

Improving Visual and Verbal Information Integration in Mathematics Textbooks

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INTRODUCTION

Like many math textbooks, *Connected Mathematics 2* has a wide variety of visuals.

We sought to improve the integration of visual and verbal information in modifying the CMP2 books.

We based these modifications on three cognitive principles: signaling, contiguity, & coherence (Mayer, 2009).

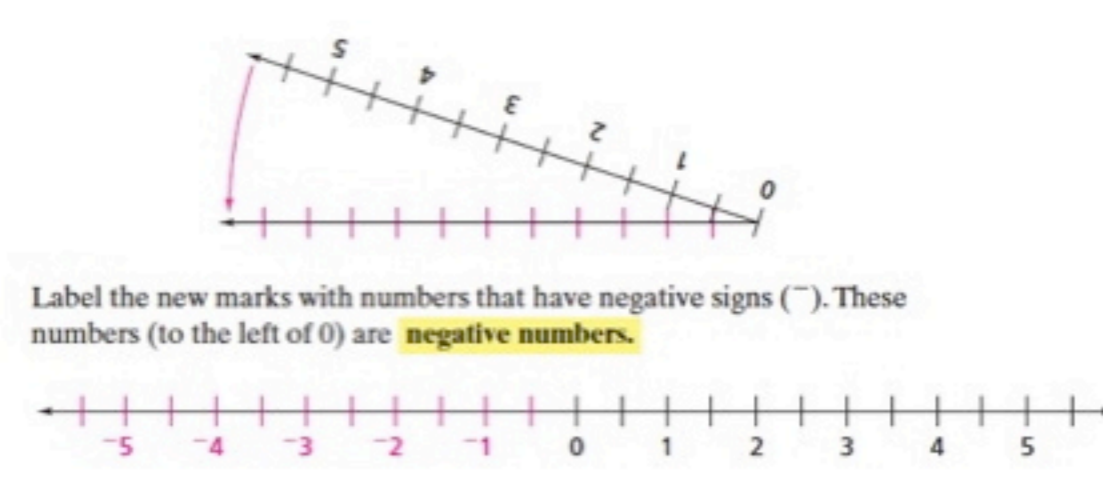
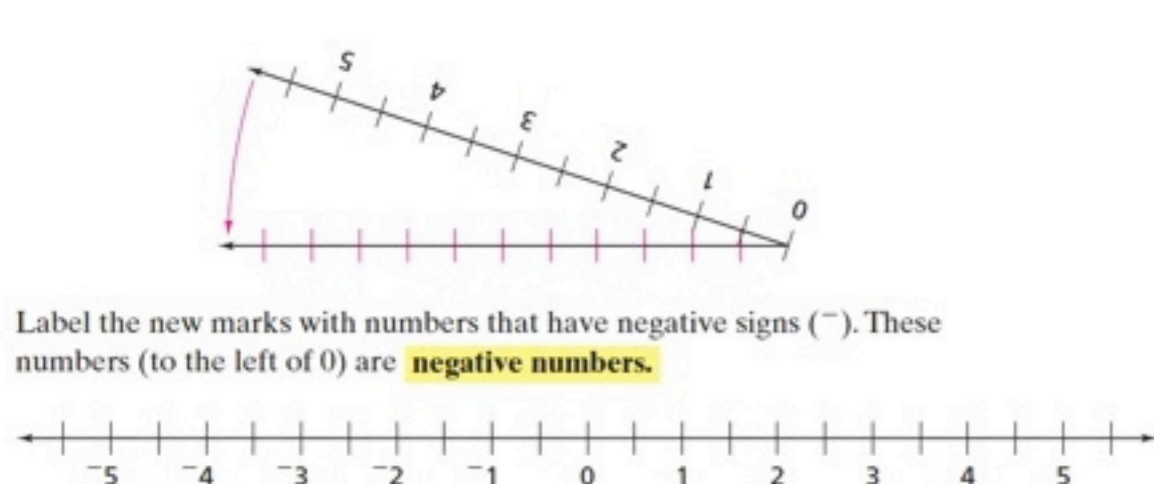
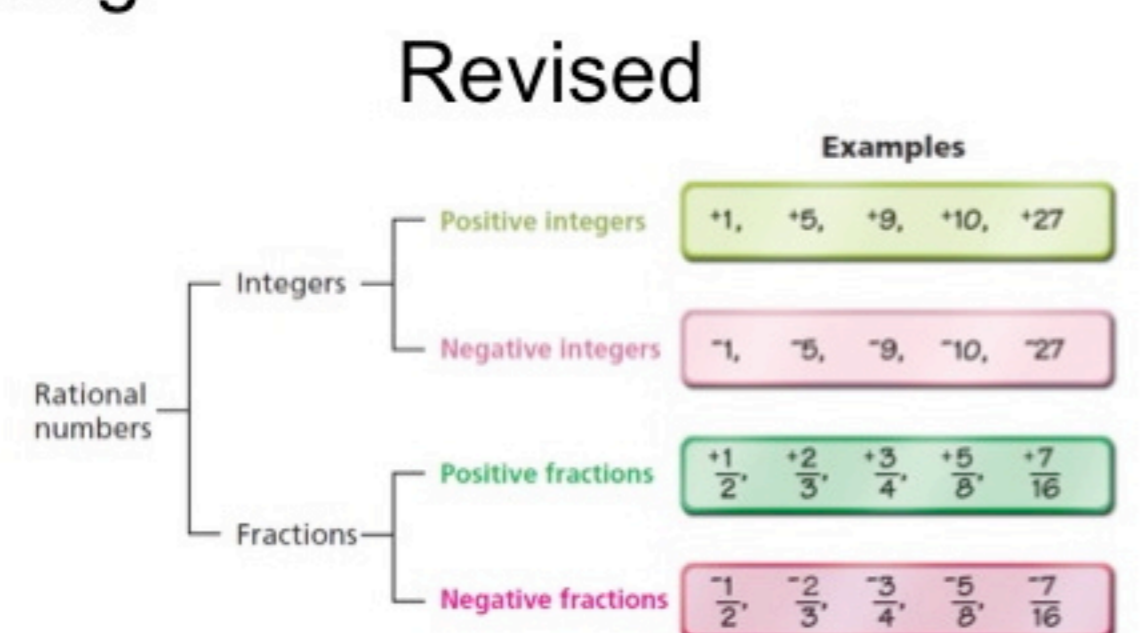
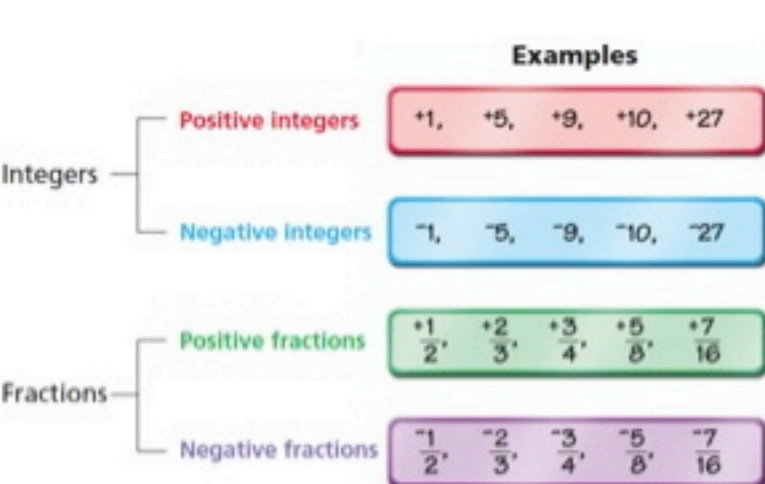
Now we are in the process of empirically testing these modifications to determine their effectiveness.



