Developing a 'mastery' approach to written feedback in mathematics

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Developing a ‘Mastery’ Approach to Written Feedback in Mathematics.

Abstract

The NCETM identified three areas which were deemed of particular significance in providing a mastery curriculum- developing deep knowledge, consolidating particular skills and ensuring rapid interventions take place in order to address misconceptions in a timely manner. The focus of this dissertation was to research the capacity a form of written feedback (mastery marking) had in providing one of these three areas depending on the child's progress towards achieving a lesson's learning objective. A range of qualitative methods were used to gather relevant data. The data collected from focus groups, whole class discussions and examinations of written feedback was then analysed. This led to particular themes being identified. These included the changing perceptions of children regarding feedback, task type, frequency and delivery and barriers for teachers to contest against when trying to provide 'mastery marking'. Findings suggest that mastery marking did provide children with more opportunities to demonstrate deep knowledge depending on the group they were in. An increased amount of time for children to respond to written feedback was also a result of the intervention. It also brought about written feedback which was more specifically tailored to the individual needs of the children. Particular constraints for the teachers had an impact on their uptake and implementation of the intervention. The implications for this study appear to be that teachers can provide increasingly effective written feedback but particular constraints can curtail their ability to do this as regularly and as accurately as they would like. In order to enhance the quality and regularity of written feedback, there appears to be a need to mitigate these barriers where possible.

Introduction

With increasingly publicised comparisons between countries in regards to school results, some might suggest that an attempt to adopt and transfer methods used in 'successful' countries into English state schools is inevitable. The proliferation of the OECD's Programme for International Student Assessment (PISA) scores into mainstream media has led to an increased awareness of and focus on which countries are the highest performing and why this is the case. With England's PISA scores recently portrayed as 'at best, stagnant, at worst declining' (Gove: 2013), an examination of the education systems present in countries outperforming England has taken place. As Silova and Sobe (2015:98) state, PISA results

have now become a justifiable reason to enact 'educational reforms' as they are used in the 'development of national level indicators' that benchmark progress and guide education and curriculum modification. Put simply, PISA scores could be regarded by some as an 'instrument for policymaking' (Gaber *et* al, 2012:647). It is these changes in educational policy that have led me to focus on the topic that will now be discussed. Despite the policy implications not necessarily being the focus of this piece, a recognition of the implications these policy changes have on teachers has led me to develop what I will term 'mastery marking'.

The terminology of 'mastery', 'mastery with depth' or 'deep understanding' are now well and truly at the forefront of the minds of primary school teachers in England. Whether or not these are understood by teachers is something which will be addressed later in the piece. The myriad of terms used at present will also be explored. Coupled with the increasing demands of 'accountability, efficiency and effectiveness' within education (Decramer *et al*, 2013:352), the need to understand, evidence and develop children's mastery of the content contained with the mathematics curriculum bolsters its significance greatly. In addition, with the recent introduction of a new 'aspirational' curriculum (Gove: 2013), mathematics at primary level has become explicitly more demanding in an attempt to align our curriculum more closely to high-performing nations such as Singapore and Hong Kong (OECD:2012). Once again, this has implications in regards to the way teachers plan, teach and assess within their own classrooms. There has been a recent rise in the profile of far eastern teaching methods through the continuing governmental support of the Maths Hub programme- specifically the recent £41 million of funding provided to develop an 'Asian style of maths teaching' (BBC, 2016). It is this changing discourse and particularly the need to embed 'mastery' into teachers' pedagogy that has brought about the focus of this piece.

The National Centre for Excellence in the Teaching of Mathematics' (NCETM) 2014 document entitled 'Mastery approaches to mathematics and the new national curriculum' outlined many of the key principles underpinning far eastern teaching methods. It is this document that inspired me to pursue the idea of 'mastery marking' in an attempt to instil some of the core ideologies mentioned in this document into my own and others practice. The three areas of particular interest explained with the NCETM's documents consisted of the need to ensure that:

1. children, who were ready, were provided with 'rich and sophisticated problems' based on content from their own curriculum opposed to being 'accelerated through new content' (NCETM, 2014),
2. there were opportunities to practice and consolidate skills that have yet to be 'mastered',
3. those who needed support received 'rapid interventions' in order to ensure that misconceptions and difficulties were addressed in a timely manner.

