STEMovation: A Path to Transforming STEM Education

Ellen Beaulieu, Professor of Chemistry: Diablo Valley College
Ted Walker, Professor of Physics: Diablo Valley College
Despina Prapavessi, Dean of Mathematics and Computer Science: Diablo Valley College
Tish Young, Senior Dean of Instruction: Contra Costa College
The STEMovation Origin Story

• Several Faculty Members Developing Independent Programs Targeting STEM success

• Chancellor Hosted District-wide FLEX Activity Promoting Educational Innovation with a Summative Call for Proposals

• Three STEM-related Proposals from our College Were Submitted

• The Proposals Were Grouped and Approved for Funding of a New Initiative - STEMovation
Three Proposals, One Mission: Increasing STEM Diversity and Success

**STEM Pathways**
- NEW program through proposal
- Targets High School Recruitment
- Mission: Provide a robust path and first year experience for aspiring STEM students from educationally disadvantaged high schools.

**MESA Learning Community**
- Recently created program augmented through proposal
- Targets STEM Majors with proven risk factors of first generation status, financial need, and high school preparedness
- Mission: Create a Learning Community of STEM majors with tailored student supports

**Professional Development**
- NEW program through proposal
- Targets STEM Faculty
- Mission: Establish a new interdisciplinary professional development thread for STEM faculty focused on proven active inclusive pedagogies for the problem solving classroom

*Increasing Access for STEM students*

*Increasing Success for STEM students*

*Increasing Retention, Success and Transfer for STEM students*
BREAKOUT 1:

Take a minute to introduce yourself to those around you.

What led you to this discussion today? Motivations? New directions at your college?
Data-Driven Priorities

• **District Research**: Submitting research queries around student success in courses to support curricular discussions, access, and equity.

• **Student Surveys**: Survey Monkey was used to poll all students to identify variables that change in the STEM student experience that are predictive of success and inform future support efforts.
Challenges in Data Collection

• Queries from research may require iterative discussions with the analysts to refine the data set. Prior planning accelerates time to answers.

• Voluntary student responses can be challenging to interpret if the prompts are not abundantly clear.

• Low response rates can cause high variability in percentage scores, so knowing the sample number with percentages is critical for interpretation.
Setting Baselines
Who are our students, and what variables track with success as they progress through our curriculum?

Survey Monkey Parameters:
Two identical surveys which were distributed to students in courses categorized as Early or Late pathway. Recognizing that students *complete coursework on variety of schedules, we* instructed them to complete the survey based on projected date of completion.
Survey Monkey Executed:

3000 slips were distributed

660 total respondents.

Early = 373 students

Late = 287 students
What is your gender?

- Male: 60.5% Early Pathway, 66.0% Late Pathway
- Female: 37.2% Early Pathway, 32.1% Late Pathway
- Decline to State: 2.3% Early Pathway, 1.9% Late Pathway
What is Your Ethnicity?

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<tr>
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<th>Early Pathway</th>
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<td>9</td>
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<tr>
<td>American Indian/ Alaskan Native</td>
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<td>0.8%</td>
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<td>3</td>
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<tr>
<td>Other/Decline to State</td>
<td>5.4%</td>
<td>8.3%</td>
<td>16</td>
<td>32</td>
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Real or Imaginary?

- Do we really have that low representation of underrepresented minorities in our STEM classes, or are they just underreporting?
- Can district research give us better answers?

<table>
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<td>African American</td>
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<tr>
<td>Multi-Ethnicity</td>
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<td>4%</td>
<td>NA</td>
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<tr>
<td>Other/Decline</td>
<td>0%</td>
<td>0.3%</td>
<td>8.3%</td>
</tr>
<tr>
<td>White</td>
<td>37%</td>
<td>48%</td>
<td>30.4%</td>
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</table>
Looking at Enrollment Numbers

CHEM 120 - Number of Successful Students per semester by Ethnicity

Percentage Success won’t be useful for setting baselines

120% growth over 4 years!
What are the goals of our students?

• What are the goals of our students: transfer, associate’s degree, or career skill development?
• How can we establish baselines for these?
• How can we track and improve outcomes

DATA: District data is not preferred since many science disciplines do not have associates degrees. Student survey was used to establish baselines and visualize trends as a student progresses at DVC.
Indicate the importance of each of these goals.

**EARLY Pathway**

- **Transfer**: Most important goal
- **Associate's Degree**: Secondary Goal
- **Obtain or Update skills for Employment**: Not a goal

**LATE Pathway**

- **Transfer**: Most important goal
- **Associate's Degree**: Secondary Goal
- **Obtain or Update skills for Employment**: Not a goal
Lessons

• **Transfer** is the primary goal of our students.

