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Realistic Assessment of Students' Mathematical Preparation in Introductory Physics Courses

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abstract

We summarize key findings of our six-year investigation into students' mathematical difficulties in introductory physics courses. After administering written and online diagnostic tests to over 7000 students at five campuses of four universities, and carrying out about 90 individual interviews, we find several consistent themes: (1) difficulties with basic pre-college operations involving trigonometry, algebra, and graphing are widespread; (2) replacing numbers with algebraic symbols significantly decreases students' problem-solving success rate; (3) most students lack familiarity with physical units or appreciation for their essential role in physics problems; (4) most students attempt to "arithmetize" algebraic operations by premature substitution of numerical values, decreasing their ability to check physical units or individual steps; (5) difficulties with different types of operations are highly correlated, in that difficulties with trigonometry imply difficulties with algebra, etc.; (6) evidence suggests that students' success on the mathematics diagnostic is closely linked to overall course success.

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