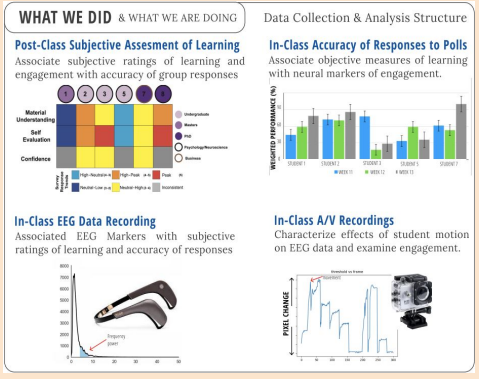
A flexible neuroscience- and technology-driven framework for Discipline-Based Education Research: Self-Assessment as a Learning Predictor

Carmen Sherlock, Alfredo Spagna
Department of Psychology, Columbia University

Introduction

What predicts student learning success? Higher education generally uses post-hoc evaluations (e.g. midterm and final exams) as proxies for academic attainment, precluding effective and timely intervention. How can instructors and students integrate real-time evaluations and predictive evidence of learning to address student learning gaps before it's too late? Our framework aims to draw from the relationships between subjective, objective, EEG, and video data collected during class to predict and quantify learning as it occurs.

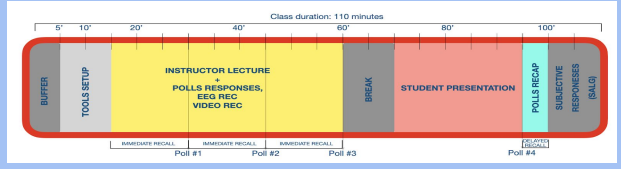


Self-assessment as a learning predictor:

- The ARCS motivation theory posits that attention is the most proximal factor to knowledge acquisition and academic success.
- Ross (2006) found that subjective self-assessments contribute to higher student achievement.
- Sitzmann et al. (2017) found that self-assessments were correlated with motivation and satisfaction.

Methods

- Eleven university students enrolled in a neuroscience course (Summer 2022) were evaluated over four weeks
- Subjective self-assessments were administered at the end of each class using the Student Evaluation of Educational Quality (SEEQ), which queries engagement, perceived clarity of instruction, confidence, skill acquisition, among other factors
- To measure objective learning, students completed frequent quizzes throughout class assessing content understanding and retention
- We ran a linear model to see if subjective self-assessment correlated to objective learning measures

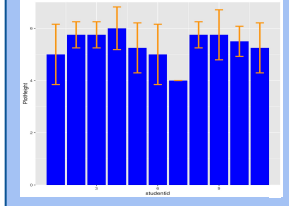


Results

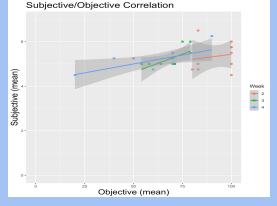
Subjective ratings of confidence, understanding of material, and active study habits were positively correlated with objective learning outcomes. Course engagement, evaluation of skill, and clarity of instruction were uncorrelated.

Confidence

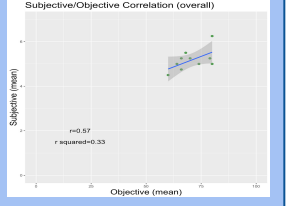
1. Presently, I am confident that I understand the foundations of neuroscience.
2. Presently, I am confident that I can be successful in this course.



Week 1 self-assessments of confidence



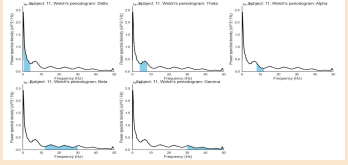
Confidence/objective correlation, week-by-week



Confidence/objective correlation, overall

Discussion & Next Steps

- Because students from historically underrepresented groups often underestimate their own proficiency, it is crucial for instructors to identify and address discrepancies among students' confidence and other subjective measures to support objective learning outcomes.
- Earlier findings from prior years indicated that learning can be *uncorrelated* with self-ratings of mastery and confidence. More data and larger samples are needed to explore this disconnect.
- Brain signals associated with attentional focus correlate strongly with subjective reports of learning. Clarifying this relationship informs educators of what to look for: as we deepen our analysis, we can identify which self-reports most strongly predict increased neural activity and increased objective performance.



Frequency bands from one subject recorded using EEG headset.

References

1. Organisation for Economic Co-operation and Development & Development Assistance Committee. (2001). *Evaluation feedback for effective learning and accountability.* OECD Development Assistance Committee. http://www.myilibrary.com?id=3567
2. Li, K., & Keller, J. M. (2018). Use of the ARCS model in education: A literature review. Computers & Education, 122, 54-62.
3. Ross, John A. (2006). The Reliability, Validity, and Utility of Self-Assessment. *Practical Assessment, Research, and Evaluation, 11*(10). https://doi.org/10.7275/9wph-vv65
4. Sitzmann, T., Ely, K., Brown, K. G., & Bauer, K. N. (2010). Self-assessment of knowledge: A cognitive learning or affective measure? *Academy of Management Learning & Education*, 9(2), 169–191. https://doi.org/10.5465/amle.9.2.zqr169
5. Marsh, H. W. (1982). SEEQ: a reliable, valid, and useful instrument for collecting students' evaluations of university teaching. British journal of educational psychology, 52(1), 77-95.
6. Ballen CJ, Wieman C, Salehi S, Searle JB, Zamudio KR. Enhancing diversity in undergraduate science: Self-efficacy drives performance gains with active learning. CBE—Life Sciences Education. 2017 Dec;16(4):ar56.
7. Tyng, C. M., Amin, H. U., Saad, M. N., & Malik, A. S. (2017). The influences of emotion on learning and memory. Frontiers in psychology, 8, 1454.