Quynh Nguyen
Synopsys Inc.
Modified ETP
Math: Grade 8
Michael Bautista
June 30, 2017

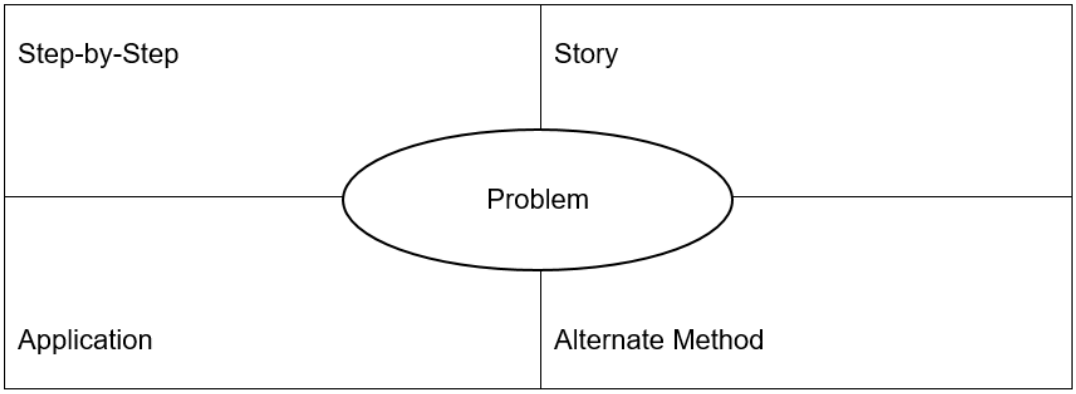
Four Square Fanfare

I've always been a firm believer in students' abilities to grow as learners, especially when it comes to math. As a result, Jo Boaler's work on mindset and approach to help students learn math is very intriguing to me. I try to communicate this way of thinking to my students, but now I also want to incorporate this practice into lessons and activities in class.

Project:

At the end of each chapter, students will be given a problem for them to solve and apply in multiple ways. The first part will have students going through the process of solving the problem using the method and procedures that we discussed in class. Students will show their work step-by-step. The next part will have students writing a story that puts the numbers of the problem into a contextual scenario. Students will then write a short paragraph (5-7 sentences) explaining how the ideas in the problem can be applied to real-world jobs or situations. Lastly, students will work with a partner to come up with a different method to represent and solve the problem.

Students will use complete this four square template for each problem.



“Step-by-step” is to assess procedural frequency. “Story” is to build creativity and develop contextual thinking. “Application” is to encourage STEM learning. “Alternate Method” is to promote finding at different ways to solve a problem. (SMART Notebook presentation to explain the Four Square strategy to students: https://drive.google.com/file/d/0ByL9jGSU-6SRejZ6cVhtUWpsY1k/view?usp=sharing)

Collectively, this process is intended to develop growth mindset in students. They will start solving the problem on their own to get their initial thinking out on paper. Students will do as much as they can to solve the problem in the Step-by-step portion; in this initial attempt, it is okay if students make mistakes because they will receive feedback from the classmates to help them continue their work and improve if necessary. This will allow students to see that mistakes are part of the learning process and they should keep trying. Also part of a growth mindset is to look at a problem in a different way and from a different perspective. Students will have the opportunity to do just that in the Story, Application, and Alternate Method portions of the task.

Timeframe:
I want this practice to extend through the entire school year (September to May). I would like to have students complete one handout at the end of each chapter as a way to summarize and review the ideas in that chapter.

21st Century Skill:
Learning and Innovation Skills: Learning and innovation skills increasingly are being recognized as the skills that separate students who are prepared for increasingly complex life and work environments in the 21st century, and those who are not. A focus on creativity, critical thinking, communication and collaboration is essential to prepare students for the future.

Communicate Clearly

- Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts
- Use communication for a range of purposes (e.g. to inform, instruct, motivate and persuade)

Collaborate with Others

- Demonstrate ability to work effectively and respectfully with diverse teams
- Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal
- Assume shared responsibility for collaborative work, and value the individual contributions made by each team member

Evaluation:
Students will complete and turn in a handout with the four square template, as shown above, for the problem.

I will evaluate students' step-by-step process to make sure they are performing the steps correctly and their alternate method to make sure the strategy is mathematically sound. Both these components will be awarded points out of 3 for correctness.

