

DEMONSTRATIONS: MORE THAN JUST ENTERTAINMENT?

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Goals of demonstrations

- ▶ **Motivate**
- ▶ **Educate**

Are these goals met?

Can demonstrations be more educational?

Does pedagogy of the demonstration affect:

- ▶ **memory of outcome?**
- ▶ **understanding of physics?**

Research strategy

**7 demonstrations presented to 7 sections ($N \approx 15$ each)
of introductory physics class in one of 4 'modes':**

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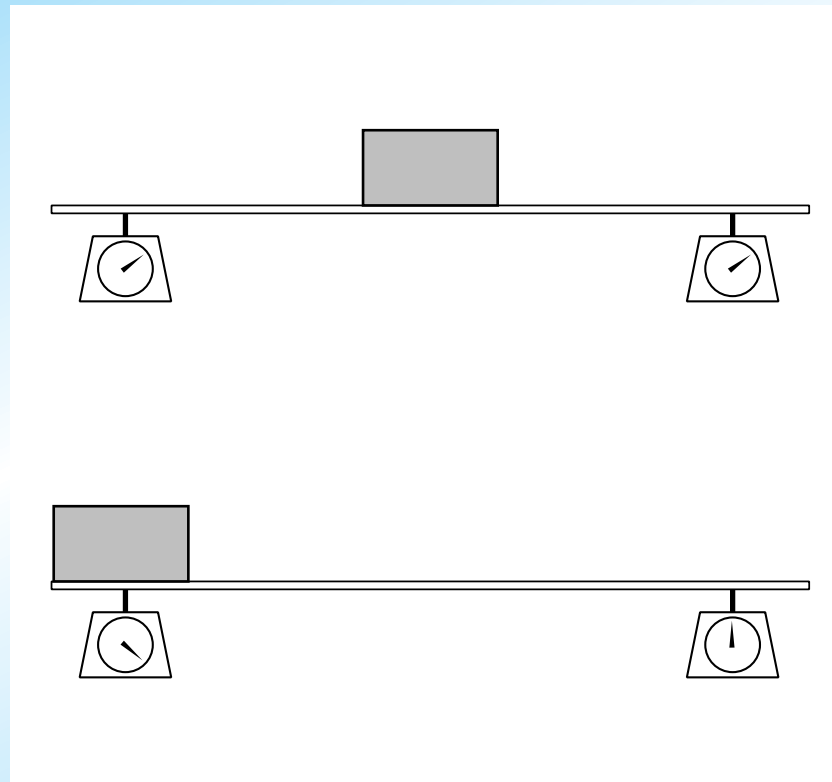
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- ▶ traditional presentation: '**show**'
- ▶ students predict before demonstration: '**predict**'

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- ▶ demonstration not shown: '**no demo**'
- ▶ traditional presentation: '**show**'
- ▶ students predict before demonstration: '**predict**'
- ▶ students record prediction and discuss: '**reinforce**'

Sample demonstration



Sample demonstration: Predict transparency

A plank of negligible mass is supported at its two ends by platform scales. When a block of metal is placed at the center of the plank, halfway between the scales, the scales have the same reading x . If the metal block is now placed over the right-hand scale, the two scale readings are:

1. right scale = x , left scale = x
2. right scale = x , left scale = 0
3. right scale = 0, left scale = x
4. right scale = $2x$, left scale = 0
5. right scale = 0, left scale = $2x$
6. right scale = $1.5x$, left scale = $0.5x$
7. right scale = $0.5x$, left scale = $1.5x$
8. none of the above

Sample demonstration: Reinforce worksheet

A plank of negligible mass is supported at its two ends by platform scales. When a block of metal is placed at the center of the plank, halfway between the scales, the scales have the same reading x . The metal block is now placed over the right-hand scale.

1. What are the two scale readings now? Why?

2. Record your observation of the demonstration.

3. Compare your prediction (1) to your observation (2). Do they agree?

☐ Completely ☐ Mostly ☐ Somewhat ☐ Not at all

4. After discussing your prediction and the demonstration with your neighbors, record why your prediction and the reasoning behind it were correct or incorrect (use the back of this sheet if you need more room).

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DISCUSSION


-
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Testing


Netscape: Physics 1 Third Computer Test

Back Forward Reload Home Search Netscape Images Print Security Shop Stop

1. A plank of negligible mass is supported at its two ends by platform scales. When a block of metal is located at the center of the plank, halfway between the scales, the scales have the same reading of 10 N as shown in (a).

(a) 

(b) 

(c) 

If the metal block is now placed over the left-hand scale, as in (b), what are the readings on the scales? Explain your answer briefly.

What are the readings when the block is placed halfway between the left-hand end and the center of the plank, as in part (c) of the diagram? Explain your answer briefly.

