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A Research-Based Approach to Transforming Upper-Division Electricity & Magnetism¹

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We present research on transforming an upper-division undergraduate electricity and magnetism course using principles of active engagement and learning theory. We build on a systematic investigation of student learning difficulties, with the goal of developing useful curricular materials and suggestions for effective teaching practices. We observe students in classroom, help-session, and interview settings, and analyze their written work. To assess student learning, we have developed and validated a conceptual instrument, the CUE (Colorado Upper-division Electrostatics) diagnostic. We collaborate with faculty to establish learning goals, and have constructed a bank of clicker questions, tutorials, homeworks, and classroom activities. We find that students in the transformed courses exhibit improved performance over the traditional course, as assessed by common exam questions and the CUE, but there is still much work to be done. Our work underlines the need for further research on the nature of student learning and appropriate instructional interventions at the upper division.

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