Cosmic Kitchen: Teacher's Guide

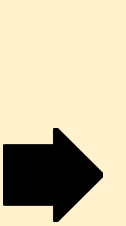
Introduction

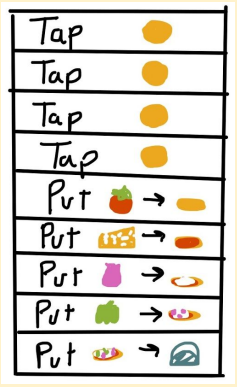
In any programming language, it is important to use functions. After research and surveying a multiplicity of educators, we learned that the concept of **function** is the most difficult introductory Computer Science concept to teach. Some of the reasons include students having trouble identifying when to use functions, functions require a higher level of thinking and planning, and it is challenging to clearly teach functions as there aren't many resources available for it as compared to other topics. Based on this research, we developed the game 'Cosmic Kitchen' which teaches players about why functions are important in programming.

Steps of Commands

In programming, every question requires students to perform a set of steps to reach the end goal. For example, to make a character move, a set of steps could be placed under each other to perform those steps in a sequence.

In the Cosmic Kitchen, the manual cooking consists of a set of steps that the player has to follow to successfully make a pizza. For example, if the player had to make a frozen cheese pizza, then he/she would first tap the dough four times, put tomato on dough, put cheese on dough, put green pepper on dough, put mushrooms on dough, then put that pizza in an oven. If those steps were converted to block programming, it would look like the image below. This example shows how the aspect of manual cooking in the game relates to programming.

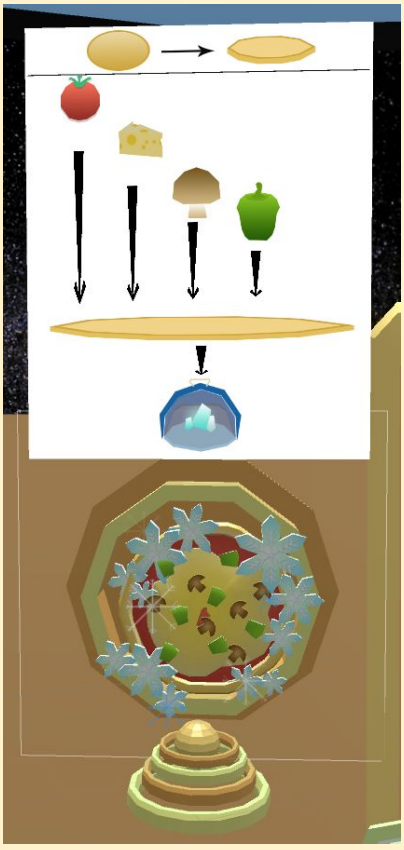


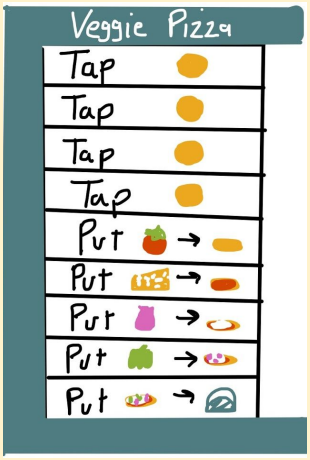


Making a Function

In programming, a set of commands could be placed inside a function. The function appears as a block in which students could place a combination of steps to save it and call when needed.

In Cosmic Kitchen, the player can manually cook a pizza and then place it in the Celestial Function Builder, which is a metaphor for a function block where students can save the combination of steps and call it when needed. If the Celestial Function Builder that contains the steps of making a frozen veggie pizza is placed in a block programming environment, it would look like the image below. On top of the Celestial Function Builder, the player could see the steps that were followed to make that pizza, just like a function block would show the steps.





