THE EFFECTS OF WORKED EXAMPLE FORMATS ON STUDENT LEARNING OF ALGEBRA

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Worked examples consist of step-by-step derivations of problems, and are often provided to students as a way to learn the procedures for solving problems. An extensive body of literature has shown that worked examples can help students learn mathematics (e.g., Atkinson, Derry, Renkl, & Worham, 2000; Booth, Lange, Koedinger, & Newton, 2013; Sweller, 2006) but how the presentation of worked examples influence student learning remains unclear. For instance, new educational technology tools that demonstrate the dynamic process of solving algebraic equations (e.g., dragging 4 across the equal sign to initiate the inverse operations and divide both sides by 4 in $4x = 6$) may provide the opportunity to explore the potential benefits of dynamic worked examples.

To study how variations in worked example presentations influence learning, we varied the format of worked example presentations of algebraic equations in an online platform. Specifically, we compare the impact of viewing worked examples in animated dynamic presentations, traditional static presentations, and sequential line-by-line presentations. Within these variations, we also compare concise worked examples (e.g., Rittle-Johnson & Star, 2007), which display only the important steps of solving algebra problems, and extended versions, which display all steps in a derivation.

Our research questions are as follows: 1) *Do concise or extended worked examples lead to larger gains from pretest to posttest?* 2) *Do students show differential gains from viewing dynamic, static, or sequential worked examples?* 3) *If dynamic worked examples lead to higher learning gains, which form of dynamic worked examples are best for learning?* Currently twelve middle school teachers with a total of 146 students have completed this study and data collection is ongoing. Students complete a pretest on algebraic equation solving, six worked example-practice problem pairs, and a mirrored posttest in a 45-minute session. Our estimated sample of over 400 affords at least 80% power to detect small to medium effects of worked example length ($f = 0.13$) and presentation ($f = 0.15$).

Data analysis for this study will be conducted once all participants have completed the study in Fall 2020. To explore our research questions, a 2 (pretest vs. posttest) × 2 (concise vs. extended) ANOVA will be conducted to test the effects of work example length, and a 2 (pretest vs. posttest) × 3 (static, sequential vs. dynamic) ANOVA, and a 2 (pretest vs. posttest) × 2 (dynamic concise vs. dynamic extended) ANOVA will be conducted to test the effect of each worked example format on learning gains.

We expect that the results from this study will help the field better understand the best way to present worked examples. Results and implications will be presented at the PME-NA conference.

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