

Dynamic assessment: Linking assessment and teaching frameworks

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[1] Introduction

In this talk I want to address both Maths Recovery cognoscenti and maths educators who may not be ‘insiders’ in the sense of having extensive experience of using Maths Recovery. Both audiences are very important and I hope that what I have to say will make sense to everybody (including those who may read this talk as the paper that it is to become). Above all I hope it will help us to develop a well-grounded consensus about how Maths Recovery is related to other developments in assessment and teaching in the wider educational sphere.

Whenever we meet something new we tend to assimilate it to whatever we are already familiar with in order to understand it. In so doing we can sometimes distort aspects of the novelty, and can sometimes overlook genuine qualities that are there for all to see. One of the conundrums (conundra?) of knowledge is that we can’t help this distortion – it’s part of the process of understanding – and this morning I will be doing this as much as everyone else has done. However, I’m pinning my hopes on the process of discussion among academics and practitioners. I hope that by locating Maths Recovery within current theories of assessment I can bring an understanding of Maths Recovery into a wider arena where it can be subject to discussion and reflection. What I really hope that we all gain from my talk this morning is an enhanced sense of the direction and uniqueness of Maths Recovery assessment and teaching and I also hope that we all end up knowing more about who we are and where we are going.

I am going to discuss two things. The first is the dynamic nature of the Maths Recovery assessment, and how the features of dynamic assessment mark it out as fundamentally different from any other kind of diagnostic assessment in mathematics. The second is the unique and powerful link between the assessment framework and the teaching framework

in Maths Recovery. My conclusions are going to be about how we can best use our understanding of the frameworks to help all primary teachers work with children in ways that enhance their potential to understand maths and to use it creatively in the present and in the future.

[2] Maths Recovery assessment as dynamic assessment

The first point I'm going to address is 'What does it mean to call the Maths Recovery assessments 'dynamic'?' This raises a further question – what is the difference between dynamic assessment and diagnostic assessment?

The main difference between the two lies in the conception of knowledge that the examiner holds. Our culture (Western, Anglo-Saxon) has a concept of knowledge that is very strongly related to the role that writing plays in objectifying what we know and making it real. It's possible to become trapped in an illusion that written words, pages and books are themselves the knowledge that we desire for ourselves and the children we teach. It's hard sometimes to un-think the metaphor of knowledge as object, and to grasp the rather less common metaphor of knowledge as dynamic thought process.

For example – the Stage 2 child 'knows' that $4+2=6$ and yet often appears not to know how many more than four there are if the hidden total is six (the missing addend problem). This is so puzzling to most people that when they first see it they are certain that the problem is simply that the child 'didn't understand the question'. This is only a puzzle if we think of early maths learning as grasping a series of one-dimensional facts that are like objects – once formed always available. Using the Maths Recovery interviews, it's quite easy to demonstrate that mathematical knowledge is not like this for young children – that it is ephemeral and appears and reappears

Especially when we are dealing with young children, we need to remember that the mathematical knowledge we want them to have is not a thing, or an object, but is a way of understanding and relating to the real world. Mathematics is more a way of thinking

and solving problems than it is a set of facts. It is in support of this more complex notion of mathematical knowledge that dynamic assessment really comes into its own.

