

Drawing Conclusions: Annotating Visual Representations Supports Students' STEM-Related Talk

Elyse C. Hertzman, Lauren C. Pagano, David H. Uttal, & Catherine A. Haden

Loyola University Chicago & Northwestern University

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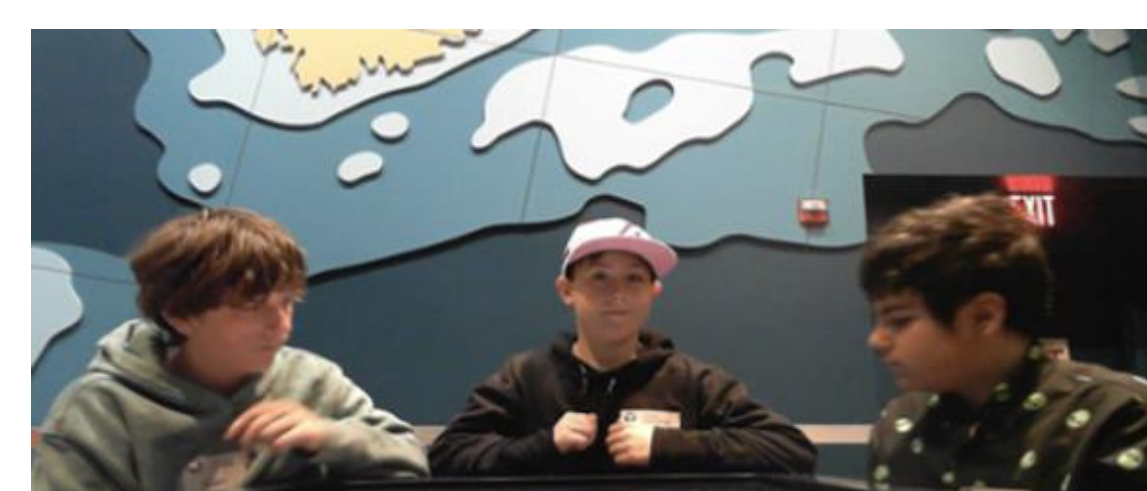
INTRODUCTION

- Informal learning experiences (i.e., field trips) can encourage STEM interest and learning. However, field trips' effectiveness can vary by activity design and school characteristics (DeWitt & Storksdieck, 2008).
- Student interactions with visual representations can increase STEM engagement and comprehension (Ainsworth et al., 2011).
- In this study, we examined
 - How school characteristics (coastal vs. noncoastal, visit history) related to students' annotations of visual data representations during a field trip to the Gulf of Maine Research Institute (GMRI).
 - How annotating data representations impacted students' STEM language use when reflecting about their field trip activities.



METHODS & PARTICIPANTS

- 445 5th-6th grade student groups from 52 schools participated in 2.5 hours of informal learning activities in which they annotated visual data representations about climate change and marine life in Maine.
 - 37.5% non-coastal, 62.5% coastal
 - 25.4% from schools visiting ≤ 10 years, 74.6% from schools visiting > 10 years.
- After their activities, students recorded short video reflections about their learning.

