Assessing the Potential of Biometric Sensors to Measure Engagement and Learning in the Classroom
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Research Question
Which teaching strategies increase student engagement in climate science?

Background
• “Engagement” is herein defined as the interest, motivation, effort that students have or show towards learning (Sinatra et al., 2015)
• Increased classroom engagement leads to increased learning - Qualitative analysis shows active learning is engaging (Freeman et al, 2014).
• Here, we quantify engagement in a controlled and a classroom setting.

How do we quantify engagement?
Skin conductivity is a biometric proxy for engagement!

Compare personal baseline with activity skin conductance to get activity engagement

Activity engagement (%) = \frac{\text{(activity skin conductance)} - \text{(baseline skin conductance)}}{\text{baseline skin conductance}} \times 100\%

Morrison et al. (2019) showed dialog most engaging in a controlled setting...
Example of a student’s raw skin conductance data in a controlled setting (Morrison et al., 2019).

(left) Average engagement response to different learning activities in a controlled setting. Overall students were statistically most engaged while answering a direct question (starred, \textit{p} < 0.05; Morrison et al., 2019).

Why? Students reported interest in dialogue activities, but also felt ‘nervous’ about giving incorrect answers in front of peers.

…but is dialogue most engaging in a real class?

IRP analysis shows exams, equations, small group dialog engaging in classroom environment

• Intro climate science class with 200+ students (ATOC1860 in Duane Physics classroom, picture below)
• Same 17 students wore hand sensors in each class. Observers recorded student behavior in each class. Engagement from hand sensor calculated with periods of “distracted” behavior (e.g., cell phone) removed. Students also self-reported engagement.

Most engaging activities: exams, equations, clicker questions, jokes/stories, polar bears
Least engaging activities: announcements, whole class discussion, concept review

Take home messages
• Perceived (peer discussion, equations) or actual (exams) high stakes activities increase engagement
• Small group discussion is highly engaging in controlled and classroom settings
• Polar bears are also engaging!

References:

Our python code for hand sensors is available on github...