I will provide time in class for students to evaluate each other's step-by-step process. This is to ensure that their work is clear enough for a peer to follow and understand. Students will receive feedback from their peers, to be written on a post it, and then they will have the opportunity to make any necessary changes.

The word problem/story component will be evaluated out of 2 points. The scenario must make sense with the numbers presented in the original problem. Students can earn up to 2 points for the application component if their explanation fulfills the length requirement and is relevant to the topic.

Connection to Fellowship:

My fellowship is at Synopsys, a software company that develops electronic products and software applications. My project with Synopsys is to manage the budget for the IT department. I look at data from their previous year's spending on products and organize the information on a spreadsheet. One of the challenges that I've faced at the start of this fellowship is to make sense of the data that was kept by different parties and consolidate it into one single spreadsheet. The difficult part is to dig through the data sheets to find the pertinent information; because each sheet was created by a different person, organizing the information in a way that made sense to them, the formatting and structure was not consistent across all the sheets. As a result, some information was misinterpreted or lost in the shuffle because it was not communicated clearly and concisely.

Through this activity, I want to have all students display their work in a structured and consistent manner so that it would be easy for me and them to keep track of their work. Also, I want to emphasize to students that they need to show their work so that anyone who looks at work can follow and understand their reasoning. It is an important skill in both academics and career for students to learn to be able to organize and communicate information clearly so that others can understand what they are trying to convey.

It took time to be able to figure out how to make sense of the previous year's data during the fellowship, but the more data I looked at, the better I got at understanding the information. This demonstrates that any type of learning is a process and requires perseverance. I want my students to see that their capacity to understand an idea or to complete a task can grow as they try to find different ways to approach a problem and/or look for ways to relate the problem to something familiar to them. This four square activity is designed to give students the opportunity to help students experience the multi-layers of learning and enable them to develop the mindset that their knowledge is not rigid; they can find a different method to solve a problem and visualize a problem in a particular scenario.

Connection to Active STEM Learning:
One of the four squares on the handout requires students to come up with an application for the problem that they just completed. Think of this as the "when am I ever going to use this?" segment. Students will investigate how the concepts they are working on relate to their everyday lives and even look into how they can use these skills in future jobs and careers. They are welcome to write from their own experience, but they will be encouraged to also do research in order to give specific examples of how the math concepts can be applied to life and career as it pertains to math, science, and technology fields. The applications do not have to be rigidly based on the problem they completed, but rather should revolve around the concept/idea or skill they used to solve the problem. For example, the problem might involve continuing a tile pattern and predicting the number of tiles in a particular figure, but instead of writing about how to specifically apply tile patterns, students should write about pattern recognition and pattern generalization.

In addition, students will have the opportunity to write a "story" to go along with the problem. This is essentially going to be where students use the numbers in the problem and write it into a word problem. The purpose is for students to think about giving context and meaning to the numbers. Students will have to use their experiences and prior knowledge in different subject areas to write applications for these problems.

Deliverables for ETP:

Students will complete a handout resembling the four square template above.

1) Task structure:
   * Steps A and B will take place to introduce the Four Square strategy. It will be completed at the end of chapter 1.
   ** Step C will occur starting from chapter 2 and continuing through chapter 9.

   A. As a class (see sample problem on last page)
   - Before students are to complete the four square template on their own, I will model the process to them.
   - I will present the problem and complete the Step-by-step and Story portions on my own.
   - As a class, we will brainstorm application ideas. I will record students' ideas on the board and then proceed to share my own application idea.
   - Students will work in their groups to come up with another method to solve the problem. Then each group with share out their new approach.

   B. In groups
   - Students will be presented with a different problem and they will work with their group members to complete the four squares. Each group will complete one, but

students will have to alternate the recording duties for each square to ensure that all members participate.

- After about 15 minutes, groups will swap papers and provide feedback to another group about their Step-by-step portion. Groups will use the protocol “I like…, I suggest..”, where they write (at least) one statement about what they liked about the work and (at least) one statement about what they suggest the other group do to improve their work.
- Groups will get their papers back after about 5 minutes and make the necessary changes.
- We will has a class discussion about what groups liked about other groups’ work and what suggestions were given. Groups will also share out their alternate method.

