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Solving challenges of integrating large datasets into Community College asynchronous online science classes by using a scaffolding-learning cycle approach to teaching and learning.

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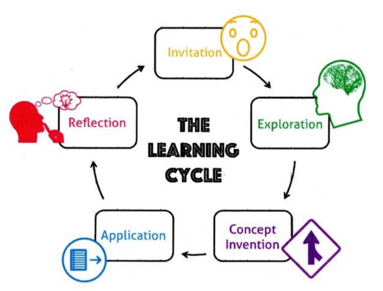
Introduction:

Faculty from 2 & 4 yr. colleges and universities who had previously implemented authentic large data-set lab activities indicated a commonality of students having issues with basic skills of 1) making observations and 2) interpreting graphs, maps and graphics. This in turn inhibited understanding concepts and/or successful completion of large data-set driven lab activities. Gallery walks, question or visual-graphic based, in traditional classrooms have been widely studied and indicate that discussion promotes higher order thinking skills that involve analysis, evaluation and synthesis. In addition, it promotes cooperation, listening skills, and team building (Francek 2006; Ambrose et al. 2010). Plotnikoff (2013) found that performance increases significantly 25-30% when exploration came before studying text or video rather than after it. Transitioning these activities to an asynchronous online classroom we are calling these **Gallery Surfing** and transitioning them into group discussions were students can learn to write detailed descriptions about graphics based on their observations using scientific language while benefiting from both peer-to-peer and faculty input. A scaffolding learning cycle approach was used to design curriculum for the 1st half of asynchronous online oceanography classes in an effort to improve students ability to explain and interpret large dataset oceanography lab activities.

Methods:

In an effort to increase student content knowledge and success, a scaffolding-learning cycle approach was deployed in 3 asynchronous online oceanography classes (n=72 students) using visual gallery surfing activities. Students were introduced to graphics using online gallery surfing group discussions to increase their observation and description abilities. Students receive peer-to- peer and faculty feedback. Faculty written comment feedback were based on the scaffolding pedagogy. Students were also ranked by faculty into 4 categories: proficient, adequate, basic, and inadequate before and after each activity. Assignment grade averages and rankings were compared to previous semester students grades for the marine sediment, primary production, and ocean issues labs discussions.

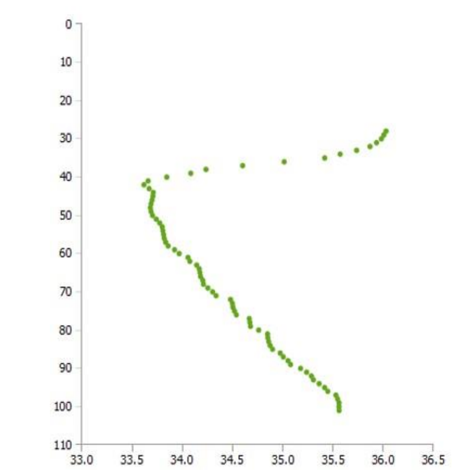


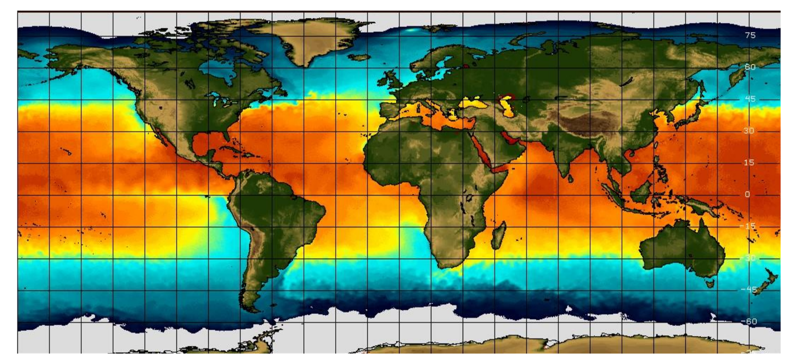
Invitation: spark interest and recall past connections
Exploration: Discuss observations, results and Discoveries
Concept Invention: generate explanations of concepts from discipline
Application – make new connections and apply previous knowledge to a new concept
Reflection: Become conscious of what they learned, how they learned and further apply knowledge

