FACULTY OF SCIENCE
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Kinesthetic Exercises in Physics Instruction

Justification and Development for University Level Physics

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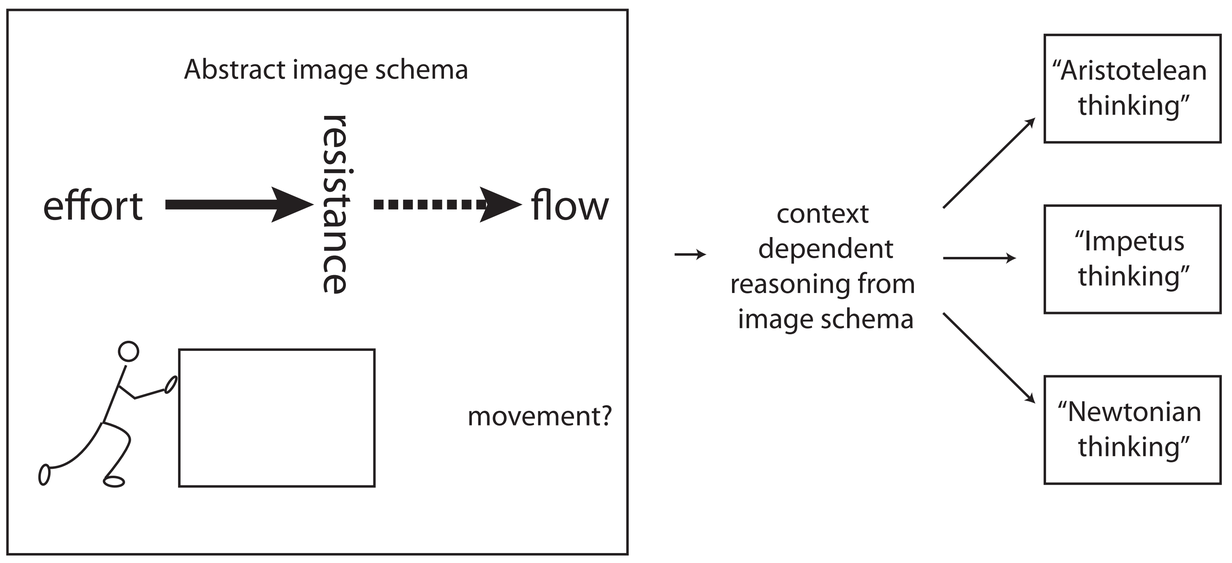
1. Why Kinesthetic Exercises?

Students "misconceptions" of mechanics may arise from faulty conceptualization of a basic embodied cognitive schema: The *effort-resistance-flow* schema [1].

This schema is a common human schema used by everyone all the time because we make bodily actions in the world [2] (See figure to the right).

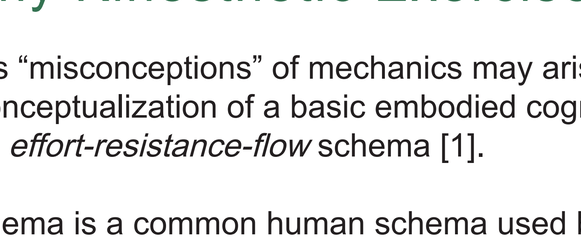
However, because the schema is so general it may lead to faulty inferences, such as "impetus" judgements where force is "transmitted and used" in an object [4].

Refining the *effort-resistance-flow* schema using kinesthetic models is a way to help students learning physics.

