



## Theory of Change

- We use Sawyer and Greeno's (2009) concept of situative learning to "resituate" current practices in CBEE into the more inclusive, integrated and holistic learning environment that we envision.
- Lasting change requires re-situating and re-negotiating multiple, interacting constituent components, including course design, pedagogies, faculty (and GTA) culture, and student culture.
- Taking a situative approach, we consider activity systems as continually co-constructed through practice, and the parts played in maintaining the systems (and resisting change) by different groups of people, structures, rules, and behaviors becomes clearer.

### **Activity Systems in CBEE**



The CBEE Activity System contains multiple interacting components.

## Inclusive Culture

*Faculty Development* 14 of 29 CBEE faculty have participated in a 60-hour development opportunity directly addressing power, difference and discrimination (DPD) in the classroom and in STEM academic culture.

#### Undergraduate climate survey (N=277)

- Departmental climate perceived as generally welcoming (vs. hostile)
- Students indicated that the climate was more welcoming to men and students born in the U.S. than to members of 12 other identity groups
- Climate perceptions predicted engineering identity and persistence, which were significantly lower for women and students of color
- Women's engineering identification and persistence was mediated by relationships with peers

#### Undergraduate focus group study (N=56)

- Focus groups investigated students' perceptions of engineering culture, engineering identity, and sense of belonging
- Students generally viewed their unit as a welcoming, inclusive environment
- Many students spoke about experiencing or witnessing bias and/or microaggressions based on social identifications such as race, gender, or nationality
- The majority of international participants and participants of color expressed a lower sense of belonging in the unit



Although the departmental climate was rated less welcoming for non-dominant than dominant groups, its effects on women's engineering identification and persistence was mediated by academic and social relationships with peers.

## **Re-Situating the Professional Formation of Engineering Identity**

#### James D. Sweeney, Milo D. Koretsky, Michelle K. Bothwell, Susannah Davis, Devlin Montfort, and Shane Lorona School of Chemical, Biological, and Environmental Engineering **Oregon State University**

The authors gratefully acknowledge support from the National Science Foundation's IUSE / RED Program under the grant 1519467. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

## Mutually Constitutive Elements

- Increasing inclusivity, diversity, and social justice in engineering education requires active cultural changes at organizational/departmental and interpersonal levels that affect the experiences and perceptions of students and faculty to increase the degree to which diverse individuals identify as engineers.
- 2. Organized cultural change leads to inclusion when it reflects and affirms the lived experiences of all members students, staff, faculty, people with complex, identities.
- 3. These changes with our core shared developing engineering and skills.
- Explicit and social students and faculty transition their and skills from engineering

engineering

## Just Teaming Practices

Summer 2018: week-long intensive workshop focused on design of Studio 2.0. Efforts included development of team norming practices and group worthy problems.

durd



- AY18: Year-long Community of Practice for CBEE faculty to discuss evidence-based practices of effective team formation, teamwork assessment, knowledge and knowing supporting socially-just teaming practice, and conflict management, among other topics.
- Aspects of implementation of functional and socially just teaming include:
  - Modules for AY 19 designed to critically explore the social and political dimensions of engineering (First-year topics: Personality, role tendencies; implicit bias; conflict modes, tendencies and management; exploration the social and political dimensions of engineering design; and assessment of teaming justice.)
  - Studio 2.0 emphasis is on group-worthy problems (complex enough to benefit from multiple perspectives and various slices of understanding)
  - Development of valid and reliable assessment instruments to measure student competencies in functional and socially just teaming.



Industry

Non-

#### Susan Bobbitt Nolen Learning Sciences & Human Development **University of Washington**

of the community (e.g., administrators) as multifaceted

(T)

should align community's mission students' knowledge

pedagogical supports for will help to identities, knowledge school world to practice world.

