Assessment for Learning in Mathematics

Contents

1. Using Assessment for Learning in Mathematics – a summary of the ideas and some pointers for reading

2. Using assessment for learning to improve behaviour – a paper written by Paul Wolstenholme, Senior Adviser Birmingham LA

3. Assessment that works for children (and for you) – looking more closely at peer and self assessment

4. Formative use of summative assessment – ways to use tests more formatively

5. Approaches to setting and marking home learning.
1. Assessment for Learning in Mathematics

Assessment for Learning is an important tool for increasing the level of learning in mathematics classrooms. Using Assessment for Learning effectively involves:

- **Setting deep learning objectives**
  Increasing learning involves setting learning objectives and success criteria that are capable of being achieved at deep levels. Such objectives and criteria should ask children to achieve a deep understanding and to be able to apply their learning to challenging problems.

  Learning objectives and success criteria set out what is to be achieved but not the quality of the outcome. Teachers have to discuss and exemplify the quality that the children should be aiming for. Children can be asked to write three questions about triangles but the quality of thinking; planning and execution of those questions should be of high quality. Think about how to show the children what they are aiming for. It may be possible to find a question that explores deep and challenging aspects of triangles. Think about designing challenging success criteria and also giving exemplification, so that children know what they are aiming for.

  Learning objectives and success criteria that are shared and discussed with children begin to give them language to discuss their learning, where they have completed the work well and where they are stuck. This allows children to begin to take charge of their learning journeys, to understand what they can do and to plot an appropriate course forward.

- **Asking questions or setting challenging activities** that allow for extended thinking and listening to the answers

  Ask questions that encourage children to explore and make connections with their previous learning, give time for answers to be reflected on, and give children the opportunity to try out their answers in pairs or small groups before presenting them to the rest of the class.

  *Children need time to think. Research evidence shows that teachers usually allow only 0.9 seconds between asking a question and expecting an answer or even answering the question themselves. Leaving only 0.9 seconds demands that children simply react, they do not think. However if between 3 and 5 seconds is left before allowing children to answer this encourages them to provide more thoughtful answers and to analyse, synthesise and evaluate.*

Children need to be challenged to analyse, synthesise and evaluate but they do not always have the language to be able to do so. See the Nutshells ‘Not more but different’ (number 19) and ‘Higher order thinking’ (number 25) for more about helping children frame, understand and answer questions that require these skills.

Website: [http://ygt.dcsf.gov.uk/FileLinks/572_MainLink.pdf](http://ygt.dcsf.gov.uk/FileLinks/572_MainLink.pdf)
Feedback

Feedback is important: children need to know what they have done well and how to improve their learning.

*Children really appreciate written and oral feedback on their work. They appreciate an explanation of where and how they have completed their work to a high standard but they also need to know where to go next in their learning. This can be problematic to some teachers as their children often complete their work so well it is hard to know where to go next. This is where planning comes in. Planning means that teachers know the next steps or that they have planned a route that will extend, broaden or deepen current learning. This is not a route that provides more of the same, but something different. Sometimes teachers may ask the children to explore where they could go next and encourage their children to negotiate a route for themselves.*

Learning to make valid and appropriate choices should be part of all children’s education, but teachers have to help their children learn to make good choices.

Involving children in the process of learning

The more children are involved in the whole process of learning the more motivated, engaged and self-efficacious they become.

*It is not enough to expect a pupil, even a highly able one, to be able to self-assess and set themselves routes for improvement. Initially the peer and self-assessment process will need to be taught and led by the teacher, step by step, looking for evidence of each success criterion one at a time, allowing more independence and therefore involvement over time. Children will come to be able to determine appropriate areas for their own development and thus feel able to take appropriate control of their own learning.*

For more information

**Excellence and Enjoyment** - Whole-school training materials
http://nationalstrategies.standards.dcsf.gov.uk/node/88755

**Assessment for Learning** - Whole-school and subject specific training materials.


The problem and the solution

A characteristic common to disruptive classes is that children do not make the progress that their teachers expect of them during a lesson. Little work of any quality is produced; exercise books, folders etc. are ill kept or they are forgotten or lost and as a consequence work is not marked on a regular basis. The poor behaviour makes it difficult to teach, the majority of teachers’ time is spent on managing behaviour and as a consequence they get tired and frustrated. In such situations the tendency is to focus on the perceived problem; that is poor behaviour. However my experience suggests that often the way forward is to focus on the solution instead of the problem. The solution is to get children to succeed in their learning. When people feel successful, they want to do more and children are no different.