The project has been undertaken in an attempt to research the capacity a particular style of marking has in providing children with one of these three opportunities through written feedback. This will be termed 'mastery marking' throughout this piece. Written feedback in the form of marking has been chosen as a way of looking to embed the three concepts due to its ability to be specific and timely (Shute, 2008:154) coupled with the head teacher of my place of work's willingness to adapt the school's current marking policy to suit the needs of my research.

The dissertation will look to provide answers to the following questions:

- To what extent does mastery marking provide children with opportunities for the three areas identified within the NCETM document?

- To what extent do children's responses change, if at all, regarding feedback from the start to the end of the project?
- How often and to whom do teachers give opportunities for mastery marking to take place?
- Do teachers' own opinions of marking change during their participation in the project?

Literature Review

A review of the existing literature around the topics of written feedback and mastery will take place in order to gain a sufficient understanding of the different theoretical perspectives regarding the aforementioned. Where possible, the implications of these findings will be put against a backdrop of professional practice using my own experience and school context to illustrate how, if at all, the theoretical constructs relate to and impact upon teaching and learning.

Written feedback

Before a detailed explanation of the marking system developed for this dissertation is provided, it is important to establish a coherent and justified rationale for providing written feedback within the context of mathematics. An examination of the existing literature will be carried out in an attempt to identify relevant points that may have an impact upon the implementation of mastery marking within my own context.

The purpose of formative feedback

Put simply, formative feedback's primary purpose can be considered as the 'enhancement of learning' (Gipps, 1994:4) and is 'intrinsic to the business of teaching' (Dowden *et al*, 2013: 349). Dixon and Haigh (2009:179) state that it is in fact the 'crucial interaction' that occurs

between teacher and learner whereby a 'learning gap *and* the actions necessary to close that gap' are identified.

As Dixon and Haigh depict, a 'discursive shift' has occurred within the realms of feedback regarding the 'roles and responsibilities assigned to teachers and learners in the processes of learning and assessment'. Early discourse from the likes of Tunstall and Gipps (1996) and Harlen and James (1997) paid great attention to the role of the teacher in the teaching, learning and assessment process. A number of writers moved this emphasis away from the teacher and assigned a key role to the learner instead (Sadler 1989; Black and Wiliam 1998) thereby bringing formative feedback more in line with contemporary 'student-centred pedagogy' (Guba and Lincoln, 1989) as learners would be, in theory, more 'actively engaged in assessment activity' (Sadler 1989). This particular model of formative feedback has been said to place greater emphasis on the ongoing student–teacher dialogue (Rust *et al,* 2005:33) and the effect feedback can have on cultivating students' self-regulation in regards to their own learning (Hattie and Timperley, 2007). This move away from the teacher being central to the teaching and learning experience has also been credited with an increased awareness and recognition of skills such as self-regulation and self-monitoring as these are now regarded as being of significant importance in the process of learning (Butler & Winne, 1995). Chen *et al* (2014:96) believed that this integration of the leaner into the assessment process would also lead to 'student ownership' in regards to their own learning or, as Resendes *et al* (2015) state, their capacity for 'knowledge building' to take place. The latter term is of significance due to formative feedback's link with the learner taking responsibility for 'continual idea improvement' (Scardamalia & Bereiter, 2006) and whether or not the information or 'dialogue' provided by the teacher is leading to 'progress toward a knowledge objective' (Bereiter *et al*, 1997). Ramaprasad (1983) believed that information provided by the teacher can only be considered feedback if it has an 'effect on behaviour' and thereby the

'quality of their knowledge-building' (Resendes *et al*, 2015:310). This once again confirms the previous point regarding the role of the learner in the formative feedback process. I will now look to focus more specifically on the role of formative feedback in a written form and its role in knowledge building.

Feedback in a written form

Formative feedback in a written form has the potential to be 'accurate and timely' (Halverson, 2010:131) due to the constant oscillation between an individual's 'current level of performance and the desired level of performance or goal' (Shute, 2008:157). It also potentially allows for timely actions to be taken by teachers in order to 'close this gap' between where the learner currently is and where they need to be in the eyes of the teacher (Heron, 2011:287). On a more pragmatic level, it also valuable as it can be 'captured on paper and can be reread by students at a later time' (Taylor, 2005 in Dekker *et al*, 2013:2). For a teacher this is clearly beneficial as it provides learners with feedback that can be referred back to at any point but also provides evidence to others outside the classroom that feedback is being provided to the children in their class. This is a point that will be become increasingly significant as the intervention begins.

