Use of Physical Models to Facilitate Transfer of Physics Learning to Understand Positron Emission Tomography

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Project Overview

- Conduct teaching interviews using simple hands-on activities
- Examine students' models of physics ideas relevant to Positron Emission Tomography (PET) image construction process
- Investigate the effectiveness of physical models to facilitate student understanding of PET technology

Research Questions

- What cognitive resources do introductory college students bring to bear when interacting with physical models?
- How does sequencing of different physical models affect activation of these resources?
- How do students transfer their physics learning from physical models to understand PET?

Methodology

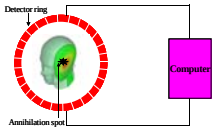
- Teaching interviews conducted in spring 2006 at Kansas State University
- Learning context and transfer context constituted two sessions of the interview
- Participants: Students enrolled in an algebra-based physics course (N=16) (eight male, eight female)
- Interview video taped and transcribed
- Phenomenographic approach adopted to analyze the data

Activities Used in Teaching Interview

Cart activity

Light activity

Simulating behavior of particle using a ball



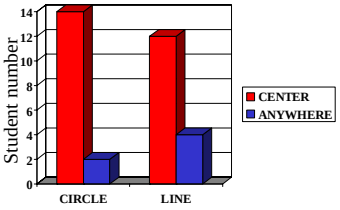
Example of PET problem

Major Findings of the Study

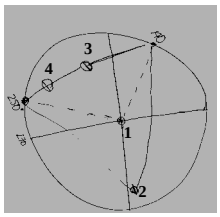
- Influence of prior experiences on complex situation
  - a) Central tendency
  - b) Use of perceived brightness and size of light to locate events
  - c) Use of classical analogy to predict the outcome of electron-positron annihilation
- Effect of the sequencing of activities in triggering relevant ideas
- Evidence of non-scaffolded transfer

Central Tendency

- Source of two lights appearing on the circumference must be at the center of the circle
- The idea modified by challenging with the help of scaffolding activities



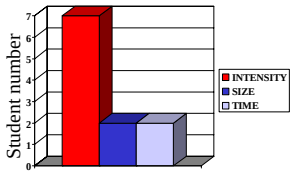
Location where the event should take place



Student's sketch of idea progression

Use of Perceived Ideas to Locate Events

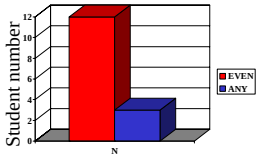
- Students inappropriately rely on apparent intensity and size to locate source
- Such reasoning is based on intuition



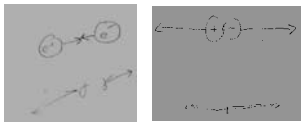
Factors considered by participants to determine event location that produces light

Students' Responses on Positron-Electron Annihilation Outcome

- The production of only an even number of gamma rays possible by an annihilation
- Conservation in a line requires 1D motion of all objects

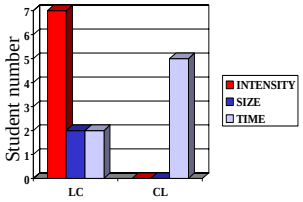


Consideration of number of gamma rays


Student sketches of gamma ray direction as a result of annihilation

Sequencing Activities

- **LC group** (the light activity introduced before the cart activity): more influence of everyday experience
- **CL group** (the cart activity introduced before the light activity): more influence of prior activity



The change in the student response after changing the activity sequencing

Types of Transfer Observed

Spontaneous Transfer (ST):
Immediately relate PET with the activities of the first session

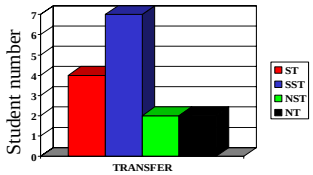
Non-Spontaneous Transfer (NST):
Relate PET with the first session only after being asked if they had seen an activity similar to PET problem

Semi-Spontaneous Transfer (SST):
Relate PET back to the activities of the first session upon being asked the reason for their answer

No Transfer (NT):
Students do not transfer at all from the first session to the second session

Results of Types of Transfer

- Demonstrated different types of transfer from learning context to application context
- The active learning in first session helped students transfer ideas to second session



Types of transfer demonstrated by participants of the study

Conclusions

- Students tend to activate resources from everyday experiences
- Immediate hands-on activities are more influential than prior experiences in activating resources
- Proper sequencing of activities using physical models facilitates spontaneous transfer

For More Information

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Introduction

Summary

Results