The history of (particularly mass) assessment is strongly related to written forms of knowledge – the model is one in which the examiner ‘tests’ for the existence of specific knowledge in the individual. This ubiquitous aspect of our culture makes it very hard for us to get away from the metaphor of knowledge as some kind of object. Dylan Wiliam in his historical research talks about the puzzled response of academics to new criteria for fairness introduced during the change from oral to written examination. Prior to this, examinations had been oral, and the criterion for ‘fairness’ was whether each candidate had been given the same conversational opportunity to demonstrate their knowledge. Once written examinations were introduced, the criterion for fairness altered radically to whether each candidate had been asked the same question. This flags up a subtle change in the common (or grounding) metaphor for knowledge. The change in the criterion of fairness tells us that there was an accompanying shift in the regulation of knowledge, from the private sphere to the public, because rules invoking fairness as objective similarity are associated with public regulation, whereas private regulation uses more complex second-order rules to achieve fairness. To give an example from the familiar, we are all governed by complex social rules and in the public sphere (governed by laws) the criterion for fair application is that the same law applies to everybody, no matter who they are. Exceptions to the rule, such as children and psychiatric cases, are very carefully defined. In the private sphere, which is governed by informal social rules, there are sets of rules common to each culture, but these rules are not applied equally to everyone. Every parent understands, for instance, that generic family rules apply differently according to the age and status of their children and that it is most unfair to simply apply them all in the same way to everyone. The way in which the notion of fairness changes between contexts reflects the differences between objective assessment on one hand and the Maths Recovery interview on the other. The Maths Recovery interview goes back to the roots of assessment by using conversation to examine knowledge as a process. In so doing it discards the metaphor of knowledge as object.

The knowledge-as-object metaphor is, however, fundamental to the measurement theory that underpins psychometric testing. The assumption that the contents of knowledge can be measured, like an object, is what underpins the design of standardised tests.

Furthermore, the process of measurement is presumed to be objectively fair and valid only if the examiner asks exactly the same question of each candidate in exactly the same manner.

This linear, one-dimensional concept of knowledge is not only misleading to teachers, but is very unfair to children outside of the norm whose understanding of the world is often missed with a simple test. This can include children who use language differently from the assessor (either due to impairment or to bilingualism) and it can include children with developmental problems, who may have unexpected skills. The notion of dynamic assessment came out of Vygotsky & then Luria's thinking about teachability, the zone of proximal development, and the shared (and hence dynamic) nature of learning. The technique was notably developed by Feuerstein, who saw underprivileged groups being disadvantaged by the 'testing' model of assessment and who got astounding results from a more dynamic way of examining and working with children's understanding. Currently there is a group of educational psychologists who are developing dynamic assessment as a more useful educational tool than conventional objective tests that are based on psychometric theory.

Dynamic assessment can certainly have a very powerful effect. It can show teachers aspects of a child they never imagined existed, it can uncover a child's reasons for doing and thinking as s/he does. It can reconnect teacher and child, parent and child. It can give children back the sense of self and sense of purpose in learning that objective tests often remove.

The main features of dynamic assessment are:

- [1] It has an interactive basis – the assessor is not removed from the child and does not try to be 'objective'; instead, he or she actively explores the learner's thinking processes through reciprocal interaction.
- [2] It emphasises the process rather than the product of learning
- [3] It asks 'why?' rather than 'what?'

[4] Its aim is to discover what can be learned rather than what has been learned

[5] It has a much closer and more dynamic link with teaching than other forms of assessment. This link is both practical and theoretical

[6] It has an overriding concern with the context and application of knowledge, and does not construct knowledge or skill as disembodied and separate from the learner

The literature on dynamic assessment is quite small – there is a distinct group of researchers who are investigating its use, and exploring the ways in which it might be useful. Joe Elliott and Carol Lidz have collaborated on an edited volume, to which I've given the reference at the end of this talk, and a number of those active in the field have probably contributed to this

Looking at the literature on dynamic assessment, it is obvious that it involves a radical restructuring of assessment concepts, and grounds the assessor in the application of the understanding derived from assessment. Conventional assessment (objective testing, that is) has a dual function – both administrative and practical – and one problem with it is precisely that it tries to serve two masters.

The obvious example is of use of objective tests is the allocation of resources in cases of special need. Objective measures of need are used to ensure that this is done fairly. (Note the assumptions about 'fairness'). Resources do need to be managed and distributed, but such a rigid notion of the 'fair' distribution of specialist teaching time has its downside. One drawback is that the specialist teacher has little idea of where to begin the teaching, and may know less about the child than if the objective test had not been done.

Dynamic assessment has only one function – that is to ground the teacher in the learner's understanding and to direct subsequent teaching. The lack of an administrative application is possibly the reason for the slow development of a field that would be so very useful to teachers.

