Shoba Subramanian, Ph.D.

Assistant Department Head
Assistant Teaching Professor
Department of Biological Sciences
Mellon College of Science

TEACHING & LEARNING SUMMIT 2016

Carnegie Mellon University

A Multi-Pronged Approach to Enhance Learning Outcomes In a Diverse Classroom

- Enable **diverse** students to learn advanced contemporary biology
- Engage students **actively** while making learning **enjoyable**!
- Integrate **science communication** into coursework

Project Design

Abstract: A combination of teaching strategies was applied in a graduate biology course to improve learning outcomes and maintain content rigor, while considering diversity in student backgrounds. First, Just in Time Teaching (JiTT) methodology allowed students to engage better in the classroom and guided the instructor to modify lecture content by spending more time on confusing elements. Second, group exercises were introduced around primary literature reading and critique to help students understand scientific discovery. These also doubled as opportunities to practice scientific communication skills. Third, a "verbal" final exam made it easy to assess students' thought processes while evaluating their grasp of the subject matter. Importantly, this new exam format also helped students deal with complex material by steering their thoughts in the right direction. These pedagogical methodologies can be easily adapted to other courses toward improving student engagement and learning outcomes.

Lessons Learned

- **Modifying lecture content based on student questions**
  - Empowers students
  - Enables instructor to reach out to student concerns on time
  **Timing is rough, especially if class size is large*
- **Using literature to understand scientific discovery process**
  - Renders abstract concepts tangible for students
  - Uses technical knowledge toward follow up analysis
  **Heavy jargon used in scientific papers is intimidating to novices*
- **Assessing final exam in an interactive verbal format**
  - Gauges student's thought process directly
  - Allows for room to evolve and build follow up questions
  **Challenging to schedule during finals week*

Pedagogical Tools and Highlights

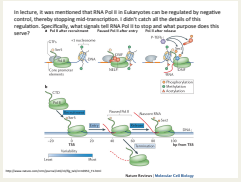
1. **JiTT – Tailor lecture content to student background by gathering confusing questions prior to class**
2. **In Class Activities – Problem solving in real time to apply and reinforce key concepts**
3. **Literature Review – Connecting concepts to pathway discovery in a disease context**
4. **Verbal Final Exam – Assess 1:1 student understanding of complex material in a demonstrable manner**

Project Evaluation

JiTT – Evaluated based on quality of student questions and student excitement

A. JiTT Module on mRNA Splicing and Regulation of Translation– September 8th 2016
- What happens if GTPase cannot alternate between its active and inactive state due to the presence of Guanine Nucleotide Dissociation Inhibitors (GDIs)? How does the elongation process adapt to it?
- What happens if GTPase is not available for some reason? Does translation stop completely until GTPase is available?
- What will happen if there is not enough GTP to supply energy? Will the translation complex stay in the mRNA, or stop translating and release polypeptide?

B.



C. At the end of class on 9.8.16, a student requested that we do more of JiTT exercises as they really learn from material taught from a student's questions' perspective. The student said this was the "coolest" way of teaching and if they become an instructor they will adopt this method!

Students complete assigned reading, and answer targeted questions for the assigned reading. In addition, they provide questions via Blackboard, which the instructor reviews and addresses throughout class. Pictured above A) sampling of student questions classified into groups based on subject matter, B) addition of new slides to lecture in order to address student questions day of class. C) Students really enjoy this format of learning.

Literature Survey, Applying Knowledge – Evaluated by Post Course Focus Group

A. Positive Feedback
- All student participants agreed that it was a useful activity for learning.
" I benefited VERY MUCH, before the course it took me greater than two weeks to read a paper. After this course, it takes me only 3 hours."
- One student wanted to decrease the number of papers from 5 to 3. But all other students disagreed and reported that 5 papers allowed them to develop their skills better.

B. Feedback For Improvements
- Timing of Paper assignments was a concern
Added a dedicated recitation session; 2 sessions/paper

Week 1 – Demystify Jargon ← → Week 2 – Group Presentation & Discussion

- Students preferred targeted questions about the paper assignment
Modified assignment to provide more focus

Data via post class focus group in Spring 2015 (gathered, moderated, and written up by Eberly Center Staff members). Question : A. " How much did you benefit from the paper review and critique? B. Would you like to extend or shrink time spent on paper discussion? What things about the paper discussion worked for you and what did not?"

Verbal Final Exam, Communication, Overall Evaluation – Evaluated by Various Tools

A. "I prefer oral to written, there's less pressure and a chance to make sure what the teacher is asking. Written exams are stressful…"
"The oral gave a chance to practice on the whole picture and synthesize all knowledge into series of experiments to finish one task."

B. **Verbal Final Weightage**
Modified to larger %

C.

Relevant Faculty Evaluation Data

D. Many students have self reported that the active training in communication as part of a science class has helped them do better in internships and be more articulate during job interviews.

Data via post class focus group in Spring 2015 (gathered, moderated, and written up by Eberly Center Staff members). A. "Did you enjoy the format of the verbal final exam?" B. "Would you prefer this to be la larger % of the final grade and the in-class exams worth a smaller percentage?" C. Upward trend in FCE data (Overall teaching (Purple); Importance of Subject Matter (Light Blue); Clear Learning Goals (Red); Explains Course Objectives (Dark Blue); Feedback to Students (Green). D. Long term benefits of project in student professional development and job placement

**Positive feedback on JiTT was obtained via focus group on being better prepared coming to class, data not included here.*

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All of my students who make teaching fun!