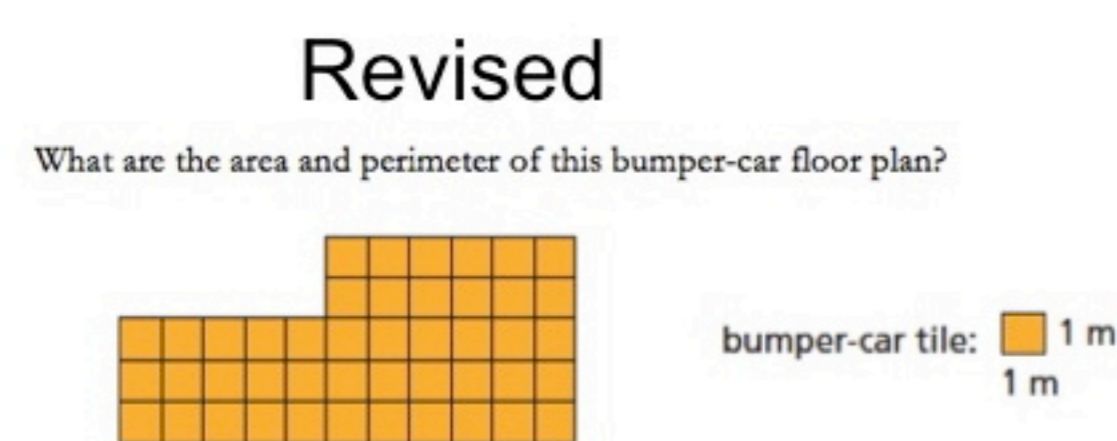
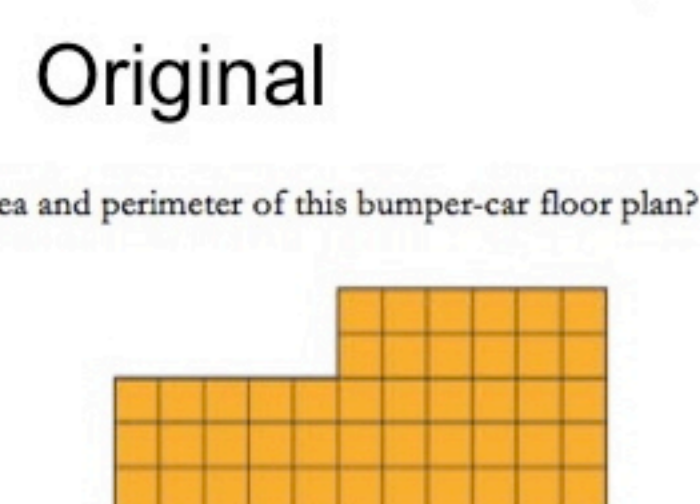
Signaling Principle

