

# Complete versus Partial Visuo-Spatial External Representations of Abstract Physics Concepts

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**Abstract:** Students were presented with a module on circuits in text and diagram format only (control-text condition), text and diagram with an animation of the voltage and currents in parts of series and parallel circuits (partial external visual representation condition), or they were given the an animation of the voltage and current throughout the entire circuit (full external visual representation condition). Students in the full external visual representation conditions performed significantly better than the control-text and partial external visual representation conditions on questions of free recall but significantly higher on multiple choice and drawing questions than the control-text group only. This evidence suggests providing complete visual external representations is most beneficial to students for reconstructing and manipulating a mental model of the abstract system without being given any hints or clues from external sources like question stems but also more beneficial than traditional textbook methods for answering standard multiple choice questions.