Learning Goals

The Cosmic Kitchen focuses on the following three learning goals related to **why** functions are important in programming:

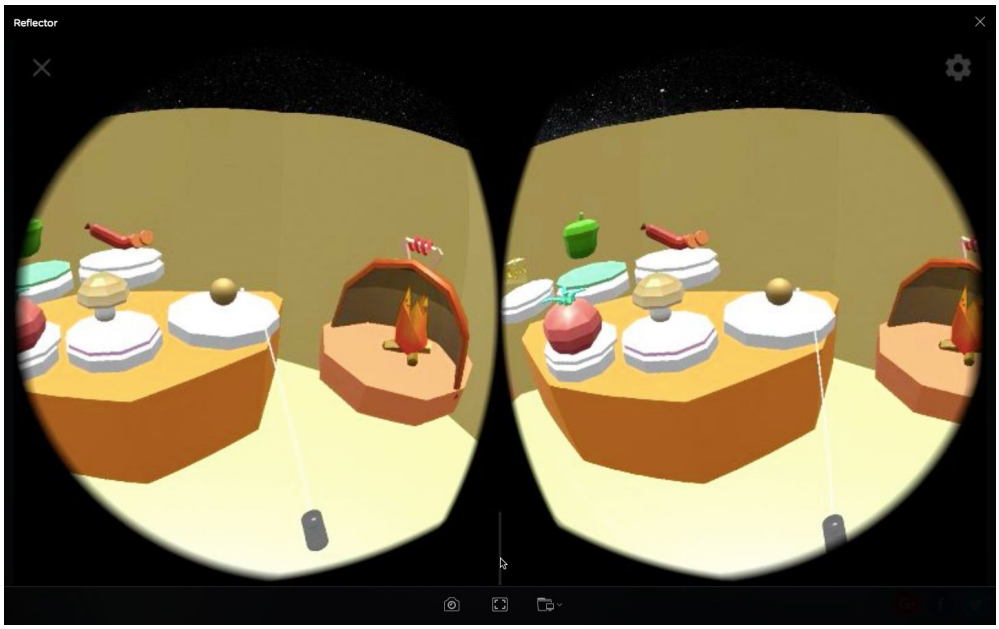
1. Writing same lines of code repeatedly is tedious
2. Functions make it easier to code
3. Functions are reusable

Level 1: Writing same lines of code repeatedly is tedious

In programming, repeatedly writing the same lines of code could get tedious. It is added work for the students as they would be writing the same lines of could even though there is an option of them putting those lines of code in a function and prevent repeating themselves. It would also make it difficult to see where the a specific line of code is if the student would like to make any edits to it.

Level 1 in Cosmic Kitchen makes this connection to programming by teaching the players that manually cooking the same type of pizzas repeatedly is tedious. The players have to manually cook the pizzas as orders come in and each order not only takes longer to finish but is also physically exhausting as players have move around to pick up ingredients and make the pizza.

Following is the video of manually making different kinds of pizzas repeatedly, just like manually writing lines same lines of code repeatedly.