Motivation and Learning

It is fun to succeed and it can be disheartening to fail. The dilemma is that sometimes failure is necessary for learning. When we reach the point of failure we know what our present limits are and therefore what we must develop strategies to cope if we are to improve. Real satisfaction comes from persevering and overcoming barriers that initially caused us to fail. Personal satisfaction is a powerful motivating force that rewards and reinforces effort and perseverance. It is intrinsic motivation because the reinforcing stimulus is an internal sense of satisfaction. Children who are intrinsically motivated do not usually present their teachers with challenging behaviour. Therefore if an intrinsic sense of satisfaction in learning can be developed in our children their behaviour will improve and the way to do that is through developing Assessment for Learning. The start is to be clear about what success with challenge looks like.

Involving Children in the Learning

Involving children in their learning means discussing with them, what they will be learning and how they will know if they are successful in their learning; in other words, sharing the learning objectives and the success criteria with them. Just as signposts on a journey help travellers stay on the correct route and monitor progress towards their destination, success criteria enable children to keep on track with their learning, monitor their progress and know how close they come to meeting the learning objectives.

Teachers need to work hard to truly share perceptions of success and quality in a way that their children can fully comprehend. This can be done in a variety of ways:

- In English, a teacher provides exemplification of the type and quality of writing aimed for in the lesson and asks children to identify the ‘good’ features. These are then noted on the board as the success criteria.
- In PE, a teacher sets up a demonstration at the start of the lesson and indicates to the children what they should be looking for in the demonstration. These are the qualities that they will be then be practising and refining and, therefore, the success criteria.
In geography, a teacher models the process of annotating a picture of a geographical feature taking suggestions from his class and making the key skills explicit. These become the success criteria for the lesson.

With very challenging classes an activity called ‘which is the best and why?’ can be useful in gaining class attention and developing an understanding of what success looks like. The children often engage with this activity because they see it as sort of game as opposed to ‘serious work’. The teacher shows them two or more examples of work, or answers to a question, and asks them ‘which is the best and why? One of the examples may be at the level at which they are working and the other at a more challenging level. The answers to the question become the success criteria for the lesson or learning episode.

Planning a Learning Episode

It often makes more sense to think of learning in terms of learning episodes rather than individual lessons. This is because sometimes pieces of work span over more than one lesson and sometimes an individual lesson may well be made up of two or more learning episodes. A learning episode must involve new learning - helping children to understand something new; achieve a deeper understanding of something they already know; introducing a new skill; or, practising and refining an existing one. Once you are clear about the aspect of learning your children need to achieve, your knowledge of their pace of learning will allow you to estimate appropriate time-spans for the learning episode, which may or may not fit discretely into whole lessons. If a permanent improvement in behaviour is to be achieved, each learning episode has to be an opportunity for success.

The starting point for planning is often to take teaching objectives from a scheme of work or syllabus and to translate them into learning objectives for each learning episode. The process relies on having a good knowledge of the subject and a good knowledge of how children learn the subject. The two things are quite different. It is possible to have a very good knowledge of the subject but not be able to teach it. Teaching requires a high degree of emotional intelligence.

“We expect teachers to understand what they teach and, where possible, to understand it in several ways….comprehended ideas must be transformed in some manner if they are to be taught. To reason one’s way through an act of teaching is to think one’s way from the subject matter as understood by the teacher into the minds and motivations of learners.” Learners and Pedagogy (1999) Jenny Leach, Bob Moon, Paul Chapman Publishers.

1. The learning objectives

Sharing learning objectives with children is the starting point for transforming the subject matter as understood by the teacher into ways in which it will become understood by the children. Discussing with the children what they are to learn is the principle that underpins the activity of sharing learning objectives:

- The act of copying learning objectives can be a useful settling activity. It provides the children with something to do which requires them to have a pen in their hand and to focus towards the board and can become a routine providing a sense of security. The quiet, whilst children copy, could also provide time for reflection on the objective.
- Many children who disrupt in class, like to copy from the board. It could be that these children like to have some writing in their books because they associate writing with learning and yet they feel
2. The Success Criteria

Having decided upon learning objectives, the next part of the process is to plan how the children will demonstrate that they have made successful progress in achieving the objectives, or in other words, to plan the success criteria of the lesson. In many respects planning the success criteria plans the lesson. Once the success criteria are clear in the mind of the teacher the learning activities for the lesson become obvious. Educational terminology can be confusing and you may well come across the term ‘learning outcome’, in this article the term ‘success criteria’ has the same meaning as ‘learning outcome’.