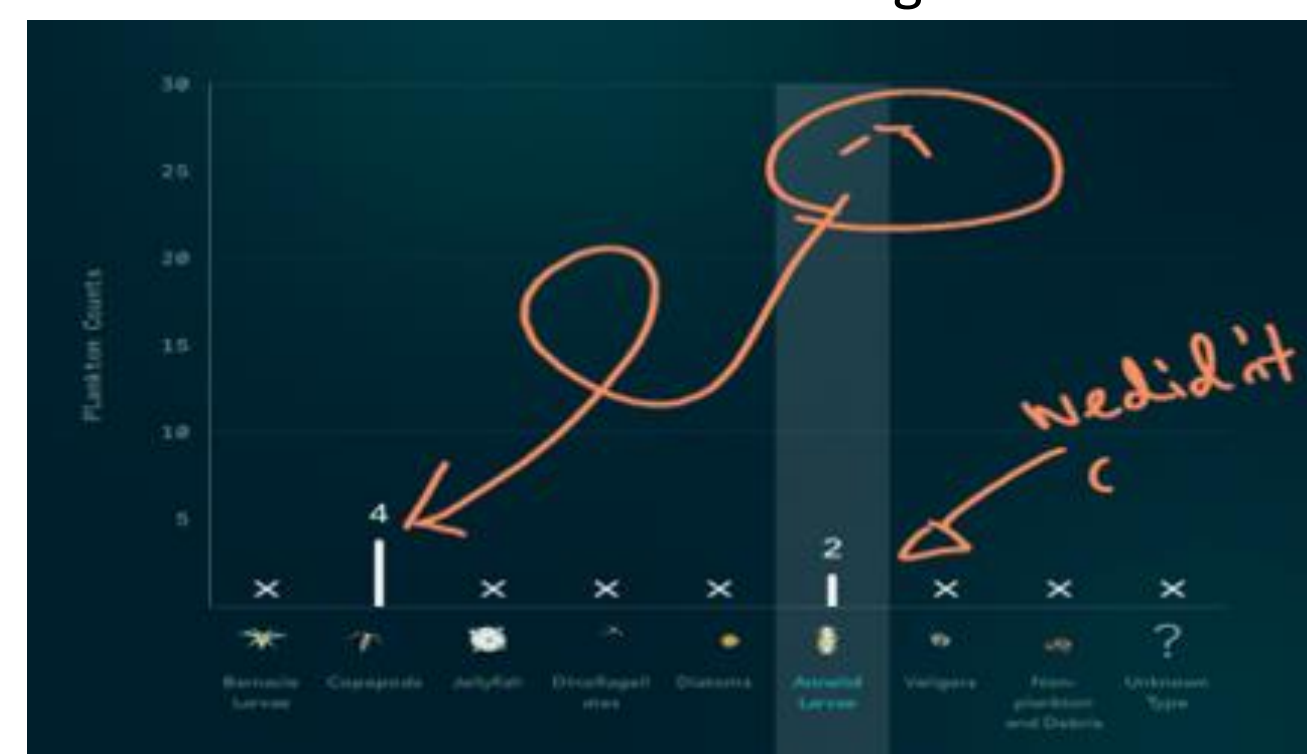


CODING

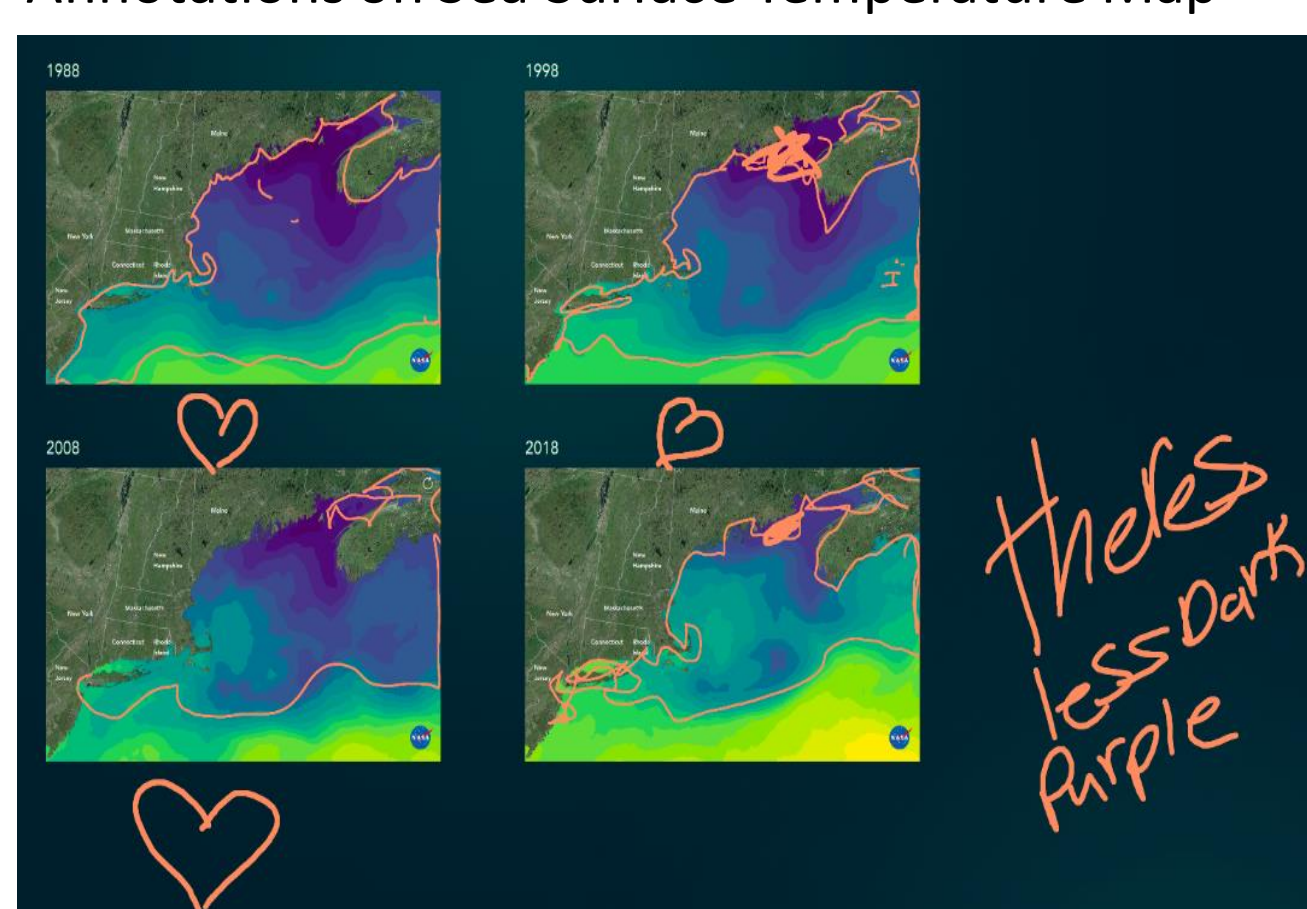
Annotations

Codes	Definition
Writing	Using words or numbers (sub-coded as $>$ or \leq 3 words)
Circling/Tracing	Outlining an area or circling data
Drawing	Drawing images and symbols (fish, happy face)
Lining	Highlighting, underlining, or crossing out text
Other	Shapes/Xs, Arrows

Annotations on Plankton Counting Chart



Annotations on Sea Surface Temperature Map



Annotations on Black Sea Bass Dissection Table

Tag	Location	lobster	Fish	Shell	Crab	Str-Lip
#0222	Maine					
#0207	Maine					
#0177	Maine					
#0247	Maine					
#0205	Maine					
#0241	Maine					
#0213	Maine					
#0282	Maine					
#0217	Maine					
#0211	Maine					
#0251	Maine					
#0255	Maine					
#0219	Massachusetts					
#0123	Massachusetts					
#0216	Massachusetts					
#0171	Massachusetts					
#0193	Massachusetts					
#0182	Massachusetts					
#0199	Massachusetts					
#0089	Massachusetts					
#0134	Massachusetts					
#0196	Massachusetts					
#0149	Massachusetts					
#0127	Massachusetts					
#0064	Massachusetts					
#0081	Rhode Island					
#0088	Rhode Island					
#0066	Rhode Island					
#0083	Rhode Island					
#0094	Rhode Island					
#0064	Rhode Island					
#0022	Rhode Island					
#0007	Rhode Island					
#0071	Rhode Island					
#0072	Rhode Island					

STEM Talk

Code	Definition
Biology	Talking about biological processes (eating, dying), marine species (lobster, black sea bass), or marine habitats
Climate	Talking about climate or climate change (temperature, hotter)
Spatial	Describing spatial locations, patterns, features, orientations, etc.
Temporal	Describing timing of events (years, days, before, after, next)
Data Analysis	Making data observations or referring to visualizations (map, table)
Math	Mentioning quantities or mathematical formulas
Industry	Talking about workers and practices in the Maine fishing and lobster industries

RESULTS

Black Sea Bass Stomach Dissection

- Students talked more about climate if from a school with a long visit history compared to if from a school with a shorter visit history, $F(1, 265) = 8.31, p = .004$.
- Students who circled the data table talked more about climate, $F(1, 265) = 112.87, p < .001$ and industry, $F(1, 265) = 4.92, p = .027$, than students who did not circle.
- Students who lined text on the data table talked less about climate, $F(1, 265) = 10.09, p = .002$, and more about math, $F(1, 265) = 5.57, p = .019$.