• **Associate’s degrees** are important secondary goals.
  • Many of our disciplines do not have them.
  • They will be hard to create due to the 60 unit transfer degree model.

• **Counseling** students on enrollment patterns that will lead to their goal with better outcomes should be a priority.
BREAKOUT 2:

What is a way data is playing a role in the work that you do at your college?

How do you and your colleagues use data to inform decision making?
GOALS OF STEMovation:

1. Improve access by recruiting more STEM majors in our service area.

2. Improve equitable outcomes for students by iteratively improving STEM student supports.

3. Increase success and transfer of our students through STEM faculty professional development and curricular alignment.
STEM Pathways

Program Goal:
Provide first year cohort for aspiring STEM majors entering our college from high schools of greatest diversity and educationally disadvantaged high schools.

Program Design:
- Meet with HS STEM faculty
- Design recruitment
- After School Workshops
- Lunchtime Enrollment Labs
- One-Hour Colloquy
- 1+ Entry level STEM classes
STEM Pathways

Fall 2016 Cohort:
- 6 students from 3 targeted high schools enrolled
- 10 students from other high schools enrolled
- 12 of 16 passed their STEM class

Fall 2017 Cohort:
- 20 students from 3 targeted high schools applied
- 27 students from other high schools applied
- A high contact method of calling, texting, and emailing applicants resulted in only 6 students enrolling.
- Program was closed for Fall-17.
Lessons Learned

• Meeting with HS Faculty is ESSENTIAL.

• Finding a way to build a program that supports students at target high schools from their freshman year could prepare them for aspiring to become STEM majors and taking the coursework to better support their success.

• Regular and persistent outreach and recruitment in these groups will be critical to get enough enrollment potentially as early as middle school.

• Due to low participation from targeted schools, we must build a program that includes them but does not rely on their participation to succeed.
BREAKOUT 3:

How could outreach benefit a program you are involved with?

Are you working as a team with other people doing outreach, and if so, how are your efforts aligned?
MESA Learning Community and STEM Student Services

Program Goal: Create a campus learning community for first generation college students pursuing STEM majors with financial need.

Program Design:

Counseling
- Educational Planning
- Advising
- Resume and Scholarship

Community
- Study Space and Groups
- Digital Resources
- Outreach activities

Curriculum
- MESA sections
- Supplemental Instruction
- Tutoring and Workshops

Career
- Field Trips
- Guest Speakers
- Career Workshops
MESA Learning Community

Fall 2014-Fall 2017:

- Held two campus recruitments in computer labs to facilitate completing the online application.
- **47 students** enrolled in 1st cohort.
- Program has grown to serve **over 160 students** as MESA or Friends of MESA students.

Transfer:

- 2 successful transfers in 2015
- 20 successful transfers 2016
- Over 30 transfers expected for 2017-18 academic year!
Working Model for our MESA program

- **Physical Space: The PUMA center**– In 1 year, our campus was able to retrofit unused space to house all three campus learning communities (Puente, Umoja, and MESA) at a **central campus location** for coordinated efforts.
- The center houses **tutoring, textbooks, computers, small and large study rooms, and a break room** fostering a “**home away from home**” to facilitate learning.
- **Workshops and Guest speakers** also present in this facility.
Biggest Successes for MESA Services

- Supplemental Instruction (SI) for MESA sections in chemistry and Math has evolved into peer led learning where one faculty instructor oversees student leaders in group study
  - Seemingly high buy in for chemistry, low for math.
  - Why? What can we learn?

- MESA sections have been useful for certain students in certain classes.
  - Is the model scalable?
  - How can we make clustered enrollment patterns scalable?
BREAKOUT 4:

What strategies have you used to scale successful programs to reach more students?

What advice would you give to others about scalability?
Faculty Focused STEMovation Initiatives

Program Goal: Create meaningful professional development activities driven by data that can improve STEM curriculum development and teaching practice

Program Design:

Data-driven Curriculum Discussions and Revisions + Innovative STEM Teaching Training = Improved Student Experience and Success
Curriculum Pathway Research

**Goal:** To identify bottlenecks, we asked, “What is the chance of success (A, B, or C) in a course based on a student’s grade in the prerequisite course?”

