**Some shortcomings in the Ofsted research review for mathematics (https://www.gov.uk/government/publications/research-review-series-mathematics)**

**Anne Watson, 27th May 2021**

The issues raised in the review are important, and the structure of the review is a useful way to think about them. The authors avoid telling teachers exactly how to teach or what models of lessons to follow, and frequently indicate issues for consideration rather than absolute instructions. However, as a research review it falls short of academic standards, obfuscating partiality and not revealing the processes by which the cited research was sought, found, selected and evaluated.

The authors have worked hard and accessed a range of research of varying degrees of relevance to the teaching of mathematics, a subject with a complex discipline and significant history, and the learning of it, about which we know some aspects but not yet all aspects. But the review is over-reliant on areas where something seems to be known according to some types of research, e.g. small scale cognition studies and arger scale innovation studies, usually about arithmetic or number. It ignores some central components of becoming mathematical in which there is little research of these kinds, such as how conceptual fields are constructed over time in long term memory, and how learners become able to solve unfamiliar problems (rather than ‘problems of the same type’ to which the report refers again and again). Machines, and children, can be programmed to solve problems of ‘the same type’ but solving problems that motivate new mathematical knowledge is a different, more complex, process.

I am going to focus on some of the problems, but not all:

1. The paper shows a fundamental misunderstanding about the role of problems and problem solving in mathematics itself and in mathematics education, including ignoring the use of problems in typical teaching in high performing countries, i.e. problems often being presented before procedural teaching , which contrasts with the conclsuions reached by the Ofsted authors. I think the authors use ‘problems’ to mean ‘questions and word problems’ rather than problems within mathematics itself that lead to the *need* for extensions, adaptations and new knowledge. They cite Japanese lesson study without crediting the role of problem solving in teaching and learning mathematical concepts in those lessons. In Chinese mathematics teaching, also cited, new topics often start with a problem that can be solved in several ways, not only one way, and is then extended to develop a need for a new perspective. The research they cite about problem solving refers to the much more limited issue of answering questions that yield to a previously learnt strategy.
2. It omits the central role of the visual dimension of teaching abstract concepts, including a reference to imagery that has no connection at all with the way this term is used in mathematics education. Mental imagery of models and diagrams that carry structural meaning, such as number-lines, grids, and geometric structures, is a core feature of mathematical thinking. Imagery in mathematics education goes well beyond ‘pictures in text books’.
3. It omits the central role of verbal interactions that enable learners to make sense of simple or complex, visual or physical, situations and that mediate all learning experiences, whether these are repetitive exercises, realistic problems, or explorations etc. Verbal interactions support scaffold learning, linking abstract ideas to direct experience through language.
4. It omits anything about the extensive experience children have of space, shape, position, movement, distance, quantity (particularly pre-school) focusing mainly on formal arithmetical knowledge while generalising results to ‘mathematics’.
5. There are internal contradictions of advice, over-generalisations of limited research results and a tendency to give pedagogic advice based on limited and situated research results. The links between research findings and pedagogic advice are too often flimsy and opinionated.

One example of the latter is about games. A search on ‘games’ in the document shows conflicting advice based on research limited to a few participants. Furthermore, they direct people to prefer competitive games over collaborative games by citing a paper which shows that competitive, collaborative and independent video games about arithmetic fluency *all* led to overall learning beyond the game. The paper also says that:

“Furthermore, competition and collaboration elicited greater situational interest and enjoyment and invoked a stronger mastery goal orientation. Additionally, collaboration resulted in stronger intentions to play the game again and to recommend it to others. Results are discussed in terms of the potential for mathematics learning games and technology to increase student learning and motivation and to demonstrate how different modes of engagement can inform the instructional design of such games.”

These complex results from one small-scale and specific study are turned into a general statement that competitive games are better for retention – which is not supported by this research study.

Here is another example where the authors stray beyond what is acceptable in a research review. They give a particular paper to support this paragraph:

“Teachers should be cautious about giving pupils ownership over their own path of progression through the curriculum. This is not just because of the influence of prior knowledge on progression through the curriculum, but because pupils might not know enough about future progression in mathematics to make the best choices now.[footnote 105] For example, deciding when and how much to rehearse basic calculations may inadvertently curtail later chances of success if pupils feel that immediate success and accuracy are the best signals to move on.”

The paper they cite is: BK Martens and JC Witt, ‘Competence, persistence, and success: the positive psychology of behavioral skill instruction’, in ‘Psychology in the Schools’, Volume 41, Issue 1, 2004, pages 19 to 30. This is a research review citing some successful methods in tennis, martial arts, playing musical instruments, and applying these to classroom behaviour (the clue is in the title of the paper). The current authors have turned this paper into a warning against teaching methods in mathematics not mentioned in the paper as ‘successful’. Yet the paper is about behaviour rather than the intricacies of abstract mathematical learning.

Now the warning in this paragraph happens to be one with which I agree; I think monitoring learners’ mathematical choices to ensure no one is disadvantaged is a social justice issue so I cannot be accused of disagreeing with the review because of personal opinion, but the referenced paper offers nothing relevant as far as I can see. Furthermore this review ignores another quote from the same paper: “It is important to remember that good teaching represents an interaction between the teacher and the learner.” This is the core of good and fair teaching. In the examples I have seen of giving learners some choices about practice there has always been interaction about evaluating choices, either before or after, and care about what is practised. The possible role of the teacher in mediating, guiding and supporting independent decisions within the overview of the expert is not mentioned, nor is the importance of the learner being able to have some control over their own feelings of growing competence.

A main problem for me is the absence of the child, the learner, as a human being rather than a cog in a massive learning system. The learner is treated as an immutable machine in an input-output model of efficient learning that is assumed not to change. I agree that much can be done by improving teaching through paying close attention to conceptual learning of the number and symbol systems on which mathematics is based, hence linking competence and confidence throughout for all learners. But the ultimate goals of education need to include the development of the independent and informed mind and there is no reason why this should be ignored in mathematics lessons. Learners *can* become better thinkers and learners through being presented with higher-order challenges supported by interaction with teachers. The CAME (Cognitive acceleration in mathematics) methods have shown that for decades but are not included in the review, despite their relevance. Could it be that the review team only sought research that might support pre-determined ideas?