Figure 1. STEM Talk in Black Sea Bass Reflection by Students' Use of Circling

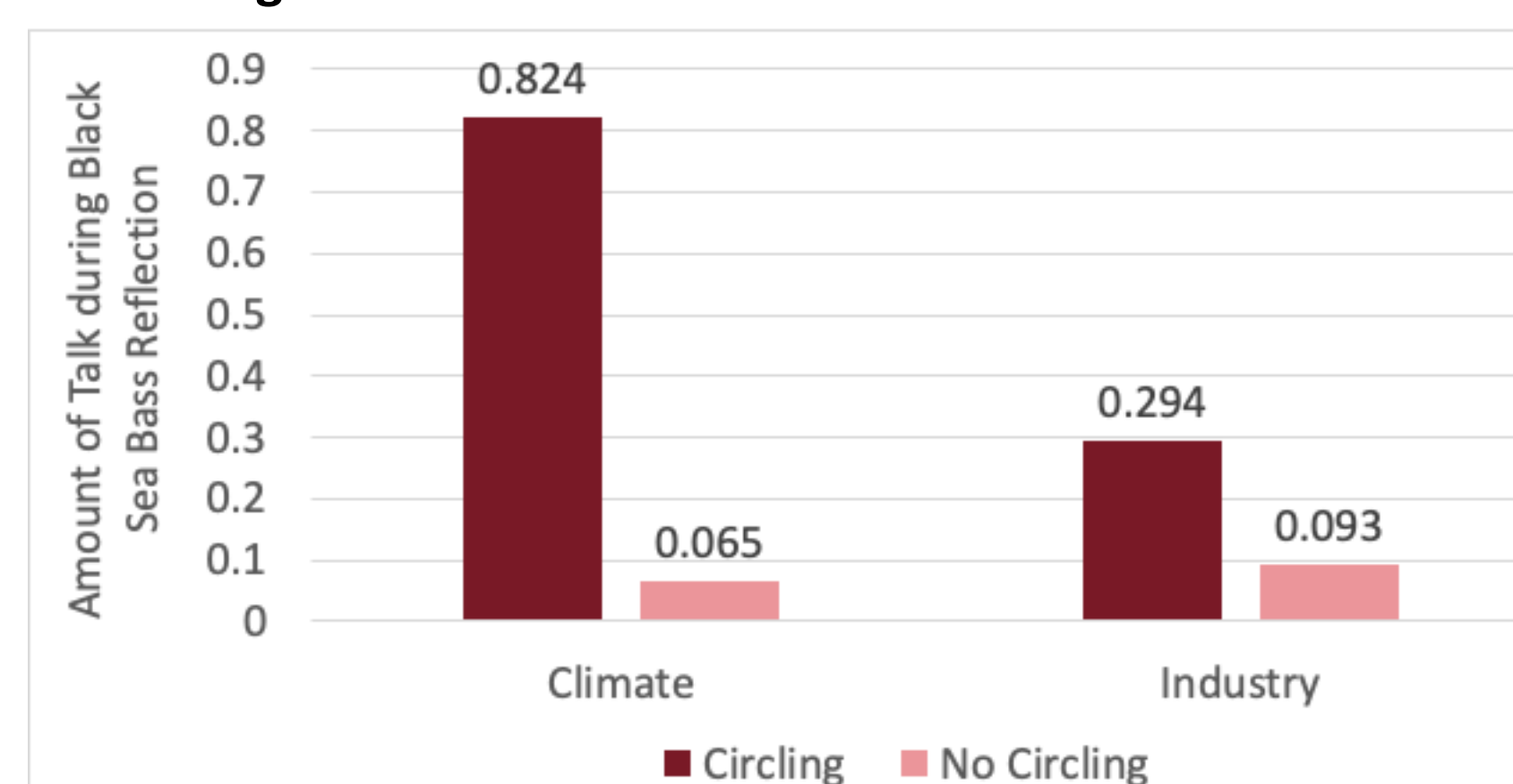
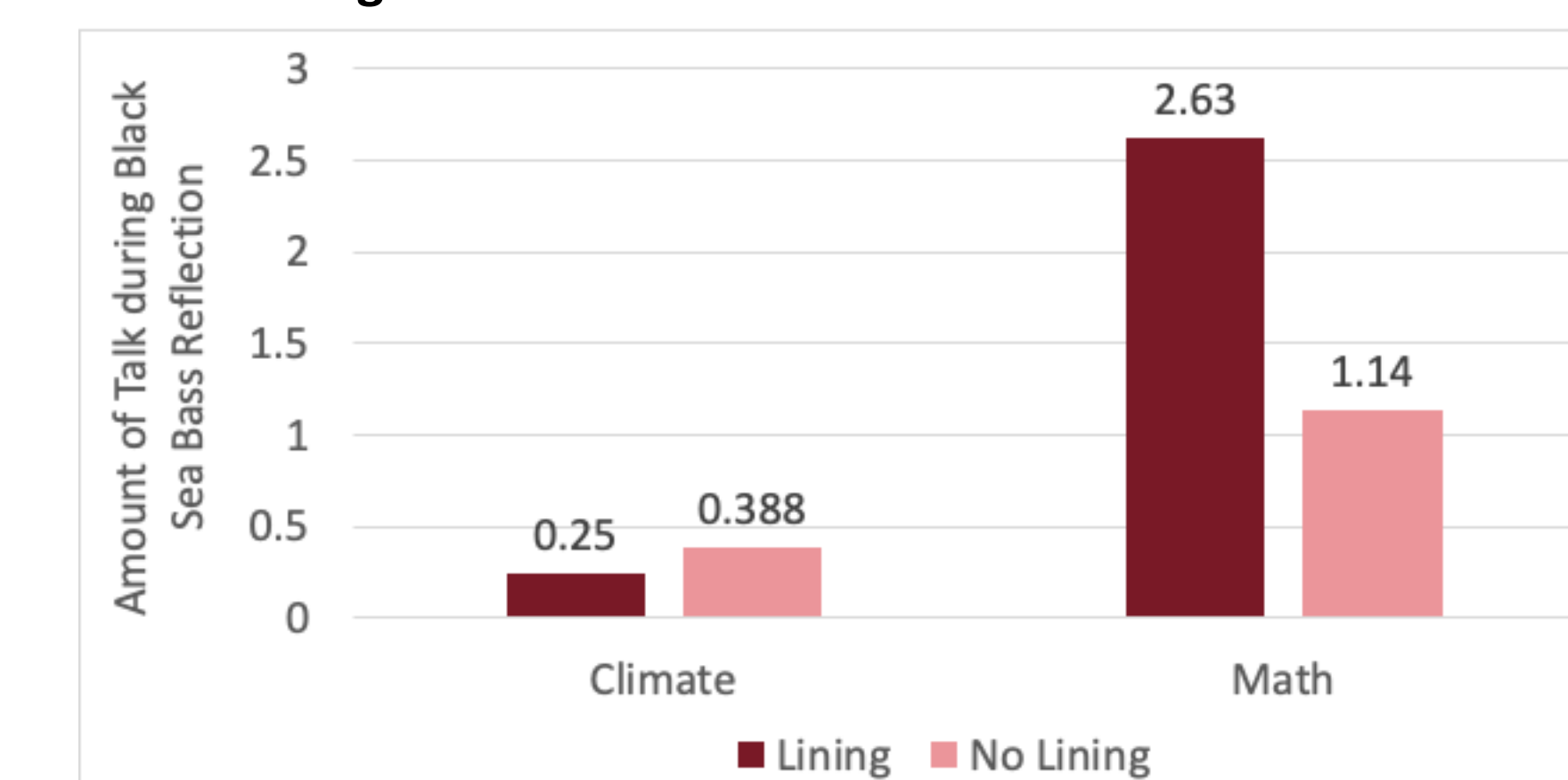


