

The Two Worlds of Engineering Student Teams

Shane Lorona¹, Susan B. Nolen², and Milo Koretsky¹

¹Oregon State University, Corvallis, OR

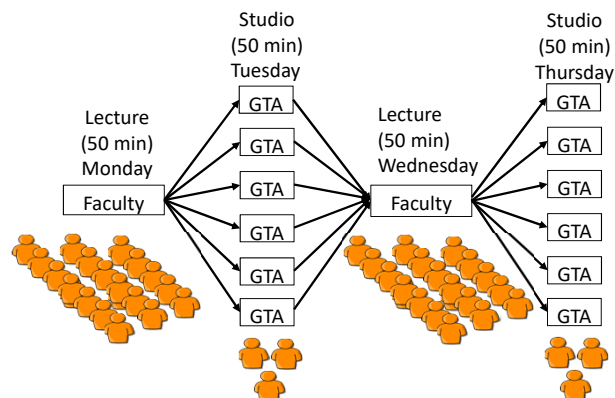
²University of Washington, Seattle, WA

Institutional change and studio

- Challenges facing engineers today are as complex as they have ever been
- Collective effort from diverse teams of talented engineers needed for solutions

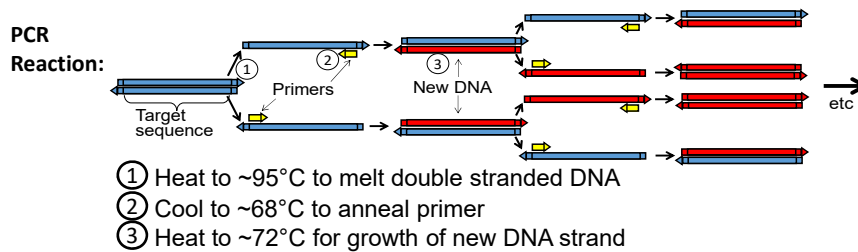


NSF Revolutionizing Engineering and Computer Science
Departments (RED)

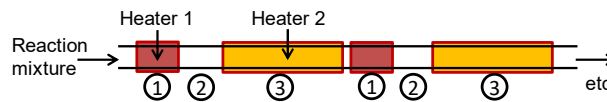


Studio 2.0: Energy Balances

“Development of Microfluidic Device for Diagnostic Testing Using Polymerase Chain Reaction (PCR)”



Heaters (2 cycles)



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Research questions

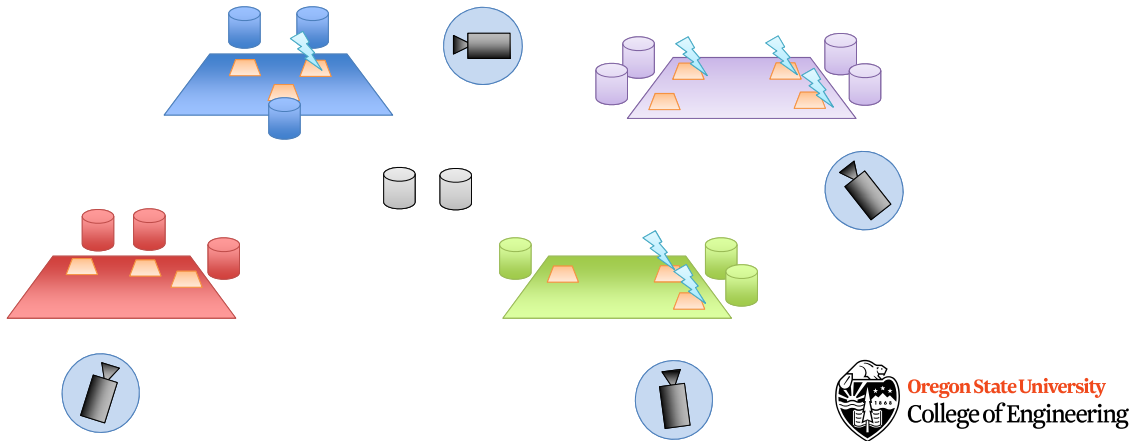
- To what degree do two student teams engage in engineering world thinking or in school world thinking as they complete the studio activity? Are there patterns in the differences between teams?
- How do each of the worlds influence their engagement as they progress towards task completion?



