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Embedding Problem Solving in the Math 30x Courses

Kelli Wasserman

kwasserman@csusb.edu

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Group-Project Instructions for Instructors

Using problems from the problem solving book, *Thinking Around the Box*, students in the Quarter Bridge courses will have the opportunity to work on problem solving in the form of Group Projects. The Group Projects serve many purposes. First, by allowing students to problem solve in groups, students are challenged to grapple with the mathematics, which is true problem solving. They collaborate on solutions, where they learn to value the ideas of others, rather than relying solely on the professor. They work on developing the Standards of Mathematical Practice (which they will need to teach to their future students), including making sense of problems, constructing arguments, critiquing the reasoning of others, using tools, and reasoning quantitatively. These skills are critical to their development as future teachers.

Group Projects (GPs) will be collaborative assignments, which will be completed over a 3 week period.

1. Part 1: Collaborating on Problem Solving

- a. Week 1: Independent problem solving. Each student must complete the assigned problem individually, to the best of their ability. Students will take a picture and upload their individual work to group assignment, once groups have been assigned. **Recommended: This work is checked for credit only. Instructor should not spend time grading for correctness or giving feedback.**
- b. Week 2: Groups are assigned randomly. Instructor may use random group generator in Blackboard, or choose another method. Once groups are assigned, students are expected to collaborate through Google Docs. This is established when one group member sends an email to the instructor that includes all group members emails. Instructor can then copy and paste email addresses into the group document sharing settings in Google. At this point, students need to decide as a group which part of the Group Project they will be responsible for completing. **Recommended: Four members per group, each group member assigned one part of the document to complete. The four sections are Visual, Numeric/Algebraic, Verbal, and Connections. Groups should choose one problem solving strategy that they want to showcase in their document. Each section should communicate and illustrate a complete solution of that problem solving strategy, in the designated representation. For example, if the group chooses a Guess and Check strategy, the Visual representation should include a series of visuals that illustrate the stages of the guessing and checking. Then, the Numeric representation may include a table that records numerically the same guesses. Additionally, the Verbal section is a verbal solution of this guess and check strategy (not a step by step account of a different section). All representations should match so that the connections section has something to connect. Group members are then responsible for reading and giving feedback on the remaining sections.** Students will have until the end of week 2 to complete their section and begin giving feedback to group members, instructor should give a due date. At that time, instructor will view each document and give feedback via comments in the living Google Doc.
 - i. **Rules:**
 1. **Collaboration should happen IN the group document. Any collaboration that occurs via text, phone call, or face to face meeting cannot be accounted for (since the professor will not be present).**
 2. **No student is allowed to change/delete/complete another student's section. They must give feedback via making comments in the document to help the owner of that section revise. This may take several trials.**

- 3. Students MUST give feedback to all sections of the document that they did NOT complete. This goes toward developing their ability to critique arguments of others, and will impact their individual grade.**
- c. Week 3: Students revise work based on teacher and group members feedback. They prepare a final draft that will be printed and turned in (only one per group). The group final draft should look professional, following instructor formatting guidelines. The final draft is due at the end of week 3.
2. Recommended: Group projects to be graded using the [Exemplars Standards Based Rubric](https://exemplars.com/sites/default/files/2019-07/2014_classic_5criteria_rubric.pdf). The rubric is available at the following website:
https://exemplars.com/sites/default/files/2019-07/2014_classic_5criteria_rubric.pdf
3. **Part 2: Reflection.** Additionally, students will complete an individual reflection that will be turned in separately. Students will respond to the following 3 prompts:

 - a. What did you learn from solving the problem?
 - b. What did you learn by collaborating on your problem solving?
 - c. Explain how you developed Standard for Math Practice _____ (to be determined by instructor; recommended SMP 3 or 6) while working on this problem? Justify your reasoning by referring to the specific behaviors outlined in the MP.

Group Project Instructions for Students

Group Projects are collaborative assignments, which will be completed over a 3-week period.

