

# Student Understanding of the Correlation between Hands-on Activities and Computer Visualizations of NMR/MRI



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Supported in part by NSF Grant DUE 04-26754



## Introduction

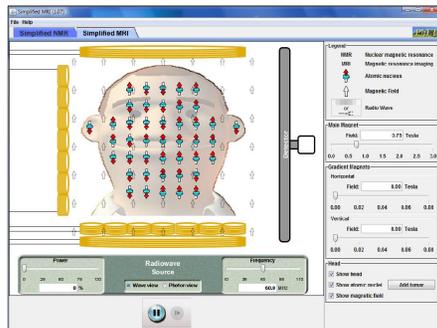
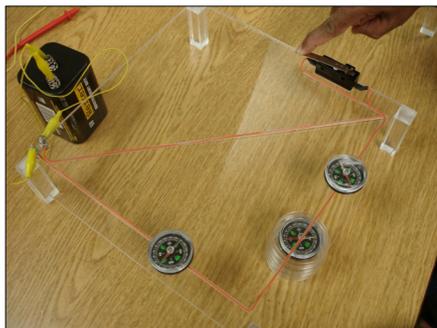
- Data from implementation of MRI learning materials<sup>1</sup>
  - Worksheet-format for student responses
- Concepts-based introductory-level physics course
  - 22 students, 8 self-selected groups
- Overall phenomenographic approach<sup>2</sup>; elicit variations among groups

## Research Question

To what extent do students understand the concepts of resonance, and how do they correlate the hands-on activities and computer visualizations designed to help them understand magnetic resonance imaging?

## The Activity

- Research-based learning materials<sup>3</sup>
- Progressive development through magnetism, resonance and nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI)
- Combination of Hands-on Activities and Computer Visualizations<sup>4</sup>
  - One-to-one correlation between hands-on activity and visualization
    - Compasses ↔ Atoms
    - Earth ↔ Main magnet
    - Tapping Switch ↔ Adjustable frequency



## Findings

- Determining the Frequency of the Compass
    - 3 of 8 groups got a reasonable number
    - 4 of 8 groups measured the time it took to stop oscillating
      - “7 seconds to completely stop, 7 oscillations, frequency = 1”
      - “8s to stop. Period = 8s, frequency = 0.8s.”
  - Identifying Correlations
    - Compasses ↔ Atoms
      - 1 group correctly identified
      - 2 groups associated with frequency
    - Earth ↔ Main magnet
      - 5 groups correctly identified
    - Tapping Switch ↔ Adjustable frequency
      - 1 group correctly identified
      - 3 groups associated with power
        - “It causes changes in power, because when the wires are tapped on by the switch it increases the strength of the frequency that is provided.”
- \* All other groups did not answer with a correlation

## Conclusions

- Introductory-level students had difficulty with frequency/resonance
  - Hindered their understanding of NMR/MRI
- Need additional scaffolding, thoughtful re-phrasing of questions, and in general smaller step-sizes through this difficult material

## References

1. Kansas State University, P.E.R.G. *Modern Miracle Medical Machines*. 2010; Available from: <http://web.phys.ksu.edu/mmmm/>.
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3. Murphy, S., et al., *Probing Students' Understanding of Resonance*, in *2009 Physics Education Research Conference*, M. Sabella, C. Henderson, and Singh, Editors. 2009, AIP Conference Proceedings: Ann Arbor, MI, p. 213-216.
4. University of Colorado, “Simplified MRI” *PhET Simulations*. 2009; Available from: <http://phet.colorado.edu>.