Pre-calculus Students’ Difficulty with Modeling Rates of Change

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Abstract: In 2004, the MAA’s Committee on the Undergraduate Program in Mathematics (CUPM) published a report to provide recommendations to undergraduate mathematics programs, stating that all mathematics courses should help students develop “analytical, critical reasoning, problem-solving, and communication skills”. This study investigated pre-calculus students’ ability to reason given a mathematical modeling task. Five students were asked to graphically represent the height of water in a bottle as a function of the amount of water in the bottle. All five students recognized the increasing relationship between height and amount of water, and the shape of the bottle would result in a non-constant rate of change in height. However, students struggled to correctly model the non-constant rate of change graphically; only one produced a correct graph. Two of the students drew concave up or exponential graphs, and the other two drew piece-wise linear graphs. The results show that students had difficulty understanding exactly how the shape of the bottle would affect the rate of change. This could suggest a lack of conceptual understanding, which could hinder the students’ success in a Calculus I course.

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