Public Abstract
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Title:Two Paths to Advanced Placement Calculus: An Examination of Secondary Students' Mathematical Understanding Emerging from Integrated and Single-Subject Curricula

This study examined high school students mathematical understanding of calculus readiness concepts after studying four years of college preparatory (integrated or single-subject) mathematics. Data were collected from 505 students, 201 experienced an integrated curriculum (IC) and 304 experienced a single-subject curriculum (SSC). Additional data were collected on a subset of 199 of these students who enrolled in AP Calculus, 59 studied from the integrated curriculum (APIC) and 140 studied from the single-subject curriculum (APSSC). All 505 students took the Precalculus Concept Assessment (PCA) a 25 item multiple choice assessment focused on functions. In addition, the AP Calculus students completed two open-ended tasks related to functions.

After adjusting for prior achievement with the Iowa Algebra Aptitude Test (IAAT), SSC students performed statistically higher ($F = 9.39$, $p = .002$) than IC students on the PCA; whereas, APSSC and APIC students performed comparably ($F = 3.54$, $p = .063$). The item analysis of the PCA suggests that students are completing four years of college preparatory mathematics (integrated and single-subject) with a procedural understanding of functions. For instance, most students could evaluate and solve functions correctly; however, they exhibited multiple misconceptions about rates of change and function inverse.

AP Calculus students tended to use similar solution strategies when solving the two open-ended tasks, including using a graph, an equation, a table, or using multiple methods. Although students used similar strategies, their ability to use these strategies effectively differed.

AP Calculus students from each curricula pathway demonstrated errors related to rates of change. Students tended to use words such as slope, rate of change, and steepness interchangeably. Student errors on the two open-ended tasks and the PCA revealed a lack of understanding of the interpretation or meaning of rate of change. Students successfully calculated the rate of change of linear functions; however, when the rate of change was not linear, students struggled to calculate it, represent it correctly on the graph, or correctly interpret the rate in a real world context.