Returning to the analogy of the journey, the learning objectives are about the destination and the success criteria the signposts that we pass along the way. The success criteria are the checks that tell us whether or not we are on track with our journey. They allow us to check progress and act as early warning indicators when progress is not good enough.

Success criteria will vary from subject to subject and from topic to topic. The following example is provided to illustrate one way of expressing success criteria. It has been taken from Language for Mathematics – Assessment for Learning in Practice by Clare Lee, Open University Press 2006. There is also much good information on success criteria in Enriching feedback in the primary curriculum: oral and written feedback from teachers and children, by Shirley Clarke (Hodder & Stoughton, 2003)

<table>
<thead>
<tr>
<th>Learning objective</th>
<th>Success criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>To learn about Pythagoras’ Theorem</td>
<td>I know what ‘right-angled triangle’ means. I have,</td>
</tr>
<tr>
<td></td>
<td>- carefully drawn 3 different right-angled triangles</td>
</tr>
<tr>
<td></td>
<td>- drawn a square against each side, making sure each angle is a right angle</td>
</tr>
<tr>
<td></td>
<td>- found the area of each of the 3 squares and put them in a table</td>
</tr>
<tr>
<td></td>
<td>- asked one other person for the areas of their squares and stated it using algebra</td>
</tr>
</tbody>
</table>

Learning activities are about processing information or practising skills in order to deepen understanding; develop new understanding; learn new skills; or, refine existing skills. They should lead progressively towards the achievement of the success criteria.

3. Actively Involved children

Learning is not a spectator sport. Children will learn most effectively if they are actively involved in learning and not treated as passive recipients of information. The teacher cannot do the learning for the children, the ball must be placed in their court if we are to avoid the situation portrayed by John West Burnham where he describes ‘children coming to school to watch teachers working’. When children are ‘doing the learning work’ they will be actively involved in their own learning. There will be a balance between teacher talk and student talk where often the children do most of the talking as the teacher will want to know from the children how their learning is going so that the activities can be adjusted appropriately.

Many children have difficulty with understanding information that is presented to them in an oral form, particularly when cognitive academic language is used. The situation would be like somebody being in an underground station in a different country with
limited understanding of the language and someone giving them the information they need in that language. The chances of getting 'lost' would be high, as would be the likelihood of becoming frustrated. The traveller would probably find a tube station map to be the most useful aid to complete their journey. They may also seek support by discussing the problem with their travelling companions and possibly seek help from an official or another traveller in the hope that they would speak the same language. Applying this analogy to a lesson, many children find it useful to have information offered visually as well as orally and to use paired discussion and questioning for clarifying their understanding. The point is not to avoid using the language of our subjects but rather to enable children to access the language they need to express their learning.

4. Motivation to learn

Planning for progression is only one part of the process of ensuring that children make progress. In order for the planning to be effective, children must engage with the lesson and this means they must be motivated.

Motivation is closely linked to achievement. The more successful someone is in accomplishing challenging situations the better they feel about themselves and the more likely they will be motivated. Success is most valuable when it is related to challenge. Succeeding in a task that we know we can already do is not as rewarding as succeeding in a task that stretches us. However, if a pupil is never successful in lessons, he or she will soon give up. In lessons the learning activities should allow children to succeed but also include a progressive level of challenge that stretches them.

"It has been found that the most motivating goals are short-term ones that are challenging but attainable, where the learners have a reasonable chance of success, and the basic skills and the support to do it. From Locke, E.A, and Latham, G.P. (1990) 'Work motivation and satisfaction: light at the end of the tunnel'. Psychologial Science, (1): 240-6 – Cited in Katherine Weare

One of the reasons that success criteria are so important is that they help to illustrate what success looks like and so provide a framework through which children can find intrinsic reward and reinforcement; success criteria are in effect short term challenging goals. Using the maths example referred to earlier, if I was a student in the lesson I would know that by demonstrating that I can do the four bullet pointed tasks, I would be successful in the lesson. I would know where I was trying to get to and what signposts I would pass on my way. Hence, I could monitor my own success as the lesson progressed and this in turn would motivate me to continue to put effort in. Thus the lesson has been planned in such a way that it builds in the opportunity for progressive success. Of course, most of the children that we have problems with will not be self motivated and merely planning for success in the way described will not in itself change them. However, planning for success is the first stage and it is in the direct control of the teacher.