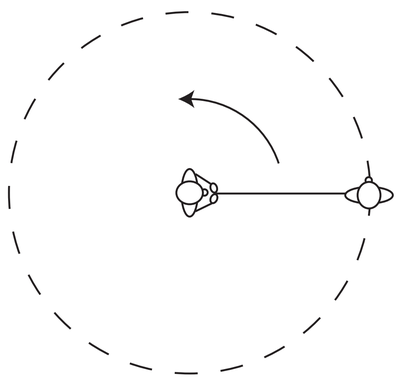


2. Kinesthetic Models Refining Effort-Resistance-Flow

(a) Model 1



(b) Model 2

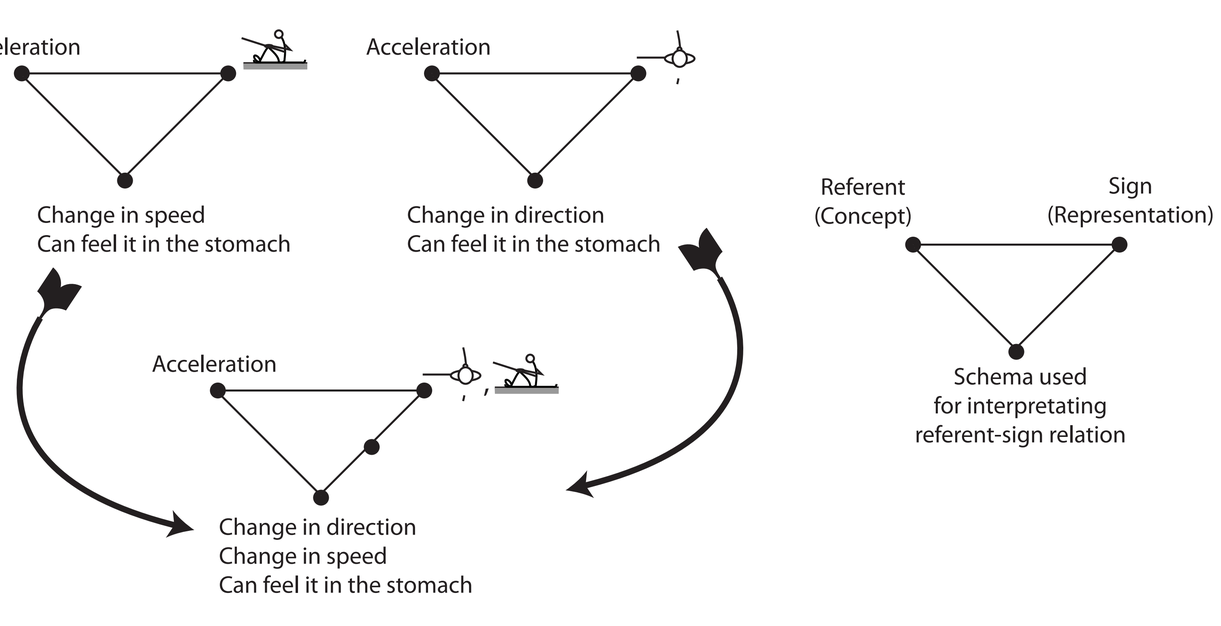


In *Model 1: Dragging an object over a surface with friction*, a student sits on a plate (plastic, wood or other) and a rope is attached to the student. Another student drags the first student.

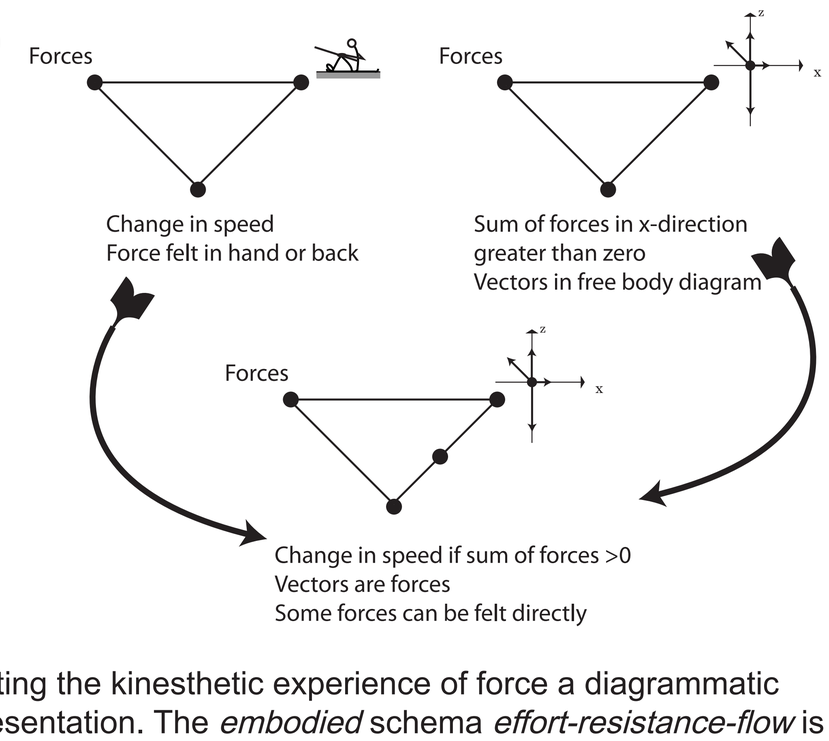
In *Model 2: Circular motion of an object*, a student is in the center while another student runs around in circles making sure the rope is taught. See [1] for more examples.

3. Integrating Kinesthetic Models in Instruction

a)



b)



Relating the concept of acceleration to kinesthetic experiences in the two models may facilitate a refinement of *effort-resistance-flow* to understand acceleration as a change in flow. The arrows signify that elements of two schemata are integrated in a more elaborate schema.

Relating the kinesthetic experience of force a diagrammatic representation. The *embodied* schema *effort-resistance-flow* is integrated in to the schema used to structure knowledge about free-body diagrams. The approach is similar to [3].

Selected Literature

[1] Bruun, J. & Christiansen F.V. (2011). Using kinesthetic models in physics instruction: Justification and model design. *Draft distributed at ESERA 2011 Conference*

[2] Johnson, M. (1987). *The Body in the Mind - The Bodily Basis of Meaning, Imagination, and Reason.* The University of Chicago Press.

[3] Podolefsky, N. & Finkelstein, N. (2007). Analogical scaffolding and the learningof abstract ideas in physics: An example from electromagnetic waves. *Physical Review Special Topics-Physics Education Research*, 3(1), 010109.

[4] Smith III, J. P., diSessa, A. A., & Rochelle, J. (1993). Misconceptions Reconceived: A Constructivist Analysis of Knowledge in Transition. *The Journal of the Learning Sciences* , 3 (2), 115-163.

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