# Writing and reflecting:
# How middle school students learn from data visualizations during field trips

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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).

- We asked the following questions:

  1. How do students' annotations vary across different types of visual representations?

  2. How does the content of students' reflections vary across field trip activities?

  3. How do students' annotations relate to the STEM content of their talk during reflection?

## Participants & Procedure

- Groups of 3-7 students participated in a 2.5-hour field trip at GMRI.

- Across four activities, students analyzed and annotated visual representations about marine life and climate change in Maine.

- After their activities, students recorded short video reflections about their learning.

- We analyzed reflections from 225 student groups across 30 schools during SY 22-23.
  - 52% coastal, 48% non-coastal communities
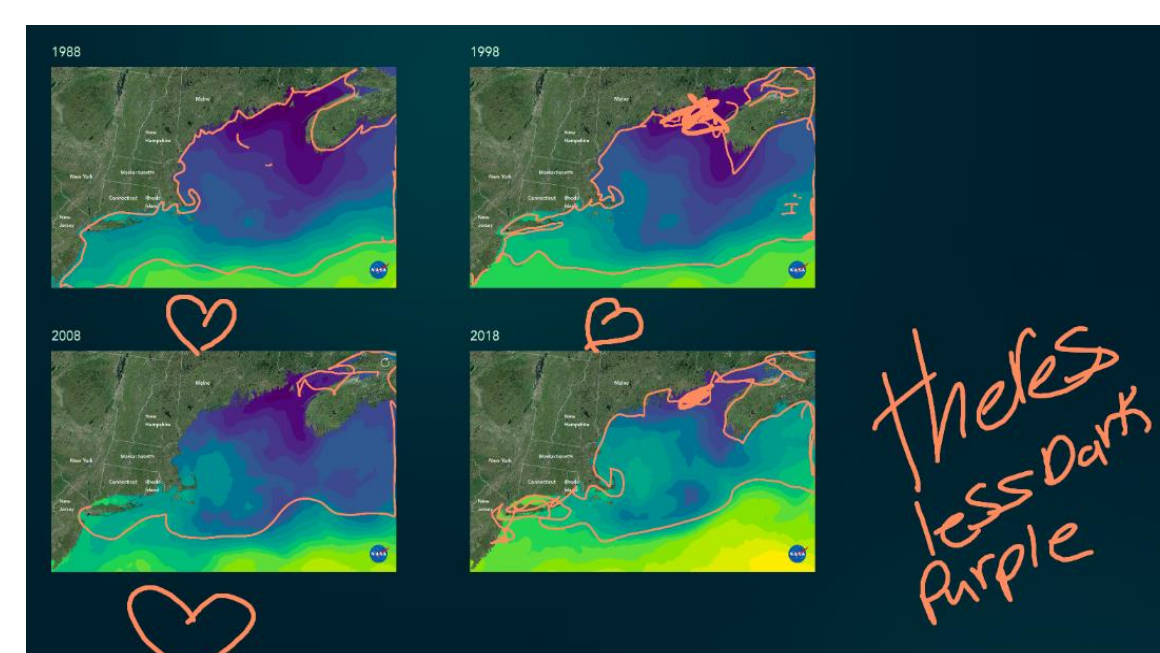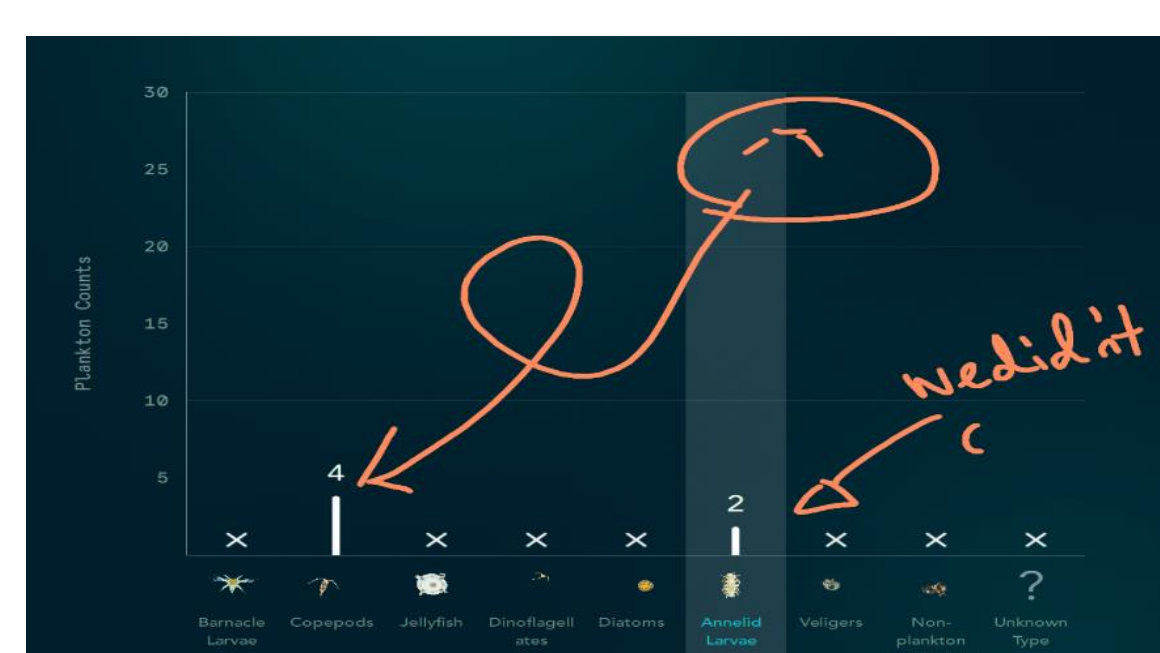  - 32% from schools coming ≤ 10 years, 68% from schools coming > 10 years