Testing

- ▶ **Web-based free-response test at end of term**
 - **questions identical to worksheets**
 - **graded solely on effort**

Testing

- ▶ **Web-based free-response test at end of term**
 - questions identical to worksheets
 - graded solely on effort
- ▶ **Analyze responses for ($N = 122$, 7 questions):**
 - demonstration outcome
 - physical understanding

Results: Outcome of demonstrations

correct outcome

no demo

show

predict

reinforce

Results: Outcome of demonstrations

correct outcome

no demo 49%

show

predict

reinforce

Results: Outcome of demonstrations

correct outcome

no demo 49%

show 54%

predict

reinforce

Results: Outcome of demonstrations

	correct outcome	<i>P</i> -value
no demo	49%	–
show	54%	0.139
predict		
reinforce		

Results: Outcome of demonstrations

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reinforce		

Results: Outcome of demonstrations

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Results: Outcome of demonstrations

	correct outcome	<i>P</i>-value	<i>P</i>-value
no demo	49%	–	0.139
show	54%	0.139	–
predict	69%	< 0.001	< 0.001
reinforce	69%	< 0.001	0.001

'Understanding' affects memory!

- ▶ **Memory is a reconstruction at instant of recall, not like a video replay**
- ▶ **Fill in gaps in memory with information from schemas and scripts (mental models)**
- ▶ **Incorrect model can lead to inaccurate memory of scenario**

'Understanding' affects memory!

"As demonstrated in lecture, both scales will read 10N, regardless of where the center of mass is located. The platform and the metal block form one unit that is being measured, so the scales show two evenly distributed readings, no matter where the metal block is placed along the platform."

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Results: Understanding

	fully correct	<i>P</i>-value
no demo	22%	–
show	24%	0.319
predict	30%	0.022
reinforce	32%	0.008

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	fully correct	<i>P</i>-value	<i>P</i>-value
no demo	22%	–	0.319
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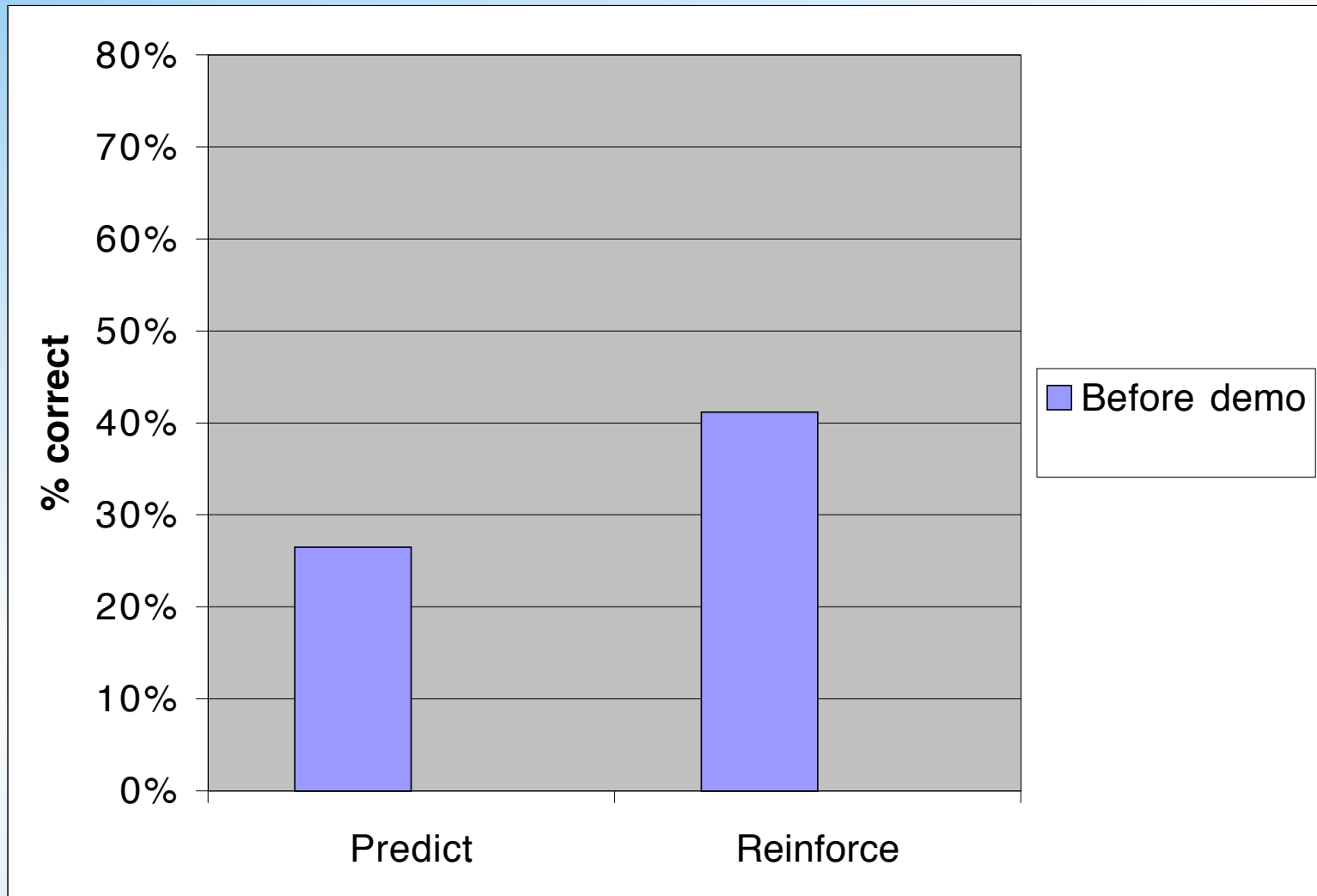
Results: Cost vs. benefit

	time (min)	outcome gain	fully correct gain
show	11	5%	2%
predict	13	20%	8%
reinforce	21	20%	10%