Unlike summative forms of assessment that traditionally occur at the end of a topic or teaching period, the timely manner of written feedback can 'avoid delays in correcting errors or deficiencies' (Goldfarb & Morrison, 2014: 12) and can be used as a vehicle to 'guide the teaching and learning process' (Halverson, 2010: 132). Foong *et al* (2015:535) added to the case for written feedback to be given due to summative feedback's inability to provide an 'instant' identification of strengths and weaknesses. Foong *et al* also state that formative feedback can advocate 'timely self-reflection' due to it being a continuous process of evaluation. In addition to the potential for on-going evaluation, it is the 'high stakes' (Dowden, 2013:351) nature of summative assessment or more specifically summative

feedback that has implications from an emotional perspective. Goldfarb and Morrison (2014) state that the idea of continuous assessment can diminish the effects of the 'pleasant or unpleasant' feeling felt at the end of a summative cycle of assessment. For example, the allocation of a mark or grade at the end of a year opposed to continuous and ongoing formative feedback.

However, written feedback can be said to have limitations depending on the way it is both delivered and received by the teacher and the learner. As Sadler (1998:79) states, due its very nature of being a 'communicative exchange', feedback is not a straightforward process. Some believe that written feedback can only be considered valuable if all parties in the feedback process understand the 'meaning' behind what is being said (Ibid:80) and that it leads to progress towards, as previously mentioned, a 'knowledge objective' (Bereiter *et al*, 1997). In fact, O'Donovan *et al* (2000) believe that if there is a lack of understanding, formative feedback can become a source of confusion opposed to something that is intended to aid understanding. Burke (2009) found that this often stemmed from teachers offering little guidance to learners on how to interpret and apply the feedback provided to them and as a result 'valuable learning opportunities are missed' (Fernández-Toro & Furnborough, 2014:36). If this confusion persists, it can affect a learners' willingness to pursue further improvement via feedback (Taras, 2002:503).

In order to avoid this potential confusion, it is important that a 'shared understanding' is established before formative feedback can be received in a meaningful manner (Sadler, 1998:82). In order for this to occur, Ilgen, Fisher, and Taylor (1979, cited in Rakoczy *et al*, 2013:64) identified four stages that must take place so that the feedback results in a change in behaviour: Feedback needs to (a) be perceived, (b) be accepted as accurate, (c) be perceived as useful, and (d) lead to actual behaviour change. This once again places great emphasis on the learner due to the central role they play in the actuation of each of these stages, thereby

concurring with Sadler (1989) and Black and Wiliam's (1998) point regarding the key role to the learner. If this shared understanding has been established, then it is the 'learner's actions' that are critical to learning (Bell & Cowie, 2001:21). These actions are thought of by Torrance and Pryor (1998:54) as acting with 'agency' which consequently can lead to learning or 'closing of the gap' to occur (Heron, 2011:287).

The concept of agency in the context of written feedback can, in simplistic terms, be viewed as learners moving away from being 'passive recipients' (Dixon & Haigh, 2009:182) of feedback to a group of 'newcomers' (Gee, 1996:32) who have the ability to reflect and be guided so that they are 'at the heart' of the assessment and feedback process (Sadler, 1989 in James, 2006:53). Acting with agency can also be considered as, according to Dresel and Ziegler (2002), having to 'initiate cognitive and behavioural adaptive reactions' in light of the feedback being perceived as useful. Bangert-Drowns *et al* (1991:223) develop this idea through the assertion that agency is not enough for learning to take place. It is in fact imperative that individuals act 'mindfully' in light of feedback in order for learning to take place. Acting 'mindfully' is considered by Bangert-Drowns *et al* as having to begin a 'memory search' in order to find the answer opposed to 'mindlessness' where the feedback does not match cognitive needs due to it being, for example, too easy, too vague or too complex. Heron (2011: 278) views 'mindfulness' in the context of written feedback as 'empowering students in the assessment process by giving them greater responsibility and control over their learning'. At this point it is important to describe in greater detail the characteristics of effective and ineffective feedback that can have positive or negative effects on an individual's learning or knowledge building.