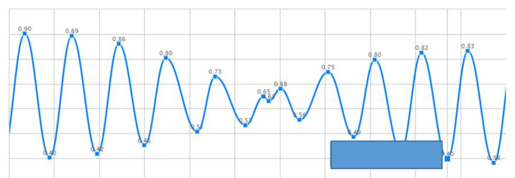
Learning cycle phase • scaffolding	Activity	Data Source (s)	Student learning outcomes
Invitation • Pre-concept generalizations	Gallery surfing discussion with Incomplete figures	OOI, IODP/Geode, NOAA, NASA	• engage in peer-to-peer knowledge exchange while activating prior knowledge to use with new oceanographic data. • Use prior math, graphing, false color image knowledge to make sense of incomplete figures • identify missing information from the graphs or figures • reflect on their own thinking and identify gaps in their own knowledge about reading graphs and figures
Exploration • true concept-generalization of previous generalizations	A. complete figure gallery surfing discussion A. Draw a trend lines for multivariate graph	OOI, IODP/Geode, NOAA	• Create more detailed descriptions of data visualizations • describe how oceanographic data may be graphed differently than their previous knowledge • Participated in peer-to-peer responses exchanging, defending, questioning, and rethinking discussion ideas
Concept invention • intellectual imitation	Geode marine sediment distribution, hypothesis and additional information needed	IODP-GEODE project	• Students describe global lithogenic distribution patterns of marine sediments using Google Earth Pro; • write a hypothesis based on those observations • identify additional oceanographic data needed to test the hypothesis
Application • complexitive or contrast stage	geode marine sediment-redefining previous hypotheses with SST, Chl, & CCD	GEODE Project	• Students revise previous sediment hypotheses that include global Chl, SST, and CCD data • describing and interpreting false color images
Reflection • Inter-connections	Primary production (PP) in relation to Biogenous sediments	OOI Primary Production	Students draw from all previous knowledge from scaffolded – learning cycle activities Identify trends, seasonal patterns, and relationship of PP to other data parameters such as latitude, temperature, onshore/offshore and/or events Identify which type of graph best represents the data for a given situation
Scientific literacy • Hand-over to independence	Ocean Issues Discussion (Climate change, pollution, overuse of resources, etc…	Students choice of data	Apply knowledge gained from small subsets of data to make predictions over longer time series Use observational evidence and relevant scientific concepts to create and support their Argument

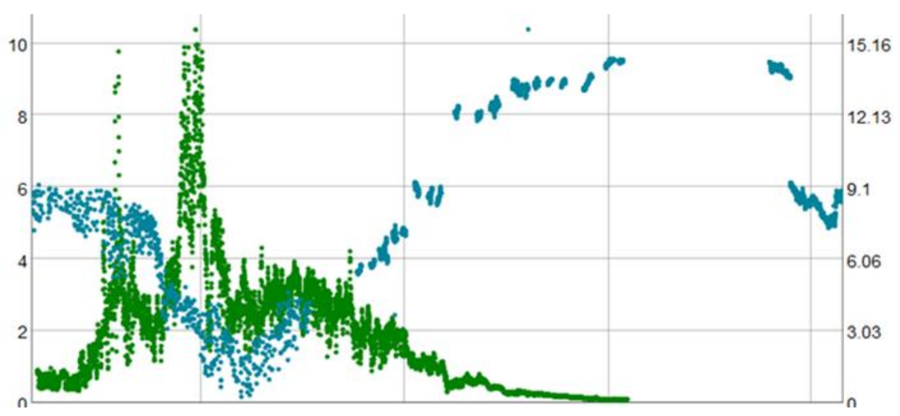
Gallery Surfing 1: Incomplete graphics for observation skills

Students make observations and descriptions of each incomplete graphic in discussion boards and respond to other students descriptions.



