Best Practice #5
Questioning

Why I chose Questioning as a Best Practice

Questioning is a teaching method which fosters active learning without the use of manipulatives or physical movement. In situations where the classroom furniture is inflexible and/or where resources are scarce, questioning is still a powerful tool for creating an active classroom. Additionally, questioning provides a valuable informal assessment of student understanding, because students do most of the talking and explaining. Perhaps most importantly, questioning is a way to model and create a culture of intellectual inquiry in the classroom. Ideally, students will start to question and discuss with one another without teacher prompting, and become independent learners.

Implementation of Questioning in the MAT092 Pilot

The power and flexibility of this method makes it one of my favorite teaching tools, and I use it throughout every lesson.

I demonstrate one example of how questioning can be used in the attached brief lesson plan, used for introducing the project, Send a Message (And Say It With Graphs!). The Project Introduction worksheet and the Project itself are attached at the end of this section.

Other examples of questioning are given in the explanations of the Active Learning Drills.

In general, much of my direct instruction is done through questioning.

Implications for the Future

Because questioning is free, easy, flexible, and powerful for creating active learning any instructor can use it.
Lesson Plan
Introducing the Send a Message (And Say it With Graphs!) Project

Objective:
Given a fairly messy, complex chart of data, students will be able to:

- Extract three “messages” or important impressions from the data, and express each one in a sentence.
- Choose an appropriate graph to express each message visually
- Construct and completely label the graphs by hand or using technology, making sure to avoid deceptive graphing practices

Background
Students have had a brief direct instruction lesson on graphical displays in the previous class, and have completed homework, using MyMathLab, on graphs. The problems on the homework require mostly reading of graphs rather than constructing them.

Materials
- Project Introduction Worksheets
- Project Papers
- Graph paper, rulers, compasses, protractors, markers, tape, scissors

Learning Methods
- Scaffolding (activating prior knowledgs)
- Questioning
- Collaborative Groupings
- Classroom Talk
Lesson

Part 1 – Activating prior knowledge (10 - 15min)

? Tell me what types of graphs you have learned about, and tell me what each type is useful for.

Collect student replies on board. Possible answers:

Pictographs Compare relative sizes of categories; look “friendly”
Bar graphs Compare relative sizes of categories
Circle graphs Compare sizes of categories that together form one whole unit
Used to show percent data as parts of a whole
Histogram Used to display data that fall into a continuous range
Line Graph Used to show two sets of data that are related
Used to show change over time especially

To refine the answers, ask questions such as:

? How are pictographs and bar graphs different or the same? What are pros and cons of each?
? How do bar graphs and circle graphs differ in what they show?
? If data can be displayed in a bar graph, can they also be displayed in a circle graph? Why?
? If data can be displayed in a circle graph, can they also be displayed in a bar graph? Why?
? Give an example of data that would make a good bar graph, but not a good circle graph
? Give an example of data that could make a good circle graph, but not a good bar graph.
? What is the difference between a histogram and a bar graph? How do they look different?
? Give an example of data that would be displayed in a histogram

? Now, remembering that a graph is a way of communicating, review for me what information should be on a good graph

Collect student replies on board. Possible answers:
Title for graph; titles on axes
Scales on axes are uniform, and start at zero if possible or show a break symbol
Bars or circle wedges are proportional to the data they represent
Circle graphs – label each sector with percent or number
Key needed for pictograph, sometimes for circle graph
What other considerations do we need to take into account to make sure we have a clear graph? (look for discussion on deceptive practices)

Can anyone sketch a graph that is deceptive? How can this graph be made better?

Part 2 – Direct Instruction – Constructing a Histogram (15 – 20 min)

- Collect height data for students on the board in inches, rounded to nearest inch.
- Discuss the fact that heights are continuous. We look at the continuous range of data represented by our class. What is the range of our heights?
- We divide the range of our data into sub-ranges, called bins. Usually 5-15 bins for a histogram (why? What would happen if we had only 2 bins? More than 15?) We’ll use 5 bins today.
- Numbers on a boundary between bins belong to the right bin. Why might it be important to have a convention for this?
- Make a tally sheet for each bin (review from homework)
- Make the histogram:
  - Horizontal axis shows the data range divided into bins, which are labeled
  - Vertical axis shows the frequency
  - Title for axes, Informative title for graph.