Effective and ineffective written feedback

Fluckiger *et al* (2010:137) state that feedback must be 'specific, simple, descriptive, and focused on the task' as well as being 'cognitive, metacognitive or self-regulative'. In addition

to this, it can also be 'general, domain-specific or task-specific' (Duijnhouwer *et al*, 2012:176). For a teacher to dismantle these statements and clarify what this means in practice could be said to be a challenging prospect. Instead, I will look to examine what has been written about what constitutes effective feedback in comparison to ineffective feedback.

Butler (1987), Wiliams (1997) and Kluger & DeNisi (1998) found that providing feedback linked to a student's standing relative to their peers (social-comparative feedback) (Rakoczy *et al*, 2013:63) had a tendency to 'impede learning'. Galloway *et al's* (2004) view of 'ego-orientation' in which the child's personal assumptions regarding their own ability are judged through a comparison with others appears a point to consider at this stage. It could be suggested that by providing scores, marks or grades that indicate a particular 'position in the pack' (Ibid:98) can to lead to, as suggested by DeBellis and Goldin (1997), learners holding a 'deep, personal truth or commitment' to the judgement of ability being linked to their position in relation to others. Black and Wiliam (1998) extend this argument stating that feedback is most effective when it focusses on individuals' 'strengths and weaknesses, preferably without any overall marks' opposed to feedback which children can extrapolate some form of positional indication from. This is an argument supported by Hyland and Hyland (2001) who thought feedback was most effective when it includes both positive and negative comments but with no recognition of achievement in relation to others. Whether or not strengths and weaknesses are the same as positive and negative comments is debatable. However, it could be said that, as Spinks (1998) and Holmes and Papageorgiou (2009) found, an understanding of what has been done well alongside comments that have elements of criticality appear to be the most favourable according to the findings within the existing literature. However, it might also be suggested that to divorce feedback from grades or marks is a struggle that many teachers, including myself, find difficult to do in an education system with an 'increased emphasis on accountability and a quest for external control mechanisms to

enhance and ensure "quality" (Mausethagen, 2013:132). External control mechanisms can be considered to be quantitative measures of progress in the form of standardised, centrally administered tests (Fuller, 2008). As a Year 6 teacher, much time and effort is given to assessing students and comparing their marks against other children in the year and end of year expectations. The interventions they receive are based on these judgements as well as the set they are in. It is not to say that a focus on feedback which emphasises strengths and weaknesses is impossible but with the continued focus on 'high-stakes national testing' (Lingard *et al*, 2013:540), it is important to recognise the pressures present within the classroom as a result of the 'infrastructure of accountability' (Anagnostopoulos, Rutledge, & Jacobsen, 2013:216) and the impact this has on teaching and learning. It could be suggested that a cultural shift, both nationally and internationally, away from testing and grade based measures of progress could allow for a 'student-cantered, deeper learning experience' (Dianis *et al*, 2015:35). As Sachs (2001) states, a move away from 'individualistic, competitive, and externally defined notions of teaching' would allow for greater time and space for teachers to create a learning environment in which the aforementioned can take place. Having said this, it is the marking system that I will research as part of this dissertation that will be tested as a means of providing feedback that focusses on the strengths and weaknesses of a child with a focus on mastery to guide and deliver the appropriate feedback needed.

At this point, I will return to the idea of criticality within written feedback. As previously mentioned a balance between positive and negative comments has the potential for feedback to aid learning and as a result can 'close the gap'. However, as Fedor *et al* (2001) point out, feedback which is controlling or critical of an individual can be 'damaging' and can therefore hinder learning. Again, a recognition of the multifaceted nature of feedback must be made due to the impact emotions can have on 'students' responses to the feedback they receive and their subsequent 'behaviour' in light of the feedback they have received' (Pitt & Norton,

2016:3). It is emotions and the influence formative feedback has on them that, as Dowden *et al* (2013:351) state, are crucial in effective teaching and learning. Varlander's (2008) findings concurred with Dowden *et al*'s assertion as they believed that emotion can have an impact on the mediation of cognition or, as Damasio (1994) state, 'cognitive function'. Particular emotional responses to feedback have been found to have an impact upon the likes of decision making, language fluency and memory (Duncan and Barrett 2007). In a study conducted by Young (2000), it was found that while many students were able to curtail the impact negative feedback had upon them, others 'entire sense of self was at stake' (Dowden *et al*, 2013:352). This highlights the precarious path teachers tread due to the need to deliver feedback which moves learning forwards but also does not bring about unfavourable emotional responses which could hinder knowledge building.