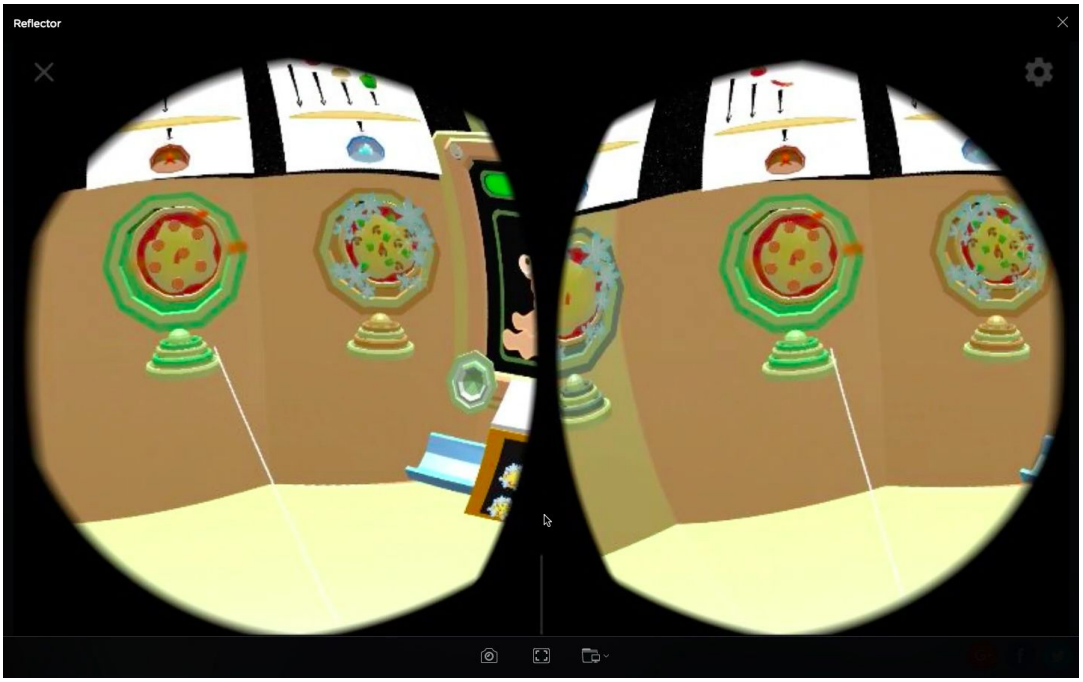
Level 1 Video

Level 2: Functions make it easier to code

In programming, functions make it easier to write code as the only action needed if the set of commands need to be called is calling the function those commands are in. The student could give any name to a function based on the sets of commands in it, which makes it easier to find it in hundreds of lines of code.

Level 2 in Cosmic kitchen makes this connection to programming by teaching that players could use the predefined functions containing the steps used to make pizzas instead of manually cooking it every time an order came in. It shows that it is a lot less tedious to use the function, which also make it easy to finish the orders. Players have predefined Celestial Function Builders given to them and their goal is to reuse the steps of pizzas from those blocks to finish the orders. As each pizza in the Celestial Function Builder looks different, it is easy for players see which pizza function to call when an order of that pizza comes in.

Following is the video of reusing the predefined steps of pizzas in Celestial Function Builders, just like predefined functions would be used.



