Testing the effect of correct and incorrect worked examples, worked examples and problem solving on learning algebra skills

Bing Ngu - The University of New England
Ouhao Chen - University of Southern Cross
Huy Phan - The University of New England
Qqab Alrashidi - The University of New England

Very few studies have investigated the relations between cognitive load imposition and motivation. Van Gog, Ericsson, Rikers, and Paas (2005) argued that students might not invest germane cognitive load in learning activities unless they were motivated. The Framework of Achievement Bests, recently developed (e.g., Phan, Ngu, & Yeung, in press), may provide theoretical grounding, accounting for the associations between students' motivation and cognitive load imposition. The cognitive load effects aim to reduce extraneous cognitive load, which will then allow an increase in germane cognitive load to facilitate learning. Therefore, effective instructions imposing low cognitive load may influence internal personal processes such as persistence, motivation, etc., to optimize students' achievement (Phan et al., in press). The Framework of Achievement Bests highlights different levels of best practice, for example: realistic achievement best (i.e., what can I actually do, at present, in regard to solving linear equations?) and optimal achievement best (i.e., what is the best that I can do in regard to solving linear equations).

We hypothesize the close alignment between sub-optimal instructions and realist achievement best, and the close alignment between optimal instructions and optimal achievement best. Using appropriate instructional design as an 'optimizing agent', the present study aims to validate the Framework of Achievement Bests on Algebra learning. From the perspective of instructional design, worked example that shows full guidance is better than problem solving that does not provide guidance (e.g., Chen, Kalyuga & Sweller, 2015, 2016). Previous studies involving worked examples focused mostly on using correct worked examples, and very few studies have considered the nature of the solution in the examples. Apparently, incorrect examples could help students recognize and rectify incorrect procedural knowledge (Booth, Lange, Koedinger & Newton, 2013). However, the effectiveness of using incorrect worked examples may not be observed for all learners (Große & Renkl, 2007). Incorrect examples were ineffective for inexperienced learners because they may not be able to locate and identify the errors in the examples. This study will test the effect of three instructions (i.e., correct and incorrect worked examples (see below), worked examples and problem solving), as well as varying levels of motivation associated with the three instructions on learning algebra skills. Middle school students will be randomly assigned to three groups (i.e., correct and incorrect worked example, worked examples, and problem solving). They will sit for a pre-test, complete acquisition problems and achievement best questionnaire, rate cognitive load invested in learning, and undertake a post-test that has identical content as the pre-test. Data collection is scheduled to occur in May 2017, and we wish to report the data at the 10th ICLTC.

Correct worked example

Line 1: 3x+2(2+x)=24

Line 2: 3x+4+2x=24

Line 3: 5x=20

Line 4: x=4

Incorrect worked example

Line 1: 3x+2(2+x)=24

Line 2: 3x+4+x=24 Can you explain why this step is incorrect? (compare this step with Line 2 above)
Line 3: 4x = 20 Explain (write a short sentence): .....
Line 4: x = 5