C. On their own

- Students will be assigned a problem relating to the chapter we are currently working on.
- Students will complete the Step-by-step, Application, and Story part of the handout for homework.
- The next day in class, students will switch papers with a partner (either randomly selected or assigned is yet to be determined) and will be given about 5-7 minutes to review the Step-by-step part of their partner’s work. They will give feedback on a post-it using the “I like…, I suggest..” protocol. Students will them have 3 minutes to share with their partner their feedback so that both parties understand what the other is trying to communicate.
- With the same partner, students will work on the Alternate Method part of the handout, where they discuss and come up with a different way to solve the problem. Both students should have the same method written on the handout. This will take about 15 minutes
- As time permits, different groups can share out their methods to the class.
- Students will take the handout home to revise the Step-by-step process according to the feedback if necessary.

2) Sample problems:

- Solve the proportion: $\frac{3}{4} = \frac{x}{14}$ (Chapter 1 - September)

- Solve the equation for x: $8x - 27 - 10 - 6x = 15$(Chapter 2 - September)

- Solve the equation for x: $8(x - 5) = 2(3x - 8)$ (Chapter 3 - October)

- Graph the equation y = 3x - 5. (Chapter 4 - November)

- Solve the system of equations using an algebraic method:

$$-x + y = 4$$
$$-3x + 6y = 3$$

(Chapter 5 - January)

- A triangle has the vertices (0,-3), (-1,-5) and (-3,-4) on the coordinate plane. Find the new coordinates if the triangle is translated 5 units up and 3 units left. Find the new coordinates if the triangle is reflected across the y-axis. (Chapter 6 - February)
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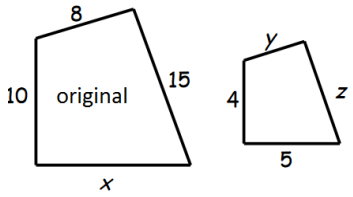
- Find the scale factor between the two similar shapes. Then find all the missing side lengths.

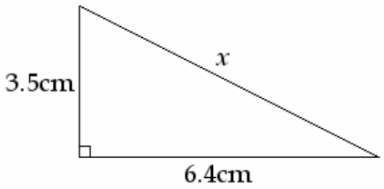


(Chapter 6 - February)

- Find the slope of the line that goes through the points (2,5) and (6,13). Write the equation for this line. (Chapter 7 - March)

- $9.8 \times 10^{6} + 4.3 \times 10^{7}$. Perform the operation without write the number in standard form. Write your answer in scientific notation form. (Chapter 8 - April)

- Find the missing side length of the right triangle.



(Chapter 9 - May)

Sample problem:

(See attachment for complete solution in Four Square layout)
https://drive.google.com/file/d/0ByL9jGSU-6SRNVE5bjV3bFVMWlE/view?usp=sharing


Fig. 1

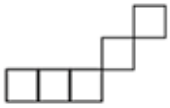


Fig. 2

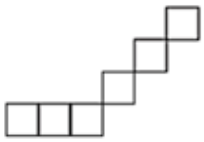


Fig. 3

1) Draw Figure 0 and Figure 5.
2) How many tiles are in figure 100?

Step-by-step: (solution)

- Draw rough sketch of Figure 100, “sum up” tiles
- Figure 100 has 103 tiles

Alternate method:

- Write rule: y = x + 3, x = Figure #, y = total number of tiles
- Figure 100: y = 100 + 3 = 103 tiles

Application:
Pattern recognition: Drawing tile patterns at various figure numbers may not be helpful to you in your daily lives, but it’s the skill of being able to recognize patterns, generalize these patterns, and use it to make predictions. Pattern recognition extends into many technology fields. One field in particular is machine learning, where a computer is programmed to constantly collect and analyze data so that it can adapt and “make decisions” as more data is available. Examples of machine learning are online recommendations for products based on what you’ve previously searched for on Amazon, or automatically recognizing faces in photos to tag your friends on social media.

Story:
There is a staircase that extends beyond what the eye can see. An ant living at the bottom of the staircase decides to go on an adventure and travel up the staircase. At the end of each day of travel, the ant draws a picture in his journal to track his progress.

1) Draw the ant’s starting position (Figure 0) and the ant’s drawing at the end of day 5 (Figure 5)
2) How many squares are going to be in the ant’s drawing at day 100?