EXPLORING FIRST YEAR MEDICAL STUDENT LEARNING EXPERIENCES IN AN INTERDISCIPLINARY THERAPEUTIC ENZYME DESIGN LAB INTEGRATING BASIC SCIENCES AND ENGINEERING

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INTRODUCTION

• Carle Illinois College of Medicine has developed engineering-infused curriculum aligned with its mission to train future physician-innovators to transform and democratize health care.
• Phase 1 curriculum is taught by Instructor teams of basic scientists, clinicians, and engineers.
• For the Foundations: Molecules to Populations course, an engineer-biochemist instructor team (Bhalerao-Yodh) developed a therapeutic enzyme design lab1 for Carle Illinois inaugural student class as a way to implement its engineering-integrated curriculum at the basic science level.

METHODS

• For the 2nd run of this lab, the same instructor team piloted a mixed-methods research study to evaluate student learning experiences and outcomes from this integrative activity. This poster outlines the results of this study.

MIXED METHODS® STUDY

I. Learning Rubric

A rubric designed by the instructor was used to each team's research summary and innovation proposal to assess attainment of the learning goals. Each assignment was rated by both instructors, and then individual ratings were discussed to reach a combined/resolved score.

II. Focus Group

A one-hour post-lab focus group with 5 student volunteers enabled exploration of student perceptions of the activity. Students were asked to discuss the following 7 questions during the session. Transcripts of audio-recorded session enabled exploration of student perceptions of the activity.

RESULTS

EXAMPLES OF NEW ALTEPLASE FORMULATIONS

Safeplase™ - incorporate an allosteric inhibitor site to bind downstream inhibitors of enzyme to lower patient hemorrhage risk.

Clothegone™ - incorporate a binding site for gold nanoparticles to increase efficiency of drug delivery and uptake and encapsulate within different size nanoparticles to fine-tune effective dose and therapeutic time window. (image right – from student team proposal)

PHASE 1 FOUNDATIONS: MOLECULES TO POPULATIONS COURSE

Preparation: Lecture Enzyme Kinetics, Regulation

Engineering Design: Small molecules and Enzymes in Biochemical Systems

LAB 1st HOUR

DIAGNOSING/TESTING

LAB 2ND HOUR

TREATING/ENGINEERING

1. Therapeutic enzyme design lab

2. Engineering-integrated curriculum

3. Student Artifact Rubric

Q1: To what extent do student artifacts reflect attainment of activity learning goals?

Q2: What are the student perceptions of this activity?

REFERENCES

1. Yodh, J. and Bhalerao, K. (2019, May) Poster Presentation at 7th Inter-Regional Conference on Teaching, Learning, Assessment, and Accreditation.
5. ACTIVASE/Alteplase https://www.activase.com
7. BRENDA informatics databases to obtain the enzyme class, sequence, organismal source, structure, kinetic parameters of the natural and synthetic variants of allopilase

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FUTURE IMPROVEMENTS

1. Provide students the rubric in advance to motivate better translation of group discussion into tangible outcomes on submitted summary.
2. Convert the rubric rating scale from a 3- to 5-point scale to further differentiate outcomes and address the impact of differences in rater’s disciplinary background on inter-rater reliability.
3. Fine-tune rubric questions to better focus on how students apply foundational knowledge towards innovation.

LEARNING ACTIVITY

1. Work in smaller teams of 3-4 students so everyone stays engaged.
2. Provide more initial exercises on how to use information garnered from these databases to bring everyone to the same level prior to the innovation activity.
3. Provide follow-up opportunities for teams to take a deeper dive into their innovation proposals.

CONCLUSIONS

1. A mixed-method evaluation demonstrated this lab exercise successfully engaged students in integrating basic and clinical sciences with engineering innovation.
2. Learning activity structure promoted creativity and teamwork between students with different training backgrounds that positively impacted students’ motivation and their ability to apply foundational concepts to medical innovation.
3. Significance: Incorporation of an application-driven, team-based task which links basic science knowledge to product design and marketing provided the drive for learning and ideation.