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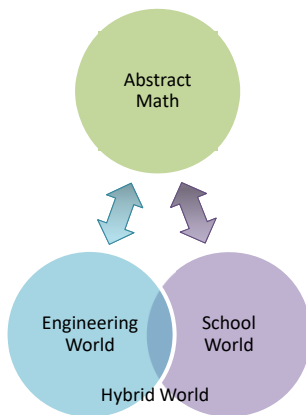
Participants and setting

- Volunteers from CBEE undergraduate engineering community who recently passed sophomore level course “energy balances”
- Teams asked to read PCR activity thoroughly and to make sense of the task over the course of 80 minutes



Figured worlds and social context coding

- Overarching framework is productive disciplinary engagement (PDE) where students use concepts and discourses to “get somewhere” on a task
- What identities, relationships, positions do participants take on as they productively engage in the task?

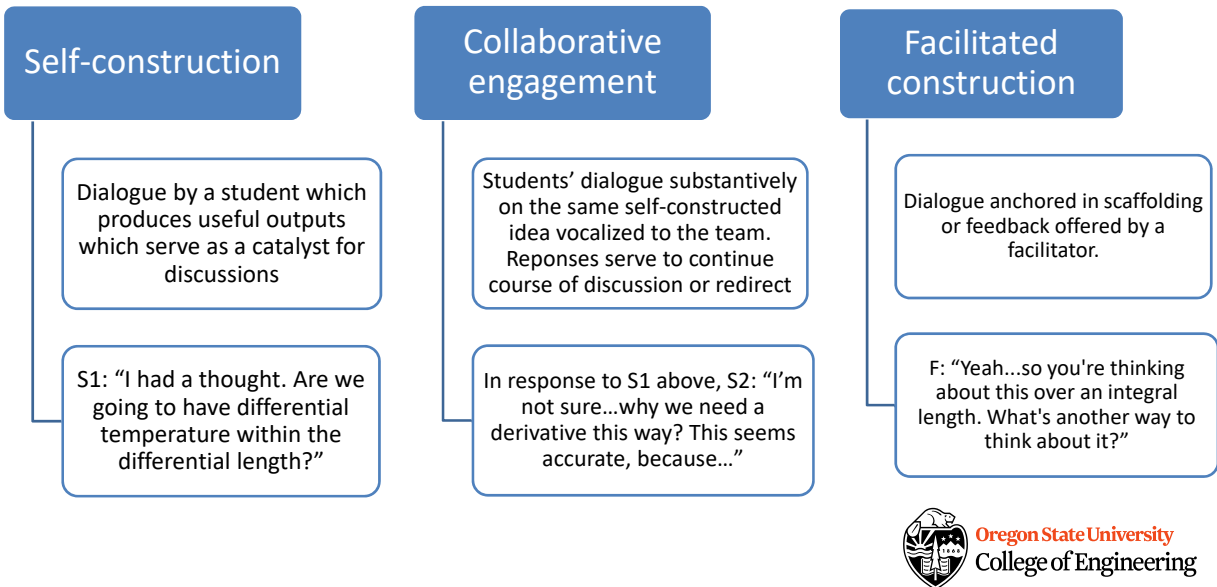


Holland et al. (1998)

- EW “So... a certain amount of power is going into the water at all times along the coil that’s in the water, and so we can assume there’s a constant amount of energy going into the water....”
- SW “I think we could probably like assume that it's completely mixed and the temperature is uniform in the heating area...because that's what we assumed in mass transfer [class] usually.”
- AM “We have another Joule unit in that...we do want another Joule...oh this should be flipped. Joules per kilogram...err...Kelvin, kilogram, Joule.”

