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Addressing student difficulties with aspects of partial differentiation in upper-level thermodynamics[1] BRANDON BUCY, JOHN THOMPSON, DONALD MOUNTCASTLE, University of Maine — We have reported previously that students demonstrate an inability to correctly equate the mixed second-order partial derivatives of the state function of volume (*nonzero* quantities in general), arguing instead that these derivatives must identically equal zero. Based on the results of our research, we have developed, designed and implemented a guided-inquiry instructional sequence ("tutorial") for upper-level undergraduate thermodynamics students to address this and related student difficulties with partial derivatives encountered on diagnostic questions. The sequence uses a graphical interpretation of partial derivatives in the context of an ideal gas $P-V-T$ surface to bridge the abstract mathematical concepts with concrete physical properties. We present pre- and post-instruction data from a classical thermodynamics course in which the tutorial was administered, and compare those outcomes to results obtained after lecture-based instruction. Based on these results, it appears that the tutorial not only addressed the difficulty discussed above but also positively impacted student performance in related topics later in the course.

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