Lesson Research Proposal for Grade Two: Data Collection & Graphing

For the lesson on May 12, 2017
At Dr. Jorge Prieto Math & Science Academy: Lesson Study Conference, Meghan Smith's class
Instructor: Meghan Smith
Lesson plan developed by: Caileen Brett, Alyssa Frollo, Emily Kempe, Meghan Smith

1. Title of the Lesson: How can we organize this information?

2. Brief description of the lesson

During this lesson students will be presented with data that they have collected as a class in a very random and scattered way and challenged to find a way to visually represent the data. Students will compare different visual representations of data to come to an understanding that bar graphs help us see data visually and clearly and we can easily answer questions about the data when it is shown in this way.

3. Research Theme

Our school's research theme this year is SMP2, reason abstractly and quantitatively. SMP2 states that mathematically proficient students make sense of quantities and their relationships in problem situations. One of the main desires we have for our students is for them to be able to decontextualize in math situations. We are focusing on quantitative reasoning in order for our students to conceptually understand problems and represent them versus computing and calculating for answers.

4. Goals of the Unit

a) Students will sort and record data into a table using up to six categories; use category counts to solve word problems.
b) Students will draw and label a picture graph to represent data with up to six categories.
c) Students will draw and label a bar graph to represent data; relate the count scale to the number line.
d) Students will know how to draw a bar graph to represent a given data set.
e) Students will solve simple put-together, take-apart, and compare problems using information presented in a bar graph.

5. Goals of the Lesson:

a) Students will organize information with a bar graph.
b) Students will understand how a bar graph represents data.
c) Students will understand that bar graphs help find information quickly.
d) Students will answer questions about the data.

6. Relationship of the Unit to the Standards

Related prior learning standards	Learning standards for this unit	Related later learning standards
1.MD.C.4 Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.	2.MD.D.10 Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.	3.MD.B.3 Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets*.

7. Background and Rationale

All of the curricula we looked at taught data collection and graphing in a very direct way. This is even true of curricula that are typically problem-solving or inquiry based. The tasks mostly require a teacher to model how to take data/information that is scattered and place it into a bar graph or pictograph.

When developing this unit, we wanted to look at the purpose behind bar graphs in the primary grades and think about how we could facilitate students' deep understanding of the benefit of this visual representation. We want students to see the usefulness of this visual representation rather than just graphing a data set because the teacher told students to graph the data set.

With these intentions in mind, we made a strategic choice for the data set we would use in our lesson. At the end of each day, students are allowed to have free choice time. In order to mark what choice they are making, they take a post-it note and write their name and their free choice. The students who are participating in this unit and research lesson are students in grade two who come from three different first grade homerooms. About one third of the students were in Ms. Smith's grade one class. Ms. Smith used Mathematics International and Teaching Through Problem Solving with her Grade One students the previous year. The other two classes used a mixture of Eureka Math and Mathematics International. In Grade One, all students learned about picture graphs and bar graphs with up to three categories of data. They had to tell how many were in each category, the total number, and how many more/less when comparing categories. Students in Grade One had experiences working with "how many more/how many less" situations. They practiced this with ten track cubes where they lined up two numbers using yellow and white cubes in order to compare how many more or less. They also played a game in Grade One with red and yellow chips. During this game, students would drop the chips, line up the red chips and yellow chips in pairs in order to find out how many more/less. Students in Grade One also graphed based on tally marks in tables. This year, instruction has followed the scope and sequence of Eureka Math, but many lessons in Ms. Smith's class have been adapted to a teaching through problem solving approach.

8. Research and *Kyozaikenkyu*

There are many reasons why graphing skills are an essential part of student learning. The ability to graph data is a valuable mathematical skill on its own, and the analysis of graphical data adds the important component of critical thinking. The basic skills required to look at and interpret graphs can span across many different contexts. Graphs are not only useful in mathematical and scientific contexts; graphs are also used in sports, politics, medicine, and in almost all aspects of daily lives. "Gathering, collecting, and interpreting numerical information is deemed an ever-increasingly necessary skill in a world that is inundated by data." (Larson and Whitin). Graphs are an effective way of visually presenting information with the intent of people being able to easily and efficiently understand information.

