

FORMING EXPLANATIONS FROM EVIDENCE USING THE CLAIM-EVIDENCE-REASONING FRAMEWORK



Master of Science in Science Education

Johanna Traut, MSSE Graduate Candidate, 2017

Science Teacher, Poultney High School, Poultney, Vermont



Background

My capstone project was conducted with my ninth grade earth science students. I chose my topic because I noticed that students struggled explaining why their evidence supported their conclusions. I believe this lack of reasoning also impacted their understanding of the content area. By implementing a conclusion writing framework students' analysis of evidence should improve along with their understanding of the content.

Research Questions

Primary Question

How will students' ability to use evidence from explanations impact their content mastery?

Secondary Questions

- 1) If students practice using an outline based on CER in their scientific writing, will it improve their use of evidence in conclusions?
- 2) In what ways does implementing a conclusion writing framework and practice analyzing data improve students' ownership of the learning process?

Data Collection and Analysis

Focus Question	Data Source 1	Data Source 2	Data Source 3
How will students' ability to use evidence to form explanations impact their content mastery?	Pre- and Post-Survey	Student Artifacts (conclusion examples)	Student Interviews
Subquestion 1: If students practice using an outline based on CER in their scientific writing, will it improve their use of evidence in conclusions?	Pre- and post-Assessment	Student Artifacts (conclusion examples)	Pre- and Post-Survey
Subquestion 2: In what ways does implementing a conclusion writing framework and practice analyzing data improve students' ownership of the learning process?	Pre- and post - Survey	Student Interviews	Teacher Field Notes

Sample Student CER and Journal Entry

CER: CLAIM - EVIDENCE - REASONING

Question: Is honey a mineral?

Claim: Honey is not a mineral.

EVIDENCE: Honey is not a mineral because it is not a solid, it is a liquid.

EVIDENCE: Honey is not a mineral because it is not inorganic.

EVIDENCE: Honey is not a mineral because it is not a crystalline solid.

REASONING: Honey is not a mineral because it is not a solid, it is a liquid. Honey is not a mineral because it is not inorganic. Honey is not a mineral because it is not a crystalline solid.

CER #Evidence [Reasoning]

3/20/17

1) The Navajo Sandstone in Utah is made of sediments that were once part of the Appalachian Mountains. These sediments can travel by a natural system where particles of rocks like sand and gravel can be moved by wind, clay, or gravity. Over years these can be moved a long ways. In this case it would be practically across the United States.

2) Metamorphic rocks come from the other two types of rocks. Metamorphic rocks are made from sedimentary rocks being put under heat and pressure. However the sediments used to make sedimentary rocks are made from the weathering and erosion being put to igneous rocks. This is all part of the rock cycle. Metamorphic rocks come from the other two types of rocks as well as the other two types of rocks come from metamorphic rocks.

Treatment

- The claim-evidence-reasoning framework was introduced
- Students practiced with the framework
- Their work was reviewed as a class to establish expectations
- Guided practice was used for additional practice
- The CER framework was used in two units to analyze content and draw conclusions about the data
 - Unit 1: Rocks and minerals
 - Unit 2: Weathering
- Journal prompts were used to gauge student understanding of the CER process and their attitude towards the framework
- Pre- and post-assessment were conducted for comparison
- Pre- and post-survey, along with student interviews, were conducted to gauge students' opinions