Formative written feedback with 'low levels of specificity', i.e., vagueness, has also been found to impede learning (Shute, 2008:156). Shute states that feedback is significantly less effective when it merely indicates whether the student's work is correct or not. This point is supported by Heron (2011:293) who found that providing specific, accurate feedback was far more meaningful to the learner: features of effective feedback which Chen *et al* (2014:97) believed to be central to improving the 'efficiency of instruction'. The type of feedback given by a teacher also has an impact on the learning of an individual. Task-level feedback (Shute, Ibid:154) typically provides more information to a learner regarding the appropriateness of their responses coupled with its ability to take into account a leaners current understanding and ability level. This is in contrast with the more generic, 'general summary' feedback that can be said to lack specificity as this method is, according to Shute, more readily given in a whole class context. It is also important to acknowledge the findings of Phye and Sanders (1994) who found that 'specific' feedback in comparison to 'generic' feedback can allow for enhanced understanding on conceptual and procedural learning tasks. However, other

variables, such as learner characteristics (e.g., ability level, motivation) must be acknowledged as they undoubtedly have an impact on an individual's understanding. In addition to this, feedback also needs to be in line with students' concepts of learning if it is to be effective (Gibbs & Simpson, 2004). This leads onto the concept of goal orientation as an 'important individual condition for the effectiveness of feedback' (Kim *et al*., 2010 in Rakoczy *et al*, 2013:65). The likes of Nicholls (1984) and Dweck's (1986) work regarding theories concerned with the 'differentiation between particular goal pursuits', specifically demonstrating competence and developing competence, have an impact on an individual's response to feedback.. Rakoczy (Ibid) talks specifically of performance goals and learning or mastery goals in relation to these two forms of competence. These two will be examined in greater detail when considering the messages conveyed to learners through feedback.

It could be suggested that from a practitioners perspective, to account for all the potential 'individual and situational characteristics' (Rakoczy *et al*, 2013:65) students may have could be a challenging proposition. As suggested by Kurtoglu-Hooton (2016:46), feedback comes with 'time management issues' and can be hard to administer effectively to a high number of individuals. However, Heron's (2011:228) belief that a pragmatic approach may need to be adopted in that those providing feedback should 'prioritise' and should refrain from giving 'feedback on everything' is a point to consider.

Another point of interest is the impact an 'external agent' (Duijnhouwer *et al*, 2012:171) can have during the assimilation of feedback. An external agent can be considered to be, as Ge and Land (2003:21) suggest, something or someone that 'scaffolds' learning. Locke and Latham (2002) believed that this scaffolding would result in 'higher performance' than if there was no scaffolding or support in place. Kluger and DeNisi (1996) provide a more detailed description of this stating that they provide information that should 'modify the learner's cognition, motivation and/or behaviour'. This once again links to the concept of

self-regulation due to the symbiotic relationship goal setting, regardless of whether or not they are self-set and externally assigned goals, and feedback has in relation to high performance (Cellar *et al*, 2011:470). It also reiterates Ramaprasad's (1983) assertion regarding feedback as only being effective if it has an 'effect on behaviour'. Examples of external scaffolding activities include question prompts (Ibid), support from a "more capable peer" (Vygotsky, 1978), reciprocal teaching (Brown, & Martin, 1987) and student-generated questioning (King, 1991). Ge and Land (2003:23) found that instruction from external sources that provide students with questions to ask themselves during feedback has shown to enhance performance. However, it is important to make a distinction between leaners asking themselves questions and being asked by an external source because, as Corno and Snow (1986) found, this involvement from another has the potential to 'inhibit learning'. However, the difference between involvement that inhibits learning and interactions which are 'crucial' when trying to 'close the gap' (Dixon and Haigh, 2009:177) are of significance as this is dependent on whether the learner can identify the gap for themselves or not. If the child is able to self-regulate or self-monitor (Butler & Winne, 1995) then, as Corno & Snow (1986) state, involvement from an external agent can inhibit learning. This clearly exemplifies the complex nature of feedback due to its potential to help or hinder learning depending on subtle differences in particular factors.