Part 3 – Project Preparation – 10 min

- Distribute Project Preparation worksheets.
  - What is a tsunami?
    - Look at the chart showing the incidence of major tsunamis, and consider it for one minute silently. Write down 3-5 things that impress you about the information in the chart. Think about what you might want to tell someone about these tsunamis. You have 60 seconds.
- Students form pairs
  - With your partner, discuss the impressions you each had from the tsunami information. Then, choose three impressions/messages you would like to share. Decide what kind of graph would be best to show each message. You have 3 minutes. Write your results on your paper.
- Each student pair joins with another pair to form a quad.
  - Now, in your group of four, compare the messages you decided on earlier. Try to agree on three messages that all four of you think are important about the tsunami data. Decide what graph type would be best for each message. Make sure you have one message that would be appropriate to display in a histogram. You have 5 min to work on this.
Part 4 – Collaborative Group Work – 30-45 min

- **Distribute Project Papers**
  (Students working in groups but each documenting own work)
  Now, you will actually convert these messages into graphs. You may make the graphs by hand or using technology, but they must be fully labeled, titled, and in proportion, without deceptive practices. Show all of your preparation work, such as tally sheets and computations, and even if you use technology, you might want to sketch the graphs roughly today.

Part 5 – Summing Up – 5 -10 min

? What did you find easy today? What did you find difficult? Why?
? What kinds of graphs are you making?
? Who plans to make the graphs by hand? Using technology? Why?
? What help do you need? What materials do you need?

Assign HW – the project is due next week.
Send a Message (And Say It With Graphs!):  
How to Get Your Reader to See What You Think is Important in the Data  
Project Preparation Activity

An ocean wave caused by an earthquake, landslide, or volcano is called a tsunami. The heights and years of the 20 tallest tsunamis on record are given below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Year</th>
<th>Height (m)</th>
<th>Location</th>
<th>Year</th>
<th>Height (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lomblen Island, Indonesia</td>
<td>1979</td>
<td>120</td>
<td>Merak, Java, Indonesia</td>
<td>1883</td>
<td>35</td>
</tr>
<tr>
<td>Valdez Inlet, Alaska</td>
<td>1964</td>
<td>70</td>
<td>Lutuya Bay, Alaska</td>
<td>1880</td>
<td>60</td>
</tr>
<tr>
<td>Lutuya Bay, Alaska</td>
<td>1958</td>
<td>525</td>
<td>Lutuya Bay, Alaska</td>
<td>1853</td>
<td>120</td>
</tr>
<tr>
<td>Amorgos, Greece</td>
<td>1956</td>
<td>30.6</td>
<td>Shimabara, Japan</td>
<td>1792</td>
<td>55</td>
</tr>
<tr>
<td>Unimak Island, Alaska</td>
<td>1946</td>
<td>35</td>
<td>Ishigaki Island, Japan</td>
<td>1771</td>
<td>85.4</td>
</tr>
<tr>
<td>Nachi River, Japan</td>
<td>1944</td>
<td>200</td>
<td>Sado Island, Japan</td>
<td>1741</td>
<td>90</td>
</tr>
<tr>
<td>Lutuya Bay, Alaska</td>
<td>1936</td>
<td>150</td>
<td>Bering Island, Russia</td>
<td>1737</td>
<td>60</td>
</tr>
<tr>
<td>Disenchantment Bay, Alaska</td>
<td>1905</td>
<td>35</td>
<td>Hila, Indonesia</td>
<td>1674</td>
<td>100</td>
</tr>
<tr>
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<td>60</td>
<td>West Coast Patmos, Greece</td>
<td>1650</td>
<td>30.5</td>
</tr>
<tr>
<td>Shirahama, Japan</td>
<td>1896</td>
<td>38.2</td>
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1. Solo: Look at the data table about tsunamis, and jot down three to five things you find interesting or important from the data.

