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Analysis of Student Learning Gains in a Biochemistry CURE course during the mandatory COVID-19 shift to online learning

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Due to the ongoing COVID-19 pandemic, institutions across the world have had to make modifications to existing curricula, especially in the experimental science lab. There is a need to better understand student learning in this environment. Using the Participant Perception Indicator (PPI) survey, we measure the students’ knowledge, experience, and confidence (KEC) growth over the course of a fully online biochemistry course. Using a combination of video explanations, experimental procedure documents and sample data students completed the Biochemistry Authentic Scientific Inquiry Lab (BASIL) Course-based Undergraduate Experience (CURE) in summer 2020. The results and analysis of the survey data gave light to three main findings. We found students learned more about bioinformatics experiments and concepts than about their wet-lab counterparts. Students did report greater gains in learning outcome KEC than in wet lab and computational techniques. Finally, students report experience and confidence gains lagged their knowledge of the techniques. Students are not as confident in their understanding of techniques when unable to perform them in the physical laboratory. Thus, even though they had great knowledge and understanding of the structure, protocols, and purpose of the experiments and techniques, their responses indicated that their experience and confidence was not on par with their knowledge.

Methods

Figure 2: Schematic sequence of experiments conducted, and techniques employed during the Summer 2020 term. All procedures, both experimental and computational, were conducted in an online learning environment. Students were provided with educational videos to help explain wet-lab experiments and the instructor was present to lead them through computational techniques and explain any questions or concerns.

Future Works

- Further testing on neurodiverse populations
- Adding new collaborators to the project
- Contact us to find out more!

Student Results

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<tr>
<th>ALO1</th>
<th>ALO2</th>
<th>ALO3</th>
<th>ALO4</th>
<th>ALO5</th>
<th>ALO6</th>
<th>Average</th>
<th>Comp</th>
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Table 2: ALOs primarily identified for the BASIL curricula and used to create the BASIL

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Introduction

Winter 2020 semester data, published in Sikora et al JCE 2020, shows the effects that a mid-semester shift to an online format had on student learning. This current study focuses on the Summer 2020 semester, where the instruction was completely online. After the development of the ALOs, a PPI survey was created based on the 7 most relevant and top-rated learning outcomes (Figure 1). After developing the PPI survey, it was distributed to students at both the beginning and the end of the semester, and analysis of the survey responses were done based on reviewing the gain scores and overall perceived student-improved indication. We are pursuing several research goals in this study.

- Convert Anticipated Learning Outcomes (ALOs) identified by Iby et al. CBE, 2018 to verified learning Outcomes (VLOs) through assessment methodology with new online courses
- Use a participant perception indicator (PPI) survey to evaluate student knowledge, experience, and confidence (KEC)
- Design targeted assessments to improve areas showing poor student understanding

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Abstract

Student Results

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Figure 3: The scores reflect participants’ ratings of their knowledge, experience, and confidence (KEC) regarding each item based on the following scale: 1-“None”; 2-“A Little”; 3-“Some”; 4-“Much” and 5-“A Great Deal”. B Indicates that an ALO pertains to techniques that are biochemical wet lab (B), computational (C), or both (BC).

- There were higher gains seen in Computational techniques in comparison to wet-lab techniques (Figure 3)
- Learning objectives served as a bridge between the instruction of techniques and student learning
- When techniques are taught paired with their respective ALOs, there was an increase in knowledge, experience, and confidence
- The gain in experience and confidence is less that the gain in knowledge (Figure 4)

Future Works

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Contact

Blog: basiliuse.blogspot.com
Email: paul.craze@rit.edu for information and collaboration opportunities.

Table 2: ALOs primarily identified for the BASIL curricula and used to create the BASIL

- Faculty were closely monitored in some months to allow for re-teaching of concepts.
- Students were encouraged to use appropriate computational resources.
- Students were encouraged to take notes; whether studying or in class assignments.
- Students were encouraged to use computational software; whether studying or in class assignments.
- Computer assignments were revised with those computationally inclined.
- Design a new course to cultivate a pure function.
- Design a new lab to cultivate a parallel process and ways to improve the lab.

Figure 1: (Sikora et al. JCE 2020)