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Research Bibliography: Calculators (four function)

Keith Jones

This bibliography lists research that has investigated the use of four function calculators in the teaching and learning of mathematics. The bibliography is not intended to be exhaustive; rather it details some of the most relevant studies and reviews across the range of research that has been published.

Cole, C. & Newson, G. (1996), Primary Children's Views on Using Calculators in School, *Mathematics Education Review*, **7**, 42-49.
Found that primary pupils are positive yet wary of calculators (and, in the latter case, even when their primary schools profess to be positive).

Fisher, J. P. & Stephens, L. J. (1992), Effects of Using Calculators on Mathematical Achievement for Remedial Seventh Grade Students, *International Journal of Mathematical Education in Science & Technology*, **23**(5), 745-748.
Found no difference between the performance of low-attaining pupils permitted to use calculators and those not allowed.

Groves, S. and Stacey, K. (1996), Redefining Early Number Concepts through Calculator Use. In J. Mulligan and M. Mitchelmore (Eds), *Children's Number Learning* (pp. 205-226), Adelaide: The Australian Association of Mathematics Teachers.
Groves, S. (1997), The Effect of Long-Term Calculator use on Children's Understanding of Number: Results from the 'Calculators in Primary Mathematics' Project, *Proceedings of the 16th Biennial Conference of the Australian Association of Mathematics Teachers*, 150-158.
Evidence from large-scale project that found that children with long-term experience of using calculators performed better than children without such experience on a range of computational and estimation tasks and had better understanding of the number system.

Hembree, R. & Dessart, D. J. (1986), Effects of Hand-held Calculators in Pre-college Mathematics Education: A meta-analysis. *Journal for Research in Mathematics Education*, **17**(2), 83-99.

Hembree, R. & Dessart, D. J. (1992). Research on calculators in mathematics education. In J. T. Fey (Ed.), *Calculators in Mathematics Education: 1992 Yearbook of the National Council of Teachers of Mathematics* (pp. 22-31). Reston, VA: NCTM.
Classic meta-analyses of about 80 previous research studies, indicating that use of calculators can, in appropriate circumstances, improve student learning, attitudes towards mathematics, and self-concepts in mathematics.

Ruthven, K. (1998), The Use of Mental, Written and Calculator Strategies of Numerical Computation by Upper Primary Pupils within a "Calculator-aware" Number Curriculum. *British Educational Research Journal*, **24**(1), 21-42.
Ruthven**,** K., Rousham, L. & Chaplin, D. (1997), The Long-Term Influence of a "Calculator-Aware" Number Curriculum on Pupils' Mathematical Attainments and Attitudes in the Primary Phase. *Research Papers in Education*, **12**(3), 249-281.
Provides evidence that primary pupils introduced to a "calculator-aware" curriculum make greater use of mental computation, particularly multiplication strategies based on distribution and compensation.

Ruthven, K. (1995), Pupils' Views of Number Work and Calculators. *Educational Research*, **37**(3), 229-237.
Found that secondary school student preferences for using/not using calculators was associated with both their degree of enjoyment of number work (and confidence in calculation) and their degree of scepticism about the legitimacy of calculators (or lack of confidence in using them). Primary schools had great influence on the formation of attitudes about calculators.

Scheuneman, J. D., Camara, W. J., Cascallar, A. S., Wendler, C. & Lawrence, I. (2002), Calculator Access, Use, and Type in Relation to Performance on the SAT I: Reasoning Test in Mathematics. *Applied Measurement in Education*, **15**(1) 95-112.
Studied the effects of calculator use on performance of almost 500,000 students on the US "Scholastic Assessment Test I". Found that

use of calculators was associated with higher performance (but note that the more able students were more likely to have calculators). Overall, the effects of calculator access were found to be small but detectable.

Warren, V. & Ling, J. G. (1994), Calculators in the Primary School since the Introduction of the National Curriculum, *Mathematics Education Review*, **4**, 30-40.
Confirms that when the statutory curriculum specifies the use of calculators, teachers will make use of them in teaching but that they feel that they need further professional development in order to use calculators most effectively in their teaching.

Other useful books and reports

Bright, G. W., Waxman, H. C. & Williams, S. E. (Eds) (1994), *Impact of Calculators on Mathematics Instruction*. Lanham: University Press of America.
Useful set of paper from a conference held in Houston, Texas, in May 1992.

Duffin, J. (1996), *Calculators in the Classroom*. Liverpool: Manutius Press.
A compendium of the six evaluation reports on the UK "Calculator-aware Number" curriculum project (known as CAN). Contains information on ways that primary schools might incorporate calculators into mathematics teaching.

School Curriculum and Assessment Authority (1997), *The Use of Calculators at Key Stages 1-3*. Hayes: SCAA.
Useful discussion paper that surveys calculator use in England. Contains an authoritative, but brief, review of research on calculator use.

Shuard, H., Walsh, A., Goodwin, J. & Worcester, V. (1991), *Calculators, Children and Mathematics*. London: Simon & Schuster.
An account of the work of the UK "Calculator-aware Number" curriculum project (known as CAN) which ran from 1986-1992.

Sparrow, L., Kershaw, L. & Jones, K. (1994), *Calculators: research and curriculum implications*. Perth, Aus: Edith Cowan University.
Reviews research findings about the computational needs of children (in relation to mathematical understanding through mental and written computation and calculator use) and suggests what might be the curriculum implications.

Research Bibliographies

Every year hundreds of teachers engage in classroom-based research for a variety of purposes. As more and more opportunities arise for teachers to get support for engaging with research, *MicroMath* is devoting a section to a series of *research bibliographies* designed to provide details of the most pertinent research on using particular ICT applications in the teaching and learning of mathematics.

Sources of support for classroom-based research continue to change and, at the time of writing, a number of the sources listed in the last issue of *MicroMath* (vol 18, number 3; Autumn 2002), including the BECTa ICT Research Bursaries, are no longer available. The D*f*ES Best Practice Research Scholarships (BPRS) scheme is also likely to change, although firm details are not yet available. It may be that the BPRS scheme becomes subsumed within plans currently being discussed for it to become the norm that all teachers complete a Master's degree, to include a suitable research study, within five years of qualifying. *MicroMath* will endeavour to provide updated information as it is published.

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