

Social and Interactive Learning at Community Colleges: Investigating the Use of Real-Time Data for Augmenting Teaching Practice in Project-Based Learning (SAIL-CC)

Carnegie Mellon University is applying for an NSF IUSE grant to research the effectiveness of Social and Interactive Learning (SAIL), focusing on its ability to augment teaching practice through real-time data, with the goal of improving student outcomes in learning, persistence, and attainment at community colleges. The project will span five years, with a longitudinal study of faculty and students. CMU is currently seeking community colleges that would like to collaborate on the project, beginning in the summer of 2022.

About SAIL-CC

SAIL-CC has been developed and prototyped through a collaboration between Carnegie Mellon University (CMU) and Microsoft. It offers an innovative and effective learning approach for information technology (IT) and computer science (CS) programs.

SAIL-CC courses consist of conceptual content, primers, and hands-on projects, that can be used in-class, hybrid, or online. The SAIL-CC platform supports experiential and iterative project-based learning, where students submit solutions to projects which are immediately auto-graded, providing timely, contextual feedback. This empowers students to iterate quickly, resubmit, and learn by doing. The platform also augments teaching practices by providing real-time data on students' work inside the platform: Who is struggling, which solutions are being tried and how often, how many attempts it takes to reach a correct approach, and other details about individual students, projects, and classes. Faculty can use this data to inform their own practices and to provide students with timely feedback and support.

SAIL-CC is intentionally designed to be used by faculty or colleges that want to customize content to fit their specific students and contexts. It can communicate directly with any institution's LMS, allowing for student enrollment and grade passback, while providing easy access to the courses, learning dashboards, and learning analytics.

CMU is committed to continually supporting and improving the platform, creating more courses, and providing technical support for community colleges into the foreseeable future. Through other current grants, CMU is also continuing to build and test a full catalogue of courses that will fully support degrees and credentials in emerging IT fields. Currently, the SAIL-CC team is in initial development of courses in cloud computing, data science and machine learning/AI.

One critically important benefit of SAIL-CC is free access to a cloud-based learning tool for individual and collaborative hands-on learning in IT and Computer Science (CS) courses. SAIL-CC eliminates community colleges with the burdens associated with the cost, infrastructure, and maintenance related to providing students this vitally important resource.

Scope of the Community College Collaboration

Two entry-level IT/CS courses will be developed as a part of this grant: Principles of Computing (with a focus on Python) and Introduction to Computing. The project team will then investigate how SAIL-CC digital augmentation of faculty teaching practice leads to improved learning outcomes, persistence, and attainment of students, especially those students traditionally underrepresented in STEM careers. SAIL-CC will be beta-tested by six collaborating community colleges, and then (after evaluation and iteration) will undergo a full pilot test of an additional 20-24 community colleges over a 3-year period.

Each institution's collaboration would include making available one or more IT/CS faculty who will:

1. Participate in 77 hours of professional development in Year 1, which includes 5 days onsite at CMU in the summer, with the remaining professional development taking place online. The professional development will cover:
 - (a) Teaching with project-based learning,
 - (b) Using the SAIL-CC content to teach two courses, and

- (c) Using the real-time data dashboard to augment teaching.
2. Teach at least one section of one or both of the entry-level courses using the SAIL-CC platform in each of the subsequent 4 years.
3. Participate in 84 hours of online professional development in Year 2, including:
 - (a) Further support of using SAIL-CC
 - (b) Culturally responsive approaches for customizing SAIL-CC courses for your context, and
 - (c) Completing the content of one of your institution's choice of SAIL's advanced courses (e.g. AI Practitioner, Data Engineer, or Cloud Administrator).
4. Teach at least one section of the chosen advanced course in each of the subsequent 3 years.
5. Participate in research and evaluation surveys and interviews through the 5 years, including providing (anonymous) baseline data in Year 1.

All costs for the professional development will be covered by the grant. Faculty time for travel, professional development, and participating in research activities will be compensated (through whichever mechanisms are compatible with each institutions' policies). Any other project-specific costs incurred by the school (e.g. technical set up) will also be covered by the grant.

In addition to the professional development opportunities, and subsequent access to a full catalogue of research-based IT/CS courses, collaborating in the project will provide institutions:

1. Vouchers for faculty to complete IT/CS certifications for completed courses, free of charge.
2. Vouchers for the participating students to complete certifications at a discount of ~50%.
3. Collaboration with Carnegie Mellon researchers on research projects, papers, and future proposals.
4. Evidence-based instruction supported by data that can support accreditation.
5. Ongoing, free access to SAIL-CC, which includes the use of the cloud-based learning environment ("sandbox") for all of the courses.

Recruitment

In preparation for this proposal, CMU and NISOD have made contact with several community colleges, offering them the opportunity to be considered for participation. Letters of Collaboration have been provided by XX schools, with a stated understanding that, due to COVID-19, these letters are not binding and will lead to discussions if the grant is awarded. After the initial institutions have decided whether they have the capacity to participate, CMU will develop criteria for additional recruitment, in order to balance geographic, rural/urban, size, faculty and student demographics, and other factors in order to have diverse contexts in which to test SAIL-CC.

Research and Evaluation

The research will focus on three intersecting areas:

1. Faculty teaching practices.
2. The relationship of teaching practices and student success to learning outcomes, persistence, and attainment.
3. Improvements to SAIL-CC that support student success.