Learning is improved when there are cues to important information (Kalyuga, Chandler, & Sweller, 1999; Koning, Tabbers, Rikers, & Paas, 2009).

Color Coding



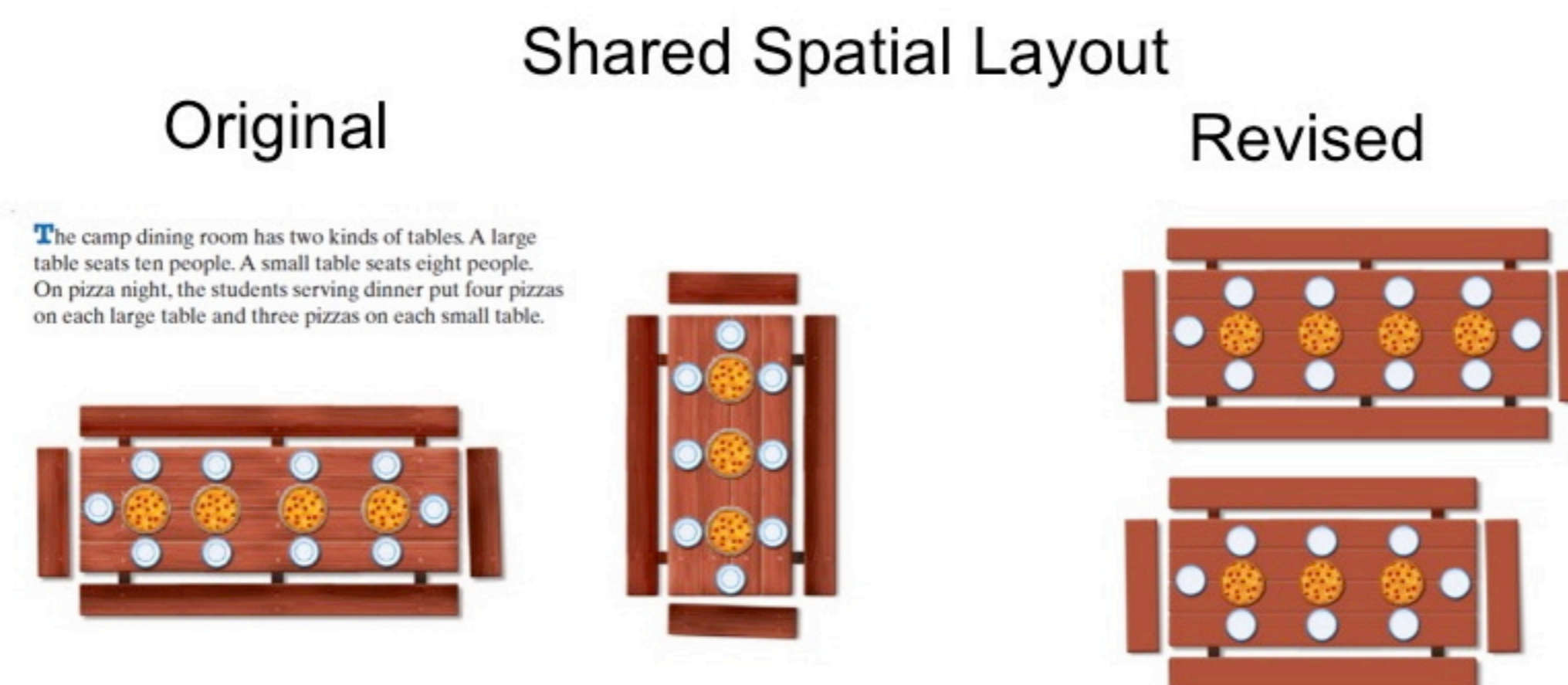
Adding Missing Information



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Contiguity Principle

Learning is improved when multiple representations are aligned along important features (Ginns, 2006; Mayer, 2002).



Spatial Contiguity

Original

The problems and the table necessary to solve the problems are on different pages.

