Learning Objectives for “computational thinking”

1) Decomposition: The ability to break down a task into minute details so that we can clearly explain a process to another person or to a computer, or even to just write notes for ourselves. Decomposing a problem frequently leads to pattern recognition and generalization, and thus the ability to design an algorithm.

2) Pattern Recognition: The ability to notice similarities or common differences that will help us make predictions or lead us to shortcuts. Pattern recognition is frequently the basis for solving problems and designing algorithms.

3) Pattern Generalization and Abstraction: The ability to filter out information that is not necessary to solve a certain type of problem and generalize the information that is necessary. Pattern generalization and abstraction allows us to represent an idea or a process in general terms (e.g., variables) so that we can use it to solve other problems that are similar in nature.

4) Algorithm Design: The ability to develop a step-by-step strategy for solving a problem. Algorithm design is often based on the decomposition of a problem and the identification of patterns that help to solve the problem. In computer science as well as in mathematics, algorithms are often written abstractly, utilizing variables in place of specific numbers.

5) Data analysis and visualization

II. Analogical Reasoning:

Transferring information or meaning from a particular subject to another particular subject.

In our experiences, can something learned in one context be transferred to a different one? Creating an analogy (transferring knowledge) is one of the most robust ways to tell

if something has truly been learned.

III. Hypothesis Testing (Causal Inference):

Can a child create an if/then statement and test their hypothesis? If [independent variable] -> then [dependent variable]. To test a hypothesis, one does so through the scientific method:

1) formulate a question
2) hypothesis
3) prediction
4) testing
5) analysis

Will the child be able to test hypotheses through trial and error? How will they isolate a variable as a causal agent?

IV. Spaced Repetition:

One of the most robust findings in memory literature. Used as a learning technique that incorporates increasing intervals of time between subsequent review of previously learned material in order to exploit the psychological “spacing effect.” Something to think about as we develop more learning apps/games in terms of when to present information and how to sequence events.

V. The generation effect:

Information is better remembered if it is generated from one’s own mind rather than simply read. In our experiences, this will translate to kids generating their own content (e.g., an originally choreographed dance vs. imitating a pre-determined routine)

VI. Multiple exemplars (comparison and contrast):

In category and word learning, it has been found across many domains that multiple exemplars facilitate category formation. For example, if you are learning the category “dog,” showing just a golden retriever is quite limiting. The more diverse stimuli you show a child (golden retriever, chihuahua, shih tzu, pomeranian), the more readily they will be able to generalize that category. In our experiences, we will need to show multiple exemplars of concepts (loops, if/then statements, etc.) to scaffold their learning.