Equipping Students for STEM Careers through Industrial Projects: The MAA PIC Math Program

Vinodh Chellamuthu
Dixie State University
St. George, UT

Jennifer Travis
Lone Star College-North Harris
Houston, TX

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Our Colleges

Lone Star College (Jennifer)
- Large community college (85,000 students) in Houston, TX
- 12,000 students at LSC-North Harris, Jennifer’s campus

Dixie State University (Vinodh)
- Public four-year university in St. George, UT
- Approximately 12,000 students
- Associate-granting institution
- Open access; lots of first-generation college students
- Standard teaching load: 4 three-hour classes per long semester
Our Background

Vinodh Chellamuthu
- Assistant Professor of Mathematics since 2015
- MS in Applied Mathematics, PhD in Mathematics
- Mentoring undergraduates in research since 2016

Jennifer Travis
- Teaching full-time at LSC-NH since 2005
- MS in Mathematics
- Received PhD in Mathematics Education in 2014, after 9 years in current position
What is PIC Math?

**PIC Math**

Preparation for Industrial Careers in Mathematical Sciences

Each PIC Math faculty member teaches a class in which students work in teams to solve a real-world problem provided by a business, industry, non-profit, or government partner.

- Emphasis on statistics and data analysis, with data provided by the partner organization.
- Builds skills needed to help students stand out in the job market and kickstart a successful career.
- Training and support provided by the MAA PIC Math Program, which is funded by the National Science Foundation (NSF grant DMS-1722275) and National Security Agency.
Why is PIC Math Valuable for Students?

- Allow students to get hands-on experience and introduce them to more career possibilities.
- Provide an opportunity for students to use the skills they learn in classes to solve messy and complex real-world problems.
- Develop appreciation for the value of mathematics in solving practical problems.
- Learn professional skills (writing, presentation, teamwork).

For more on WHY this is valuable, watch Michael and Suzy’s webinar!

PIC Math and the Best Jobs in the 21st Century
by Michael Dorff and Suzanne Weekes
https://www.youtube.com/watch?v=B5M4ByxtEdk
Fast Facts on PIC Math Program

- Started in 2014
- 5 cohorts of PIC Math faculty so far
- Over 180 total PIC Math faculty
- Over 150 institutions
- 6 community colleges

For more information:
https://www.maa.org/programs-and-communities/professional-development/pic-math
Major Tasks

- Arrange for your college to offer the class next spring (Fall 2021)
- Arrange industry partners and projects (Fall 2021)
- Recruit students (Fall 2021)
- Teach PIC Math class (Spring 2022)
Support Provided by MAA PIC Math Program

- Training workshop - Spring 2021
- Model for you to follow
- Resources: links, sample syllabi, sample problem statements, calendars, etc.
- Precedent and credibility - helps get your institution on board
- Network of current and past PIC Math faculty
- Ongoing advice and support from PIC Math organizers
- Travel money for students to present their work (or virtual presentation option)
- Stipend - can use to buy out a course release if your institution allows
Our Experiences - Vinodh

Structure of the Class

- The Class
  - MATH 4800 (Industrial Careers in Mathematics)
  - 3 credit hours
  - Prerequisites: Permission of instructor
  - Letter Grade
  - Met TTh 1.5 hours
  - Counted toward degree plan for several STEM majors, including mathematics majors and minors
  - acting as a “applied learning” project class for the new degree program “Applied and Computational Mathematics”
Our Experiences - Vinodh

The Students

- Mentored students on industrial projects for four semesters
  - Spring 2019 (13 students)
  - Fall 2019 (6 students)
  - Spring 2020 (8 students)
  - Fall 2020 (3 students)

- The Students
  - 7 math majors, 8 engineering, 3 computer science, 1 finance
  - Majority first-generation college students
  - Some in Multivariable Calculus, some in Linear Algebra, some in introductory programming classes
  - Publicized through Linear Algebra class, math club and STEM club
Problems Tackled by our Students - Vinodh

Parks Data:
Develop an algorithm to predict trail activity on five key trails in Zion National Park based on park entrance activity. This will help the Zion National Park administration to allocate resources more effectively and improve the visitor experience.
Problems Tackled by our Students - Vinodh

Red Cliff Lab:
Create a filtering tool for an auto transmission company, that uses historical data to predict the likelihood of a potential customer to spend money on transmission services. This will allow the company to improve allocation of resources and thus increase revenue.
Problems Tackled by our Students - Vinodh

Southwest Mosquito Abatement & Control District (SWMACD):

- Goal is to develop mosquito abatement strategies to control mosquitoes in Southwest Utah.
- Determine a mathematical model that describes how treatment effectiveness is related to the number of adult mosquitoes trapped and other influencing factors.
Our Experiences - Jennifer

