Should I Use My Calculator?: Mental versus Calculator Assisted Arithmetic

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Introduction: Calculators and Mathematics

Early studies investigating the influence of calculators on learning found that participants using calculators were faster and more accurate than their counterparts without calculators. Participants using calculators, however, showed no attitudinal improvements, and conceptual improvements were only evident for those already working at a higher computational level (for a review see Roberts, 1980). More recent studies have found that mental calculation is critical for recall of mathematical learning, and have supported the position that calculators may be more useful for students who already possess the cognitive processes necessary to retrieve answers, than for students with weak mathematical ability (Crutcher & Healy, 1989; McNamara, 1995). This study investigates the claim that calculators permit more rapid computations than mental arithmetic.

Methods & Results

Adult participants (n=15) completed a timed calculation test and responded to a questionnaire about their attitudes towards mathematics. Two subtests of the Kit of Factor-Reference Cognitive Tests (French, Ekstrom, & Price, 1963) were used to measure calculation fluency. Total problems correct across two pages of multi-digit addition, subtraction and multiplication problems were used as a measure of calculator assisted calculation fluency or mental calculation fluency depending whether the pages had been completed with or without a calculator. All participants completed both the calculator assisted and mental calculation fluency measures. Conditions and pages were counterbalanced.

Participants completed significantly more problems when working without a calculator than when working with a calculator (43.5 vs. 36.1), $t = 2.41$, $p < .05$ (Figure 1). In contrast to previous findings, this study did not find a speed advantage for calculator assisted arithmetic.

Nervousness towards mathematical activities did not significantly affect mental calculation fluency, $F(3,11) = 1.90$, $p = .188$, but did significantly influence calculator assisted calculation fluency, $F(3,11) = 4.65$, $p < .05$.

Implications

The exact impact of calculators on mathematical concept development remains unclear. The introduction of calculators into mathematics curricula has been perceived as changing the teaching of mathematics from routine procedures to thinking, reasoning and conceptual skills (Usiskin, 1999). Many studies have supported the use of calculators and other technological tools, yet, these studies often involved a control group that had been taught very differently from the experimental group. It could be the teaching, and not the actual usage of the calculator, that influences the mathematical performance and understanding of students. Since participants in the present study completed the same tasks under the same conditions, their performance should only have been affected by the use, or non-use, of the calculator. Thus, the inefficiency of calculator assisted arithmetic becomes apparent.

Although technological tools may support mathematical conceptual exploration, and provide a feeling of security for students with math anxiety, they may not actually improve calculation fluency. One can begin mentally calculating the next problem while still writing down a previous response. This efficiency cannot occur while using a calculator, thus rendering mental calculation more rapid, as demonstrated by the results of the present work.

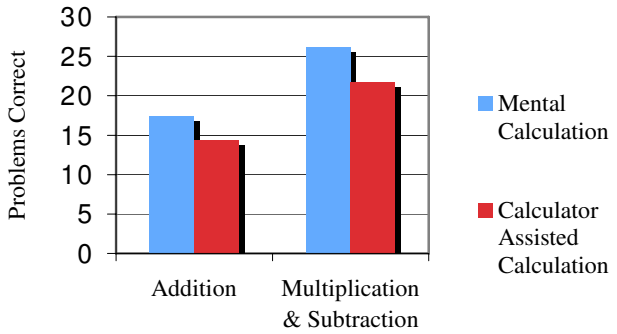

Figure 1: Comparison between mental and calculator assisted calculation fluency.

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