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Enhancing course development through conversati

Gilbert, Brian T

Enhancing Course Development Through Conversations

Brian Tidbury Gilbert, Dr. Amanda Musgrove-Richer, and Dr. Nicole Sandblom
Department of Chemistry

UNIVERSITY OF CALGARY

Introduction

As many undergraduates in the Faculty of Science know, the unit on buffer systems in first year chemistry is one of the toughest parts of the course. However, despite this difficulty being commonly seen, there is still a large gap in the literature on the teaching and learning of buffer systems[1]. Due to the gap in literature about teaching buffer systems, this undergraduate research project built upon the work of Orgil and Sutherland[2] and looked to determine if there really is a statistical backing to the claims of difficulty with buffer systems, determine why such a difficulty exists, and attempt to address the observed issues through the implementation of a learning simulation.

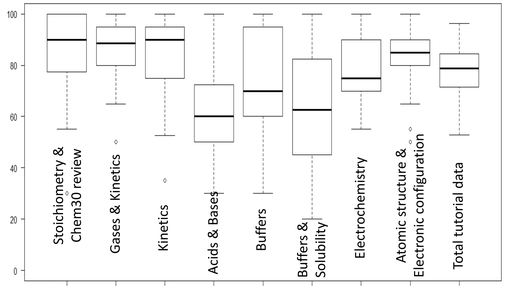
Results

A simulation was built in the Java™ programming language following the guidelines[3] set out by the PhET group in order to maximize the educational benefit to students. Each component was designed to address a specific misconception observed during the study. After implementing the simulation into the lectures and buffer tutorials, students were better equipped to answer buffer related questions and were stronger in their understanding of buffer phenomena.

Conclusions

Based on course performance and student feedback, students are now more equipped to succeed in introductory chemistry and are leaving the course with a much deeper understanding of course content. In moving forward from this research, we would recommend implementing simulations and demonstrations into post-secondary classrooms to help students grasp complex/abstract concepts in the sciences.

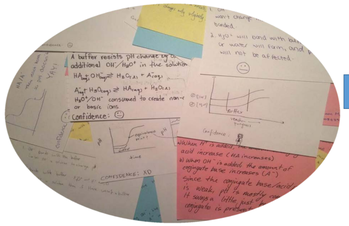
Experimental Approach



Tutorial grade analysis. Tutorial grades analyzed to determine most difficult concept in introductory chemistry

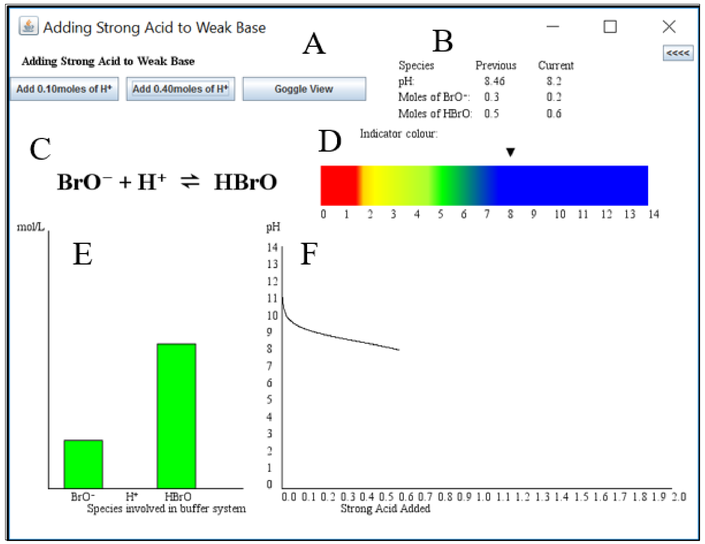
Focus group 1. Gathered verbal student responses outside of conversations with course instructors

Prior knowledge assessments. Students indicated that they struggled to recall information and skills from high school chemistry prerequisites



Misconception cards. Identified the reasons that students have difficulty in the topics identified during the first focus group

Focus group 2. Collected verbal feedback from students about newly implemented resources



Buffer simulation/visual aid

A. Buttons chosen to allow students to guide their own inquiry without giving information overload
B. Modified ICE (Initial-Change-Equilibrium) table included to numerically display results of simulation
C. Reaction included to connect buffer function to the reactions learned in lecture
D. Universal indicator slider included to visually connect simulation to laboratory and in-class demonstration experiences
E. Component bars included to visually represent the mechanisms that work to buffer the pH in solutions when strong acid or base are added
F. Titration curve included for students to have a familiar visual about buffer systems to relate all other components to.

References

1. Teo TW, Goh MT, Yeo LW. 2014. Chemistry education research trends: 2004-2013. Chemistry Education Research and Practice. 15: 470-487
2. Orgill MK, Sutherland A. 2008. Undergraduate chemistry student's perceptions of and misconceptions about buffers and buffer problems. Chemistry Education Research and Practice. 9: 131-143
3. Adams WK, Perkins KK, Wieman CE. 2006. PhET look and feel.

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The University of Calgary Conjoint Faculties Research Ethics Board has approved this research study as REB15-3014, REB15-3014_MOD1, AND REB16-1085