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Quantifying exponential growth: three conceptual shifts in coordinating multiplicative and additive growth.

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Summary: This article presents the results of a teaching experiment with middle school students who explored exponential growth by reasoning with the quantities height (y) and time (x) as they explored the growth of a plant. Three major conceptual shifts occurred during the course of the teaching experiment: (1) from repeated multiplication to initial coordination of multiplicative growth in y with additive growth in x ; (2) from coordinating growth in y with growth in x to coordinated constant ratios (determining the ratio of $f(x_2)$ to $f(x_1)$ for corresponding intervals of time for $(x_2 - x_1) \geq 1$), and (3) from coordinated constant ratios to within-units coordination for corresponding intervals of time for $(x_2 - x_1) < 1$. Each of the three shifts is explored along with a discussion of the ways in which students' mathematical activity supported movement from one stage of understanding to the next. These findings suggest that emphasizing a coordination of multiplicative and additive growth for exponentiation may support students' abilities to flexibly move between the covariation and correspondence views of function.

Classification: I23 M63

Keywords: algebra; exponential growth; functions; reasoning

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