

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



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Introduction

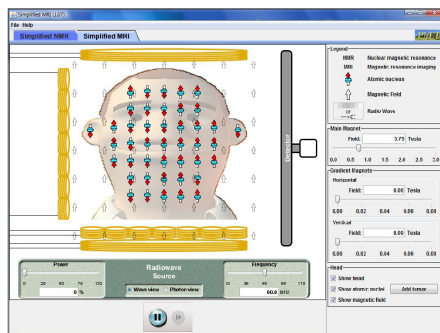
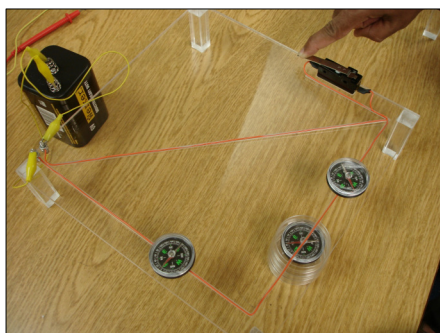
- Data from implementation of MRI learning materials¹
 - Worksheet-format for student responses
- Concepts-based introductory-level physics course
 - 22 students, 8 self-selected groups
- Overall phenomenographic approach²; elicit variations among groups

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 materials³
- Progressive development through magnetism, resonance and nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI)
- Combination of Hands-on Activities and Computer Visualizations⁴
 - 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

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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>.