Table 1. *Crosswalk of computational thinking practices and data practices*

Data Practice	Computational Thinking Practices				
	Decomposition	Pattern Recognition	Abstraction	Algorithm	Automation
	What are the parts?	**Do any of the parts repeat or correlate?**	**What can we generalize?**	**What rules describe the process?**	**How can we automate the process?**
Creating Data	Identifying all components and processes necessary to collect the appropriate data to answer a research question is a critical first step in engineering any investigation.			Designing the investigation requires organizing the components and processes identified during decomposition into a logical order so that data will be repeatable.	Examining the investigation design algorithm to determine where automation may make the process more efficient.
Collecting Data		During data collection, pattern seeking is critical in determining if the design is generating appropriate data to answer the research question.	While collecting data, abstraction provides the process to identify confounding variables not previously identified as well as reduce any extraneous observations	As the process of data collection progresses, evaluating the algorithms being used is important to verify that the process is producing appropriate and unbiased data. New algorithms may be formulated to address any shortcomings of the previous design.	Automation during data collection must be monitored (at least initially) to verify that the automation tool is working within appropriate range of measured parameters or taking measurements in the appropriate time increments
Manipulating Data	An important part of generating descriptive statistics like mean, median, quartiles, etc. requires determining what data and descriptive statistics are necessary for answer the research question with the	As the data are being organized, pattern recognition is helpful in determining if there are concerns from the data collection that might have influenced the resulting data	Abstraction can be used to help identify the extraneous material (noise) or attribute a reason for bad data	Organizing data is algorithm dependent. The order of the data, the arrangement in the tables, etc. are critical before descriptive statistics or visual representations can be created. These algorithms may be discipline specific as	The widespread availability of computer programs allows for the automation of the data manipulation. However, it is important to recognize the potential pitfalls

	data collected.	beyond the parameters being tested		well.	that the user might inadvertently cause (e.g., incorrect formulas, data incorrectly formatted, etc.)
Visualizing Data	Organizing your data for visualizing requires determining which components should and should not be displayed to answer the research question.	The primary role of visualizing data is to try to make patterns more explicit.	Abstraction is important for identifying the real and perceived trends in the phenomena		The widespread availability of computer programs allows for the automation of the data visualization. However, it is important to recognize the potential pitfalls that the user might inadvertently cause (e.g., data incorrectly formatted, missing data, etc.)
Analyzing Data	Analyzing requires the ability to identify potentially small- and large-scale patterns that might have arisen. Additionally, the recognition of the various components in the investigation that might influence the results are important.	The purpose of analyzing is finding and explaining the patterns	Explaining patterns requires using the data to make some generalizations beyond just the investigation	The ultimate goal of analyzing is identifying an algorithm that can be applied to explain the phenomena	Computer programs that allow for conducing inferential statistics (chi square, t-tests, etc.) can automate the process of analyzing the data.