Improving Visual and Verbal Information Integration in Mathematics Textbooks

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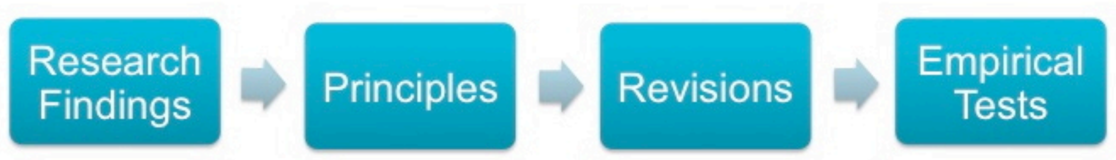
INTRODUCTION

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.

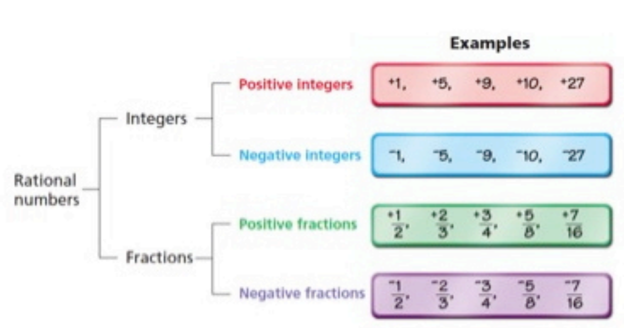


Signaling Principle

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

Color Coding

Original



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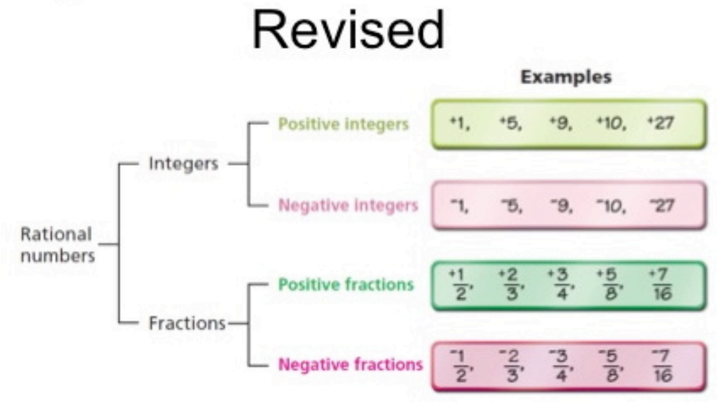
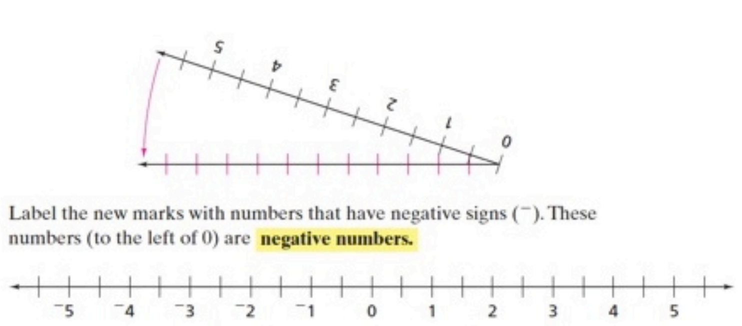
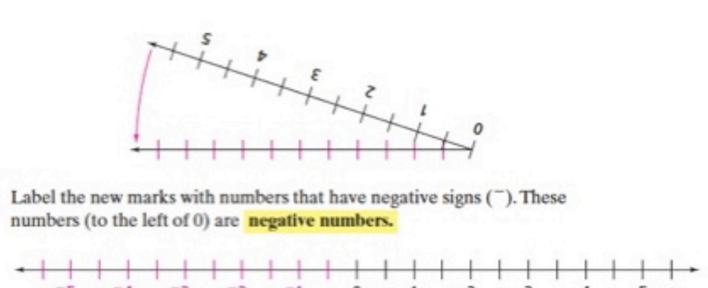
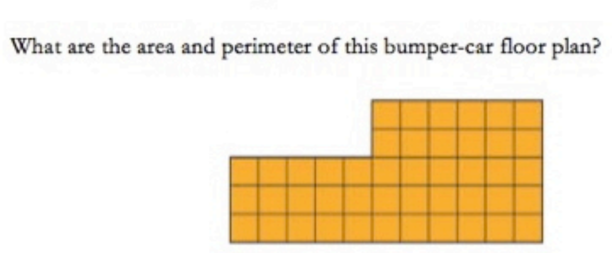