5. Setting the pace

Another aspect of the lesson in the direct control of the teacher is the act of setting the tasks and deciding how long to allow for completion. Children in classes where the behaviour is unsatisfactory will usually take far longer to complete a task than should be required. To them the learning activities are insignificant in relation to their social activities; therefore the time limits given to activities should be tight and be stuck to rigidly. This causes frustration to those children who don't like to do much work - in some classes that is the majority. However the pace of the lesson should be determined by the teacher and not the children, until, of course, the class becomes
well motivated when the pace will become more of a cooperative venture. Children with little self discipline respond best in situations that have tight structures.

6. Feedback

One of the most important ways in which we can motivate children is through the provision of feedback. Feedback can be any response provided to a learner in relation to their performance, for example informing children of test grades is a form of feedback. Feedback helps the student to improve by suggesting actions that can be taken by the student which they then act upon. This type of feedback is called formative feedback or formative assessment. Sadler (1989) describes formative assessment as a sequence of two actions.

“The first is the perception by the learner of a gap between a desired goal and his or her present state (of knowledge and/or understanding and/or skill). The second is the action taken by the learner to close that gap to attain the desired goal. The learner first has to understand the evidence about this gap and then take action on the basis of that evidence. Although the teacher can stimulate and guide this process, the learning has to be done by the student.”


So, children who make good progress in their learning are less likely to present behaviour problems. The teacher helps the student to make progress by helping him/her to understand the ‘gap’ and how to close it, through the provision of formative feedback which may be oral or written. The feedback must be acted upon for it to be effective. Focused marking involves indicating what has been done well and providing guidance to improve or extend the learning underpinning the work. Responding to the comment could be the starting task for the lesson in which the books are returned. Certainly, opportunities for children to act on comments must be made for the comments to be effective and the time invested to be worthwhile.

7. Making good use of plenaries

At the end of a lesson if a student feels that he or she has achieved something they are likely to feel good about themselves and therefore more likely to be motivated the next time. The plenary provides for such an opportunity but with challenging classes it is not easy to organise. One idea is to forewarn children of the expectation of a plenary by putting the questions you are going to ask as part of the plenary on the board at the start of the lesson. For example ‘this lesson I have learnt to…..and I know this because…..’ or ‘this lesson I have improved my skills of…..and I know this because…..’ An effective plenary helps the children to think about what they have learnt and involves them summarising the key features of that learning. It is more beneficial for the children to do this summarising activity than the teacher:

“Plenaries were often the least active part of lessons. Teachers tended merely to sum up what happened during the main phase and children did not have the opportunity to articulate what they had learned. When children had such opportunities, they proved an important part of the learning process.”


On the other hand if the children did not make much progress because of their poor behaviour it may be most beneficial for the children to summarise the reasons why they made such poor progress what would be needed to redress the situation.

In conclusion

The most important aspect of managing behaviour is that children know it to be worthwhile attending to the lesson. This is neither simplistic nor easy. Noticing and commenting on positive behaviour, providing clear learning objectives and success
criteria, keeping a good pace in the lesson and summing up the lesson by asking the children to summarise their own learning are all aspects of building an ethos of successful learning. Children who know that they will be successful in the lesson, however challenging it is, will behave well.

### 3. Assessment that works for children (and for you)

Assessments that are used in mathematics should work hard to help children move their learning forward. All too often assessment measures the children without helping them know how to improve.

‘It is no use spending so much time weighing the pig that you don’t have enough time to feed it!’

In this section we look at using assessment in a way that enables the children to know where they are and know how to improve without causing too much work for teachers.

**Using Peer and Self Assessment**

Peer and self assessment are an important set of approaches for a teacher. They help develop the children’s abilities to know what is required in a piece of work and to develop the discernment to self-assess – an important life skill.

