

## ONLINE PROBLEM SOLVING

Course: The E in STEM

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I tried to work through all of the problems listed on the 'Online Problem Solving' assignment sheet; I worked on the problems in the following order: *Trio Match Game*, *Tower of Hanoi*, *The Three Jugs Problem/Three Glasses Puzzle*, *Entrapment*, and then *Wolf/Sheep/&Cabbage*. I felt successful on all of the problems except for the *Three Jugs Problem/Three Glass Puzzle*; I also think I could improve in the number of points obtained for the *Trio Match Game* if I continued to play and replay that problem solving game.

### *LEAST CHALLENGING PROBLEM – Wolf, Sheep, and Cabbage*

After trying all of the problems, I felt that the *Wolf, Sheep, and Cabbage* problem was the easiest to solve. I solved it successfully in my first try, and it only took me about one minute to solve and complete. The style of the problem seemed similar to the style of the *Tower of Hanoi* problem, so it probably helped me to have tried the *Tower of Hanoi* problem before the *Wolf, Sheep, and Cabbage* problem. It also seemed rather easy, because the instructions were very simple; I just had to remember to never leave the sheep and cabbage and/or the sheep and wolf alone on the side of the river. I may have previously solved problems similar to *Tower of Hanoi* and *Wolf, Sheep, and Cabbage*, which would have helped to trigger my memory for solving such problems; however, I do not specifically remember any particular similar problems I have solved in the past.

Based on my understanding of Kirkley's article, "Principles for Teaching Problem Solving" (2003, p. 8), the type of problem seems to be a mix between a well-structured problem and a moderately structured problem. It is *mostly well-structured* in that there is only one right answer (i.e. the wolf, sheep, and cabbage must successfully be placed from one side of the river to the other side of the river), and only the starting information/instructions are needed to solve the problem; however, I have a suspicion that there may be more than one solution strategy to reach the final correct answer. I tried the problem a couple times, but I used the same method/strategy to be successful each time. I would need to observe *at least* one other person attempting and successfully solving this problem in order to confirm if there are other strategies for solving the problem.

I do not feel as though I used much of a strategy to solve this problem. I read the directions, I made sure the cabbage and sheep were never alone together, I made sure the sheep and wolf were never alone together, and then I just quickly solved the problem of moving all three things from one side of the river to the other side. Since I do not feel as though I used much of a strategy beyond simply following the instructions, I also think I did not really develop a strategy. The only action I took that I could consider a development of a strategy for this particular problem was to have worked through the *Tower of Hanoi* problem of a similar style *before* first attempting this problem. In the *Tower of Hanoi* problem, I also had to move three objects from one side to another side with one basic criterion that the bigger pieces could not ever be placed on top of the smaller pieces while moving them. The prior similar experience helped me to quickly visualize how to solve the *Wolf, Sheep, and Cabbage* problem *and* to transfer the skills obtained from the previous experience to this problem.

The only declarative knowledge needed to solve this problem was stated in the instructions. The sheep should never be alone with the cabbage, because the sheep eats the cabbage when not supervised by the human; the sheep should also never be alone with the wolf, because the wolf eats the sheep when not supervised by the human. As for procedural knowledge, I think it was just necessary to know that ‘objects’ did not just have to move from right to left; objects could be moved from right to left and then left to right – all in order to avoid the ‘forbidden’ pairings of sheep/cabbage and sheep/wolf. I think that initially one might think the ‘objects’ could only be moved in one direction, but that is not the case. Since I figured out right away the flexibility of moving ‘objects’ back-and-forth, it made solving the problem quite easy.

#### *MOST CHALLENGING PROBLEM – The Three Jugs Problem/Three Glasses Puzzle*

After trying all the problems, I still think *The Three Jugs Problem/Three Glasses Puzzle* was the most difficult. I actually was not able to view and work through *The Three Jugs Problem* on my computer, but the *Three Glasses Puzzle* was the problem that presented itself when I followed the link given (<http://www.cut-the-knot.org/water.shtml>). I am assuming that *The Three Jugs Problem* (which I was unable to view) is of a similar style as the *Three Glasses Puzzle* since it was on the list of problems on the page with the *Three Glasses Puzzle*. I still have not managed to solve the *Three Glasses Puzzle*. I gave up, and I figure I will try it again later. I just felt like there was no solution to the problem as I tried *several* ways to make one of the three glasses contain only four ounces of water. It was easy to make one glass filled with five ounces of water, but it felt impossible to manage only four ounces in one of the glasses. I felt I needed to quit, forget about it, and then try it again with a calmer mind. I may just be more of what Kirkley (2003) states is a novice problem solver for this type of problem; I may just need more experience with this type of problem in order to better solve it.

This is another problem that I would consider well structured as well as moderately structured – *maybe* ill structured. It seems as though there is only one correct answer, but I am still unsure if the final four ounces of water will be in the five-ounce glass or the eight-ounce glass; maybe there is more than one right answer. There may be more than one strategy to solve this problem, or maybe there is a clear and simple step-by-step method to solving this problem. Since I still have not been able to solve the problem, it is difficult to be certain. My strategies have been to do a lot of trial-and-error, but with no success yet; I have been moving around different amounts/ounces of the water between the glasses in a different order for each attempt, but I have only been able to manage five or three ounces in a cup – not four ounces. When I attempt this problem again, I think I should more clearly note down the order of filling up the glasses in order to avoid the unsuccessful methods. Basically, I think that more and more practice for me, personally, will help me to develop the correct strategy(ies) and ‘mental model’ to solve this type of problem. I think the only declarative knowledge needed was the information/instructions for the problem, the visual of the three different glasses (three-, five-, and eight-ounce), and basic addition/subtraction math knowledge. It is the procedural knowledge that evades me right now; I have a suspicion there is one simple step that I am missing in order to place exactly four ounces of water into one of the glasses. The ‘know how’ of this problem would probably be easier to determine if I had more experience with this type of problem

Kirkley, J. (2003). Principles for teaching problem solving. Plato Learning White Paper – Free to publicly distribute – noted on article.