Adding Missing Information

Original



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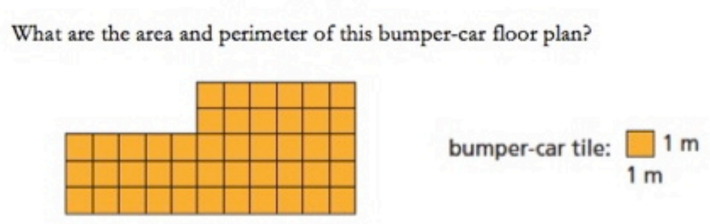

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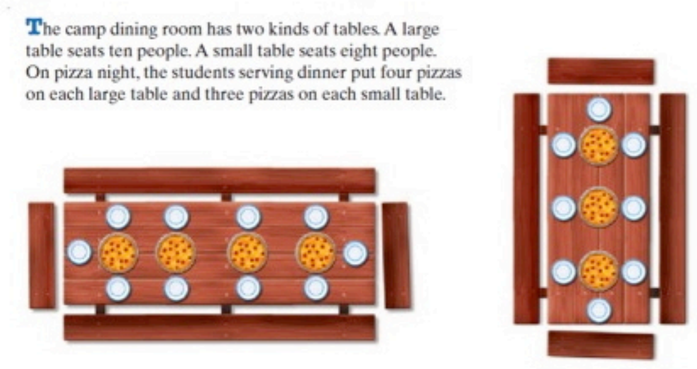
Contiguity Principle

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

Shared Spatial Layout

Original



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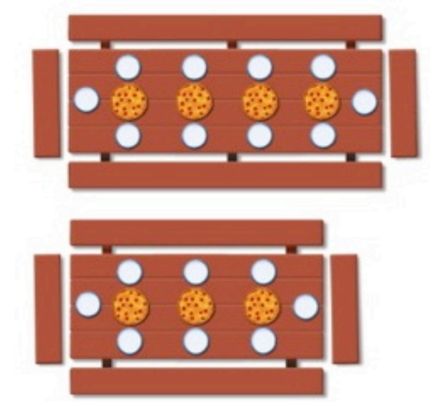
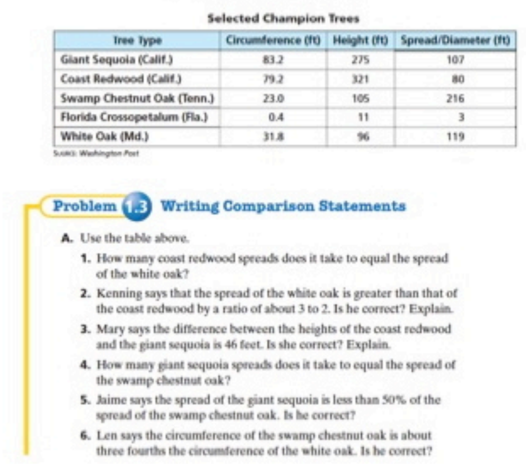


Spatial Contiguity

Original

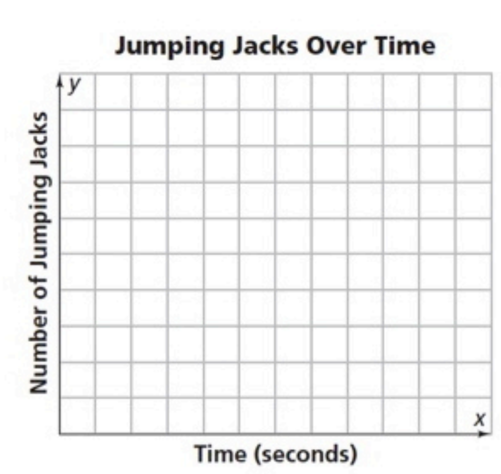
The problems and the table necessary to solve the problems are on different pages.