Currently the literature on dynamic assessment is small and diverse, and assessments themselves are not very advanced. So for instance, there are few that are located in particular curricular domains, and there are none as far as I'm aware that are linked to principled and well-structured teaching frameworks. In this respect, Maths Recovery is an exceptionally advanced example of dynamic assessment.

There is no doubt that dynamic assessment techniques can provide the teacher with exceptional insights into learner's understanding and their teaching needs, but there are inevitably some problems with it and I shall now go back to a discussion of Maths Recovery assessment as an illustration of how dynamic assessment at its best can work.

[3] What the Maths Recovery assessment framework can give the teacher

The Maths Recovery assessment framework is structured along such clear dimensions that, even on the first use it tends to push the teacher away from the kind of thinking that describes mathematical knowledge as an object. The nature of mathematical knowledge for the child, and the ways in which mathematical learning takes place, become very clear to teachers very soon after they have first tried the initial assessments on children that they know. This shift in thinking is very interesting to watch, as teachers variously

- replace their one-dimensional representation of the child's thinking for a more complex representation
- use the complex and multi-stranded framework to ground and express their intuitions based on years of observing children learn mathematics
- try to balance curricular (or implicit textbook) definitions of early maths learning with the multi-dimensional representation that the Maths Recovery interview creates

The assessment framework uncovers aspects of maths learning that teachers sometimes don't see. It also shows teachers how children are learning, or how they might be coping with the demands of the classroom.

Example – a 5 year old child with a well constructed verbal strand and very immature arithmetical strategies (perceptual at most). The teacher's first response to watching the

assessment task on video was ‘Oh gosh that child’s been fooling me all year’. Then her understanding gradually emerged, and she started to voice her opinions of the child’s classroom setting. Her eventual opinion was that the child was using her verbal strengths to cope with classroom demands for mathematical operations that were beyond her.

Children’s maths learning can be hidden from the teacher when the curriculum assumes simple linear growth, because she only sees the children’s knowledge in relation to her mathematics teaching activity. The teaching activity is driven by the curriculum, and is often divorced from cultural activity that is truly relevant to the child. The Maths Recovery assessment framework offers a very different view precisely because it is grounded in a framework that is radically different from the curriculum framework that guides the classroom teaching. The Maths Recovery assessment takes the teacher outside of her usual role, and requires her to interact with the child’s knowledge in a very different way from normal. This is the fundamental process underlying dynamic assessment, and such assessment can convey a sense of *how* the child uses knowledge and *why* the child responds in certain ways rather than *what* knowledge exists as though ‘in the child’s head’. Describing Maths Recovery assessment as dynamic in this way also explains why the interview style is so important – if it is delivered in the same way as an objective test, its dynamic nature is lost.

The experience of Maths Recovery interviewing can in itself revitalise the teacher’s approach to teaching – but it can also confuse and disorient teachers - not to speak of the disillusionment that they can feel when they realise how far off the mark their textbooks or curricular guidelines actually are. It’s useful that Maths Recovery has a teaching framework that is as complex and multi-dimensional as the assessment framework. It has a well worked out pedagogical framework that helps the teacher to act on the insights gained from the assessment, and to develop the direction of the child’s learning

[4] How the teaching framework can guide the teacher’s thinking

The teaching framework builds on the complexity that is already in the teacher’s mind from the assessment by offering a dimension of five phases – one for each of the stages of arithmetic learning – to locate and direct teaching. Each of the five phases is in effect a

separate framework, but these frameworks link to each other through the teacher's thinking about the direction of children's conceptual development. So a teacher uses teaching procedures to guide a child's thinking through one phase into the next. That is one dimension of the teaching framework – the forward dimension that guides the direction of teaching. Within each phase there are cross-cutting strands of maths development (verbal, spatial, logical) that the teacher uses to frame mathematical experiences in different ways. This is the second dimension that structures the mathematical content of the teaching. A third dimension of the framework is the application of the teaching principles, which emphasise the interactive basis of the teacher challenge and child problem-solving.

