A Meta-analysis of the Worked Examples Effect on Mathematics Performance

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BACKGROUND

• Worked examples are worked out problem solutions that learners’ study when practicing new material (Sweller, 1985).
• Worked examples can be designed to evoke connections between procedures and concepts by supplementing them with self-explanation prompts that encourage learners to make these connections explicit (Berthold et al., 2009; Catrambone & Yua, 2006).
• Studying worked out problem solutions encourages learners to devote their cognitive efforts to studying the relevant features and processes of solving the problem (Sweller, 2012).
• An Institute of Education Sciences’ (IES) Practice Guide (IES) released in 2007 concluded that there was moderate evidence that interleaving worked examples and problem-solving was effective for mathematics learning.
• The proposed meta-analysis would assess the overall effect of WEs and examine whether or not the evidence is consistent with conclusions made by IES in 2007.

EXCLUSIONARY CODING OF STUDIES

METHODS

ANALYSIS

• Given our interest in the overall effect of an intervention, we used Hedge’s g as our effect size of choice.
• To analyze our data, we used Robust Variance Estimation (RVE) to account for the nesting of effect sizes for every mathematics outcome within studies and manuscripts.
• Our 185 effect sizes ranged from -1.80 to 4.66, with 41 effect sizes in the negative direction and 144 in the positive direction.
• The average effect size was g = 0.43 within our robust variance estimation (RVE) model with a 95% CI from 0.31 to .55, p = .031.
• According to Cohen’s standards, worked examples have a small to medium (g=0.43) effect on mathematics outcomes.
• Significant heterogeneity was detected, with I^2 = 94.46%.
• We assessed moderators of the example effect on mathematics performance measures using meta-regression and our analyses indicated that none of the moderators were statistically significant.

WORKED EXAMPLE EFFECT

READER QUESTIONS

• What is the average effect of worked examples on mathematics performance outcomes?
• What moderates these effects?

STUDY DESCRIPTORS

1. Include 40 articles, reporting a total of 49 studies, which reported a total of 185 effect sizes.
2. 46 experimental and three quasi-experimental studies.
3. 32 articles included studies using correct worked examples; Seven articles included studies using incorrect examples and four included comparison conditions; Four articles included studies involving faded worked examples.
4. Moderators explored were type of example, administration format, grade/school level of participants, and content area targeted.
5. 20 US articles, remaining conducted internationally.
6. Majority of studies reported included performance outcomes measured by percent accuracy with just three articles reporting on problem-solving errors.

DISCUSSION

• Cohen’s Standards - Medium effect. IES standards - “practically meaningful”. Learners who study worked examples improve almost half of a standard deviation (g = .43) in their mathematics performance compared to those who do not.
• Only five of the forty articles reviewed were published by 2007 when the IES published a report claiming moderate evidence to support interleaving problem-solving practice with worked examples.
• We found that the effects persisted regardless of the specific moderators tested.
• Our findings indicate that the worked examples effect appears to be robust to variations in design, age, and content area differences.
• Future work might contribute to design and age considerations to include a more nuanced understanding of these considerations as they relate to cognitive load theory.
• More widespread use of worked examples, as well as professional development for teachers in creating and using their own worked examples with their students may be a fruitful practical next step.