Revised

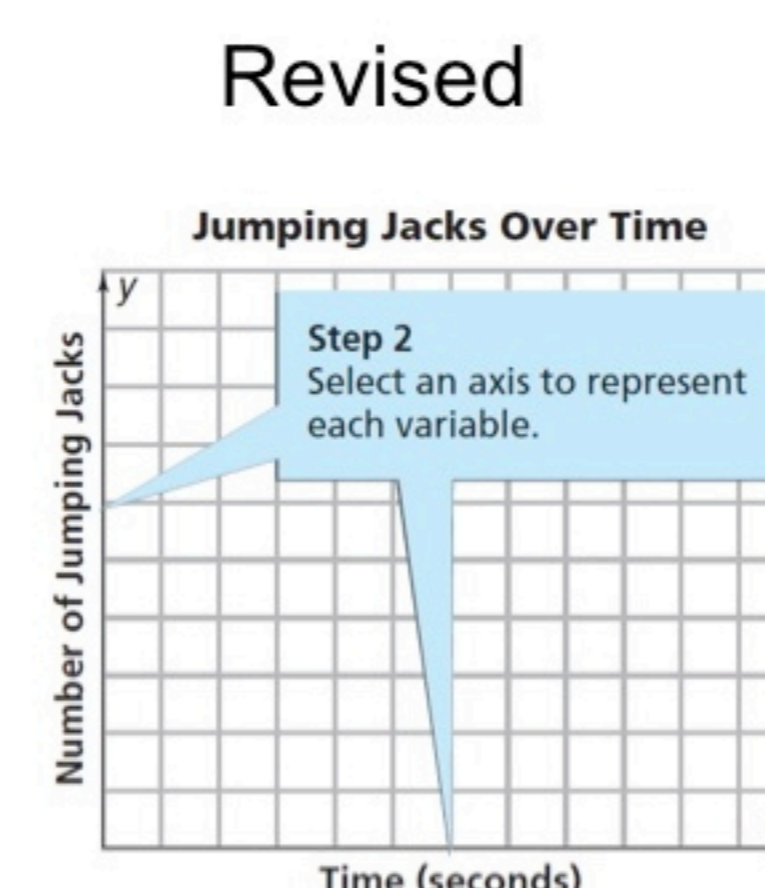
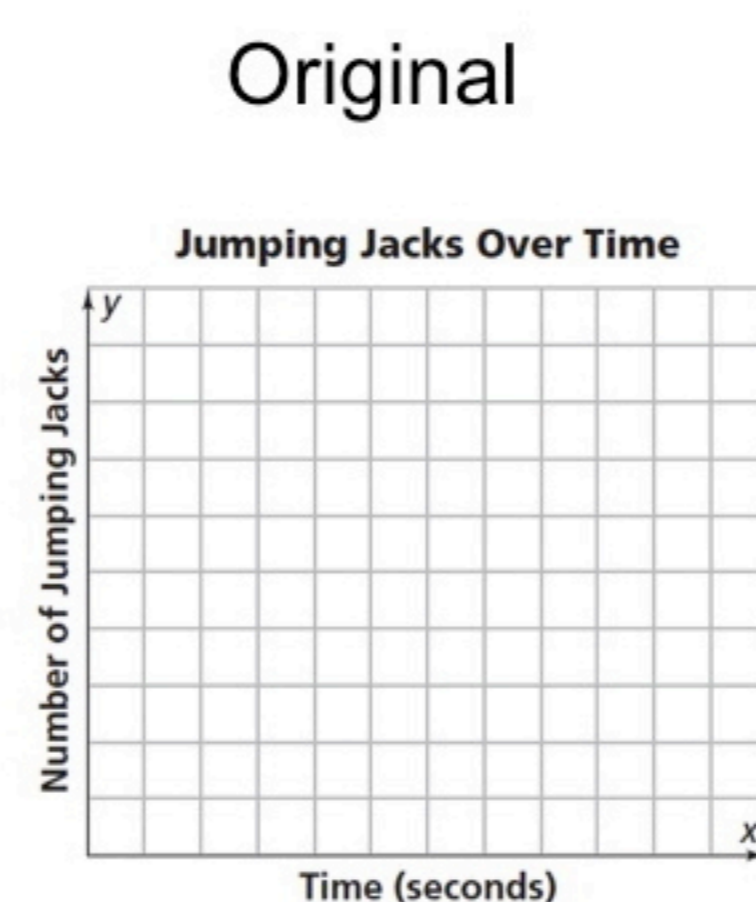
Tree Type	Circumference (ft)	Height (ft)	Spread Diameter (ft)
Coast Redwood (Calif.)	83.2	275	107
Coast Redwood (Calif.)	79.2	247	80
Swamp Chestnut Oak (Fla.)	23.0	105	216
Florida Crossover Oak (Fla.)	6.4	11	3
White Oak (Ind.)	31.8	90	119

Problem 1 Writing Comparison Statements

A. Use the table above.

- How many coast redwood spreads does it take to equal the spread of the white oak?
- Kenning says that the spread of the white oak is greater than that of the coast redwood by a ratio of about 3 to 2. Is he correct? Explain.
- Mary says the difference between the heights of the coast redwood and the giant sequoia is 46 feet. Is she correct? Explain.
- How many giant sequoia spreads does it take to equal the spread of the swamp chestnut oak?
- Janice says the spread of the giant sequoia is less than 50% of the spread of the swamp chestnut oak. Is she correct?
- Leo says the circumference of the swamp chestnut oak is about three-fourths the circumference of the white oak. Is he correct?