This multi-dimensional instructional framework (phases, strands/ topics and principles) can guide the teacher in thinking about how to frame a dynamic engagement with the child's mathematical thinking, and how to organise children's experiences of problem solving so that they engage with truly mathematical thinking. This is the real key to maths teaching – how to engage children and persuade them to think mathematically. I don't know about your government, but our government seems to think that this ability to engage children is an aspect of a teacher's personality. The popular story goes that 'engaging' and 'motivating' maths teachers need to be well organised, good performers – capable of making the subject come alive while they hold their class enthralled. (A picture that's likely to make even the best teacher feel slightly inadequate on a bad day) This mystique obscures the simple fact that engaging children in maths is a technical skill, not a personality trait. The teacher doesn't need to be some kind of pied piper capable of enthusing children about obscure problems – that image is very likely to send teachers off on the wrong track. What primary teachers need to be able to do is simply to recognise the 'cutting edges' of a child (or a group of children's) maths development, and then teach around that edge, letting the child take more and more control of the direction of learning. The communication during such teaching is about abstract intangible things – in the early stages, numbers, and their organisation; in the later stages, relationships between numbers. The most important feature of good mathematical communication is that the child understands what the teacher is talking about, and can respond in kind.

So often, when children are failing in maths class, it's not because the lesson is badly planned or the teacher is not good – it's because the failing child simply doesn't understand what it is that is to be learned. If the teacher doesn't have an effective way of talking about what is to be *learned* (as opposed to what is to be *done*) in class, then it's not surprising that children reformulate the mathematics according to their own goals. Often they get by on their social skills or on the limited mathematical abilities that they have, with the aim of completing the task that has been set and with no reference to its mathematical content. Without clear communication about the intangible thing (the abstract mathematics) that is to be learned from the procedure, it's not surprising that it never occurs to children that the aim of their learning is to develop their understanding to a higher level. After all, their teacher is just asking them to *do* specific things, without mentioning the intangibles that are to be learned. Soon, mathematics becomes a subject whose aim is simply to learn to carry out the procedures that have been set. When this happens, the means have become the ends and maths has become a very dull subject indeed.

Think about this as the difference between mindful learning (learning with consciousness of what is to be learned and how it is to be accomplished) and its opposite.

The key to understanding the difference between 'doing' and 'learning' in maths – and how to get this difference over to children – lies in recognising that the intangible referent, the abstract mathematics, is communicated indirectly, through the pattern of activities, not directly, through what is spoken about or done. The way in which activity is patterned and developed in the classroom communicates powerfully to children about the real aim of the class.

In the Maths Recovery lesson (and here we're talking about the one-child lesson) the teacher moves from topic to topic – but not randomly. The topics are coherently linked around the child's direction of learning and the teacher returns again and again to the same mathematical theme reflected in different ways in different tasks. It may be simple addition concepts, or it may be grouping or it may be multiplication. Whatever it is, it will be approached from several different angles and the child will get the message that it

is this higher-order mathematical topic that is being learned – not the procedures that take place within each topic. Learning how to arrange mathematical meaning in this way is a centrally important tool for the primary teacher, and one that need not remain in the individual lesson.

[5] How the two frameworks together can guide creative teaching across a range of curricula

So the teacher has experienced the Maths Recovery assessment, has understood the complex multi-dimensional nature of maths learning, and has learned how to use patterning and organisation of topics to direct children's attention to the higher-order mathematical topic embedded within a lesson. What then? Once the primary teacher is experienced in these matters, there are a number of possibilities for using the assessment and teaching frameworks for creative teaching.

It is at this point that teachers themselves begin to say that they can use the curriculum (or the textbook) actively rather than just following it. They can see how it is possible to use the textbook to create meaning, and they have a better understanding of the mathematical meanings that the textbook authors are trying to create through their suggested activities. The focus has moved away from doing the activities and towards the meaning embedded in them, and teachers are more able to move the children's focus in a similar direction.