Graphing is also a topic that allows students experience the clear application of math in their lives and the larger real-world contexts. The NAEYC's statement on early childhood mathematics articulates this with three main points, "teachers can enhance children's interest in mathematics by creating graphs about familiar routines and classroom events; teachers can emphasize the persuasiveness of graphs and mathematics in the world by integrating their use across subject fields such as science, visual arts, technology, engineering, social studies and language arts; and graphing provides a meaningful opportunity for children to represent and communicate important mathematical relationships." (National Council of Teachers of Mathematics, 2006).

When students learn how to prepare graphs and analyze the data from a graph, we are preparing them to understand and evaluate graphs in any context. This is because students will understand the different components of the graph, recognize how the components relate to the data, and gain the skills to evaluate data from graphic representations. Further, having students create graphs also helps them identify trends and patterns in the data, observe inconsistencies, and draw their own conclusions about a specific topic. It is essential that children have regular and rich opportunities to gather, represent, and interpret their own data. This will help them with real world and academic contexts in which they need to use numbers to "frame arguments, justify policies, and attempt to change others' opinions." (Larson and Whitin).

When teaching graphing, specifically analyzing graphs, it is important for the teacher to ask open-ended questions to the students about the data. The open-ended questions allow for a variety of responses and multiple entry points for children who have different ability levels and prior experiences. This also enables children to "recognize a range of mathematical relationships in a graph, to elaborate on their ideas, and can help teachers better assess what children know and understand so they can plan learning experiences that further expand children's horizons" (Larson and Whitin). Another important point for teachers is to encourage children to "be aware of the limitations of their graphs" in order to build "healthy skepticism" about numerical information and data. Teachers can ask students questions such as, "what does your graph not say?" in order to instill a critical eye in children and increase their mathematical reasoning. Instruction that includes graphing helps to build the kind of challenging, rigorous, and robust mathematics learning community which will support students to become confident and competent mathematicians.

9. Unit Plan

Lesson	Learning goals and tasks
1	The Research Lesson **Goal:** Students will organize information with a bar graph and answer questions about the data. **Task:** How can we organize the post-it notes to help us answer the questions we have?
2	**Goal:** Students will understand the importance and purpose of drawing bars for a bar graph. **Task:** I lost some of the post-it notes from our graph yesterday, what should we do?
3	**Goal:** Students will strengthen their understanding of organizing information into a bar graph. **Task:** Practice day-organizing data into a bar graph.
4	**Goal:** Students will practice organizing information into a picture graph. **Task:** Practice day-organizing data into a picture graph.
5	**Goal:** Students will compare quantities using data from the bar graph from Lesson 1. **Task:** How can we find how many more students chose iPads than Magna Tiles?
6	**Goal:** Students will strengthen their understanding when comparing quantities using data from a bar graph. **Task:** Practice day-comparing quantities
7	**Goal:** Students will find the total amount from Lesson 1 bar graph. **Task:** How can we use this graph to find the total amount of free choices?
8	**Goal:** Students will strengthen their understanding of finding total amounts from bar graphs. **Task:** Practice day-finding totals from bar graphs

10. Design of the Unit and Lesson

When developing this unit, we wanted to look at the purpose behind bar graphs in the primary grades and think about how we could facilitate students' deep understanding of the benefit of this visual representation. We want students to see the usefulness of this visual representation rather than just graphing a data set because the teacher told students to graph the data set. The unit aims to have students discover different ways to visually represent data and then practice the new idea that they discovered on the following day.

The lesson was designed around data that the class has been collecting. In the days leading up to this lesson, when the students had free choice time, they received a post-it note and they wrote their name and the free choice station they selected, then posted the post-it note on the board.

Thus students will have a connection to the data, which we hope will increase their interest in the task and ensure they are able to make the connection to how math can help them in their life.