Structure of the Class

- Taught Spring 2020
- Honors Seminar
- 4 Honors credits
- Pass/No Pass
- Met TTh 1.5 hours
- Did not count toward a degree plan
11 students total
5 female, 6 male
9 were first-generation college students
1 math major, others variety of STEM (biology, engineering, computer science)
Half in Calculus, others in College Algebra, Trigonometry, Precalculus
Almost all had zero programming experience
Publicized through Honors; asked colleagues to recommend calculus students
Half already in Honors, half joined Honors to take class
Problems Tackled by our Students - Jennifer

**Houston Astros:**
Provide the Astros with recommendations on what types of fan promotions are most effective at increasing home game attendance.
Crown Beverage Packaging:
Analyze spoilage data and provide company with recommendations for how they can improve or better understand can spoilage at the Conroe plant.
Our Experiences - Jennifer

4 student teams (2 Astros teams, 2 Crown teams)

Format/timeline:

- CliftonStrengths workshop for students - January
- Crown plant tour - February
- 1st half: Individual biweekly meetings with each student
- 2nd half: Virtual meetings with teams nearly weekly
- No intermediate presentations for corporate partner
- Semester extended, then class extended
  (final presentations in June, final reports in July)

Tools used:

- LaTeX for all slides and reports.
- Python/Jupyter Notebook for plots
- All feedback on writing given verbally (virtually)
Our Experiences - Vinodh

- Survey before the start of the semester
- Student teams picked based on their strengths (e.g., math, programming)
- No more than three members per team
- Python/Jupyter Notebook introduction
- Industrial Sponsors present the problem to their teams
- Individual biweekly meetings with each student
- Team meetings outside the class discuss progress
Finding Industrial Sponsors

Jennifer
- Lone Star College Foundation
  “Who is your dream partner?”
- Personal Network
- Written summary of program and expectations

Vinodh
- Dean with business connections
- After first successful semester, companies started approaching me!

KEY: First semester will be hardest; success “breeds” success!
Biggest Challenges - Vinodh

- Collaborating with multiple stakeholders and getting them excited and buy into the proposed project.
- Mixed levels of mathematical maturity within the class.
- Putting together a team based on their skill set (programming, communication - oral and written skills).
- Mitigating the fear of the real-world problem solving and getting them excited and motivated.
- Keeping students on task (biweekly reports, team presentations).
- Receiving feedback from industrial sponsors.
- Unrealistic Deadlines: meeting the deadlines was challenging on top of other courses students taking that semester.
Biggest Challenges - Jennifer

Before the class started:

- Institutional hurdles - getting the class approved and built
- Deciding which students to invite
- Deciding the partners and nailing down projects
- Stress - Would it all come together and actually happen?

During the class:

- Lack of knowledge of computing (me!)
- Lack of knowledge of computing (the students)
- Lack of knowledge of data science and analytics (me!)
- Getting all students on each team actively involved
- One data set not in an ideal format for students to work with
- TIME CONSTRAINTS
Biggest Rewards - Jennifer

- Interacting with students on deeper level
- Students as collaborators - on analysis and written report
- Seeing students grow in knowledge and courage
- Personal growth (thinking of me, not the students)
  - “Will this make me braver?”
  - Computing knowledge
  - I now love LaTeX …. I’m never going back!
- Providing students with a unique opportunity that will help them in the future
- Hopefully: Beginning something that will be a long-term plus for my college
Seeing students going from “consumers” to “producers.”
Students were successful in their internship/job interviews.
Supported the university motto, “Active Learning, Active Life.”
Increased cross-disciplinary collaboration within the university.
Helped to design “hands-on” curriculum within the math department.
Increased opportunities for collaboration with the local community (BIG) partners.
Small curriculum changes (such as this class) can lead to big innovations:
  • Establishing Modeling and Simulation Hub
  • Creation of Certificate in Modeling and Simulation
Rewards - for Students

Help students grow in:
- Data analysis knowledge - valuable for any major
- Confidence
- Professional communication skills - written and oral
- Problem solving skills
- Critical thinking
- Working and thinking independently

Resulting in:
- More competitive for REUs, scholarships, and internships while in college
- Helps them land first STEM job after graduation
Timeline for You as PIC Math Faculty

- February/March 2021: Apply to PIC Math Program
- Late spring 2021: PIC Math Training Workshop
- Summer and Fall 2021: Find industry partners and projects
- Fall 2021: Recruit students
- Spring 2022: Teach PIC Math class
- Summer 2022: Students present their project at MAA MathFest (or virtual version)
Thank you! Any questions?

- Jennifer Travis
  Jennifer.Travis@LoneStar.edu

- Vinodh Chellamuthu
  Vinodh.Chellamuthu@dixie.edu

For more information:
https://www.maa.org/programs-and-communities/professional-development/pic-math