Figure 2. STEM Talk in Black Sea Bass Reflection by Students' Use of Lining



Sea Surface Temperature Mapping

- Students talked more about industry if from a school with a shorter visit history compared to a school with a longer visit history, $F(1, 148) = 5.04, p = .026$.
- Students from coastal communities talked more about biology, $F(1, 148) = 6.68, p = .011$ and climate, $F(1, 148) = 4.34, p = .039$, than students from noncoastal communities.
- Students who drew on the maps talked more about biology than students who did not, $F(1, 148) = 4.46, p = .036$.
- Students who wrote on the maps talked more about biology, $F(1, 148) = 3.20, p = .043$ and climate, $F(1, 148) = 3.70, p = .027$, than students who did not write.

Figure 3. STEM Talk in Sea Surface Temperature Reflection by Students' Use of Drawing

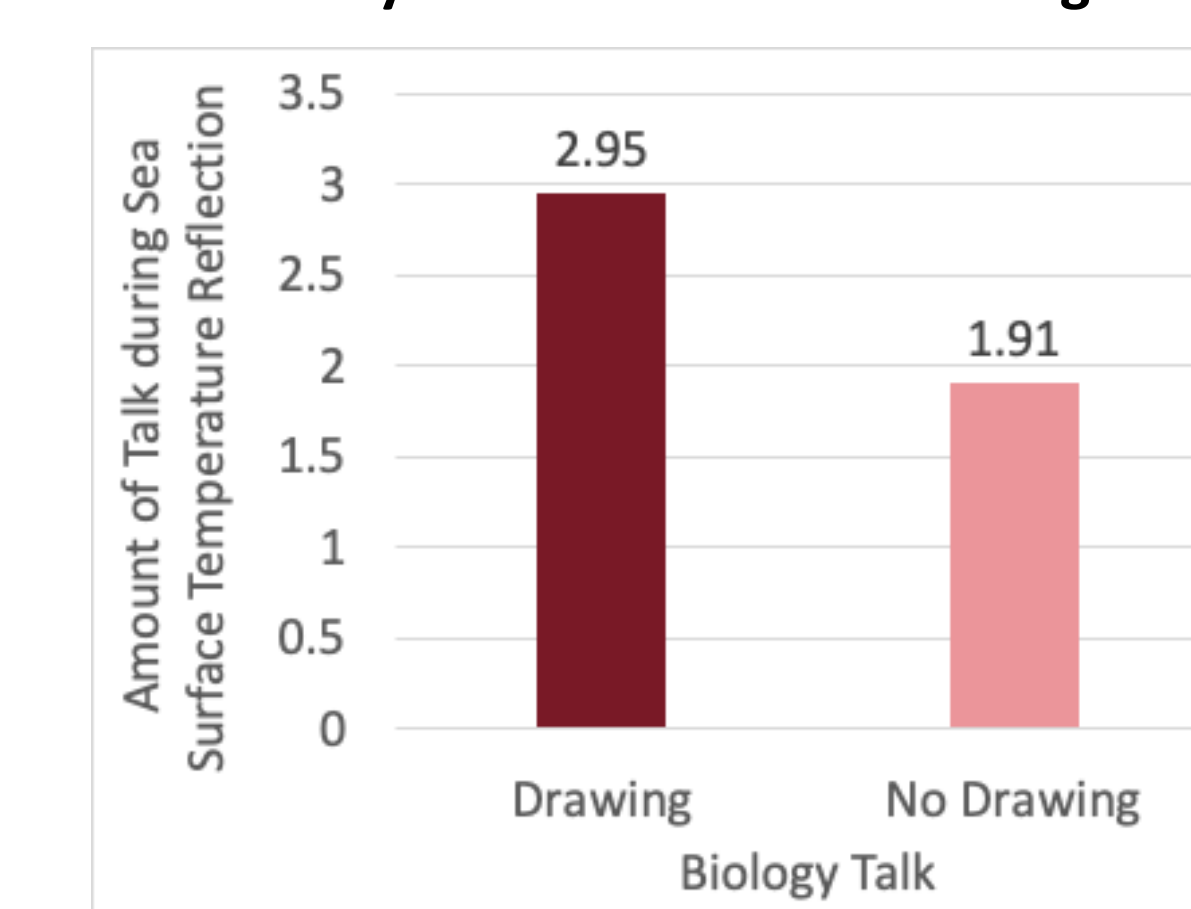
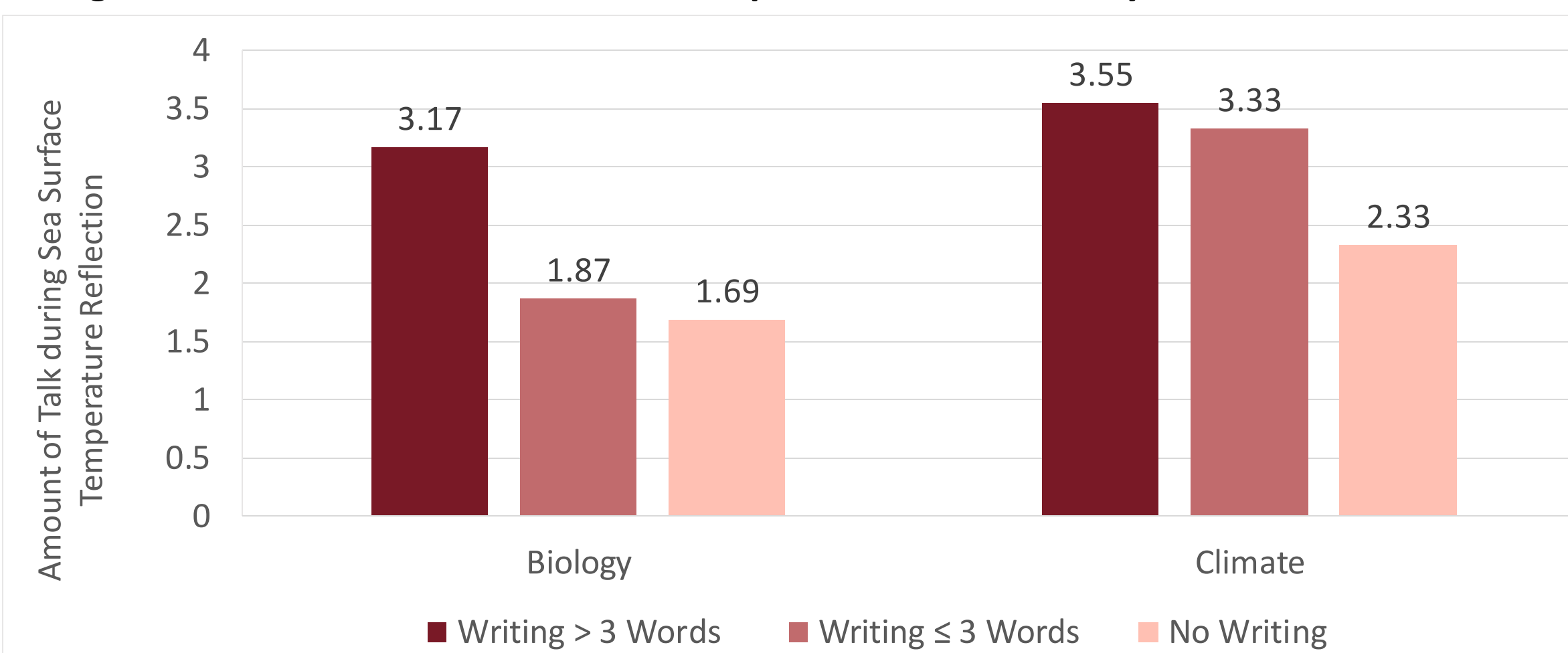


Figure 4. STEM Talk in Sea Surface Temperature Reflection by Students' Use of Writing



DISCUSSION

- Students' annotations of data visualizations may have positive effects on STEM learning. Specifically, circling and lining may promote learning when interacting with data tables, but drawing and writing may support learning when viewing maps.
- Students from coastal communities may talk more about STEM because of the personal relevance of the field trip topics.