Understanding the Maths Recovery assessment and teaching frameworks can give primary teachers a basic grasp of maths teaching and learning, and this in itself can give rise to creativity in teaching – simply due to the fact that the teacher is freed from slavishly following the textbook. There are also more specific ways in which teachers can use the frameworks, quite apart from the dynamic teaching of an individual child described in the previous section. I shall map out three possibilities:

[1] The possibility of using Maths Recovery as a framework for planning curriculum outcomes for classroom maths

[2] The possibility of using Maths Recovery as a framework for differentiation – not by seeing children as having fixed ability but by fine-tuning goal setting within interaction

[3] The possibility of using Maths Recovery as a framework for managing whole school maths policies and curricula

The first possibility is one in which the teacher is empowered to use sophisticated developmental thinking to plan out how to connect specific children with one or more curriculum goals. A particular example that comes to my mind is the tricky one (in the Scottish curriculum) of the missing addend, which is naively placed immediately after simple addition in the text. It's the bane of every First Year teacher's life – except those fortunate enough to have done Maths Recovery. Maths Recovery teachers recognise that children cannot understand it until they have reached Stage 3, understand why the children cannot do it, and simply postpone it until later – if necessary, passing it on to the teacher in the following class. They are also able to explain very articulately why some of their children can't do this, and when they may be expected to be able to do it. Similar examples could be cited of early grouping in relation to understanding multiplication, the management of fractions and percentages in relation to 'non count by ones' developments, and the management of place value teaching and double-digit addition and subtraction in relation to 'tens and ones' concept development. If primary teachers have a good understanding of the Maths Recovery frameworks, they tend to be able to articulate clear teaching principles across a range of mathematical phenomena.

The second possibility is one in which teachers begin to see differentiation as possible within a whole class rather than as requiring ability grouping. In a conventional view of maths teaching, learning is linear (even some mathematicians believe this) and children's ability is spread across the spectrum in a one-dimensional way, with least able children at one end and most able at the other. On this viewpoint, the best way of differentiating teaching is to group children by perceived ability and provide them with the content that is appropriate for each group. On this reasoning, low ability children get simple things to do (usually boring and repetitive too) while high ability children get complicated things to do. One effect of this style of differentiation is that low ability children never get to see the mathematical sense of what they are doing because they are permanently locked into activities that consist of repetitive procedures. When they have an understanding of the

Maths Recovery frameworks, teachers find it easier to see that the spread of ability is much more complex, with some children of apparently 'low' ability able to surpass children of 'high' ability in some respects, and needing just as much challenge and complexity in their work. This makes differentiation multi-dimensional rather than one-dimensional, and teachers get more confidence in engaging all children in challenging work, rather than reserving perceived 'challenge' for 'high ability' children. Because the frameworks emphasise challenge as opposed to 'drill', and define challenge in relation to a child's understanding, teachers can see the role of challenge in even the least able child's learning. Their notions of differentiation become very much more sophisticated, and are related directly to children's learning needs rather than to differentiating between 'simple' versus 'complex' work in maths. They also begin to see how important breadth is to the most and the least able children alike. This is all as a result of understanding the frameworks and moving away from a linear view of maths learning.

The third possibility is an example of how understanding the frameworks allows teachers to take charge of and direct the maths curriculum in their own school. By using short-form Maths Recovery assessments across a whole year group at some predefined point of interest (e.g school entry, transition from Infants to Juniors) the senior management in a school can decide with teachers how best to focus the curriculum delivery according to the profiles of understanding of a whole group of children. Maths Recovery assessments, being dynamic, will provide teachers with an overview of the *kind* of teaching that a group of children require (as opposed to the *content* of teaching required, as in purely diagnostic assessment). This then gives them the opportunity to deploy the assessment/teaching frameworks in a range of strategies according to the profiles of the children in their class or school. In some schools it may be appropriate to have targeted 1:1 or small group teaching for a while, while in others whole class teaching at various levels may be indicated. On the basis of such screening the school may decide for instance to delay the introduction of writing until the majority of children have developed additive concepts, or to delay the introduction of fractions until the children have developed non-count-by-ones strategies.