During the research lesson, the teacher will display the post-it notes from two days' worth of free choice time on the board, arranged randomly, and ask students to create a visual display of the data that is easy to read and understand. The ultimate goal of the lesson is for students to appreciate bar graphs and understand why they are useful in terms of understanding data/information clearly.

The Common Core Standards only require students in grade two to use four categories of data, but we think students will better see a purpose in representing data with a bar graph if there are more than four categories. There are six categories for free choice time that students could pick from: iPads, Magna Tiles, Computers, Play Doh, Coloring, and Math Tools.

11. Research lesson

Steps, Learning Activities Teacher's Questions and Expected Student Reactions	Teacher Support	Assessment
Introduction Teacher will display post-it note data on the board, organized randomly, and students will explain what the post-it notes/data represent and how they collected this information. "What questions do you have about this information?" Anticipated responses: • I wonder which activity was chosen the most? • I wonder which activity was chosen the least? • How many choices are on the board? • Did magna tiles have more than play-doh? • Did more people pick computers or iPads? "Why is it so hard to answer these questions?" (the post-it notes are all over the board, we can't read them, it is hard to see).		Do students remember what the data represents? Are students able to generate questions about the data? Can students verbalize why it is hard to answer the questions?
Posing the Task "How can we organize the post-it notes to make it easy to answer the questions we have about our choices?" Students will think individually, then work on the problem in groups.	Teacher will write the task/guiding question on the board. Provide a "mini" set of post-it notes at their desk that reflects the same data on the board.	Do students understand the task? Are students eager to solve the problem?

Anticipated student responses 1. Students create a written list with the data. 2. Students group same data together 3. Students group same data together and categorize in a graph type of display (horizontal or vertical). The main goal during independent work is that students will brainstorm how they would organize the data before working in groups, write their idea in journals, work together with their group with the physical data, and then come to the carpet ready to share out different ideas.		Are students able to tackle the problem? Do students have a solution method that they are ready to share at the discussion? What are the different ways groups are thinking they should organize the data? Do the post-its help students gain insight into the problem? Are students using accountable talk in groups?
Comparing and Discussing For this lesson, the board will serve as a "thinkpad" for students to collaboratively work on moving from random data to creating a visual display that helps us understand the data. We want the progression to move from randomly organized data, to grouped data, to a bar graph of the data. We plan to use the post it notes to re-order the data in an organized way.	Main point about the post-it notes is that each post-it represents an individual data point, but the data points together create a bar. What ideas did you come up with? What do we think about this group's idea? Can we answer our questions from the beginning of our lesson? How can we make it easier remember which bar is which? (labels) You have seen something like this last year. Do you remember what it was called? Reference graph from Grade One: -What do you think about this? -What does this graph have that we don't have? -Why are there numbers here? (scale) -What do you think about what we've done versus this graph? -What do we think about this scale?	Are students defending their ideas? Are they responding to each other's ideas? Are students able to explain why it is hard to analyze random data? Are students able to justify why it is easier to understand the information when it is categorized? Are students able to answer questions about the data when it is grouped together? Are students able to label the graph and explain the different components/what

		they mean? Are students able to express why the graph is helpful?
Summing up New Learning Statement: Bar graphs help us organize information and answer questions about the information. Students will write a reflection in their journals about their experience with the task today.	Let's go back to our questions you came up with at the beginning--can we answer them now? (revisiting introduction). Teacher will ask students what was new today that they discovered.	Is the new learning statement reflective of what students learned today? Are students able to express what they learned/who they learned from?

12. Evaluation

- Do the students understand what the bars in the graph mean?
- Do students appreciate the bar graph as an effective way to organize and display information?
- Did the use of post-it notes help students think about ways to organize the data?
- Was the board used effectively to help students communicate their ideas to each other?
- Was the context motivating for students?

13. Board Plan

Post-its scattered randomly
then
Post-its grouped by activity
then
Post-its arranged in a bar graph