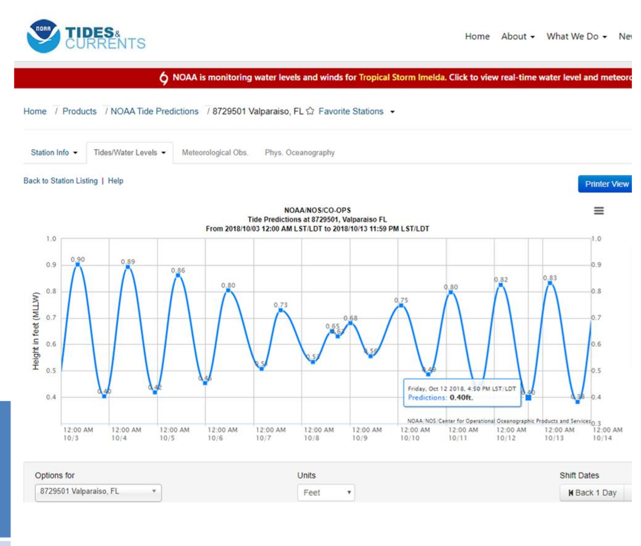


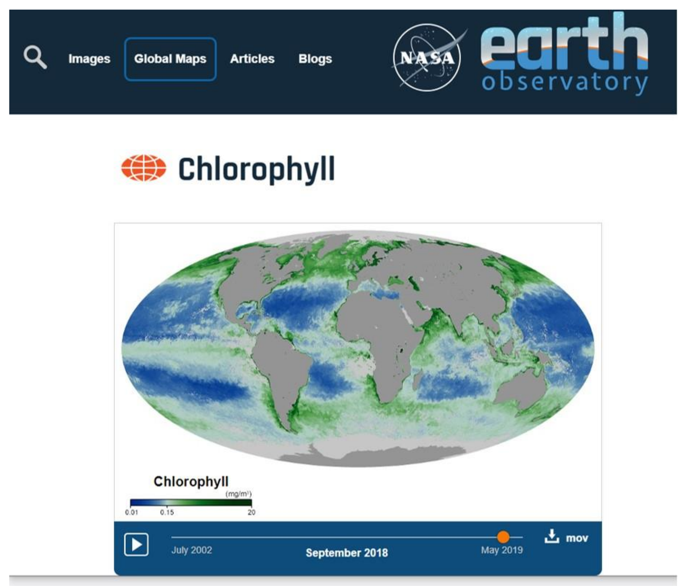


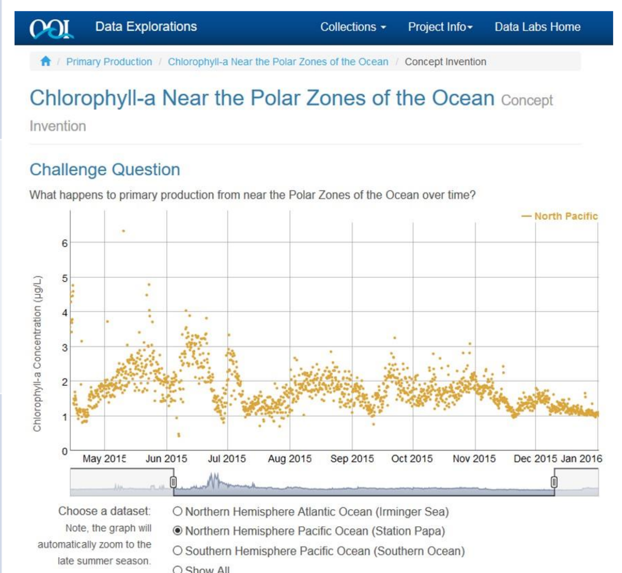


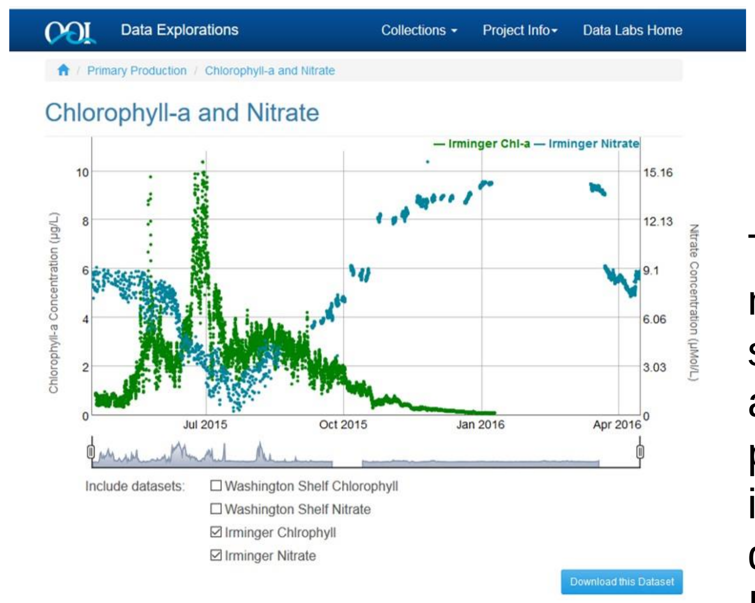
Gallery Surfing 2: Complete graphics for observation and basic Graph interpretation skills

Students were asked to make observations and more detailed descriptions and basic interpretation of the complete graphics without trying to make any conclusions since they've not covered these concepts in class yet. The same graphics were used in both gallery surfing exercises.

