

The Effects of Explicit Math Instruction Before Chemistry Content Instruction At The High School Level

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Research Question:

Will direct instruction on mathematics lead to improved student understanding of chemistry content that relies on mathematics principles?

Old Bridge High School:

- 6th largest high school in NJ
- 28 sections of Chemistry
- 10th, 11th, and 12th graders
- No pre-requisite math



Background:

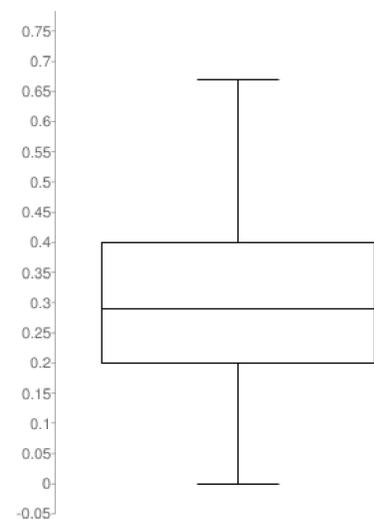
Darlington and Bowyer (2016) showed that students in higher level math classes performed better in chemistry and Villafane and Lewis (2016) showed that math ability was the best predictor of success while Tai, Sadler, and Loehr (2005) concluded that the higher math a student took in high school translated to greater success in science classes in college. Johnston, Watters, Brown, & Loughlin (2016) showed the ability of supplemental math to help students in chemistry class and Arnaud (2011) showed how some universities are structuring mathematics for chemist classes. The usage of supplemental math is important in bridging gaps in math abilities as a high school chemistry class will typically show diversity in the incoming academic experiences of students

Treatment:

Two chemistry classes ($N=49$) were exposed to short mini-math units before regular units of study in chemistry. The mini-math units focused on underlying mathematics concepts seen in the upcoming chemistry unit such as manipulating algebraic equations before a unit on gas laws. A Mathematics Diagnostic Test and Confidence in Mathematics Survey were given pre and post treatment and interviews were conducted at the end of the treatment.

Table 1
Data Triangulation Matrix

Focus Question	Confidence Survey	Mathematics Post Test	Unit Test	Interview
<i>Primary Question:</i> 1. What is the impact of direct mathematics instruction on student test scores?	X	X	X	X
<i>Sub Questions:</i> 2. What is the impact of direct mathematics instruction on student confidence in answers?	X			X
3. How does mathematical understanding relate to ability to learn new chemistry material?		X	X	X
4. Does early mathematics instruction help teacher provide more support during regular chemistry lessons?			X	X



Data:

Figure 2 shows the correct responses to the Mathematics Diagnostic Test in blue. Most students were able to answer question 2 while only 2 students correctly answered question 3. Figure 4 shows student pre-treatment responses to the Confidence in Mathematics survey where the majority agreed with statements about feeling overall confident in mathematics. Post treatment the mathematics diagnostic test had a nominal gain of 0.29

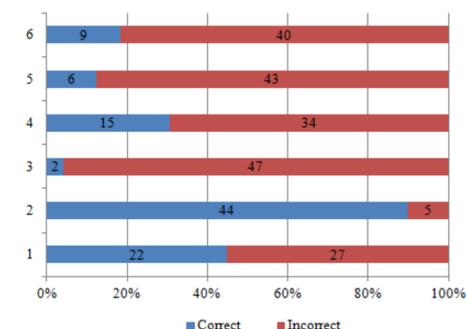


Figure 2. Pre-treatment mathematics diagnostic test question by question scores ($N=49$).

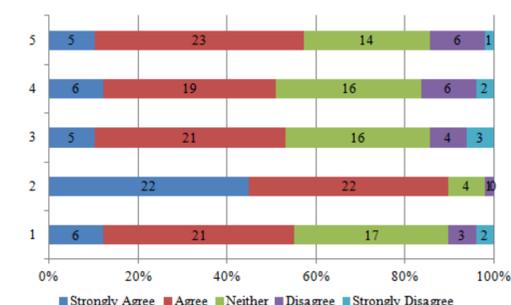


Figure 4. Pre-treatment confidence in mathematics survey results questions 6-10 ($N=49$).

Conclusion:

Student abilities and confidence in mathematics did not change post treatment. There was not a significant improvement in student understanding of chemistry content that relied upon math. Interviews revealed that students wished there was a prerequisite math course for the chemistry course.

References:

- Arnaud, C. H., (2011), Math for chemists: Math methods courses let professors teach chemistry in greater depth, *Chemical & Engineering News*, 89(18), 33-34
- Darlington E., (2016), How well does A-level Mathematics prepare students for the mathematical demands of chemistry degrees?, *Chem. Educ. Res. Pract.*, 17, 1190-1202.
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