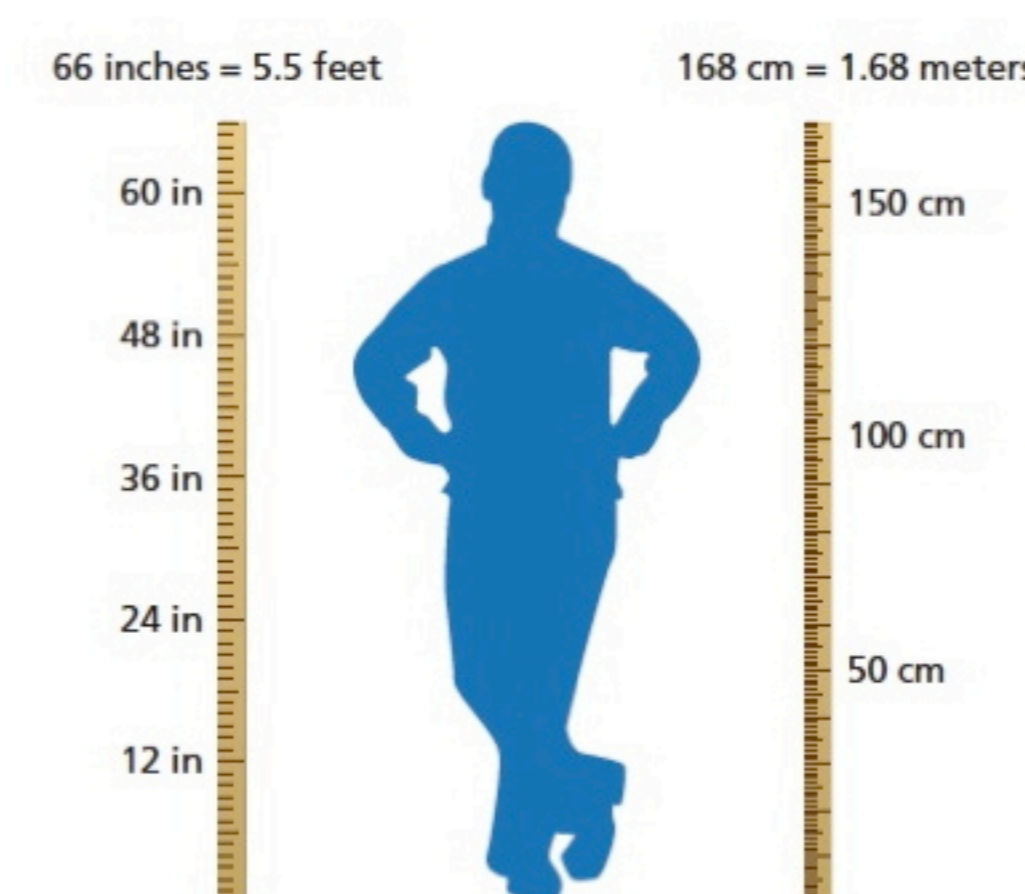
Integrate Verbal and Visual Information



Coherence Principle

Learning is improved when interesting, but irrelevant words and pictures are removed (Harp & Mayer, 1998; Mayer, 2002).

Replace Math-Irrelevant with Math-Relevant



Coherence Principle (continued)

Remove Seductive Details



Julia says that sometimes she uses estimation to decide where to place the decimal in an actual product. With the problem $0.9 \times 1,305$, a reasonable estimate is $1 \times 1.3 = 1.3$. Even 1×1 is a good estimate. I think that the actual product is a little more than 1. When I multiply $9 \times 1,305$ I get 11,745, so I know the actual product is 1,174.5.

Use Julia's estimation strategy to find the product N.

- $31.2 \times 2.1 = N$
- If $6,946 \times 28 = 194,488$, then $694.6 \times 2.8 = N$.



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Empirical Tests

Two experiments to examine the effects of the revisions: Problem solving and lesson reading.

Problem solving:

- 50 seventh-grade students
- 8 story problems (4 revised and 4 original; between and within subjects)
- Revisions did not affect problem-solving accuracy
- Revisions also did not affect student's reports of their level of interest, confusion, or perceived difficulty
- Problem solving may involve different processing than does reading lessons.
- More research needs to be done to reconcile these findings with others on the seductive details effect.

Lesson reading:

- In progress with sixth- and seventh-grade students
- Read lesson (original or revised) while eye movements were recorded, wrote recall, solved problems
- Preliminary eyetracking data indicate revised lessons were easier to read than original lessons.

The findings from these experiments will contribute towards refining cognitive principles for future revisions.