In all these examples, which are merely an indication of possibilities, an understanding of Maths Recovery assessment and teaching frameworks allows teachers to take professional action across a range of difficult circumstances. It also allows them to base their teaching on in-depth understanding of the early learning of maths. While understanding of the frameworks allows primary teachers a specialist understanding of maths teaching and learning, it does not override their principle specialisation – which is primary education. In all this talk of maths education, we need to remember that primary teachers do not teach maths – they teach children. They also teach in context, and manage whole children in their social contexts. The Maths Recovery frameworks let primary teachers do all this without losing sight of the contextualised child. Maths Recovery lets teachers start with the child not the context. It lets them link contexts across the curriculum and it lets them see maths learning as an integral part of a young child's social identity.

[6] Conclusion

From what I have seen of the literature on dynamic assessment, it seems to me that Maths Recovery is a very advanced form of dynamic assessment, with the advantage also of having a well-structured teaching framework connected to it. Maths Recovery offers all the benefits of dynamic assessment. It works well for disadvantaged and non-mainstream children, it connects directly to practical questions of what and how to teach, and it gives primary teachers the insights and intuitions that only very advanced professional development can bring. Maths Recovery could be a model for the way to develop dynamic assessments in other curricular areas and link these firmly to practical teaching, teacher professional development, and the development of the curriculum in primary maths.

Maths Recovery also has tremendous potential to aid and develop the practice and theory of primary mathematics teaching. One of the questions that I have about the potential of Maths Recovery is the future direction that it might take in the context of primary teaching and learning as a whole. There are at least two possible directions that I see. One is to produce a category of primary teachers who specialise in mathematics teaching and

learning. This is already happening in some parts of the UK, and it is a development that accords with current perceptions of maths as a difficult subject that many primary teachers dislike. Because Maths Recovery starts with the child rather than the subject, it is a very effective way to develop understanding and teaching expertise in primary maths. Teachers who have experienced such development can then become leaders in the field of primary maths education, and can take responsibility for further development of curriculum and practice within the area of mathematics. This is a big advance on the current situation, where secondary-trained maths teachers usually advise primary teachers on how to teach maths to young children.

There is a second direction possible – and this is to make the teaching of mathematics equivalent in stature and importance to the teaching of language and literacy. Language and literacy are seen as such an integral part of primary teaching and learning that it would be unthinkable for experienced primary teachers to profess themselves unequal to the challenge of developing the curriculum or dealing with additional support needs in their own classrooms in the field of literacy. Mathematics for some reason is not seen as so integral – teachers do not need to read the relevant research, develop fluency with the relevant technical language, or see the links between learning mathematics and children's wider cultural and social development. Apart from some contextualisation, mathematics learning can be disconnected from children's experiences and from the wider primary curriculum in a way that would be unthinkable for language learning.

For example, any primary teacher teaching small children the elements of literacy without considering what role literacy played in their life outside of school would be regarded as ignorant and possibly dangerous. Yet teachers almost never enquire into children's use of maths at home. As another example, literacy is naturally linked to a range of experiences – drama, poetry, painting – that are an integral part of the child's shared culture. Maths is rarely linked to the wider culture, to the extent that adults and children perceive maths as frustrating because 'I could do it, but I never could work out why anyone would want to do such as thing'. If we taught literacy the same way we teach

maths, we would surely not be surprised to find a large proportion of young people leaving school illiterate.

In its very broad description of early mathematical development, Maths Recovery also has the potential to help teachers understand cross-curricular links between mathematics and other subject areas, and to embed the mathematics curriculum in the wider curriculum. One very important example of this lies in the as-yet-little-researched topic of links between underlying processes in reading and maths. Once teachers have acquired the specialist language and discursive community that helps them to make sense of what they see children doing, they do start to make links between what they see as underlying difficulties in maths and reading/writing difficulties in the same children. In the future, and with further curriculum development through Maths Recovery, teachers may also be able to help children to see that their maths learning is just as integral to their wider cultural development as reading and writing.

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