easy for even the most overwhelmed student to identify and ask their questions? In this workshop, I will present techniques I have developed in my Anatomy & Physiology courses to address this issue. We will look at strategies for in-class conversations, ways to utilize peer-tutors, and formats for course study aids that help normalize the experience of feeling overwhelmed during the learning process and assist students in learning to identify their questions so that they are more likely to seek help. During the workshop, participants will have an opportunity to discuss and share their own strategies for addressing this issue and consider ways to incorporate new ideas into future courses.