# Learning Functions Through Vending Machines

## Analyzing the Vending Machine Task

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## PURPOSE

The purpose of this study is to analyze how students' understanding of functions is impacted through the Vending Machine Task.

## INTRODUCTION

Function concepts are a key feature of the North Carolina Mathematics Standards. Given this prevalence, it is crucial that students develop a deep conceptual understanding early in their mathematics career. The Vending Machine Task is a virtual GeoGebra Task that challenges students to analyze machines to determine if they are a function or not. This task assists students with developing an understanding of relationships between quantities, comprehend input and output, and define what a function is. Determining the impact of this task could provide a bridge to deeper mathematics learning.

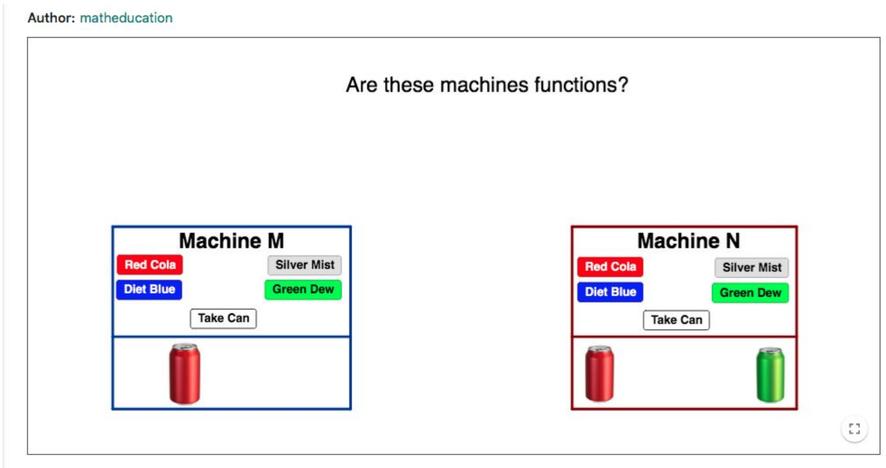
## METHODS

Secondary math students were placed into pairs to interact with the Vending Machine Task. Videos of five student pairs were evaluated to determine the strategies and mathematical language they used to complete the task. The researcher developed a priori and emerging codes to analyze each student pair. After the researcher coded each video, the faculty mentor coded as well to achieve inter-rater reliability.

## RESULTS

When first beginning to interact with the task, it was evident that students had never interacted with this representation before. Each of the five groups had varying strategies when beginning to interact with the task. Through trial and error, each group of students learned the importance of selecting each color multiple times, taking the can each time, and observing patterns through each machine. The researcher also studied how each pair arrived at their function or non-function decision. Roughly two pairs consistently analyzed input and output to make their decision, while the remaining three pairs compared machines one to another.

While working through the task, each machine invoked different language from each pair of students. Students quickly arrived at the conclusion that consistency in the product was important. The researcher also observed the frequency that students compared machines to function topics they were familiar with, such as x-value, y-value, input, and output. Each group used this language on multiple machines to build their understanding of this new representation. The researcher also noted the frequency that students invoked their knowledge of various function representations, such as a table, graph, or equation. Two groups consistently referred to graphs and equations to explain their rationale for each machines. The remaining groups referred to these representations when interacting with difficult machines or when not agreeing with their partners' rationale.




This is an example of what students interact with. Each button produces a different can selection. In the image, in Machine M, red and blue both produce a red can and silver and green produce a silver can. In Machine N, red, blue, and silver each produce the corresponding color, but green produces a red and green can.

## DISCUSSION

Students frequently use the "Vertical Line Test" to learn functions in elementary and middle grades. This procedural method of learning cripples students with applying functions in higher level mathematics. By selecting the input and output from each machine, students were able to participate in the mathematics and understand how function are developed. By using the mathematical language they were familiar with, students were able to apply what they knew (including input and output) and conceptually understand what each graphical or algebraic representation means.

## CONCLUSION

In conclusion, the Vending Machine Task transformed students' conceptions of functions and produced a new way of thinking about functions and their applications. If implemented appropriately, secondary students would likely benefit from this task. Completing this task would move students from a procedural understanding of functions to a conceptual understanding. This conceptual understanding will allow students to apply their thinking in unknown or abstract scenarios, which would assist in developing deeper mathematical reasoning.

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