Enhancing conceptual understanding of Newtonian mechanics through a two-cycle action research study on peer instruction

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Abstract

We present findings from a two-cycle action research study investigating the impact of Peer Instruction (PI) on Matriculation students' conceptual understanding of force and motion. The study was motivated by persistent student misconceptions, overreliance on algorithmic problem-solving, and low engagement. Using the Half Force Concept Inventory (HFCI) as a diagnostic and assessment tool, we established a baseline average score of 26.8% (N=8). Cycle 1, which consisted of three PI sessions, resulted in a moderate normalized gain (g = 0.49), raising the post-test average to 56.3%. Reflection on Cycle 1 led to intervention refinements, including the use of more contextualized concept questions and structured discussion prompts. In Cycle 2, the post-test average increased significantly to 89.3%. Qualitative analysis of student reflections revealed enhanced self-efficacy, collaborative learning, and metacognitive awareness of misconceptions. The results indicate that iterative refinement of Peer Instruction, with a focus on contextualization and guided discourse, can effectively promote robust conceptual change and address well-documented difficulties in introductory mechanics.