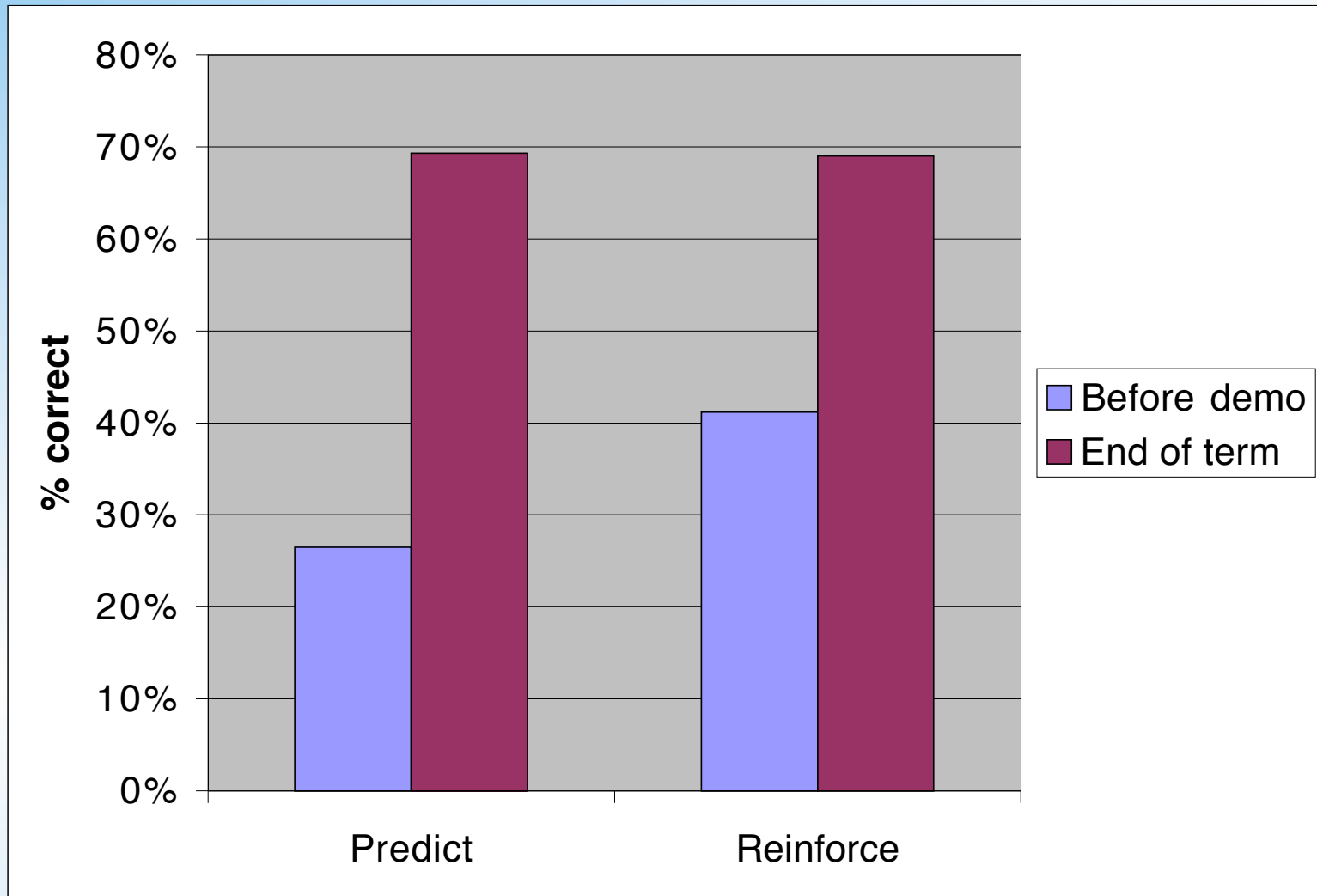
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Accuracy of predictions



Accuracy of predictions



Conclusions

- ▶ **Demonstrations without active engagement produce little gain in understanding**
- ▶ **Predicting outcome gives significant learning gains without costing time**
- ▶ **Initial predictions do not affect degree of eventual understanding**

Research: Staff and students of Physics 1

Demonstrations: Wolfgang Rueckner, Nils Sorensen

**Inspiration/Discussion: Pamela Kraus, Gay Stewart,
David Sokoloff, Michael Wittmann**

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**For a copy of this talk and
additional information:**

<http://mazur-www.harvard.edu>