Experiment in Teaching and Learning Problem Solving

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During a recent middle years methods class at the University of Regina, 28 students, in groups of four, spent three weeks gathering data on their group members, developing a story context that was meaningful to them, and within this context, creating a problem. Their problem, addressing middle years mathematics content, was then given to other groups to solve. Each group solved at least two other problems, provided feedback on these problems to the problem creators, and reflected on the different processes of a) posing a problem, b) solving a problem, c) providing feedback on a problem, and d) accepting feedback and changing parts of the original problem. All of these different processes were carried out as a group. Lastly, each group had to submit their 're-worked' problem, a summary of feedback from others, reflections on the different processes, how their problem might be used in the middle years curriculum, and how they determined (as a group) that I should evaluate their problem. Below are the seven problems developed by the groups in the class.

In solving the problems created by others, each group was asked to consider the following.

1. What kind of problem was it?
2. Was sufficient information provided to solve the problem?
3. Could the problem be solved in more than one way?
4. Was there misleading or deliberate irrelevant information provided? What did you do with this information?
5. Was this an interesting problem to solve?
6. Did you enjoy trying to solve this problem? Why or why not?
7. Did you successfully solve the problem? Did you solve it the way the problem designers had planned?
8. Comment on the problem's creativity.
9. Comment on how well you worked as a group in solving the problem.
10. Can you offer suggestions to improve the wording of the problem to make it easier/harder/more interesting, etc.?

We ask you the teachers, and, in turn, your students, to work the following problems and address the above ten items. We, the students of EMTH 215, section 30, would like your feedback on our problems. We would also like to provide you with feedback on your strategies and solutions. You can write to us at the following address:

Students of EMTH 215-030, The Faculty of Education, University of Regina, Regina, SK, S4S 0A2. You can Mail us to us at [TheCentralizer @MathCentral.uregina.ca](mailto:TheCentralizer@MathCentral.uregina.ca).

We will be pleased to communicate with you. If you want to talk about a specific problem given below, then simply give the students' names, and make sure you write EMTH 215-030 in your communication with math central.

1. Who Buys Lunch by Jason, Kim, Jennifer, and Gisele

   Jennifer and Gisele are supposed to meet at the boathouse in the Wascana Marina 5 minutes ago. Jennifer is on the water in a rowboat, rushing to get there as soon as possible. She is travelling at a speed of 25 km/h. The distance remaining that she must travel is 1/4 that of Gisele's remaining distance. Gisele is travelling in a car, polluting the environment, from out of town at a speed 3 times that of Jennifer's. Her remaining distance is 20 km. Who will arrive at the boathouse first and be able to guilt the other into buying lunch?

2. The Great Escape by Niki, Jodi, Kyrie, and Gina

You are a zookeeper at the Vancouver Metropolitan Zoo. After a freak earthquake splits the ground, you and three animals are stranded on a dangerous cliff. You must jump the gorge to bring the animals to one safe place. You can take only one animal at a time because of the width of the gorge. If the Boa Constrictor cannot be left with the Bald Eagle, with the broken wing, or the Koala Bear, how many times will you have to jump the gorge to get all the animals to safety.

3. Mmmm...Sandwiches by Kevin, Mike, Amie, and Geof

   Arnie eats 6 inch Subway Subs at a rate of one every 45 minutes. Kevin eats four times faster than Arnie, Geof eats 1.5 times faster than Kevin, and Mike eats as much as the three combined.

   If Subway bakes 350 12 inch loaves of bread every day (24 hour period), will the four gourmands be able to clean out the establishment before the next batch of bread is baked?

4. O.C.R.E. or Bust by Tom, Gary, Jodi D., and Greta

   One hundred and fifty students left the University of Regina to attend O.C.R.E. (Off Campus Residential Experience) at Fort San, Sask. During their first day, the most ambitious 12% of the O.C.R.E. students decided to look for the spirits of Fort San. They were never seen again. The next morning 55% more of the O.C.R.E. students left than had left the day before. These students were last seen 'caring and sharing' with the bears. That night 25% more of the O.C.R.E. students left than had left in the morning. These students had gone to 'reflect' on the rapid expansion of the ice fishing hole. The reflections of these students still haunt Fort San today. The next day 40% more of the O.C.R.E. students left than had left the previous night. They were last seen building a Quinzhee, somewhere around a destroyed section 30 Quinzhee. How many O.C.R.E. students returned on the bus headed for the University of Regina with Greta, Gary, Jodi and Tom?

