

RELATIONSHIPS BETWEEN UNDERGRADUATES' ARGUMENTATION  
SKILLS, CONCEPTUAL QUALITY OF PROBLEM SOLUTIONS, AND PROBLEM  
SOLVING STRATEGIES IN INTRODUCTORY PHYSICS

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ABSTRACT

This study explored the effects of alternative forms of argumentation on undergraduates' physics solutions in introductory calculus-based physics. A two-phase concurrent mixed methods design was employed to investigate relationships between undergraduates' written argumentation abilities, conceptual quality of problem solutions, as well as approaches and strategies for solving argumentative physics problems across multiple physics topics.

Participants were assigned via stratified sampling to one of three conditions (control, guided construct, or guided evaluate) based on gender and pre-test scores on a conceptual instrument. The guided construct and guided evaluate groups received tasks and prompts drawn from literature to facilitate argument construction or evaluation. Using a multiple case study design, with each condition serving as a case, interviews were conducted consisting of a think-aloud problem solving session paired with a semi-structured interview. The analysis of problem solving strategies was guided by the theoretical framework on epistemic games adapted by Tuminaro and Redish (2007).

This study provides empirical evidence that integration of written argumentation into physics problems can potentially improve the conceptual quality of solutions, expand their repertoire of problem solving strategies and show promise for addressing the gender gap in physics. The study suggests further avenues for research in this area and implications for designing and implementing argumentation tasks in introductory college physics.