

Using Optical Analogies While Teaching Physics of X- rays and CAT scans

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2007 AAPT Winter Meeting

Modern Miracle Medical Machines Goals

- Conduct research on students' models in the realm of medicine-related physics
- Develop active engagement instructional materials to help students learn applications of modern physics to contemporary medicine

Context of Previous Research

1. Clinical interviews with students of various backgrounds
2. Clinical interviews with health-related majors
3. Clinical + Individual Teaching interview series with GP students, primarily pre-meds
4. **Group Teaching Interviews**

Group Teaching Interview

- 8 groups (20 students) so far
 - 4 groups of GP students (2+2+3+3)
 - 4 groups of senior health-related (2+2+3+3)

Expectations

- to probe more deeply into transfer in individual students
- to look at the social interactions component of transfer
 - Overlapping core knowledge of a group
 - Overlapping zones of proximal development of a group

Cyclic Teaching Frameworks

- Learning cycle (Karplus)
 - exploration, concept introduction, application
- Modeling cycle (Wells, Hestenes & Swackhamer 1994)
 - model development, evaluation, and application

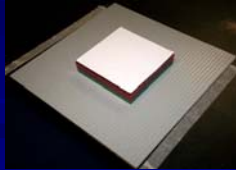

Students investigate the phenomena before a formal introduction of the concept

Interview – Part I

- Discussion Around Pictures
 - Nature of X-rays, imaging properties
 - Personal experience
 - Comparison with other techniques
 - Focusing on comparison X-rays and CAT scans
 - limits of information
 - frontal pictures versus slices
 - 2D versus 3D


Interview – Part II

- Playing the role of a Lego physician
 - What is inside?
- What kind of equipment do we need?

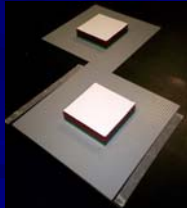
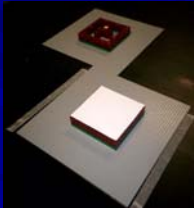
Interview – Part II

- Analog of X-rays?
- What can you get from one-side measurements?
- What else we can do?



Comparison Between Boxes

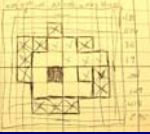
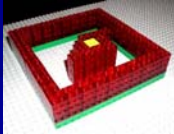
- How the open box can help us?

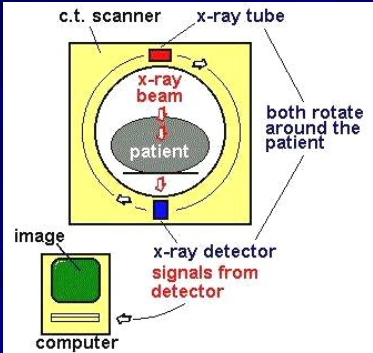

Discussion of Errors

What could have been done better and what couldn't?

- not focused light... reflections... neighboring layers are absorbing light even if they are not in the direct path of it... don't know whether it would have mattered if we have done it from all 4 sides

Explaining CAT scans

Pre Activity Comparison Discussion



Bone structure... cannot get any real decent tissue information... we cannot really see muscles, how ligaments are attached... obviously X-ray images involving skeletal structure of the body...



Here you see bone, you see organ tissue, skin tissue, kind of everything

Post Activity Comparison Discussion



We can see how organs interact or are arranged according to each other... here we cannot tell for one of the fingers if it's pushed back or something... normally you really can't tell...



Unless you get a different picture from that side... here you definitely get more information... different kind of information.

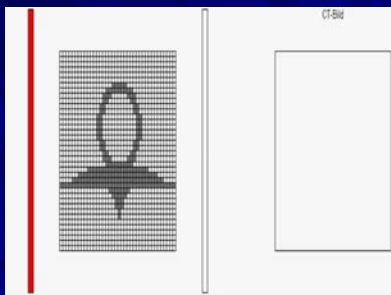
Preliminary Results

- All the students liked the activity and recommended it for future use
 - I felt like this lab was very helpful
 - I would love to do labs dealing with medical technology in physics
- Almost all enthusiastically participated in all the routines
- At both stages students successfully interact clearly creating the targeted common core knowledge

Some problems

- Students are somewhat resistant to a cyclic discovery format (10 out of 14), want everything be explained theoretically before they start doing anything
 - “knowledge is propagated” e.m.
- Some (3 out of 14) thought that computer simulation would work better
 - going to address now

Computer Animation



Thank you!