

Negative Examples in Lecture Improve Student Learning

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Views on Examples

Question: Which slide do you think would lead to more learning by principles students?

A

GDP: Terms

Further examples of a **capital good**:

- hammer owned by a carpenter
- manufacturing plant
- an oven owned by a bakery
- a bulldozer owned by a construction company
- a jetliner owned by United Airlines
- a delivery truck owned by UPS

U.S. total: \$34 trillion



B

GDP: Terms

Further examples of a **capital good**:

- hammer owned by a carpenter
- manufacturing plant

Looks like a capital good, but are **not**:

- money someone saves for retirement
- a business buying a new tool
- stock in a corporation (sold on Wall St.)
- oil Exxon owns in an oil field (a natural resource)

U.S. total: \$34 trillion



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Importance of Negative Examples

“One of the mad things about examples/non-examples is that it’s almost a unified theory of learning in the sense that so many theorists from a range of different traditions have advocated for it in one form or another. Socrates, Aristotle, Vygotsky, Bruner, Skinner, Ausubel, Sweller all basically say the same thing on this which is that learning is driven by clear distinctions—knowing what something is requires knowing what it isn’t.”

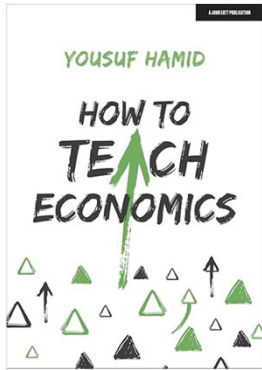
– Carl Hendrick

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Context

“What do College Seniors Know About Economics,” Walstad and Allgood, AER P&P, 1999

“The Superiority of Economists,” Fourcade et al., JEP, 2015



**“Theory of Instruction: Principles and Applications.”
Engelmann and Carnine, 1982**

Direct Instruction

direct instruction

**“Why Minimal Guidance During Instruction Does
Not Work,” Kirschner, Sweller, and Clark, 2006**

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Testing Negative Examples: Data Collection

Extensive use of iClicker Cloud

Three large sections in fall and spring 2024

Concepts: capital, money, technology

Teaching methods (on Thursday):

positive examples (P)

positive and negative examples (P/N)

positive and negative examples with a clicker question (P/N/C)

MC Assessment on the following Tuesday (iClicker)

hopefully not confounded by student studying

“Grade Targets and Teaching Innovations,” Allgood, 2001

dataset: students who had the lesson & assessment

1,229 students with 3,043 total observations

GDP: Terms

Question: How many of the following would be considered a capital good?

- hammer owned by a carpenter
- money someone saves for retirement
- manufacturing plant
- a business buying a new tool
- stock in a corporation (sold on Wall St.)
- oil Exxon owns in an oil field (a natural resource)

A. 1 B. 2 C. 3
D. 4 E. 5 or more

U.S. total: \$34 trillion



**active
learning**

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Testing Negative Examples: Crossover Design

Concept \ Treatment	P	P/N	P/N/C
Capital	S6, F2	S7, F5	S4, F6
Money	S7, F5	S4, F6	S6, F2
Technology	S4, F6	S6, F2	S7, F5

Addresses differences in sections and concept difficulty

Fixed Effects: $y_{st} = \alpha_s + \beta x_{st} + \gamma c_t + \epsilon_{st}$

$x_{st} = \text{P/N, P/N/C}$

$c_t = \text{capital, money, section, semester}$

Random Effects: $y_{st} = \beta x_{st} + \gamma c_t + \delta s_s + \epsilon_{st}$

$x_{st} = \text{P/N, P/N/C}$

$c_t = \text{capital, money, section, semester}$

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Testing Negative Examples: Methods of Analysis

Models:

1: panel random effects model controlling for section

2: panel student-level fixed effects

3: pooled cross-sectional OLS

4: panel probit

5: pooled cross-sectional probit

6: pooled cross-sectional logit

	Model 1	Model 2	Model 3
P/N	0.2334	0.2326	0.2339
(t-scores)	(12.52)	(11.86)	(12.16)
P/N/C	0.2502	0.2350	0.2523
(t-scores)	(13.26)	(11.86)	(12.96)
R ² overall	0.1199	0.1084	0.1173

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Conclusion

Negative examples meaningfully increase assessment scores

We suggest economists use negative examples

Design could be used for other studies

Further work needed on active learning

**Likely other useful concepts from cognitive science for
economics educators**

Thank you!

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