Revised



Integrate Verbal and Visual Information

Original



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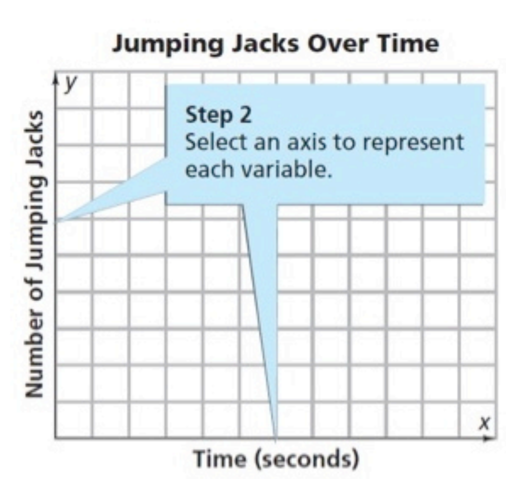


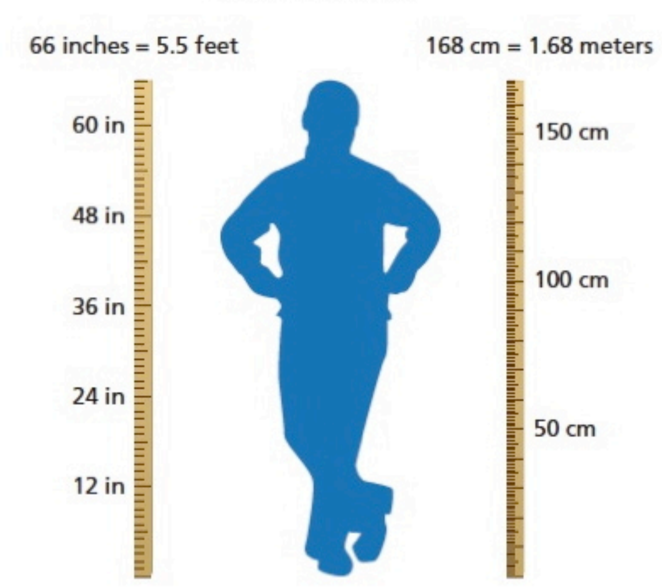
Coherence Principle

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

Replace Math-Irrelevant with Math-Relevant

Original

Revised

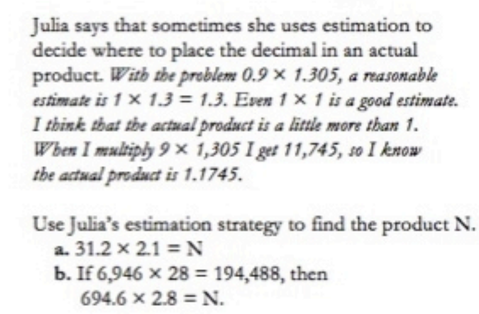


Coherence Principle (continued)

Remove Seductive Details

Original

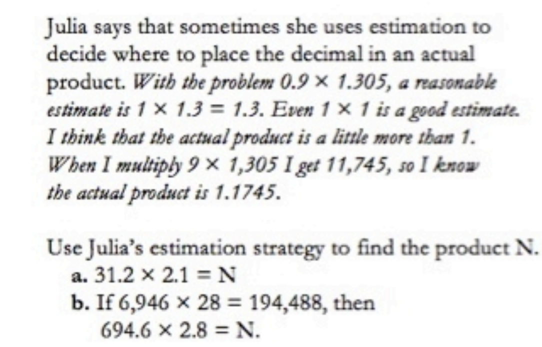
Revised


Julia says that sometimes she uses estimation to decide where to place the decimal in an actual product. *With the problem 0.9 × 1.305, a reasonable estimate is 1 × 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 × 1,305 I get 11,745, so I know the actual product is 1.1745.*

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

a. 31.2 × 2.1 = N

b. If 6,946 × 28 = 194,488, then 694.6 × 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 difficult
-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.