Full Contact Learning
Employing the body as a learning tool

Mary Bridget Kustusch and Susan Fischer
DePaul University
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Embodied Cognition

“In an embodied cognition perspective, all abstractions are understood in terms of basic sensory-motor experiences such as object permanence and movement” (Scherr et al, 2012a)
Our thought is grounded in our sensory experience

- Time metaphors
- Representational gestures
- Perspective-taking
Our thought is grounded in our sensory experience

- Time metaphors
- Representational gestures

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**Table 5.3.**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>(00:38:18;00)</td>
</tr>
<tr>
<td>3.2</td>
<td>(00:38:19;30)</td>
</tr>
<tr>
<td>3.3</td>
<td>(00:38:29;10)</td>
</tr>
</tbody>
</table>

*B:* {but when you bind thrombomodulin to the back side of thrombin}

{suddenly that Protein C Inhibitor is in there (0.5) a: THOUSAND} FOLD FASTER (0.5)

{So there’s a lo:ttta evidence sugesting} {that so:mething like this is going on. (2.0)}

*(Becvar et al, 2008)*
We use our bodies to think

“The common thread across these accounts is that gestures are not simply an external manifestation of what is on the gesturer's mind. Instead, the act of gesturing influences the representations and processes that take place in the gesturer's mind.” (Alibali, 2005)
Using our bodies to learn

“Theories of embodied cognition and cognitive linguistics suggest to us that among all possible objects, a particularly cognitively compelling sense of permanence might be attached to the self, and that use of the human body might have special significance for learning.” (Scherr et al, 2012b)
We should allow students to use their bodies to learn

- Kinesthetic activity
- Embodied representation
- Physical mnemonics
- Embodied interaction
- Embodied Learning Activity (ELA)

Any activity where the body is used as a tool for learning!
Reasons to use ELAs

Allow students to...

• ... make sense of counter-intuitive scenarios
• ... ground abstract ideas in the concrete world
• ... create their own ideas
• ... develop shared language and community
Motivating the activity

For rotational motion:

\[ \text{linear momentum} = (\text{mass}) \times (\text{velocity}) \]
\[ p = mv \]

\[ \text{angular momentum} = (\text{moment of inertia}) \times (\text{angular velocity}) \]
\[ L = I\omega \]

What is the moment of inertia of an object? Rulers + Binder clips!
What did we learn?

It is harder to “flip” the ruler the further the binder clip is from the pivot point. “Harder” means a larger moment of inertia.

The moment of inertia of an object depends on how the mass of the object is distributed.

If you change the location of the pivot point, you affect the difficulty in “flipping” the ruler.

The moment of inertia of an object depends on where the pivot point (or axis of rotation) is.
What did we learn?

The two identical solid cylinders shown below are spinning about different axes.

Which configuration has the larger Moment of Inertia?
How does this apply?

How does this apply to angular momentum and ice skaters?

Compare what is happening
    when the skater first starts spinning, and
    when the skater is about to finish the spin.
What changes?

What can we learn about angular momentum?

(angular momentum) = (moment of inertia) * (angular velocity)
Activity 2:
Some ELAs use the body...
... as a sensor

Feeling 1-dimensional motion

Using a bicycle wheel to feel changes in angular momentum
Creating non-linear charge density

“building” DNA

Energy Theater
... to explore relationships

Flow of charges in a uniform current density

Energy transfers & transformations for a hand pushing a box across a floor at constant speed.

Sky Time: relationship between time and astronomical motion

The life cycle of a star
... to represent abstract ideas

Transverse Waves

Time evolution of a complex 2-state system

Acting out the meter of a poem
Creating an ELA

I want an ELA that explores...

• ... interactions or transformations
• ... complex or dynamic systems
• ... changes in orientation or perspective
• ... quantities with properties that vary in space
• ... something too abstract for an ELA
Questions to consider:

• What are your goals for the activity?
• What do you want your students to learn?
• How much do you want the students to direct the exploration?
• How much time will it take?
• Can you get all students involved?
• How can you make it safe to participate?