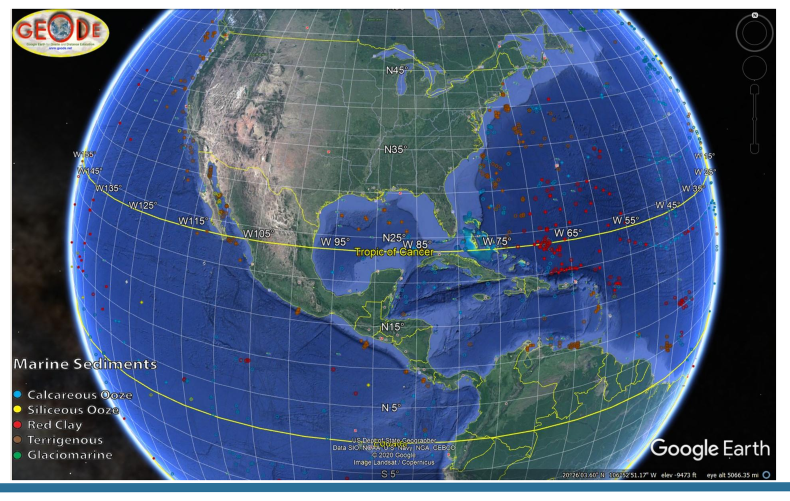








Concept Invention: GEODE Marine Sediments

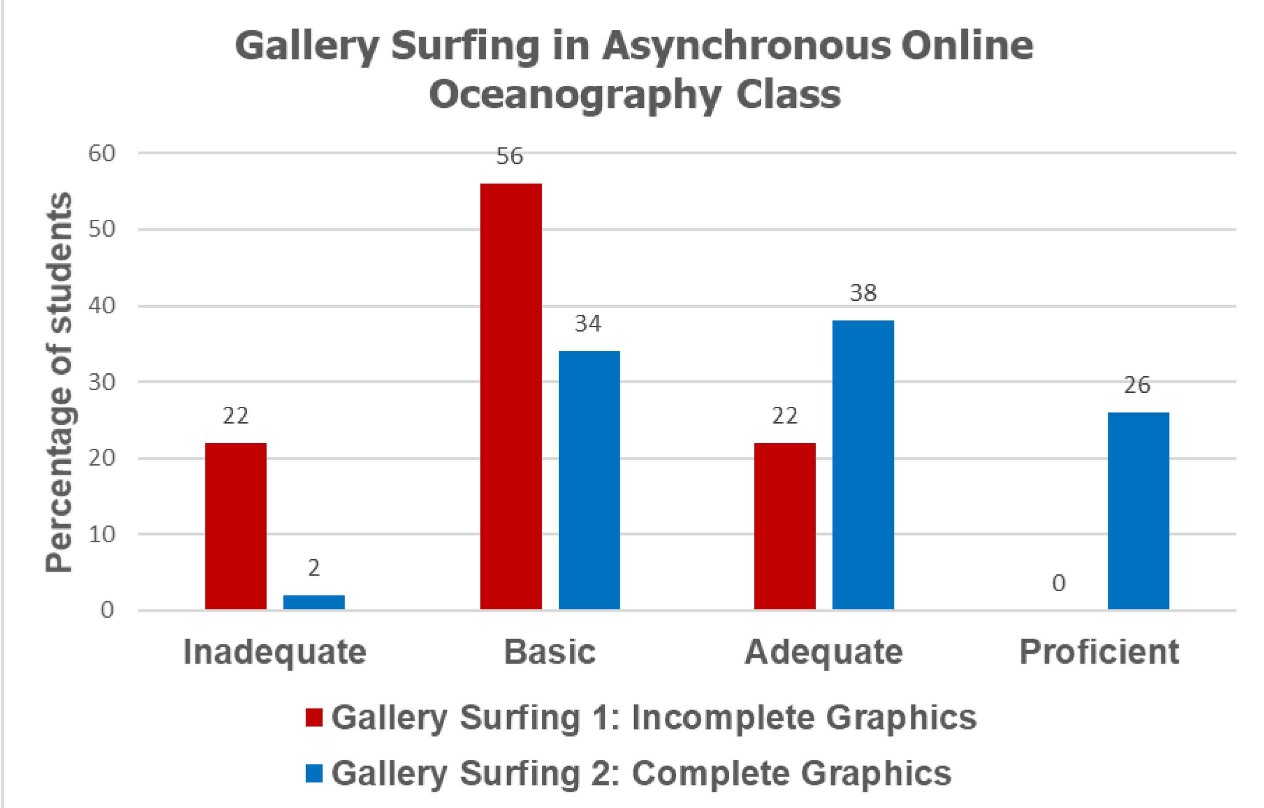


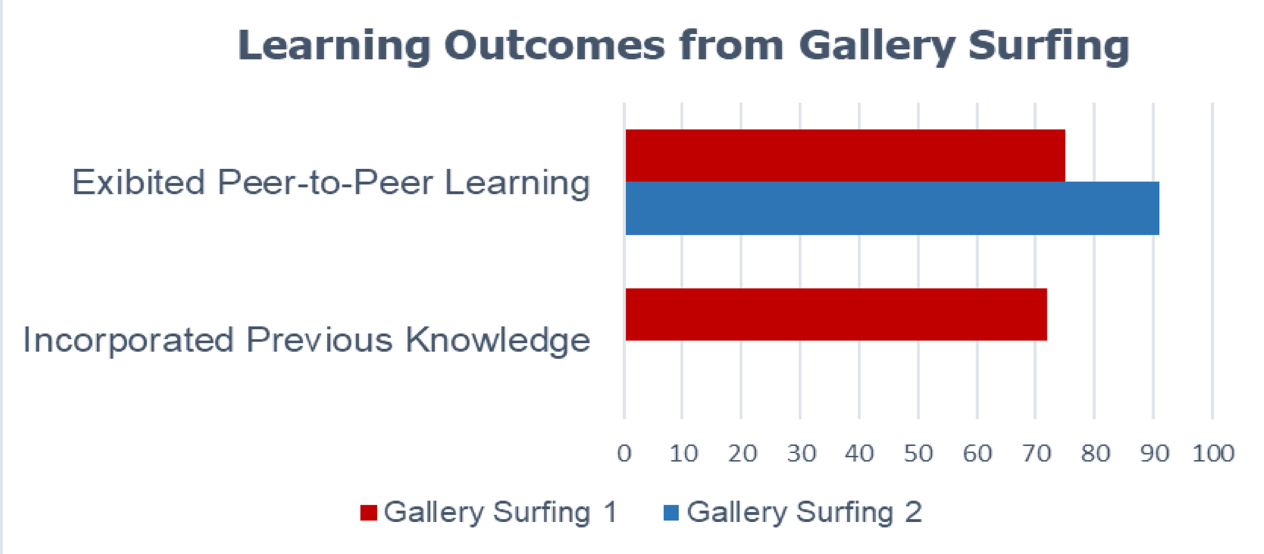
Results :

Students were ranked into 4 categories:

- **Proficient -**Ability to read and describe graphics, identify data trends, and identify correlations between datasets.
- **Adequate** – Ability to describe basic graph features and makes some detailed observations
- **Basic –** Ability to describe some graph features and/or make a very basic description
- **Inadequate –** Inability to read or interpret graphs. May just guess at what it is rather than making observations.

The students were also ranked if they noted a relationship to previous knowledge during GS1 as well as if peer-to-peer knowledge building was noted in their discussion with other students in both GS1 & GS2 .





Percentage of students (n=72) 1. exhibiting peer-to-peer learning within their replies to other students. 2. Percentage of students relating their previous knowledge to the oceanography graphic.

Conclusions:

The results indicate an increase in the percentage of students that were able to make observations, read and interpret different oceanography graphics. This scaffolded learning-cycle approach also indicates peer-to-peer knowledge transfer as well as the students ability to incorporate previous knowledge and revise their previous ideas into their new knowledge base. In addition, Preliminary evidence indicates that students were more successful on later assignments that use large datasets and require higher-order and critical thinking skills in the Concept Invention, Application, Reflection and Scientific literacy stages.

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