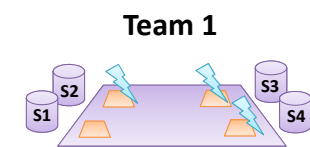
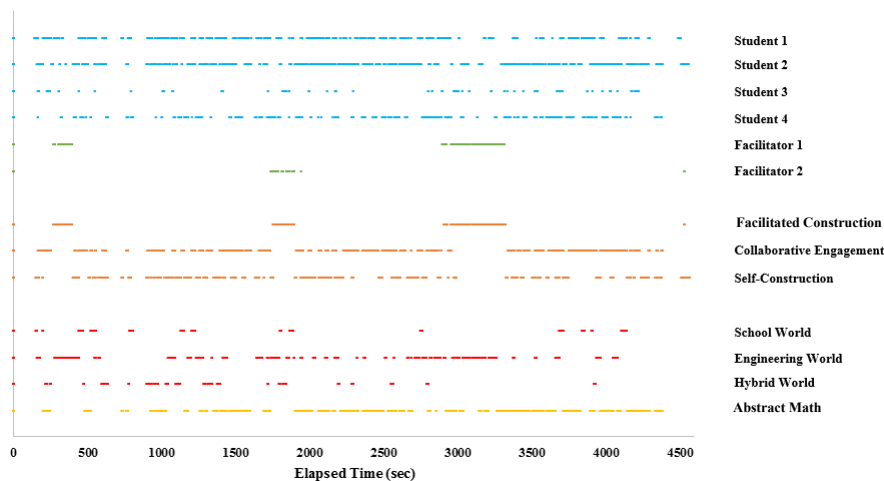


Types of engagement coding



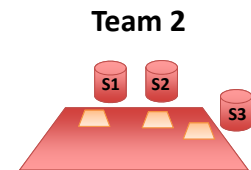
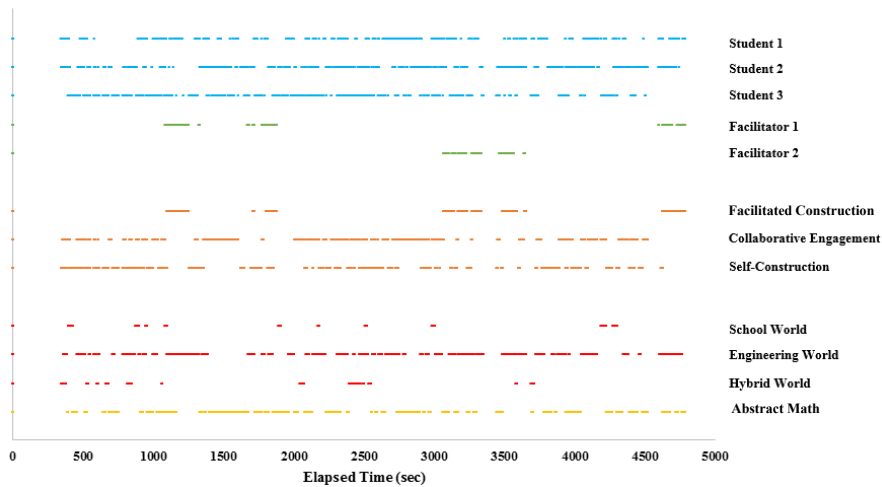
Dynamic team interactions

- Two teams of the four were selected for an in-depth comparative case study
- Qualitative codes plotted to observe change with time



Dynamic team interactions

- Two teams of the four were selected for an in-depth comparative case study
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Quantitative look at interaction patterns

Table 1. Type of engagement coding for the two teams analyzed

| | | Facilitated-construction | Collaborative engagement | Self-construction |
|--------|----------------------|--------------------------|--------------------------|-------------------|
| Team 1 | Talk Time (sec) | 556 | 1424 | 993 |
| | Percent [†] | 19% | 48% | 33% |
| Team 2 | Talk Time (sec) | 635 | 1327 | 1146 |
| | Percent [†] | 20% | 43% | 37% |

- Strikingly similar engagement coding between the two teams, despite differences in distribution of discourse among team members



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[†]Calculated as a percent of talk time coded with the three types of engagement. Not all utterances coded.

