Automatic recall and executive functioning

Helen J Williams explores how to work positively with the contentious introduction of automatic recall for learners in the early years.

The latest iteration of the Early Years Foundation Stage Framework (EYFS) in England (DfE 2020) has included some contentious changes. For mathematics, these are the removal of shape, space and measures as statutorily assessed, when we know that spatial reasoning predicts later achievement, and not only in mathematics (Wai, Lubinski and Benbow, 2009). The new statutory framework has two Early Learning Goals for 4-5-year-olds to be assessed against at the end of the Early Years Foundation Stage (EYFS) and both relate to number. Here is the goal that is causing concern:

> Automatically recall (without reference to rhymes, counting or other aids) number bonds up to 5 (including subtraction facts) and some number bonds to 10, including double facts. (DfE 2020)

In this article, I focus on the term 'automatic recall' and look at how, since we are stuck with it, we might work ethically and responsibly alongside it. Elsewhere, I have discussed the changes to the EYFS and the primary mathematics curriculum more generally (see notes at end of article).

What is automatic recall?

Those of us objecting to the term 'automatic recall' have been painted as being 'against' working towards fluency. This is not the case. I agree with having 'fluency' as one of the three aims of the English mathematics national curriculum, along with 'reasoning' and 'problem solving'. I do not believe it is correct to use the terms 'fluency' and 'automatic recall' interchangeably. This definition of fluency comes from 2104, when the English national curriculum introduced it as an aim:

> To be mathematically fluent one must have a mix of conceptual understanding, procedural fluency and knowledge of facts to enable you to tackle problems appropriate to your stage of development confidently, accurately and efficiently. (NCETM 2014)

'Automatic recall' as a term seems to have slipped in recently and it is difficult to find a definition for this. A dictionary definition defines 'automatic' as, "done or occurring spontaneously, without conscious thought or attention". Conceptual understanding is seen as being at the root of fluency; for automatic recall this does not appear to be the case. This, to me, is critical. To imply that a four- or five-year-old should have recourse to abstract number facts "without thought or attention" is dangerous. This term implies a drilling of abstract number facts, particularly with the inclusion of the words: "without reference to rhymes, counting or other aids". For four- and five-year-olds this is not appropriate.

Before moving on to exploring some games that I have found effective, and fun, to play with four- and five-year-olds working on fluency with small numbers, it is worth pointing out that what follows is not about getting children to attain a tick next to 'automatic recall'. It is about what we do anyway, as part of young children's entitlement to high quality early mathematics. What follows is based firmly in building children's confidence, their competence and their enjoyment; as well as working on developing children's Executive Functioning.

Put simply, 'executive functioning' is the set of mental processes responsible for how we control our own behaviour and work towards goals. These skills are critical for young children's learning and are predictive of later mathematics achievement, as well as wider school success. Joswick et al's authoritative article (2019) examines how making small changes to a simple game aimed at developing numerical competencies can also work on developing important higher-order executive function skills. I realised that a game that I had been working on and with for many years fitted this narrative, where there would be an additional emphasis on children's executive functioning as well as their fluency and confidence. I describe it in what follows. I have to credit and thank the sadly missed BEAM (Be a Mathematician) team and in particular the ILEA pack *Count Me In* for the original idea.

Boss person and X-ray eyes

In this version we are working with number pairs up to a total of 8. I would always introduce a new number game using an amount that children are already fairly fluent within, say 5 (and number cards 0,1,2,3) and work up gradually as the game becomes familiar.

You need: a shallow box or tray, 8 buttons or similar, cards numbered 0,1,2,3,4, (the children can make these) and a partner.

To play: Decide who starts as the boss. The other person (the one with X-ray eyes) goes away until they

are called back. Whilst they are gone, the boss:

- Chooses two of the cards, places them in the box and counts the correct amount of buttons into the tray for each card,
- Checks how many buttons there are altogether and pushes the buttons into one pile,
- Turns over one of the cards. Then,
- Calls back their partner. Tells them by looking in the box with their X-ray eyes, to work out which number is written on the hidden card.

Swap roles and play again choosing two different cards each time.

Figure 2: A game with 8 bears in the tray. Boss person has hidden a card for their partner with X-ray eyes to identify.

Let us examine what is involved in this game as it stands here.

Firstly, the total to calculate changes each time two different cards are selected. This is more demanding than keeping the total constant, dividing this into two groups and hiding one of these. Whereas there are only five possibilities for two groups in this case, there are nine possibilities in the version described above. Once a 5-card is included, the number of possible pairs increases to 14 and the maximum total to calculate, to 9. So, it is worth considering carefully where we want the challenge to be!