<table>
<thead>
<tr>
<th>Peer and Self Assessment are useful because …</th>
<th>…</th>
<th>…</th>
</tr>
</thead>
<tbody>
<tr>
<td>they encourage children to listen to one another.</td>
<td>they encourage children to ask questions about the quality of work that can be produced.</td>
<td></td>
</tr>
<tr>
<td>they extend children’s repertoire of ways to tackle a task and help them to learn more effective or efficient strategies.</td>
<td>others' work may contain a wide range of imperfections and misconceptions through which a student may explore their own.</td>
<td></td>
</tr>
<tr>
<td>they show children different ways of completing the work.</td>
<td>they encourage a co-operative learning environment in the classroom.</td>
<td></td>
</tr>
<tr>
<td>they ask children to use criteria to comment on others' work through which they can come to a better understanding of the criteria.</td>
<td>they enable children to have an overview of what it means to complete a task to a high standard.</td>
<td></td>
</tr>
<tr>
<td>it is possible to become more conscious of what you are trying to achieve yourself when you have to explain to other people.</td>
<td>children can obtain an objectivity through peer-assessment that they can then apply to their own work.</td>
<td></td>
</tr>
<tr>
<td>children can become more involved in and responsible for their learning.</td>
<td>they help in creating a better and more productive relationship between children and teacher.</td>
<td></td>
</tr>
</tbody>
</table>

Look at the ‘short sharp’ suggestions in the table on the next page. You may already be using many of them. Pick one idea and consider how it could be usefully developed in your school. Now look at the longer, more formal ideas. Again you may
well be using some of them. Pick one and think how it could be developed to help the learners in your school.
<table>
<thead>
<tr>
<th><strong>Short sharp ways of using peer and self assessment</strong></th>
<th><strong>How could this be used in your school?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Ask children for their level of confidence with a particular piece of work, using traffic lights or thumbs up, down or horizontal.</td>
<td></td>
</tr>
<tr>
<td>Tell the children to work in pairs and listen to one another’s responses to a problem and to ask questions about points that they do not understand.</td>
<td></td>
</tr>
<tr>
<td>Ask children to decide whether they think an answer is reasonable, whether they can add to the answer, or whether they would have given another answer.</td>
<td></td>
</tr>
<tr>
<td>Ask children to use success criteria to comment on the strengths of each other’s answers to a homework and to identify areas for improvement.</td>
<td></td>
</tr>
<tr>
<td>Ask children to use post-it notes to identify exactly where another pupil has shown a good response to the success criteria. Use another colour to point out a part of their work that could be improved.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Longer more formal peer &amp; self assessment ideas</strong></th>
<th><strong>How could this be used in your school?</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Work as a class to develop success criteria for a unit of work.</td>
<td></td>
</tr>
<tr>
<td>Ask children to analyse a test mark scheme and devise their own for a question.</td>
<td></td>
</tr>
<tr>
<td>Use exemplar pieces of work from anonymous children, maybe last year’s. Ask your children to use success criteria to judge how well the work has been completed and how improvements could have been made.</td>
<td></td>
</tr>
<tr>
<td>Tell the children to mark each other’s work without giving them the answers. Ask them to use all available resources to confirm the answers are right or wrong and why.</td>
<td></td>
</tr>
<tr>
<td>Ask children, working in groups, to write five questions and then swap their questions with another group. The new group answers the questions and identifies the best two. The ‘best two’ are collected from each group and used for the next test.</td>
<td></td>
</tr>
</tbody>
</table>
## Approaches to setting and marking home learning

<table>
<thead>
<tr>
<th>Approach to home learning</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Home learning is set once every week and the teacher marks every book once a week.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home learning is set once a week, alternate home learnings are peer or self assessed against clear success criteria, the teacher takes the books in and marks the other home learning every other week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home learning is set once a week. Once every two weeks the homework is an ‘Assessed Piece’ that is set out in the scheme of work, and is completed in a separate book. The assessed piece is thoroughly marked and commented on, the children respond to these comments in class. Ordinary home learning is marked in class, checking it is completed and using a variety of peer and self assessment techniques to enable both the children and the teacher to know exactly what issues or part-conceptions the children have.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home learning is set once a week. The scheme of work identifies one piece during each topic that is designed to explore the children’s understanding of the topic. That piece is marked in detail by the teacher and the teacher adjusts the learning activities that follow it to help children overcome part-conceptions or move forward more quickly.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>