

Teaching Electromagnetic Motors in Context:  
Students' Views

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## Introduction

- Developed a series of activities to teach motors in the context of a blender
  - Activities presented at last year's meeting
- Current focus on students' perceptions of the activities:
  - What ideas do students have about the blender after completing the activities?
  - How do students perceive the value of the demonstrations in relation to the blender?

## Methodology

- Teaching Interviews<sup>1</sup> with 12 students
  - Mock instructional setting where students interact with activities to facilitate learning
  - Based on the Zone of Proximal Development<sup>2</sup>
  - Students came from all levels of introductory physics

<sup>1</sup>Engelhardt (2003); <sup>2</sup>Vygotsky (1978)

## Sequence of Activities

The diagram illustrates the sequence of activities. It starts with a blender on the right. A bracket connects it to a breadboard on the left. From the breadboard, arrows point to a motor assembly and a coil. From the motor assembly, an arrow points to another coil. Finally, a bracket connects the second coil back to the blender, indicating the final assembly stage.

## Results: Cause of Magnets/Magnetic Field

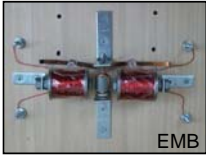


- Magnets result of current (4 of 11)
  - "You've got your current running through these coils setting up a... magnetic field."
- Other responses:
  - "charge" "electricity," the blender being "powered up" and having "oppositely charged bundles of wire"
- Three students gave no mechanism for creating magnets/magnetic field.

## Results: Cause of Spinning

- Spinning attributed to magnetism (6 of 11)
  - "that causes a magnetic force within and because this [rotor] is inside here [coils] that magnetic force gets this [rotor] spinning which in turn gets the entire blender spinning."
  - Two of these students also included a role for current
- Other responses:
  - "electricity," "metals reacting upon each other," "charge," "electrons moving," the switch connecting the blender's parts with the outlet cord, and the "power source."

### Results: Similarity to Blender (1)

- **Most Similar:**
  - EMB (10 of 12)
- **Most Different:**
  - EC (4 of 12)
  - RG (4 of 12)
  - Both EC and RG (3 of 12)

### Results: Similarity to Blender (2)

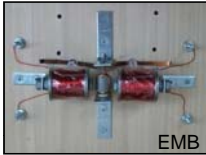

Reason	S or F*	Frequency
Same pieces		
Coils		
"Motor"		
Spinning		
Magnets		
Electromagnet	F	1
Works same	F	2

\* Structure (S) or Function (F)

"I think this one [PMB] helped me a lot because um I didn't really see where the magnets were and so once I saw that these were magnets and it was causing it to spin I could see the magnets were being produced here [coils in blender]."



### Results: Usefulness (1)

- **Most useful:**
  - EMB (3 of 12)
  - PMB (3 of 12)
    - "This one [PMB] was useful just in knowing that, okay, they're blatant magnets here."
  - EMB and PMB (4 of 12)

### Results: Usefulness (2)





- **Least useful:**
  - EC (5 of 12)
    - "It just seemed like it was added information that I already learned from all this [previous activities]."
    - Reason even given by students who needed EC to identify magnets in EMB.
  - EC and RG (3 of 12)

### Results: Order of Activities

Sequence	Frequency
RG, PMB, EC, EMB	4
PMB, EMB	
RG, PMB, EMB	
Do not change	
RG, EC, PMB, EMB	

"I kind of see how the transition from the magnet to the coil wires would work."

### Summary (1)

- **Current** given as most common reason for magnets/magnetic field
- **Magnets/magnetic field** given as most common reason for spinning
- No evidence that students knew what the terms meant or how they applied to blender

## Summary (2)

- Students focused on **spinning** and **magnets** to decide if an activity was similar to the blender
- Most students chose to either move **EC** to earlier in the activity sequence or to remove it entirely



## Limitations and Future Work

- Due to small sample size, we cannot draw generalizations from this data.
  - More interviews needed to see if trends hold.
- Next steps:
  - Analyze students ideas as they progress through demonstrations.
  - Investigate different activity sequences.
  - Connect activities to material covered in introductory physics courses.

Thank you!

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