Teaching Chemistry Through Real-World Contexts

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Introduction

Science 2B, the culminating class in the integrated chemistry-biology curriculum at Urban School, has remained a rather traditional, content-focused course. Too often, traditional chemistry curricula focus on facts and equations, presenting key concepts as disparate, unrelated ideas[1]. Context-based approaches to chemistry aim to increase student engagement, motivation, and deep understanding by making the learning process more meaningful for students.[2] In order to emphasize the interdisciplinary nature of chemistry, the Science 2B curriculum was revised and organized around four guiding questions. These questions had an environmental-focus and provided a clear context for the chemistry content students were studying. The revised Science 2B curriculum contained the following aspects of a context-base course:

- **The context of the guiding question became the driving force for chemistry content[3]**
- **Chemical concepts were explored in the context of real-world applications[2]**

Guiding Question	Subquestion	Relevant Chemical Concepts
Why do humans use the fuels we do?	How much fuel would it take to power Urban School for a day?	Combustion reactions, balancing equations, energy of reactions, and stoichiometry
What are atmospheric consequences of our fuel use?	How does the composition of our atmosphere affect life on Earth?	Gases, Ideal Gas Law, Combined Gas Law, Equilibrium
Why are increasing carbon dioxide levels affecting the ocean?	How has the pH of the ocean changed over time?	Solubility, Intermolecular Attractions, Acids and Bases, Molarity, and Equilibrium
What does it mean for a marine shell to dissolve?	How is ocean acidification affecting oysters along the West Coast?	Solubility, Molarity, Equilibrium, Stoichiometry

Research Questions

Focus Question:

Does teaching chemistry in the context of real-world applications lead to improved conceptual understanding and increased desire for inquiry among learners?

Sub-questions:

1. What was the effect of teaching chemistry in context on student engagement and motivation for learning?
2. How does teaching chemistry in context affect the development of higher order thinking skills in students throughout Science 2B?
3. What is the effect of teaching chemistry in context on the ability of students to apply their understanding of chemistry in novel situations?

	Data Source 1	Data Source 2	Data Source 3
Focus Question	Chemistry Content Assessments	Chemistry Application and Higher-Order Thinking Skills (CAHOTS) Assessments	Attitudes and Motivations Survey
Subquestion 1	Attitudes and Motivations Survey	Student Interviews	Teacher Surveys
Subquestion 2	CAHOTS Assessment	Attitudes and Motivations Survey	Student Interviews
Subquestion 3	Chemistry Content Assessments	CAHOTS Assessment	Attitudes and Motivations Survey

Methodology

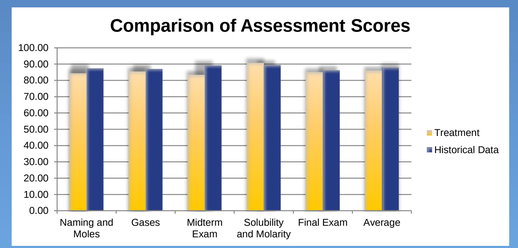
The treatment was conducted in Science 2B, a chemistry-focused course taken by all sophomores at Urban School of San Francisco. Rather than organizing Science 2B around chemical concepts, the course was organized around four guiding questions, found above. Each question provided a clear context for the chemistry students were learning. Students completed the following assessments at regular intervals throughout Science 2B:

1. Chemistry Content Assessments
2. Chemistry Application and Higher Order Thinking Skills Assessments
3. Chemistry Attitude and Motivation Surveys

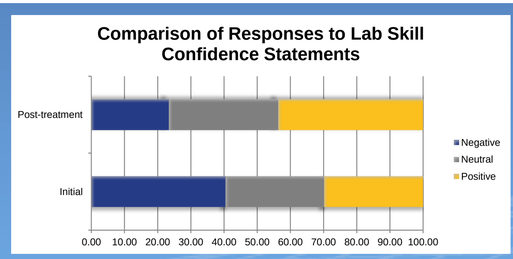
Additionally, qualitative information was gathered through:

1. Student interviews
2. Teacher Feedback Surveys

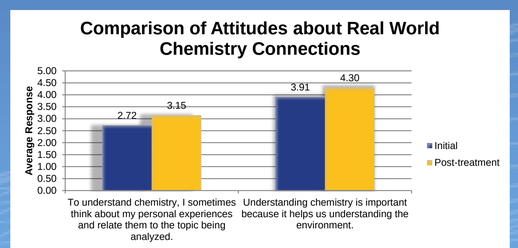
Results



A context-based approach to chemistry had no statistically significant impact on student understanding. Students continued to demonstrate strong understanding throughout the treatment.



A statistically significant change in *confidence in lab skills* was observed. Students became more comfortable designing hypotheses and analyzing data. Students' desire for, and comfort with, inquiry increased throughout the treatment.



Students became increasingly willing and able to identify connections between chemistry content to their everyday lives. A statistically significant increase was observed in students' ability to make *real-world connections*.

Conclusions

1. A context-based approach to chemistry did not have a statistically significant impact on student understanding. Students maintained a high level of understanding throughout the treatment.
2. A statistically significant increase in students' desire for inquiry was observed. In particular, students made significant gains in their confidence with lab skills.
3. Students maintained high levels of motivation and engagement throughout the treatment.
4. A context-based approach to chemistry requires the integration of multiple concepts. As a result, students became more comfortable synthesizing information throughout the treatment. Students became less likely to rely on lower order thinking skills like memorization. Additionally, students were more likely to view chemical concepts as interwoven and connected.
5. Students became more comfortable applying their understanding in new situations. In particular, they were more likely to seek to connect new chemical concepts to their everyday experiences.

Overall, a context-based approach to chemistry had positive impacts on student engagement and desire for inquiry. It also provided opportunities for students to practice synthesizing, integrating, and applying their knowledge in the context of new situations. Students developed higher order thinking skills as they more readily considered chemical concepts in the context of real-world phenomena.

References Cited

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2. 3. King, D. (2012). New perspectives on context-based chemistry education: Using a dialectical sociocultural approach to view teaching and learning. *Studies in Science Education*, *48*(1), 51-87.
3. Overman, M., Vermunt, J.D., Meijer, P. C., Bulte, A. W., & Brekelmans, M. (2014). Students' perceptions of teaching in context-based and traditional chemistry classrooms: Comparing content, learning activities, and interpersonal perspectives. *International Journal of Science Education*, *36*(11), 1871-1901.

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