Research Questions

1. What PD/supports are needed for faculty to develop self-efficacy in data-augmented teaching?
2. How do varying data displays impact faculty use of real-time data?
3. In what ways do faculty use dashboard data to improve student learning outcomes?
4. What is the fidelity to the PBL approach and use of SAIL-CC data across time?
5. When courses are contextualized by faculty, what is the impact on student outcomes?
6. What kinds of outlier detection is needed to identify struggling students (and what "kind" of struggling)?
7. What constitutes good contextual feedback for students, and how can it be autogenerated?
8. How does SAIL-CC increase students' self-efficacy and belonging into the domain?

Evaluation Questions

1. Do faculty develop self-efficacy in data-augmented teaching through the PD experiences?
2. Are faculty able to successfully transfer SAIL-CC efficacy in a content-familiar course to courses with more demanding content?
3. Are students more successful (i.e., learning outcomes and persistence) in entry-level courses when using SAIL-CC than in traditional teaching methods?
4. Do students increase credential or degree attainment and/or success in employment endeavors (longitudinal)?
5. Do gating methods in hands-on projects reduce time-on-task (by focusing the training)?

With its robust data capture system, SAIL-CC will be a primary source of data for the research and evaluation. Additional data sources will include surveys, self-efficacy assessments, qualitative interviews, and student persistence and attainment data from collaborating community colleges.

Evaluation Plan

The evaluation will incorporate process evaluation (i.e., how well the project is achieving its goals), formative evaluation (in the beta test phase and during each semester of the 3-year pilot), and summative evaluation (at the conclusion of the pilot). Staffing for the evaluation work is in planning, and will align with NSF recommendations in using one of two options:

1. An external evaluator (Eberly Center or other) conducts annual process evaluation, and the formative and summative evaluation is conducted by the Project Advisory Board using the SAIL-CC data, online surveys, and institutional information.
2. An external evaluator (Eberly Center or other) conducts all phases of the evaluation.

The SAIL-CC Team

In addition to the Beta and Pilot community colleges, the SAIL-CC platform will be developed through collaboration with two advisory boards and the National Institute for Staff and Organizational Development, the leading PD provider for community colleges.

Content Advisors

The content advisors are community college faculty who will work as a part of the SAIL-CC project team. The Content Advisors will work closely with the CMU team to revise the PD for the beta test and the pilot, guiding the development of learning objectives and projects for the entry-level courses, ensuring that they are modularized and easily customized for variable settings across the United States.

- Crystal Pendergrass: Southside Virginia Community College (VA)
- Richard Taha, City College San Francisco (CA)
- Jeremy Hoffman, Des Moines Area Community College (IA)
- David Law, Harford Community College (MD)

These advisors represent diverse community colleges, across urban/rural, small/large student numbers, geographic region, and student demographics. Each of these institutions have participated in the current SAIL-CC prototype-test project, with one faculty member at each school completing the PD for a course in Cloud Computing and subsequently teaching the course.

Content Advisors will participate in a two-day face-to-face meeting in Year 1, and then work virtually with the CMU team through years 1-3, consulting on the iterations of the SAIL-CC platform. Content Advisors will be contracted (as individuals) and paid an hourly fee, with an estimated time commitment of 80 hours in year 1, 20 in year 2, and 10 in year 3.

Project Advisors

Project Advisors will work as a part of the SAIL project team, providing insights in their specific areas of expertise.

- TBD: Advisor in automated detectors and dashboard data for teaching and learning.
- TBD: Advisor in project-based learning.

- TBD: Advisor in culturally responsive teaching (CRT), and leader of the CRT PD webinars that will help faculty develop skills for customizing course content and approaches to employ asset-based approaches in their specific contexts.
- TBD: Underrepresented students and STEM identity.

Project Advisors will participate in a two-day face-to-face meeting in Year 1, and then work virtually with the CMU team through years 1-5, consulting on the iterations of all SAIL-CC platform and consulting on the decision-making processes.

National Institute for Staff and Organizational Development (NISOD)

NISOD provides high-quality and faculty-focused programs and resources for community and technical colleges that want to make the most of their professional development dollars. For over 40 years, NISOD has aligned a wide array of benefits with the needs of our members, which explains why the American Association of Community Colleges named NISOD, “The country’s leading provider of professional development for community college faculty, staff, and administrators.” NISOD will consult on the refinement of the PD, provide support to participating faculty, lead the CRT webinars, and participate in dissemination and sustainability activities.

PI Team

The SAIL-CC project will be led by a team from CMU:

PI Majd F. Sakr is a Teaching Professor in the Computer Science Department within the School of Computer Science at Carnegie Mellon University. Majd leads the work of CMU’s Technology for Effective and Efficient Learning (TEEL) Lab, which focuses on research in learning methods, technology for learning systems, curriculum development, and workforce training. He is also the co-director of the Master of Computational Data Science Program at the School of Computer Science at Carnegie Mellon. From 2007-2013, Majd was a Computer Science faculty at Carnegie Mellon University in Qatar, where he also held the positions of Assistant Dean for Research and Coordinator of the Computer Science Program. He has held appointments at the American University of Science and Technology in Beirut and at the NEC Research Institute in Princeton, New Jersey. His research interests include online education, cloud computing, and human-robot interaction.

Co-PI Christopher Bogart is a post-doctoral researcher at CMU and a member of the TEEL Lab. His work is focused on how humans clarify complex ideas and instructions among themselves as inspiration for new ways of enhancing human-computer interaction in software engineering.