



Integrating Computational Thinking and Science Learning in Minecraft

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Motivation & Approach



Crop Alternation

Though it may not look like much, dirt is filled with a mix of nutrients and micronutrients to make sure plants grow healthy.

To help plants make sure they get the nutrients they need from the soil, farmers rotate crops on a plot of land. One year they might grow corn which absorbs a lot of nitrogen, the next they might grow beans which leaves nitrogen in the soil.



Plants with Potassium, Nitrogen, and Phosphorus deficiencies

Coding Objectives - Beautification

Clean up pollution

Replace gravel and dirt with grass

Simple paths, lighting, fences

Randomly place flowers or bushes



Playground if you can complete!



```
--compare
--if match destroy and replace
-- or move
for i=1,45 do
  turtle.select(1)
  if turtle.compare() == true then
    turtle.dig()
    turtle.select(2)
    turtle.place()
    turtle.select(1)
  end
  turtle.turnRight()
Press Ctrl for menu Ln 1
```



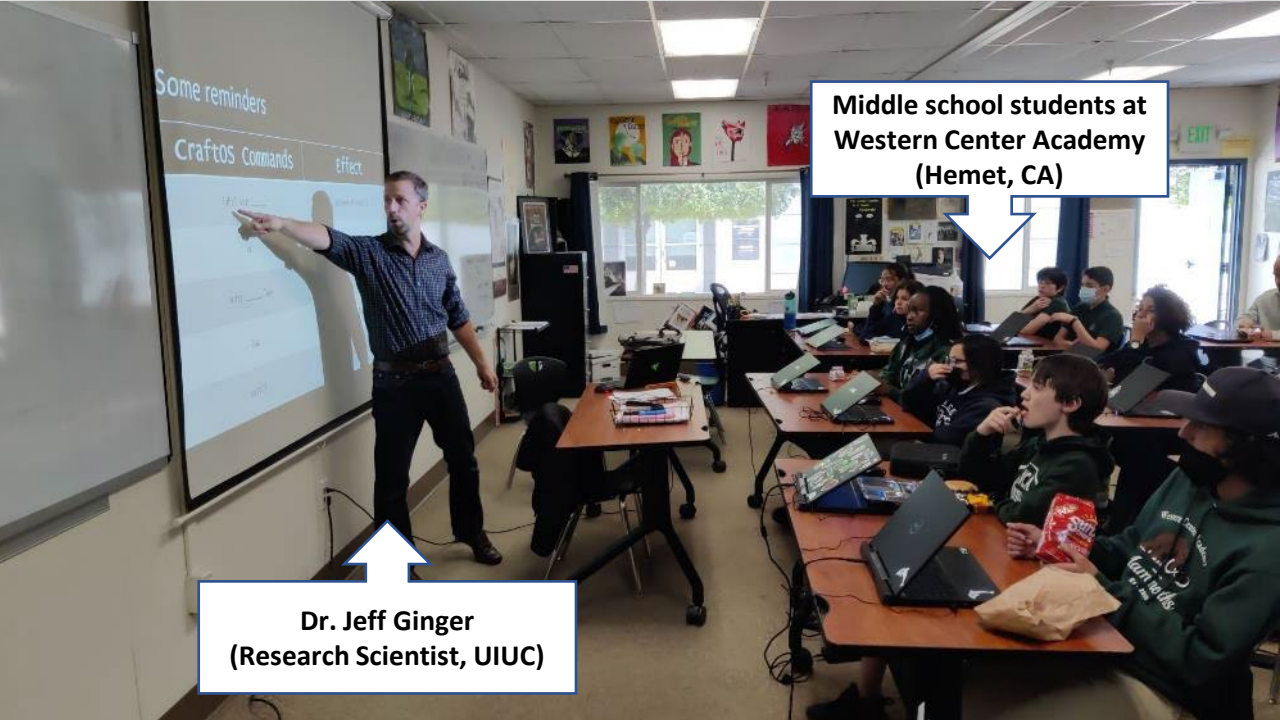
Future societal challenges will require strong STEM knowledge and an ability to think creatively and computationally

Our approach integrates coding within middle school informal science learning using Minecraft.

