

## Students' Modeling of Microscopic Friction: Dynamic Transfer Perspective\*

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## Research Questions

- What associations do students construct between information provided through external inputs and their own internal knowledge?
- What factors mediate these associations?
- How do these associations influence the students' model construction/reconstruction of microscopic friction?

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## Theoretical Framework

### Contemporary Perspectives of Transfer

- Actor-oriented transfer<sup>1</sup>
  - personal creation of similarities
- Preparation for future learning<sup>2</sup>
  - adaptability to new situations
- Coordination class theory<sup>3</sup>
  - Class C transfer (re-use prior knowledge)

<sup>1</sup>Lobato (2003) <sup>2</sup>Bransford & Schwartz (1999) <sup>3</sup>diSessa & Wagner (2005)

## Methodology

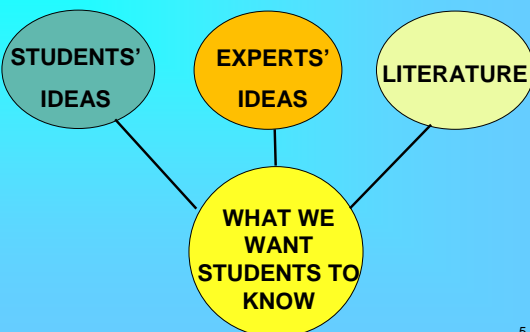
### Teaching Interview<sup>4</sup>

- 'Mock' instruction
- Two one-hour session/student
- Videotaped

<sup>4</sup>Engelhardt *et al.* (2003)

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## Establishing Target Ideas

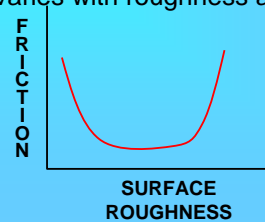


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## What We Want Students to Know

(Relevant to this Talk)

- Friction is dependent on the area of contact between atoms and NOT on macroscopic area.
- Friction varies with roughness as shown below:



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## The Informant

- Introductory College Physics Student
  - Had High School Physics
  - Enrolled in second semester calculus-based physics.

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## Analytical Framework

'Two-level framework'

- Associations between knowledge elements.
- Control of these associations.

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Redish (2004)

## Model Building

Feeling & Sketching of surfaces

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## Model Building

Metal Blocks Activity

Graphing of Friction vs. Surface Roughness

Wooden Surface-Sandpaper

Feeling & Sketching of surfaces

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## Metal Blocks Activity-Prediction

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.... The top (smooth) and the (rough) sides will probably have more friction because they are not both quite smooth. The top will be less because they are both quite smooth.

<..basis of prediction?> ...just the roughness and smoothness of the sides. The more roughness there is, there'll be more friction. Basically it's the same reasoning I used for these (points to the wooden block and sandpaper)

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## Metal Blocks Activity-Prediction

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## Metal Blocks Activity-Explanation

??COGNITIVE  
DISSONANCE??

Can't explain  
phenomena at  
hand using  
present model

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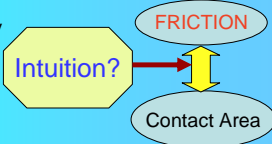
## Model Building



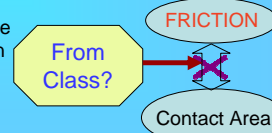
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## Paper & Transparency - Prediction

"...greater friction would probably be that one (uncrumpled paper) because it's gonna have more area in contact with the surface because it's flat..."



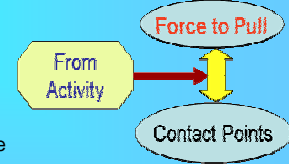
"...but actually wait, they would be the same because I guess friction doesn't really depend on the surface area touching the surface..."



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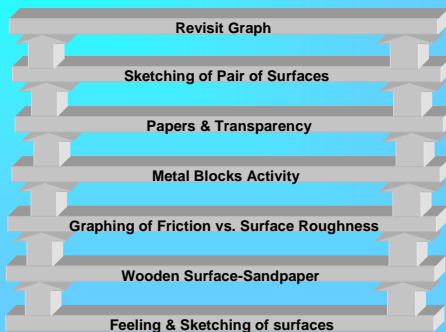
## Paper & Transparency - Explanation

"...because in that one (uncrumpled) the entire surface is resting on top of the plastic. In here (crumpled paper) it has very few points of contact and so it's not attracted as much as that one (uncrumpled)."



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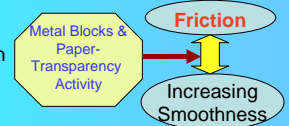
## Model Reconstruction



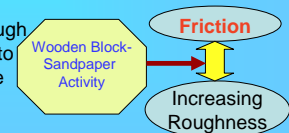
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## Model Reconstruction In Progress

"...with the smoother it is, like here (smooth side of the metal block), there's a lot more friction and as it gets a little bit rougher like the sides (rougher side of metal block) there'll be less friction."



"...once you get really, really rough like the sandpaper, it will start to go up again, so there'll be more friction."



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### Model Reconstruction In Progress

Wooden Block-Sandpaper Activity

↑ Friction ↓

↕

↑ Increasing Roughness ↓

+

Metal Blocks & Paper-Transparency Activity

↑ Friction ↓

↕

↑ Increasing Smoothness ↓

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### Conclusion

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- The metal block and transparency activity seem to activate and strengthen the association of friction with increasing smoothness.

↑ Friction ↓

↕

↑ Roughness ↓

**BEFORE**

→

↑ Friction ↓

↙ ↘

↑ Increasing Smoothness ↓    ↑ Increasing Roughness ↓

**AFTER**

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### Conclusion

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- The scaffolding activities appeared to facilitate efficient control of the activation of appropriate associations to explain his observations and construct a new model of microscopic friction.

**BEFORE**

→

**AFTER**

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### Current Directions

- Develop Instructional Material
- Validate & Pilot Test Instructional Material

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## Thank You!!!

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