*Are our pathways aligned for success?*

*What can we change?*

Queries were run for MATH, CHEM, and PHYS pathways.
Early Calculus Sequence

Course (Grade in prerequisite course):
- Pre Calc (A/B)
- Pre Calc (C)
- Calc I (A/B)
- Calc I (C)
- Calc II (A/B)
- Calc II (C)
- Linear Alg (A/B)
- Linear Alg (C)

Percentage Success in Course (A,B,C):
- Pre Calc (A/B): 67.88%
- Pre Calc (C): 47.34%
- Calc I (A/B): 64.56%
- Calc I (C): 34.44%
- Calc II (A/B): 77.77%
- Calc II (C): 47.57%
- Linear Alg (A/B): 83.82%
- Linear Alg (C): 68.57%
Early Calculus Sequence

Poor alignment early in the Calculus sequence.
C-Gap Classes are a Major Focus

• This data identified “C-gap” courses where a student receiving a C in the prerequisite is in great danger of being unsuccessful in the current course.

• These bottlenecks (Precalculus, Calculus I & II, General Chemistry I & II) while predictable demand that we attack the alignment issues.

• We are pursuing both curricular revisions and enhanced student services to improve outcomes.
BREAKOUT 5:

How could data improve communication and increase buy-in at your college?
Good alignment in the physics sequence.
Why did the Physics pathway look comparatively better?

• In F-15, the Physics department instituted a workbook of modules for PHYS 129 in an attempt to **standardize this curriculum** for variety in instruction and help students **meet critical learning outcomes**.

• Fall 15 had nine modules, Spring 16 had 13 modules, and beginning in Fall 2016 all 16 modules in the workbook were being used in all sections.

• **Goal for Research:** Quantify the impact from this change.
Early Impact of Standardizing PHYS 129 Curriculum

The introduction of the workbook appears to have helped C students make dramatic gains.

- Phys Engin A (A/B in Intro Phys)
- Phys Engin A (C in Intro Phys)
- Phys Engin A (NO Intro Phys)

<table>
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<th>Year</th>
<th>Success Rate</th>
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<td>38.8%</td>
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<tr>
<td>2016</td>
<td>63.1%</td>
</tr>
</tbody>
</table>

Growth:

- S-13: 90.5% to 77.8%
- F-13: 28.6% to 63.1%
- S-14: 57.7% to 38.8%
- F-14: 36.4% to 56.6%
- S-15: 59.1% to 38.8%
- F-15: 75.0% to 54.0%
- S-16: 81.0% to 75.0%
- F-16: 77.8% to 62.6%
Early Impact of Standardizing PHYS 129 Curriculum

The introduction of the workbook appears to have helped C students make dramatic gains.

Modest Gains?
Focus for Backwards Design and Counseling for C-gap Courses

• *Is a C in an early STEM course a litmus test for future STEM success?*

• A C in an early STEM course should **trigger mentoring conversations** with a student who intends to persist in STEM on **real variables they can change to increase likelihood of success at the next level.**

• Instructors at all levels must know **Exits and Targets** of their course related to courses at the next level and previous level and **calibrate their assessments** to enhance global curricular success.

• Consistency in communicating Faculty Expectations can better **align curriculum for global success** (e.g. PHYS 129 to 130).
BREAKOUT 6:

What data could you gather that will start important conversations?

How can you collect that data?
Faculty Learning Program (FLP)

Program Goal: Ten STEM faculty and one dean participated in the FLP through NSF funded partnerships with UC Berkeley, CSU East Bay, and Sonoma State to improve instructional practice.

Program Design:

Learn About Learning
- The importance of talk
- Facilitating discussion to develop expertise and improve motivation
- Avoiding stereotype threat

Redesign Lectures and Assessments
- Learning experiences should be social and active
- Apply Backwards Design

Evaluate and Refine Practice
- Implement major course revisions
- Evaluate Taped lectures
- Iterative Curriculum Improvement
General Chemistry I Exam I performance with FLP techniques

Number of students in that grade category

Percentage Score (90 = 90-100, 80 = 80-89 etc)

F16 - Lecture Based
General Chemistry I Exam I performance with FLP techniques

Number of students in that grade category

Percentage Score (90 = 90-100, 80 = 80-89 etc)

- S17 - Some Active Learning
- F16 - Lecture Based
### General Chemistry I Exam I performance with FLP techniques

<table>
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<th>Percentage Score (90 = 90-100, 80 = 80-89 etc)</th>
<th>Number of students in that grade category</th>
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- **S17 - Some Active Learning**
- **F16 - Lecture Based**
- **F17 - Complete Active Redesign**
The **DVC STEMovation Machine**

**Input Initiatives:**

- STEM Pathways
- K-12 School Outreach

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**Diagram:***

- **Student Supports**
- **Professional Development**
- **Curriculum Development**
- **MESA**
- **Counseling**

**Data**
Thank you for Participating!

We would also like to thank:

Marilyn Sargent and the District Research Team
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