

## CONTEXTUAL VISUAL INFORMATION IN MIDDLE SCHOOL PROBLEM SOLVING: A PUZZLING SITUATION

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Research findings on integrating visuals with text have indicated that students learn less when interesting but irrelevant materials, such as decorative images, are included (e.g., Harp & Mayer, 1998; Mayer, 2009; Sweller, 2005). The basic idea is that these can overload processing and disrupt student learning and performance, but evidence with math problems is mixed (e.g., Berends & van Lieshout, 2009). Based on the theories and previous research findings, we revised eight problems in an existing mathematics curriculum. We used four types of revisions within-subjects; three removed decorative images and one added relevant information to the visual.

Fifty seventh-grade students each completed eight problems. We assessed students' problem solving accuracy and strategies in addition to their math background, math attitudes, and contextual recall as these measures potentially influence the effect of visual representations. Revising the problems in concordance with the research-based principles did not have a consistent effect on performance or strategy use, nor were these effects related to students' math ability or anxiety. This is in contrast to what is often found in applications of these principles in science (see Mayer, 2009). Adding labeled dimensions to a visual increased the use of units, although not necessarily in a correct way. Of note, we found that the revisions did not affect students' opinions about the problems. The recall measures indicated that students encoded the contextual information from the text and/or visuals. Additional processing of the contextual information (as seen by correct recall) tended to be associated with lower mathematical accuracy, but this was unrelated to the presence of the decorative image. Overall, the lack of consistent effects indicates the need for further research on the influence of these principles in mathematics.

Given the multitude of visual representations in mathematics textbooks, it is critical to understand how visual information (both decorative and relevant) influences students' problem solving. The math ability level of our students was relatively high, and other individual differences may explain the lack of consistent effects. Investigating student attitudes as well as their contextual memory broadens the research base, so that researchers and educators can develop more nuanced understanding of the uses of visuals. Most clear from this research, however, is the need to further address how to enhance the integration of visual and verbal information in the mathematical problem solving of K – 12 students.

### References

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