1. **Part 1: Problem Solving and Connections.** Each group will submit ONE document. Your names, Math 301A *and* the name of the instructor should be written on the first page.
 - i. **Solve the problem (independently) in multiple ways.** This will be checked separately for completion.
 - ii. **Collaborate with classmates!!** This assignment will be done outside of class. A Google doc will be established for each group, and will be **monitored by the instructor** for collaborative participation and contributions. While everyone cannot type/enter everything into the document, everyone should have a role in **every part** of the document. This means that it is NOT intended to be a divide and conquer assignment. Every group member is responsible for reading through the entire document and ensuring that there are no grammar errors, no mathematical errors, no spelling errors, precise academic language is used, and that the solution is clear, makes sense and is justified.
 - iii. Together **select** one visual representation, and either a numeric or algebraic representation to showcase in your FINAL draft. Decide as a group which solutions make the most sense (if any, you may decide to try something different). You may decide as a group how to showcase your work. For example, you may have a section dedicated to your visuals and a separate section dedicated to your numerical or algebraic representation; OR you may integrate the two representations together, including verbal explanations.
 - iv. Connections: This is your written section, and it is separate from any written explanation you feel you need for your solution. **This section is reserved for you to describe how the two representations (visual and numeric/algebraic) are related and they MUST be stated explicitly. You may also write extensions here and tell why this solution makes sense** (stating that both methods “got the same answer” is NOT justification for why the solution makes sense).

2. **Part 2: Reflection.** EACH person will write an individual reflection. In your reflection, respond to the following questions:
 - i. What did you learn from solving the problem?
 - ii. What did you learn by collaborating on your problem solving?
 - iii. Which Standard for Mathematical Practice (SMP3 or SMP6) did you develop while working on this problem? Justify your reasoning by referring to the specific behaviors outlined in the MP.

Suggested Problems for Collaborative Group Projects

<u>Math 301A QBR</u>	<u>Math 301B QBR</u>
<p>Handshake Problem: The Supreme Court first met in 1790. The Court has many traditions, including the “Conference Handshake”. When the Justices assemble to go on the Bench each day, each Justice shakes hands with each of the others. The ritual was established by Chief Justice Melville W. Fuller as a reminder that “differences of opinion on the Court did not preclude overall harmony of purpose.”</p> <p>How many handshakes take place among the nine Justices of the Supreme Court during a “Conference handshake”?</p>	<p>Climbing Stairs: Yazmin decided to get some exercise by taking the stairs from the first to the fifth floor in her apartment building. The first time she went up the entire flight, she walked up some steps and ran up 16 steps. This took a total of 60 seconds. The second time she went up the entire flight, she walked up some steps and ran up 28 steps. This took a total of 42 seconds. How long would Yazmin take if she walked up the entire flight of steps? (You may assume constant rates for walking and running.)</p>
<p>Chip and Dale: Chip and Dale collected thirty-two acorns on Monday and stored them with their acorn supply. After Chip fell asleep, Dale ate half the acorns. On Tuesday, they collected thirty-two additional acorns, and Dale ate half of the total supply. This pattern continued through Friday night, with thirty-two acorns being added and half the supply being eaten. On Saturday morning, Chip counted the acorns and found that they had only thirty-five. How many acorns had they started with on Monday morning?</p>	<p>Yojanas: One person travels 5 <i>yojanas</i> a day. When he has proceeded for seven days, the second person, whose speed is 9 <i>yojanas</i> a day, departs. In how many days will the second person overtake the first?</p> <p><i>Solve this problem in two different ways, one of which includes graphs of the distance traveled versus time for both travelers, plotted on the same set of axes. Briefly explain how the graph illustrates a solution to the problem.</i></p>
<p>Cats and Birds: Judy has cats and birds. Altogether her animals have 15 heads and 42 legs. How many does she have of each animal?</p>	<p>Spring Garden: Indira’s spring garden has half as many tulips as daffodils and three times as many hyacinths as tulips. If there are a total of 204 flowers in Indira’s garden, how many of each flower does she have?</p>
<p>Julie’s Garden: Julie loves to eat fresh vegetables, so she always plants a large garden in the spring. Two rows of her garden are planted with lettuce. One-third of the rest is planted with squash. Half of the remainder is planted with beans. Three-fifths of the remaining land is growing tomatoes, leaving three garden rows for fresh herbs. How many rows does Julie’s garden have altogether?</p>	

**Problems selected from the text *Thinking Around the Box* by Davida Fischman and Shawnee McMurrin.