Probing and Improving Student Understanding of Common Electrical Devices

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Motivation

- Enhance learning experience for college students in introductory physics classes.
- Broaden appeal of physics through real-life applications and devices.

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Research Questions

- Phase 1
  - What everyday electrical devices interest students?
  - What do students know about those devices?
- Phase 2
  - What are students' ideas about how some particular devices work?
  - What instructional strategies can facilitate students to construct their understanding of these devices?

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Phase 1: Research Plan

- Semi-structured interviews
  - Group and individual interviews
  - Students enrolled in algebra-based physics
- Topic: Everyday Electrical Devices
  - Students choose particular devices
  - Probe students' knowledge of how device works

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Phase 1: Results

- Large variance in devices chosen
  - Generally electronic devices
- Variable interest depending on device
  - "I kind of am actually... I don't know why I would be about a computer and not these..."
- Focus on usability, not function
  - "It's like, in a normal, everyday basis. Like, what can I do with them? I'm not so concerned with what's in them."

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Phase 2: Research Plan (1 of 2)

Focus on blender

- Motors already covered in class
- Concept applicable to many devices
- Most students familiar with blender

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Phase 2: Research Plan (2 of 2)

- Teaching interviews
  - N=15 enrolled in algebra-based physics
    - Six (6): had covered motors in class
    - Nine (9): had not covered motors in class
- Focus of Investigation
  - Students' initial understanding of blender
  - How students' understanding changed by interacting with demos

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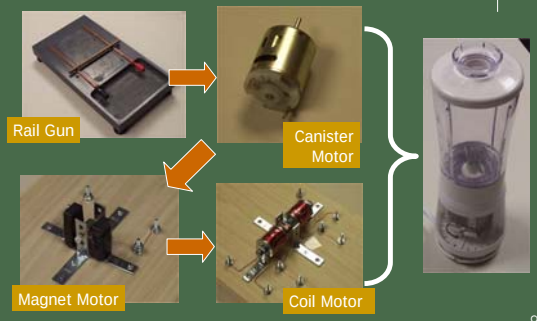
Phase II: Sequence of Demos



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Phase II: Themes (1 of 2)

- Epistemic mode
  - Knowledge is 'self-constructed'[1]
- Intuition-based Reasoning
  - 'Phenomenological primitives'[2]
    - Reversing input will reverse output
    - Closer is stronger
    - Canceling out
  - 'Attunement to Affordances'[3]
    - Use similarities between demos and blender e.g. attaching battery to the motor

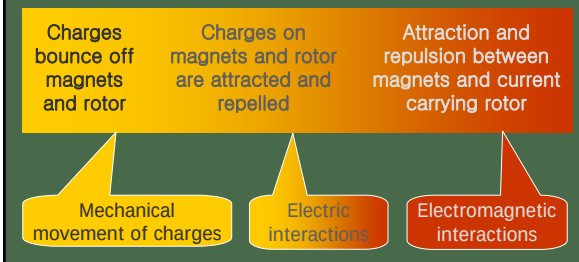
[1]Hammer & Elby, (2002) [2]diSessa, (1988) [3]Greeno, *et. al.*, (1993) 10

Phase II: Themes (2 of 2)

- Structure over Function
  - Focus on structural similarities not function[4]
- Confusing charges & magnets
  - Described magnets as being charged[5]
  - Combining ideas of magnets and charges[6]
- Lack of variation
  - No significant differences between students who had material in class and those who had not.

[4]Mestre, (1994) [5]Maloney *et. al.*, (2001) [6]Hrepic *et. al.*, (2005) 11

Spectrum of Ideas



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Future Work

- Phase III : Curriculum Development
  - Based on Teaching Interview results:
    - Identify instructional goals pertaining to blender.
    - Design assessments to measure instructional goals.
    - Develop curriculum to help students achieve goals.
- Phase IV : Curricular Implementation
  - Deploy unit into algebra-based physics classes.
    - Investigate whether unit achieves the instructional goals.
    - Modify unit based on results and re-deploy.

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Thank you!

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