Results and Student Quotes

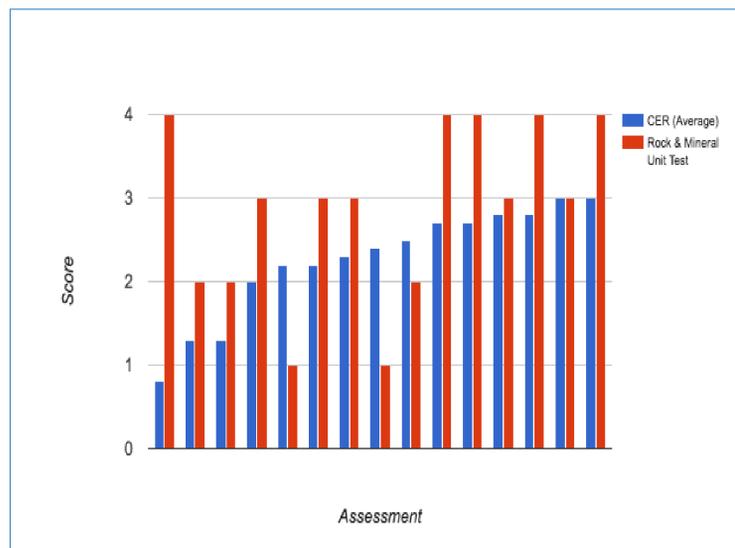
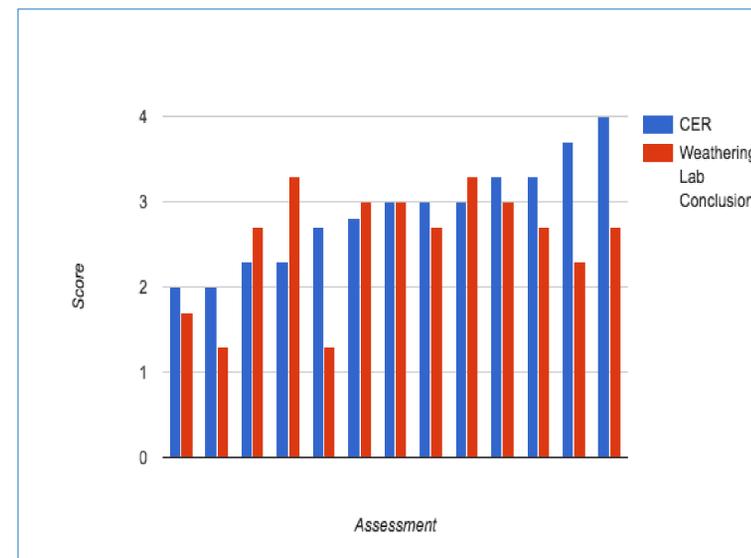


Figure 1. Comparison between CER artifacts and assessments during Unit 1, (N=15).

"The Claim Evidence Reasoning framework always helps my to organize my thoughts and ideas. It is harder to just write it out on a sheet of paper than first doing it on the CER framework."

Figure 2. Comparison between CER artifacts and Assessments during Unit 2, (N=13).



"I need more help writing my claim and reasoning because it is hard for me to get the right details."

"Yeah, it helps me to focus on my claim and find supporting evidence. It is like writing a constructed response in science."

Results and Student Quotes

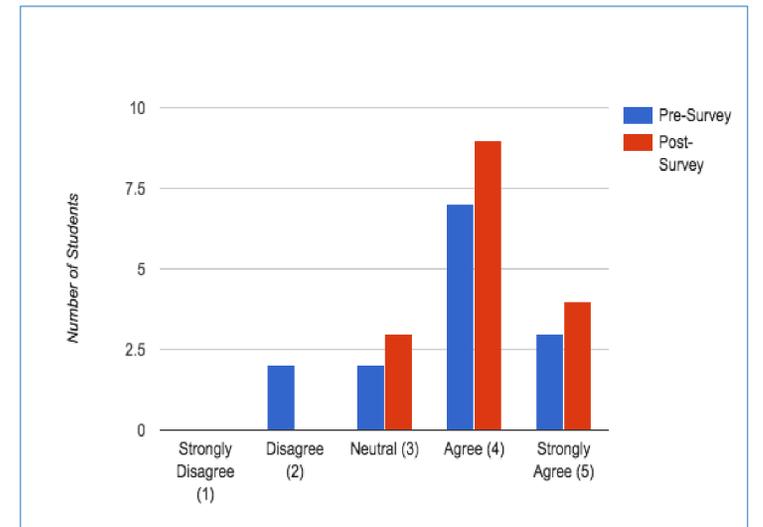


Figure 4. Individual responses for pre- and post-survey statement "I feel confident in my ability to support a claim with evidence" (N=15).

"you could understand it better. Instead of moving on and maybe forgetting about it, having to focus on it and write it down helped you "see" it in the end."

Conclusion

Content Mastery

- There was a general trend but no strong correlation between improvement on CER and assessment scores
- Framework helped students organize their thoughts and improve science writing
- Did not improve students' confidence in conclusion writing

Evidence Usage

- The largest gains were seen in stating clear claims and using appropriate and sufficient evidence
- Appropriate evidence was consistently used, while evidence used was not always sufficient
- Use of evidence dependant on the task, understanding of concepts, and student buy-in

Student Ownership

- Limited to no increase in student ownership of learning process was observed
- While students did not take more ownership, outlining evidence did aid students in work completion

Overall

- Helped students organize thoughts
- Using as a formative assessment to gauge students' understanding and misconceptions was very useful