## Data Visualizations and Annotation Coding


Black Sea Bass Stomach Dissection Data Table


Plankton Microscope Analysis Bar Chart


Otolith Tracing Scatter Plot


Sea Surface Temperature Map

| Codes | Definition |
|---|---|
| Writing | Using words or numbers (sub-coded as > or ≤ 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 |

## Reflection Coding

- Transcripts of students' reflections were analyzed for STEM-related 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 |

## Results

Figure 1. Students' Annotations across Visual Representation Types
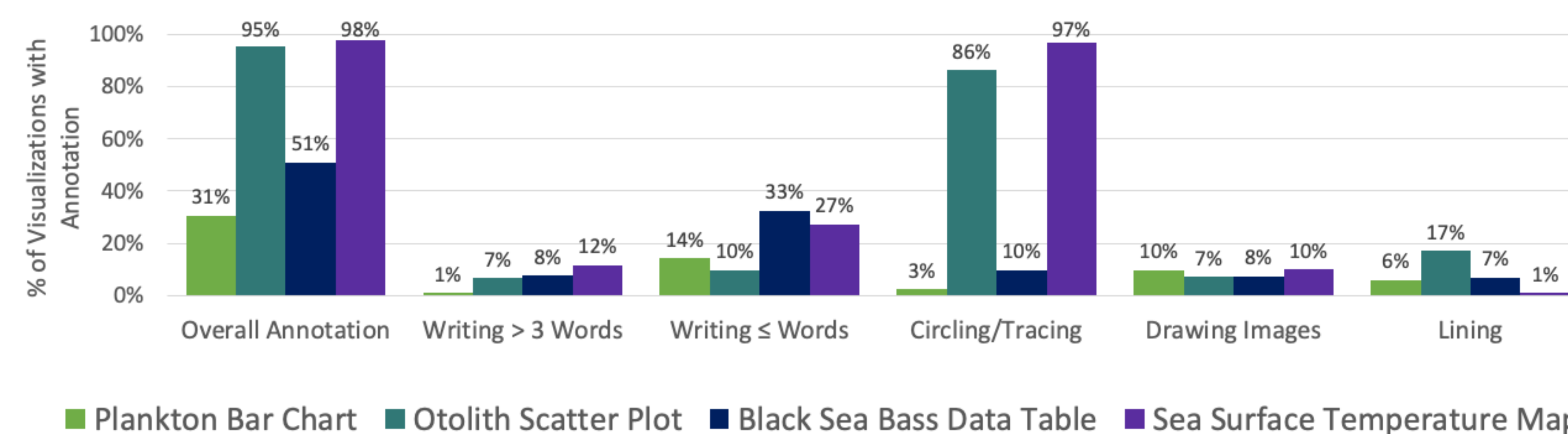