2. Working with a Partner: Compare your results from part 1, and together decide on three facts/messages you find most interesting from the data. Also decide what graphical display would be best to convey each message.

3. Now, working in groups of four: Compare your lists of three messages and the graphical displays you think are appropriate for conveying them. Narrow your list to three messages you can all agree on, and decide what graphical display would be best to convey each message.

4. Solo: complete the project, making a table and a graph to display each of your messages. You may compare your work with others, but your finished project will be graded independently according to the rubrics attached to each of the pages.
Send a Message (And Say it With Graphs!)

Data, Graphs, and Statistics Project

An ocean wave caused by an earthquake, landslide, or volcano is called a tsunami. The heights and years of the 20 tallest tsunamis on record are given below:

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</table>

The table above contains a great deal of information. You must decide what YOU think is most important and/or interesting to share about these data, and use a graph to display the information in a meaningful way. The type of graph used will depend on what you want to show/tell your audience.

Choose three facts/messages you found interesting or important about the data above. For each fact/message, decide what type of graph would display this well. (Try to use three different types of graphs, and make sure that one of them is a histogram.) Then, for each message, rearrange the data into a new table to make drawing that graph easier, and produce the graph that carries your intended message.

Remember, your graph must have labels, a meaningful title, and be scaled appropriately. You might also need a key, a summary caption, or other addition to help the reader to get your message.
1. Fact/Message #1
   a. What I want to tell my reader is (Use a complete sentence to explain this):
      
   b. This can best be shown using the following type of graph: __________________________
      
   c. Rearrange the necessary data from the original table into a table you will use for compiling a graph to tell your message:
      
   d. Now, make your graph and attach it. You may make it by hand or use Excel. Make sure you label your graph and scale the axes or sectors appropriately. Make sure your graph has a meaningful title. If you need to use colors, a “key”, or a summary caption to make your message clear, do so.
Message #1: ______________ out of 24 points

<table>
<thead>
<tr>
<th>Grading Standard/Attainment of Standard</th>
<th>Not Yet Demonstrated (1)</th>
<th>Approaching the Standard (2)</th>
<th>Generally meets Standard (3)</th>
<th>Consistently Meets or Exceeds Standard (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student has stated a clear message which is consistent with the information in the data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student has chosen the appropriate graph to convey the message</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student has summarized the appropriate data in a table which includes the necessary information for producing the graph</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table is correct, neatly made, readable, and clearly labeled.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resulting graph is proportional and conveys the intended message.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graph is labeled, meaningfully titled, with appropriate additional information to convey message clearly.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

Comments:
2. Fact/Message #2
   a. What I want to tell my reader is (Use a complete sentence to explain this):
   
   b. This can best be shown using the following type of graph: __________________________
   
   c. Rearrange the necessary data from the original table into a table you will use for compiling a graph to tell your message:
   
   d. Now, make your graph and attach it. You may make it by hand or use Excel. Make sure you label your graph and scale the axes or sectors appropriately. Make sure your graph has a meaningful title. If you need to use colors, a “key”, or a summary caption to make your message clear, do so.
Message #2: ______________ out of 24 points

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Comments:
1. Fact/Message #3
   
a. What I want to tell my reader is (Use a complete sentence to explain this):

b. This can best be shown using the following type of graph: ____________________________

c. Rearrange the necessary data from the original table into a table you will use for compiling a graph to tell your message:

d. Now, make your graph and attach it. You may make it by hand or use Excel. Make sure you label your graph and scale the axes or sectors appropriately. Make sure your graph has a meaningful title. If you need to use colors, a “key”, or a summary caption to make your message clear, do so.
Message #3: ____________ out of 24 points

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