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Dr. Josh Brown's - The "E" in STEM: Meaningful Content for Engineering

Online Problem Solving

Wolf, Sheep & Cabbage - (Moderately structured problem)

<http://www.plastelina.net/game1.html>

"Wolf, Sheep, and Cabbage" was an interactive problem that focused on moving three objects – a wolf, a sheep, and a box of cabbage – from one side of the lake to the other side. The only problem was the wolf and sheep couldn't be left together, and the sheep and cabbage couldn't be left together. This problem was the easiest to solve of the four that I attempted. I feel it was easiest for me because it involved only a few variables that had to be manipulated in a strategic order. I was able to brainstorm the order in my head and decide next steps based upon my success in working step-by-step through the problem. There was more than one acceptable solution. Again, it depended upon mental modeling to solve the problem in order for the user to invent a strategy that suited the context of the problem. I was able to manipulate the problem and solve it successfully on the third attempt. It took me two tries to figure out that I could load and unload items on and off of the boat. As soon as I learned I could do so, the process was simple. Therefore, in order to be successful, the user had to understand the declarative knowledge of what item pictorially represented the wolf, sheep, and cabbage. The user also had to know that leaving the wolf and sheep or sheep and cabbage together would result in a negative result. Additionally, the user had to know how to manipulate the buttons on the screen to load/unload items and get the boat to travel across the lake. With these facts and the procedural understanding in place, moving the wolf, sheep, and cabbage successfully across the lake was rather easy. There was more than one acceptable solution.

Tower of Hanoi - (Moderately structured problem)

<http://www.cut-the-knot.org/recurrence/hanoi.shtml>

"Tower of Hanoi" is a moderately structured problem that tests the users' ability to move disks from one peg to another. With specific parameters in place, such as the final product being stacked with the largest disk on the bottom and smallest on top, as well as a specific stacking rule (large disks cannot be stacked on top of small disks during the moving process), this problem posed little difficulty for me. This problem was the second easiest to solve of the four that I attempted. I feel it was one of the easier problems to attempt most likely due to the manipulation of the pieces and the confines of only being able to stack a small piece on top of a larger piece. With these requirements, it limited the possibilities

for movement and thereby focused me even more on my strategy. The first time I attempted to solve this problem it took me thirty-one moves. I was then able to solve the problem in twenty-three moves and fifteen moves on my second and third attempts, respectively. After my third attempt, I tried to solve the problem several times thereafter and still only achieved fifteen moves. I believe the problem was based upon declarative knowledge such as the user ing what disks were smaller in size than others (or larger than others). The user also had to understand the concept of moving the disks from one peg to another as well as the concept of stacking – placing items on top of other items. With regard to procedural knowledge, the user had to create a strategy to move the disks from one peg to another and in doing so create a plan as to where to place the disks and strategize the stacking in order not to violate the rules. There was more than one acceptable solution.

The Three Jugs Problem - (Moderately structured problem)

<http://www.cut-the-knot.org/ctk/Water.shtml>

Based on a school math word problem I've seen before, "The Three Jugs" problem was the second most difficult of the four that I attempted. Understanding immediately there had to be a mathematical expression to solve the problem, I went straight to work trying to make some meaning of the problem. Needless to say, it took me quite some time to actually solve the problem. Once I solved the problem, I attempted to do it again to prove to myself I had mastered it, but no such luck. With respect to declarative knowledge, the user had to know what the goal was as well as know that you couldn't just pour half of a jug ("eyeball" it) to yield a particular amount. The user had to know that each jug contained a different amount – eight quarts, five quarts, three quarts. There were no in-between sizes. The user also had to know why they were attempting the puzzle – to get four quarts into two jugs. Sounds simple right? I identified this problem as a moderately structured problem. It was evident to me that the problem possessed a clear goal that required a strategy to fit the particular context. The problem also required mental modeling or other means of problem representation such as drawing or sketching to build reason. Although, I do question if "The Three Jugs" would be a well structured problem since it is based upon a mathematic equation needing to be carried out step-by-step to arrive at the solution. To my knowledge, there is only one possible solution.

Cheater Hangman - (Well structured problem)

<http://www.theproblemsite.com/games/hangmanvariation.asp>

The hardest of all the problems I attempted, "Cheater Hangman" is not your typical game of Hangman. Each time I attempted to solve the word I got hangman. I couldn't figure out what I was doing wrong! I attempted to play the game several times, but each time ended in failure. I even chose common letters such as R, S, T, L and no matter what vowel, still was not successful. In order to even have had an attempt at being successful, the user had to possess a certain level of declarative knowledge. The user had to know what to do to play (choose one letter at a time and attempt to solve the word using the

limited information provided). The user also had to know that each time you guess a wrong letter you get closer to ending the game unsuccessfully. In fact, there are only nine attempts to solve the word problem before the game ends. Also, the user had to know the reason behind playing the game - to solve/identify the vocabulary word before the drawing of a man hung can be fully created, with one line drawn after each incorrect answer. I classified this problem as a well structured problem. One must depend on their declarative knowledge in which after attempting a few times the learner simply memorizes the process and continues until success is reached. The only problem is, this game cheated! After several unsuccessful attempts at solving various problems, I read the description provided on the website and figured out why I wasn't as successful as I had planned. It wasn't the strategy I was employing, which is the basic strategy most would use in word recognition. It was the genius of the computer searching for every possible word that could be made, and modifying the hidden word every time I guessed something different.