Quantitative look at interaction patterns

Table 2. Figured world and abstract math coding for the two teams analyzed

| | | School World | Engineering World | Hybrid World | Abstract Math |
|--------|----------------------|--------------|-------------------|--------------|---------------|
| Team 1 | Talk Time (sec) | 234 | 847 | 216 | 1492 |
| | Percent [†] | 8% | 30% | 8% | 53% |
| Team 2 | Talk Time (sec) | 187 | 1563 | 214 | 1366 |
| | Percent [†] | 6% | 47% | 6% | 41% |

- Low school world coding for both teams
- Significant amount of time for both teams spent in abstract math
- Deficit in engineering world utterances for Team 1 nearly all allocated to abstract math



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[†]Calculated as a percent of talk time coded with the three figured worlds and abstract math. Not all utterances coded.

Quantitative look at interaction patterns

Table 3. Figured world coding filtered for collaborative engagement utterances

| Collaborative Engagement Talk Time (sec) | | | | | |
|--|--------------|-------------------|--------------|---------------|----------|
| | School World | Engineering World | Hybrid World | Abstract Math | No Code |
| Team 1 | 159 (11%) | 190 (13%) | 76 (5%) | 878 (62%) | 121 (9%) |
| Team 2 | 106 (8%) | 562 (42%) | 109 (8%) | 519 (39%) | 31 (3%) |

- 29% difference in collaborative talk time coded in engineering world between Team 1 and 2
- Team 2 nearly even talk time distribution between engineering world and abstract math
- Team 1 collaboratively engaging in abstract math 62% of the time



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Discussion and synthesis

- Collaborative engagement in engineering world almost always represents desired talk where team members are arguing, defending, explaining, and elaborating using reasoning based in engineering norms and practices
- For Team 1, key opportunities to collaborative engage in engineering world were rebuked



S2: "So I guess what I'm saying is, is it gonna be at 95 degrees C for like half of this chamber..."

S1: "I think that that might be overcomplicating the situation. This is...this is a class where [indiscernible] ok it goes into the heater and is at that [target] temperature now."

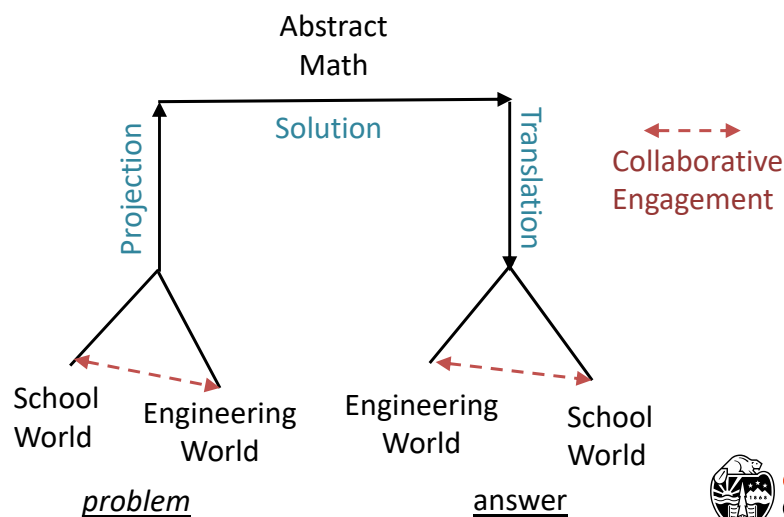
School World



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Discussion and synthesis

- We explain the difference in the teams' pattern of interaction with the following core model



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