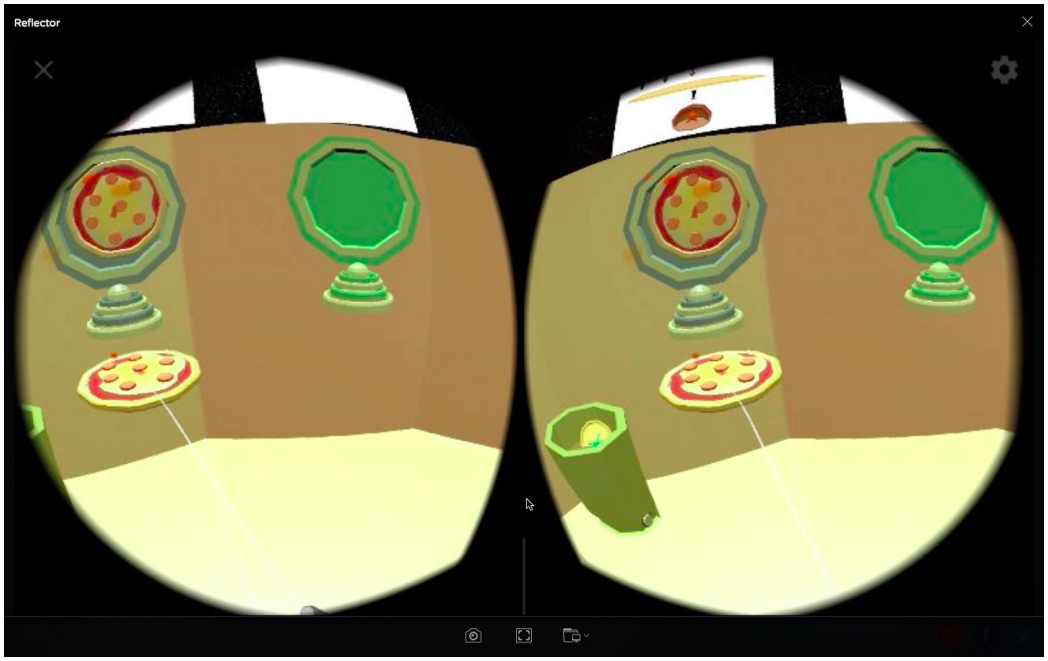
Level 2 Video

Level 3: Reusing functions

In programming, one of the most important uses of a function is that it could be reused multiple times. There could be a function made using a combination of steps and every time those combination of steps are needed, students can simply call that function. This way they don't have to repeat those steps at several locations in the code. This is also referring to the famous DRY principle in programming: Don't Repeat Yourself.

Level 3 in Cosmic Kitchen makes this connection to programming by teaching the players that if there is an order of five veggie pizzas, the player has to manually make the veggie pizza only once and then after placing it in the Celestial Function Builder, he/she could reuse those steps of making that pizza as many times as needed. It also teaches that if there is an order of just one cheese pizza and five veggie pizzas, then the player can deliver the veggie pizza by reusing the function and then deliver the cheese pizza by manually cooking it. This shows that not every line of code needs to be added to a function.

Following is the video of manually making pizzas, placing them in the Celestial Function Builders, and reusing those steps when needed. This is related to making and calling a function in programming.



Level 3 Video

In summary, the goals in the game are linked to the learning goals in programming. Following is the correlation between the two for every level:

Level	**Goal In Game**	**Goal In Code**
1	Manually cooking the same pizza repeatedly is tedious.	Writing the same line of code repeatedly is tedious.
2	Use the predefined steps of making pizzas in Celestial Function Builders.	Using predefined functions. Functions make it easy to code.
3	Reusing the steps of making pizzas from Celestial Function Builders.	Functions are reusable.

Sample Lesson Plan

Target Audience
7th-12th grade

Subject
Introduction to Computer Science

Overview of Lesson
1. Teach what functions are in programming
2. Play the 10 - 12 minute game that teaches the importance of functions
3. Worksheet and short class discussion about how the game relates to functions
4. Post assessment about functions in the form of group activities

Part 1: Teach Functions
1. Let's say you wanted to make a cheese pizza, how would you do it?
   Flatten dough
   Put tomato sauce on dough
   Put cheese on dough
   Put pizza in oven
   Take pizza out
2. Now if there are 3 orders of cheese pizzas, how would you do it?
   Flatten dough
   Put tomato sauce on dough
   Put cheese on dough
   Put pizza in oven
   Take pizza out

   Flatten dough
   Put tomato sauce on dough
   Put cheese on dough
   Put pizza in oven
   Take pizza out

   Flatten dough
   Put tomato sauce on dough
   Put cheese on dough
   Put pizza in oven
   Take pizza out
3. Who knows what a function is?
   Functions are a set of commands that could be grouped together and reused as many times as needed.

4. How would I make a function of a cheese pizza?

Pizza Function
Flatten dough *Put tomato sauce on dough* *Put cheese on dough* *Put pizza in oven* *Take pizza out*

5. If you had to make 1 cheese pizza using this function, how would you do so?
   Pizza Function

6. If you had to make 3 cheese pizzas using this function, how would you do so?
   Pizza Function
   Pizza Function
   Pizza Function

Part 2: Play Cosmic Kitchen Game

The students will now play the game. The game is teaching the importance of functions through cooking pizzas in space. Through this game, we are hoping that the students would understand the importance of why functions are easy to use, reusable, and could be used as sub-steps in programming.

