Increasing Student Confidence with Evidence-Based Argumentation

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Introduction

The purpose of this investigation was to help improve student achievement and confidence with the argumentative format similar to the ACT writing assessment. Students were trained in close reading strategies, Claim-Evidence-Reading (CER) frameworks and argumentative essay writing. The goal was to help students to practice and improve their writing and literacy skills while increasing their understanding of complex science topics. The ability of high school students to research a topic, think critically about sources and compose an opinion or argument from the information gained is becoming increasingly important in a world of easily accessible, but often low-quality information sources. Most standardized assessments of student achievement now include a written portion, such as the ACT, which asks students to analyze and evaluate three given perspectives, "state and develop a perspective on the issue, and explain the relationship between that perspective and those given." (ACT.org) This writing format is elegant because it requires information synthesis at the highest level. Not only do students need to understand the topic and process the perspectives given, but they also must form an opinion of their own and support it with evidence. As I graded our district writing assessment last fall and saw very few students who were writing with this level of finesse, I began to wonder whether we properly prepare students for this type of thinking and writing, and if not, then how to improve. My overall goal was to see if a series of treatments using evidence to support claims could lead students to a new understanding of scientific concepts and create a lasting skill in building written arguments in the ACT format.

Research Questions

The primary question investigated was "How does the use of evidence-based argumentation in science class impact students' scores on ACT-like writing assessments?"
Sub questions:

- Will the use of Claim-Evidence-Reasoning models increase the frequency of evidence used to support conclusions in lab write-ups?
- Will the use of close reading strategies and argumentative writing lead to deeper understanding of complex science topics ?

Sample and Demographics

This study was conducted within a 10th grade Biology I course. Two sections received the treatment (N = 54) and participated with differing levels of success in this project. Students were a mix of high-achieving and average kids, upperclassmen who were re-taking the course and students with special needs. Thirteen had Individualized Education Plans (IEP's) or 504 accommodations. Two students had special needs specific enough to have a dedicated paraprofessional, one more was legally blind and one was in the process of learning English as a third language. There were about 23 students in the first period of the day (8:20 AM to 9:10 AM) and 27 students in the second period (9:15 AM-10:05 AM) with some fluctuation occurring throughout the year. Classes ran 45 minutes on Mondays and 50 minutes on Tuesday-Friday.

Helena High is a public class AA school in the state capital of Montana, with roughly 1,600 students. About 48% of the students qualify for free and reduced lunch. Most of the students live in an urban/suburban setting, but many live in more rural surrounding areas and travel many miles daily to attend school in Helena. The students are mostly white Caucasians (>87%) with a low percentage (<13%) Native Americans, African Americans, Hispanic/Latino and other ethnicities. Most of my students are between the ages of fourteen and sixteen.

Methods and Materials

For this investigation, students participated in three treatments throughout the year to improve their use of evidence in argumentation. First, students were given articles on complex science topics to read and analyze using the close reading format. These were then discussed in class and reinforced with videos, notes, and activities where applicable. Second, students were asked to complete discussion and conclusion sections in their lab notebooks using the CER format (Table 1) modified from McNeill and Kajcik, 2011. Third, students were asked to complete bell ringer questions in their notebooks using evidence to support a clam for which no specific data were provided. Summative assessment scores were compared to assess changes or improvements. I compared scores on the fall and spring district writing assessment (DWA) and an in-class essay on a complex ecological topic in the same format.

Table 1. Claim-Evidence-Reasoning grading rubric—used to assess bell ringer questions and lab discussion sections.

CER Grading Rubric

Discussion and Conclusion sections in your lab notebooks will be graded according to this scale.

	3	2	1	0
Claim	Fully and clearly answers question.	Addresses question but is unclear or vague.	Doesn't address question. Incomplete.	No claim
Evidence	Specific data used appropriately.	Some data included; not sufficiently explained.	Lacks specific data and analysis. Incomplete.	No evidence
Reasoning	Relates directly to all pieces of evidence.	Relates to claim, but isn't specific to evidence	Lacks connection to claim and evidence.	No reasoning
Research	Connects specific reasoning to scientific concepts.	Adds to reasoning but lacks connection to scientific concepts.	Lacks connection to reasoning and scientific concept.	No research

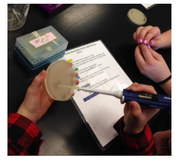
Students were also given pre- and post-surveys in the Likert format to assess their confidence with skills related to reading and writing about science topics and using data as evidence to support arguments. These surveys were used to quantify changes in student perception of class and confidence with skills.