Problems are inspired by real-world challenges – hard to solve, engaging, and designed for computational approaches.

Coding instruction (Lua) occurs in science problem solving contexts, with gradually increasing difficulty and open-endedness





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Minecraft as a STEM “vehicle”



Pros:

- **Minecraft provides many inherent links to STEM.**
- **Extremely high familiarity for most middle schoolers**
- **High level of customization (for learners, educators,+ researchers)**
- **Online camps were just as successful!**

Cons:

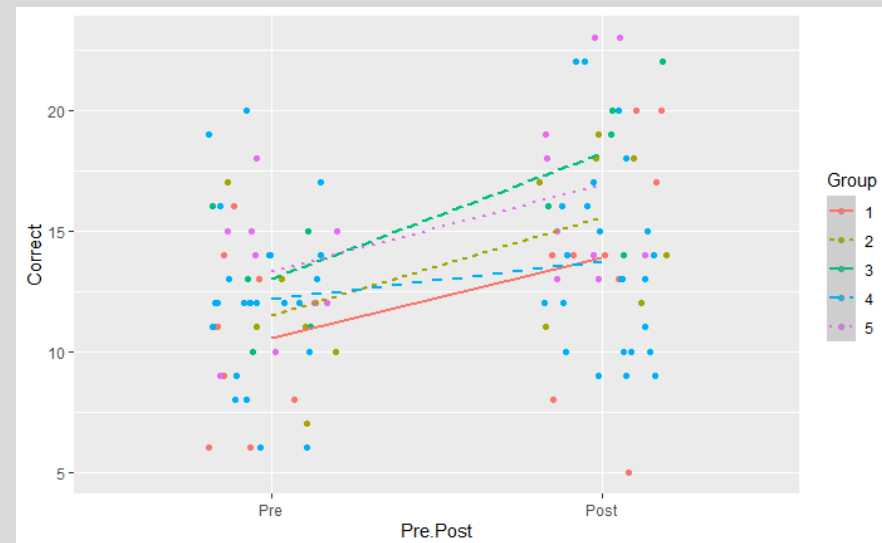
- **Minecraft capabilities \leftrightarrow learning goals**
- **Some incoming misconceptions about what our camps are about**
- **For experienced players, Minecraft “mode” > academic goals**
- **Educators need a high tolerance for “off-task” play & exploration**





Results

- **Consisting gains in coding skills/knowledge (CTT)**
- **Some negative transfer from block-based coding to-text based**
- **Agricultural problems is our most consistent favorite challenge**
- **Many examples of creativity in student solutions**
- **Most students adopted a trial-and-error approach to debugging**



```
1-- look for logs automatically and collect them
2-- be able to traverse hills
3-- be able to replant trees
4
5function detectLogs()
6  while turtle.detect("birch_log") do
7    result = true
8  end
9end
10
11function hills()
12  if not turtle.detect() then
13    turtle.down()
14  end
15end
16
17function replant()
18  turtle.place("birch_sapling")
19end
20
21-- be able to know when the tree ends
22function mine()
23  detectLogs()
24end
25
26
27
28
29
30
```

```
1-- look for logs automatically and collect them
2-- be able to traverse hills
3-- be able to replant trees
4os.loadAPI("HelpfulAPI")
5
6function hills()
7  if not turtle.detectDown() then
8    turtle.down()
9  end
10end
11
12function replant()
13  turtle.place("birch_sapling")
14end
15
16-- be able to know when the tree ends
17-- but how
18function mine()
19  i=1
20  for i<10 do
21    while isWood()
22      if result == true then
23        turtle.dig()
24        turtle.up()
25      else
26        print("false")
27      end
28    end
29  end
30end
31
```





THANK YOU!

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<https://publish.illinois.edu/stemc-minecraft/>

<http://hchadlane.net>