If it is a class of about 20 students and there isn't enough time to have everyone play the game, the teacher could download the AirMore App and screenshare the game being played by one student on a screen, so that the entire class could watch and learn. This game has 4 levels and each level teaches a specific importance of functions, which the class discussion could be based on:

1. Level 1: Writing same lines of code repeatedly is tedious
2. Level 2: Functions make it easier to code
3. Level 3: Functions are reusable

Part 3: Worksheet Template

Name: _____

1. What do you think this game was teaching?

2. What are the two ways of making a pizza in the game?
    1.

    2.

    Which way of making a pizza is more tedious? 1 or 2

    Which way would you rather make a pizza? 1 or 2

3. What programming concept does this game involve? *(The following options could be changed based on what the students have learned already)*

    a. Loops b. Functions c. Conditionals d. Variables

4. What about that concept is being taught?

5. How does it teach that concept?

Part 3: Worksheet Answers

1. What do you think this game was teaching? Any answer that the student has could work for this question as later on in the worksheet, we are building the answers to those related to functions.

2. What are the two ways of making a pizza in the game?
    1. Click on the dough multiple times to flatten it. Then put the different ingredients on the dough. Then put that pizza in one of the ovens. Then deliver it.

    2. Click on the dough multiple times to flatten it. Then put the different ingredients on the dough. Then put that pizza in one of the ovens. Then put that pizza in the Celestial Function Builder. Click on that pizza to reuse the steps followed to make that pizza. Then deliver it.

    Which way of making a pizza is more tedious? **1** or 2

    Which way would you rather make a pizza? 1 or **2**

3. What programming concept does this game involve? *(The following options could be changed based on what the students have learned already)*

    a. Loops **b. Functions** c. Conditionals d. Variables

4. What about that concept is being taught?
    - Functions make it easier to code
    - Functions are reusable
    - Functions could be used as sub-steps

5. How does it teach that concept?
    After placing the pizza in the Celestial Function Builder, the steps to make that particular pizza could be called whenever needed. This shows that functions are reusable and they are also easy to use as we don't have to manually make that pizza every time an order for that pizza comes in. In level 4, there is a pre-made cheese pizza function. We could use that function to create a cheese pizza and then add ingredients to it. This way, we don't have to manually create a cheese pizza every time, as every pizza contains the steps used to make a cheese pizza.

Part 4: Class Discussion of worksheet and game

Class discussion going over prior worksheet in order to help the students understand what the prior experience was teaching and why it relates to class work material.

Part 5: Post Assessment Group Activities

Ways to implement this assessment: *Class discussion by bringing up students to the board / Group activity by teaming students together competitively / Individual assignment or homework*

Assessment Questions:

1. Write the steps of making a cheese pizza
2. Write the steps of making 1 pepperoni pizza
3. Write the steps of making 3 pepperoni pizzas
4. Write a function containing the steps of a pepperoni pizza and call it 3 times
5. Write the steps of making 1 veggie pizza
6. Write the steps of making 4 veggie pizzas
7. Write a function containing the steps of a veggie pizza and call it 4 times
8. Write the steps of making 1 everything pizza
9. Write the steps of calling 4 everything pizza functions
10. Using the functions you have created above, write the steps of making 3 pepperoni pizzas, 5 veggie pizzas, and 2 everything pizzas
11. From all these steps, which ones are the common steps for all 3 kinds of pizzas?
12. Let's say that we have a cheese pizza function, what do you think that function would have in it?
13. If you had to make 1 pepperoni pizzas, using this cheese pizza function that we just created, how would you do so?
14. How could you make a pepperoni pizza function using a cheese pizza function?
15. Using that function, make 5 pepperoni pizzas
16. After this assessment, you could continue the lesson with introducing parameters and having them make different kinds of pizza functions using parameters.