   (Hint: decimal numbers are to be rounded off to the nearest whole number).

5. The Cross-country Ski Race by Wendy, Luke, Rick, and Mike.

   While out at O.C.R.E. (Off Campus Residential Experience), all the sections decided to have a cross-country ski race. The race was structured in such a way that there were four members per team and each member carried a full canteen of four cups of water. Each canteen is capable of taking one member forty minutes down the trail. How can the team co-operate so that one member of the team has enough water to cross the finish line, in a minimum time of one hour and 10 minutes and all the other members are able to return safely home with enough water?

6. Menu Madness by Kelly, Roxane, Vickie, and Delphine

   Kelly, Vickie, Delphine, and Roxane went out for lunch. They decided to eat at the Utopia cafe, where they gave their order to their waitress, who in turn gave the order slip to the cook. When the meal was ready, the waitress could not find the food order form that explained which meal was to go to which customer. The cook had accidentally dropped it into a pot of hot oil. The waitress was horrified. It was her first day on the job and she did not want to make a mistake. She tried to remember the order for the food.
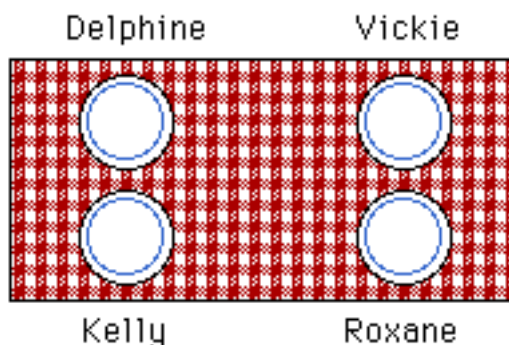
She gave the pizza and the coffee to Roxane, the Coke to Vickie, the hamburger and milk to Delphine, and the cheeseburger and tea to Kelly. The waitress had unfortunately given the wrong meals to the wrong customers. Kelly, Vickie, Delphine, and Roxane had to pass the correct meals to the correct customers. The pizza and the coffee was passed three people to the right of Roxane. The Coke was passed three to the left. Delphine passed the meal she received one to the right. Then Kelly passed the hamburger and milk to the person who passed the pizza and coffee. This person passed it on to her right. Kelly had two meals at this time, so she passed the cheeseburger and tea three times to her left. Finally everyone could eat. Who ate which meal?

7. Rumor Has It By Shannon, Laura, Shirley, and Christy

   At noon, while standing in line at the cafeteria, Valerie asked Todd to the 'Sweethearts Ball' on Valentine's Day. Valerie told Jamie the good news right away. In the next ten minutes Jamie told Cameron and Scott. Cameron told Susan and Lisa, and Scott told Trent and Mike, within the next ten minutes. This continues until 1:00 p.m. with each person telling two others every ten minutes. Altogether, how many people would know?

The above 28 students all experienced group processes with respect to creating, solving, and providing feedback on problems. Part of their evaluation for the creation of their problem could easily have come from feedback from other groups, and also from their own group members. The students could change their existing problem into a new one by modifying the known, unknowns, or the restrictions placed on the answer. These problems all emerged from an experience that one or more group members had had, which reinforces Dewey's (1906/1964) notion that all problems arise naturally within experience, and teaching and learning consist of the reconstruction of the experience which leads to the progressive organization of subject matter, and the reconstruction of experience requires reflective thinking (or problem solving), and Burton's (1984) idea that 'problem solving happens in an environment where skills which have already been acquired are exercised. Indeed, one of its major services is to enable pupils to start from where they are and use whatever they can to make progress' (p. 10). For children to engage in problem solving at all, the problem must fit with a problem already stirring in their own experience, or occasion a problem to arise. Their experience must be brought forth to 'manage' the problem, or the problem must occasion the children to reconstruct their experience.

Note:
In the Spring of 1997 some students in grade 8 at Truro Junior High School in Truro, Nova Scotia solved these problems, sent us their solutions and then created problems of their own for inclusion in the Resource Room.