- As shown in Figure 2, there were significant differences between the black sea bass and sea surface temperature reflections for students' use of biology, climate, temporal, data analysis, and math language, $t$s > 4.00, $p$s < .001.

Figure 2. Students' STEM Talk in Reflections across Activities
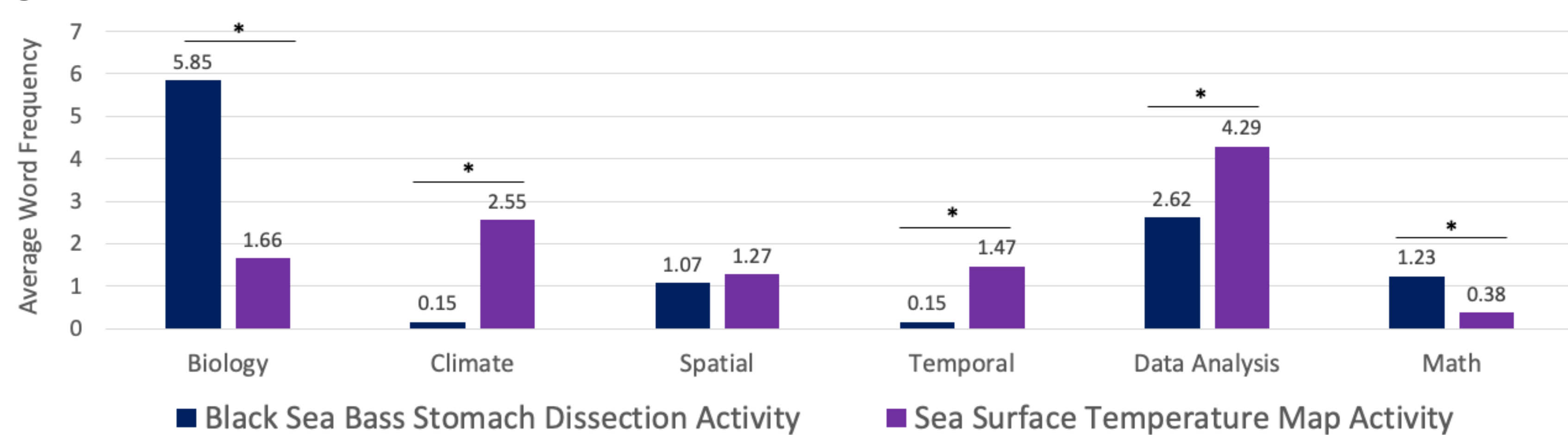


- Students who drew images ($M$ = 3.19) talked more about biology than students who did not draw ($M$ = 1.84), $F(1, 144) = 7.12$, $p = .008$.

- For the sea surface temperature activity, students from coastal communities ($M$ = 2.45) talked more about biology than students from non-coastal communities ($M$ = 2.23), $F(1, 144) = 4.38$, $p = .038$.

## Discussion

- Students' use of annotations varies across activities and visual representations and may relate to their talk about STEM content when reflecting.

- Students use more annotations when activity prompts direct them to do so, so educators can promote annotation through direct instruction.

- Students' personal backgrounds (e.g., residing in a coastal/noncoastal community) may impact how they use and discuss STEM-related information.