Meaningful, Consequential Learning "I had such a great time in studio this morning. I feel like a real chemical engineer for once. I'm proud of my new ability to attack these problems by using my math skills and intuition. I love solving these kinds of problems and am excited for my future.". - Student participant Studio 1.0 Computer lab 6: Regression Analysis ChE, BioE, EnvE 213 You are responsible for determining the reaction rate constant, k, for the hydr  $(C_{12}H_{22}O_{11})$  to glucose  $(C_6H_{12}O_6)$  and fructose  $(C_6H_{12}O_6)$  in aqueous solution HOLOH The hydrolysis reaction is monitored by a polarimeter. In this technique, the an polarized laser light is measured as it is passed through the solution. The change related to the concentration of sucrose. Write the stoichiometric equation for the overall reaction The kinetics for this irreversible 1<sup>st</sup> order reaction can be described by the follo differential equation:  $\frac{dC_s}{dc_s} = -kC_s$ where  $C_s$  is the sucrose concentration in [mol / m<sup>3</sup>], k is the 1<sup>st</sup> order reaction in and t is time in [hr]. Solve this equation assuming you know the initial concen initial condition at t = 0,  $C_S = C_{S0}$ ). Get the TA to verify your solution. Hint: u To determine the rate constant, concentration vs. time data are needed. Draw a what the experimental equipment would look like. Show it to one of the instru-Go to the link http://jimi.cbee.oregonstate.edu/statistics/rate/ and run the experi-In Excel, use a logarithmic transformation of the data to determine a value of l transformed data and the best fit line. . In Excel, verify the value you calculated is correct using the "solver" approach Calculate the standard error from the sum of the squares of the residuals and the 8. Fill out the following ANOVA Table SS df MSS F p for the p-value use =FDIST(F,df num,df denom) \_\_\_\_\_ ----School World Enginee 159 106







# Studio 2.0:

	INTEROFFICE MEMORANDUM				
TO FR SUI DA	TO:ENGINEERING PROCESS DEVELOPMENT TEAMFROM:BENITO BEAVER, VICE PRESIDENT OF ENGINEERING, BEAVER DAM SWEET TREATSSUBJECT:BATCH PROCESSING RECOMENDATIONDATE:MAY 4, 2016				
Ou sou rea Rat	Ir new OrangeCandy product line needs to go into volume production. For the process, we need a arce for glucose ( $C_6H_{12}O_6$ ) and fructose ( $C_6H_{12}O_6$ ). We will produce these sugars through a hydrolysis action using sucrose ( $C_{12}H_{22}O_{11}$ ) as a reactant in aqueous solution (0.5 M HCl) with our proprietary teEnhancer additive that is believed to catalyze the reaction.				
	$\begin{array}{c} CH_{2}OH \\ H \\$				
	HO H				
. <sup>-1</sup> ], ligi con	e hydrolysis reaction is monitored by a polarimeter. In this technique, the angle of plane-polarized laser ht is measured as it is passed through the solution. The change in angle can be related to the ncentration of sucrose in solution.				
of Th	e biochemists from the consulting firm we hired report that the kinetics for this irreversible 1 <sup>st</sup> order action can be described by the following ordinary differential equation:				
	$\frac{\mathrm{d}C_s}{\mathrm{d}t} = -kC_s$				
wh is t wa	where $C_s$ is the sucrose concentration in [mol / m <sup>3</sup> ], $k$ is the 1 <sup>st</sup> order reaction rate constant in [hr <sup>-1</sup> ], and is time in [hr]. However, they are not able to provide us a value for the rate constant, $k$ , since we do not want to provide them access to our proprietary additive.				
Th pro fin: pro flo	e quality we provide to our customers is of utmost importance at Beaver Dam Sweet Treats. The ocess design team reports that it is critical that at least 70% of the initial sucrose has reacted to make the al product acceptable. Conversion less than 70% requires reprocessing the entire batch. Due to oduction bottlenecks, we also need to run the process for as short a time as possible. Due to process w requirements, our two batch reactors need the to use the same process time.				
Ple wil	<ul> <li>ase determine the rate constant and use it to make a process recommendation that you are confident l reach the 70% conversion requirement. I suggest you do the following analysis prior to experiments.</li> <li>First, the equation above must be solved to get a relationship between concentration and time.</li> </ul>				
	• Second, concentration vs. time data are needed. It is helpful to draw a rough schematic for your				

_		 	Facilitated Construction Collaborative Engagement Self-Construction School World Engineering World Hybrid World Abstract Math/Thermodynamics
_	 	 	Facilitated Construction Collaborative Engagement Self-Construction School World Engineering World Hybrid World
_	 	 	Facilitated Construction Collaborative Engagement Self-Construction School World Engineering World
	 	 	Facilitated Construction Collaborative Engagement Self-Construction School World
	  	 	Facilitated Construction Collaborative Engagement Self-Construction
	 · ·	 	Facilitated Construction Collaborative Engagement
	 · _ ·		Facilitated Construction
			Facilitator 2
			Facilitator 1
	 		Student 3
			C - 1 - / 2
		 	Student 2

borative Engagement Talk Time (sec)						
ering World	Hybrid World	Abstract Math	No Code			
190	76	878	121			
562	109	519	31			

Well distributed dialogue among all members of Team 2 with individual contributions that change with time as students offer their strengths and perspectives is indicative of productive disciplinary engagement during the task. Our data indicates that instances of School World and Hybrid World reasoning do not require this depth of justification or elaboration.