Data Collection Timeline

- September 27th—Students take fall DWA
- October 2nd and 9th—DWA grading training sessions
- October 10th-12th—DWA grading
- October 13th—Likert pre-survey and initial skills assessment
- October 16th-22nd—Close read/Claim-Evidence-Reasoning practices
- October 25th-31st—Ecology topics argumentative essay in class
- February 8th-15th—CER bell ringers, Bacteriophage and bacteria lab write-ups
- February 2nd-21st— Close read/Claim-Evidence-Reasoning practices
- April 25th—Students take spring DWA
- May 25th—Spring DWA scores and data available
- June 4th—Likert post-survey and final skills assessment

Figures 1-3: Helena High School (photo credit Helena IR); Science classroom at HHS; Bacteriophage investigation





Results

Students showed a high level of improvement in using evidence to support claims in bell ringers (Figure 4). Confidence in the use of data also improved over the year (Table 2).

Figure 4: Percent of CER answers to bell ringer questions using evidence to support claims

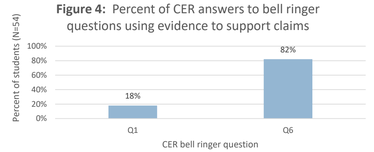


Table 2: Likert Survey results—confidence using evidence

	Pre-Intervention	Post-Intervention	Confidence +/-
1-Strongly D isagree	36%	15%	-21%
2-Somewhat Disagree	25%	18%	-7%
3-Neutral	14%	8%	-6%
4-Somewhat Agree	22%	35%	+13%
5-Strongly Agree	3%	24%	+21%

Note. I am comfortable using data as evidence to support an argument (N=34).

An analysis of the DWA data support statistical significance in the effectiveness of the treatment to improve student scores (Figure 5). The mean score for my students was 3.00 in the fall and 3.43 in the spring. The standard deviation for the fall scores was 0.82 and in the spring it was 1.02. A paired, two-tailed Student's t-test for significance scored below the 0.05 benchmark showing statistically significant improvement in overall student achievement on the DWA; t(66)=2.00, (p=0.019). A normalized gain analysis of the averages which stated that (g) = (3.43-3.00)/(6-3.00) showed a gain of 15% from fall to spring. As a class percentage, 47% of the students started the fall with a proficient score with 35% nearing proficiency and 18% not proficient. By the spring, we had improved to 56% proficient with only 26% nearing proficient, but the same 18% of students were still not reaching proficient levels. These modest improvements are not more impressive than the entire HHS sophomore class, which showed high percentages of improvement in all three categories as well (Figure 6).

Figure 5: DWA scores by percent for students in my classes

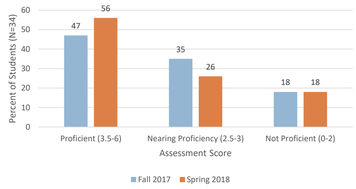
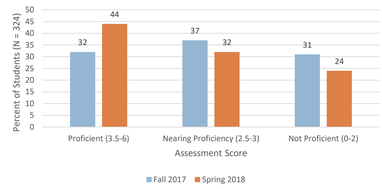


Figure 6: DWA scores by percent for all HHS 10th graders



Discussion and Conclusion

Students who used the CER format, completed the close reads, and applied these skills to their lab write-ups were able to improve their scores on the DWA even if they were already proficient. Students who did not participate in all or most of the treatments did not improve. Many students—even the most high-achieving students who always do their work and try to get it right—can improve their use of evidence in argumentative writing through the use of CER frameworks in other settings. Six students who participated in most of the treatments still showed no improvement on their DWA scores. It is possible these students were already producing the highest level of argumentative writing they will ever achieve. It is also possible that continued participation and effort by this group could lead to modest improvement.

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