A Model for Teaching IC4 Interactive by Inductive Reasoning
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Goal: C programming is abstract and difficult for middle school and even high school students to grasp. In this paper, a method for learning is proposed that capitalizes on immediate concrete experiences to develop intuition about the language before the formal language rules are presented.

Inductive Learning Procedure:

1. Present students with pre-built robots. We envision 10 students working in pairs working with 5 pre-assembled robots. These robots are fully assembled out of LEGO blocks and have all the programming necessary loaded onto an RCX module that is built into the assembly.

2. Demonstrate to the students that the robots are capable of performing a simple task on their own. A good program would be to pre-program the robots to roll forward for 3 seconds, stop, back up for a 1/2 second, turn 45 degrees to the right, roll forward for 1 second, and then repeat the 1/2 sec. backup, 45 degree turn, and 1 second forward roll for 1 minute and then stop.

3. The students are then asked to completely disassemble the robot into its individual parts and reassemble it back to its original operating condition. They are instructed to keep notes as they disassemble their robot so that they can use the notes to guide the reconstruction. They are also expected to organize, count, and identify all parts once the disassembly is completed.

4. It is expected that pairs will take varying amounts of time to complete task #3. Once a pair completes the re-assembly, they demonstrate that the robot has been restored to working order and then they are presented with a hard copy of the program source code.

5. The students either have their own laptop with a copy of the code or a copy of the source code sitting on the desktop of the laptop of the instructor. The students are then asked to remove specific features from the program. These features may be:

a. punctuation marks
b. calls
c. variables
d. integers

A master program is saved for each pair that retains the original program. Each change is assigned a different name and after being downloaded onto the RCX, students observe the effects of their changes on the behavior of the robot. Students keep track or their

observations in a notebook.

6. Students then attempt to identify the parts of the source code that influence the various actions of the computer. They confirm their predictions by adjusting the appropriate variables that control:
a. run time
b. initial forward roll time
c. turning angle
d. back-up time
e. short cycle forward roll time

7. Next, students are asked to program the robot to do the exact same sequence but to turn 45 degrees to the left during each cycle.

8. Finally, the students are asked to build a robot from scratch that performs a new series of tasks using what they have learned from tasks #1-#7.

9. At the end of this sequence, the students are presented with the basic rules of C programming and introduced to new concepts such as sensors, switches, etc.
We have found that it is difficult to teach C programming to students without having immediate concrete application experiences to hold and sustain interest. Using this inductive approach places the robot in the student's hands and gives the student a chance to experience immediate feedback regarding the consequences of their programming changes and adjustments. Also, the students start with a fully functioning robot and they know that a correctly operating robot is real rather than some dreamed of possibility in the future.

Requirements:
We are planning to introduce students to this method in a one week robotic summer camp experience at our school. Five high school students who have participated in our previous Botball and FIRST competitions will be asked to build 5 identical robots and program them with 5 identical programs as described above. These high school students will serve as the mentors for the summer camp. They each will be assigned a pair of students to monitor and supervise.

The tuition charged for the camp will help the high school students defray travel costs to next year's Botball and FIRST competitions. To use this plan requires five sets of LEGO Mindstorm building kits and at least one laptop.