Calculators: Friend or foe?

Jeremy Hodgen and Colin Foster discuss the place of calculators in the classroom.

Parents and politicians frequently worry that using calculators in the school classroom might de-skill learners and prevent them from thinking for themselves and developing mental and written methods of calculation. Is this a valid concern? In our recent work on a guidance report on mathematics teaching for the Education Endowment Foundation (EEF, 2017), entitled *Improving Mathematics in Key Stages Two and Three*, we looked at the evidence for the effects of calculator use on learning. We found that appropriate use of calculators can improve learners' understanding of mathematics, and that, when taught well with calculators, learners actually used them *less* (Ruthven, 1998). Using calculators in considered and thoughtful ways seems to be particularly important with younger learners, and although we recommend that primary-age learners should not generally be using calculators every day, we believe that they should be using calculators frequently.

We think that it is important that calculators are not used to compensate for learners' numeracy difficulties, because then they could prevent learners from addressing those difficulties. No-one wants to see learners dependent on using a calculator to calculate 2 × 10. Instead, we think that calculators should be used to support deeper thinking about mathematics. Here are some examples of the kinds of calculator use we think are valuable:

Use estimation to "Beat the calculator": One learner finds the answer mentally more quickly than another learner does by typing into the calculator. Learners could be asked to generate examples of calculations that they can do more quickly mentally than on a calculator. A simple example would be 1.5 billion + 1.5 billion = 3 billion, which would take longer to type into the calculator than it would to think about. Older learners could tackle calculations such as $\frac{222\,222\,222\,222^2}{444\,444\,444\,444}$, which some calculators will not get exactly right, by building up patterns starting from $\frac{22^2}{44}$ and also by thinking about it as $\left(\frac{2 \times 111\,111\,111\,111^2}{4 \times 111\,111\,111\,111}\right)$ (Foster, 2010, p. 25).

Support problem solving involving calculations with realistic numbers: Before calculators appeared in classrooms, the numbers in problems had to be contrived to make calculation simple. This sometimes meant that the operation needed could be guessed based on the particular numbers chosen. With calculators, we can give learners problems involving much more realistic numbers, which avoids giving away clues, and means that learners have to think more carefully about the structure of the problem. Taking away the burden of tedious calculation allows learners to focus on wider aspects of the problem, and consequently to tackle more challenging problems.

Explore number patterns using the constant key: Learners are required to predict, describe and explain, not just press a key unthinkingly. For example, if we enter 5 and then keep on adding 3s, will we ever get to exactly 100? If we enter 100 and then keep on dividing by 2, will we ever get to exactly zero?

Explore multiplicative structure by trial and improvement calculations: For example, young learners could be asked what number they would have to multiply 8 by to get 18. They could experiment on their calculators, maybe starting with 2 and gradually homing in on the correct value. Afterwards, they could work on justifying why 2.25 must be the right answer and seeing that this is 18 ÷ 8.

An important goal is for learners to make sensible choices about when, and when not, to pick up a calculator. It can be helpful to ask learners for the same problem, "What would be a good mental way to do this? What would be a good written method? What would be a good method on a calculator?" For example, to increase £40 by 15% mentally, a learner might find 10% and 5% and add those to the original £40. But, using a calculator, they could just do 40 × 1.15 in one step.

Jeremy Hodgen is Professor of Mathematics Education at UCL Institute of Education. He can be contacted at jeremy.hodgen@ucl.ac.uk.

Colin Foster is an Associate Professor at the University of Leicester. He can be contacted at colin.foster@leicester.ac.uk.

References

Education Endowment Foundation (2017). *Improving mathematics in key stages two and three*. London: Education Endowment Foundation. Available from: https://educationendowmentfoundation.org.uk/public/files/Publications/Campaigns/Maths/KS2_KS3_Maths_Guidance_2017.pdf.

Foster, C. (2010). *Resources for teaching mathematics 14–16*. London: Continuum.

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.