



Canadian Association
of Physicists

Association canadienne
des physiciens et physiciennes

Contribution ID: 3657

Type: **Invited Speaker** / **Conférencier(ère) invité(e)**

(I) Argumentation with contrasting cases: Facilitation of deep structure learning in introductory physics

Monday 19 June 2023 14:00 (30 minutes)

There has been noted concern regarding the retention, academic success, and motivation of students in STEM courses, especially physics. Many factors can impact students' persistence in STEM courses, however students who do persist often find themselves underprepared for problem-solving within authentic settings. Problem solving is a highly valued 21st Century workforce skill in Canada (Hutchison, 2022) that recent graduates seem to lack (Cavanagh, Kay, Klein, & Meisinger, 2006; Deloitte & The Manufacturing Institute, 2011; Binkley et al., 2012; Finegold & Notabartolo, 2010). To positively impact undergraduate physics education, conversations are needed on ways to transform curricula that support diverse populations of students. There are increasing calls for using evidence-based teaching strategies to improve STEM instruction (Cooper et al., 2015). Prior studies have revealed that both contrasting cases and argumentation tasks can support deeper learning and problem-solving skills. Yet, students are seldom encouraged to justify or to explain their solutions. They rarely reflect on the appropriateness of their responses and consider alternative solutions. Studies suggest that appropriate scaffolds are needed for these instructional strategies to be successful. In this talk I describe how we have integrated contrasting cases and argumentation and alternative forms of writing prompts (similarities and differences, invent a unifying statement, and argumentation) used in introductory physics for non-science majors as well as in calculus-based physics. Results suggest that prompts for identifying similarities and differences within cases tended to promote identification of surface features irrelevant to solving the problems. However, argumentation prompts to evaluate competing theories tended to support deeper understanding of underlying physics principles and appropriate application of principles.

Keyword-1

Problem-Solving

Keyword-2

Scientific Argumentation

Keyword-3

Contrasting Cases

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Session Classification: (DPE/DGEP) M2-5 Teaching Introductory Physics | Enseigner l'introduction à la physique (DEP/DEGP)

Track Classification: Technical Sessions / Sessions techniques: Physics Education / Enseignement de la physique (DPE-DEP)