The boss is being asked to combine two small quantities and their partner is reversing this process; so, in effect they are modelling the relationship between addition and subtraction. 3 + 5 = 8 and 8 – 3 = 5.

They are linking the numerals to the amounts and using the total amount to find the missing number. It is a wonderful revelation when the person with x-ray eyes can 'see' the hidden number (yes, they are allowed to touch the buttons). The adult can, after they are successful, ask these questions:

What do you notice?

How do you know there is a 3 on the hidden card?

How else do you know there is a 3 on the hidden card?

To deepen and strengthen the mathematics, we can make several alterations to this game over time, varying the mathematical demand. Variations might include:

- Increasing the cards to include a 5-card (see above)
- Playing with two sets of 0-4 cards (allowing double facts)
- Instead of pushing the buttons together, the Boss removes one card but keeps the two amounts separate and arranges each quantity so we can easily see at a glance how many there are. This shifts from using counting to subitising in exploring the composition of a total.
- Choosing three cards and hiding one, to explore how a total is composed of three small quantities (Figure 3)
- Playing with one constant total, say 6, and hiding the buttons instead of the number-card. Keeping the total constant reinforces the bonds within that total and works towards recall.

Figure 3: Playing with three cards to make a total.

Executive Functioning

What has executive functioning to do with this game? Executive functioning includes three elements:

(1) inhibitory control
(2) working memory
(3) attention shifting and cognitive flexibility.

In relation to the original Boss Person game: 'Inhibitory control' stops the child from making a wild guess or just grabbing and looking at the hidden card; 'working memory' is employed as the child remembers how the game works and that the number of buttons will match the total of the two chosen cards and 'attention shifting and cognitive flexibility', is engaged as the child has to move between the whole quantity and the two part-quantities, as well as shift between being the Boss and the person with X-ray eyes.

It is important for the development of children's executive functioning skills, that they have control as they play games such as these, rather than us. Simply following adult instructions and answering the adult's question "So, what number is on my hidden card?" will not cut the mustard. As the Early Childhood Mathematics group suggests:

Switching the focus from child thinking to adult teaching is particularly unfortunate for mathematics, as building positive learning dispositions is essential in order to prevent maths anxiety, as well as to develop children who are confident mathematical thinkers and problem solvers. (ECMG 2020 https://earlymaths.org)

Finally

I have found repetition of a simple game, which we can all enjoy, that can be played independently and that we vary over time, to be a powerful way of fostering fluency and confidence with four- and five-year-old children (in fact, all children). Repetition is essential. When the rules of a game are well known, we can focus on the mathematics (in this case the combinations of amounts to make a total) embedded within it. We can discuss these with the children as well as 'what might happen if …' we add a 5-card? Moreover, in providing a context that is understandable and familiar, we can move backwards and forwards between using the manipulatives and working in our heads. "Pretend I have 5 buttons and you can see number card 2 – what is my hidden card?" becomes a perfectly accessible question answered without reference to "rhymes, counting or other aids".

Based on my observations of the children when they play independently without my input, I am clear why, how and when to introduce a variation to the game and what alteration might be fruitful. Such games are rich and meaningful mathematical experiences in their own right, and rightly demand the use of aid.

If assessment is to be trusted, it needs to be reliable and based on what we know from research as indicative of later achievement. Goals should describe what is typical development, describing what almost all children are likely to achieve at the end of their Reception year. We need to be clear about this when talking to our colleagues. This particular section of this Goal does not satisfy either of these criteria. In order that inappropriate and over-ambitious targets do not discourage teaching for depth and understanding, we need to discuss these issues and remember that the ELGs are 'best fit' and not 'achieve all'. I am rather fond of the notion of 'principled non-compliance', developed by Dr Richard House. This refers to professionals invoking the age-old Hippocratic Oath of 'Do No Harm…' in supporting a refusal to comply with Government impositions that professionals know will harm their clientele. In this case, the young children they work with. Enjoy the games and deepen the learning by creatively interpreting the 'automatic recall' part of the Number Goal.

Notes

My blog about the changes to the EYFS: https://info125328.wixsite.com/website/post/why-are-we-so-worried

My article about the importance of shape, space and measures: https://famly.co/blog/the-child/helen-williams-spatial-reasoning/

The Early Childhood Mathematics Group (@EChildhoodMaths) has a rich website of guidance: https://earlymaths.org . Here they lay out the research behind objections to some of the changes to the 2020 ELGs: https://earlymaths.org/a-mathematical-dogs-dinner-2/

Helen J Williams is a teacher, researcher and writer specialising in early years mathematics. She tweets as @helenjwc

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