Messages conveyed through feedback

In order to consider the signals or messages conveyed through feedback, it is important to acknowledge the role of classroom goal structure (Skaalvik & Federici, 2016). The aforementioned refers to 'signals that students receive, primarily from their teachers, about what is important in school'. Specifically, it makes reference to institutional practices or policies which teachers enact and the impact this has upon the learning environment (Ames, 1992; Patrick *et al,*. 2011). The messages conveyed by a teacher are said to have an impact

upon the goal orientation of a learner. Much of the research states that one of two goal orientations can be taken in light of the messages conveyed by a teacher or the environment in which the inhabit: mastery or performance goal orientation (Rakoczy *et al*, 2013:64).

A classroom environment which places emphasis upon understanding, recognising student effort, values improvement and mistakes as being a natural part of the learning process (Skaalvik & Federici, 2016;136) is said to have a mastery goal structure present. In regards to the feedback that is given in this environment, Ames (1992) stated that it acknowledged effort, progress towards goal attainment and individual improvement. These features could be said to demonstrate one of the two goal pursuits presented by Nicholls (1984) and Dweck's (1986) – 'developing competence'. The feedback and the individual receiving the feedback are therefore focussed primarily on the task (Skaalvik & Federici, 2016:137). In contrast, an environment which has a performance goal orientation may consist of learners receiving feedback which emphasises test scores and comparisons between other students (Skaalvik and Skaalvik, 2013). In this environment, Patrick *et al* (2011) stated that feedback would indicate success when an individual had outperformed other learners or had exceeded normative standards opposed to 'effort or improvement' (Skaalvik & Federici, 2016:135). I would suggest that this links back to Galloway *et al's* (2004) view of 'ego-orientation' in that this can lead to a learners own judgement of themselves being linked to their 'position in the pack'. Referring back to the work of Nicholls (1984) and Dweck (1986), it could be suggested that feedback with a performance goal orientation places greater emphasis on 'demonstrating competence' opposed to 'developing competence'. Research portrays a myriad of potential outcomes in light of feedback which is aligned with a performance goal orientation, for example self-handicapping (Wolters 2004), low levels of persistence in the face of a challenge (Ryan et al. 1998) and a reluctance to seek help (Karabenick, 2004).

Once again, the above highlights the complexity of feedback and how the messages conveyed through it can have an impact on the 'effectiveness of feedback' (Kim *et al*, 2010 in Rakoczy *et al*, 2013:65).

The literature review at this point has identified many of the key theoretical perspectives around the concept of written feedback. It has highlighted what effective written feedback is and illustrated what ineffective looks like as well. It is at this point that I will now look to examine the existing literature and provide contextual illustrations where relevant from a practitioner's perspective on another significant term present within the dissertation title: mastery.

Mastery

The term 'mastery' is now at the forefront of mathematics teachers' minds due to its proliferation amongst educationalists. With an attempt by the likes of the Department for Education (DfE) and the NCETM to move away from past curriculum design which consisted 'almost exclusively on the mathematical content (e.g., operations on numbers; measurement; algebra; geometry)' (Schoenfeld, 2015:184) to a more 'insight-based problem orientated environment' (Intaros *et al*, 2014:4119), it is important at this point to try and establish what is meant by mastery and what it may look like in practice.

The NCETM (2014) state that mastery is achieved when an individual has a 'deep, long-term, secure and adaptable understanding' of a particular mathematical topic. They go on to state that the process of achieving this is underpinned by being fluent, being able to reason mathematically and having the capacity to solve problems thereby achieving the aims of the national programme of study for mathematics (DfE, 2014). I will now look to examine this terminology used by the NCETM and the DfE in order to establish a coherent understanding

of what mastery is and what it looks like in practice. Despite being a relatively new *term* in regards to its now widespread use amongst the teaching community, it is important to acknowledge that 'mastery' should not be thought of as a new *concept*. In fact, much of the literature that will be made reference to was written before mastery became the contemporary zeitgeist it now is. In fact, the likes of mastery learning (Mevarech, 1991), mastery goal structure (Patrick *et al*, 2011) and mastery orientation (Harackiewicz *et al*, 2002) are well-established theoretical concepts and have their own distinctive yet related discourse. Rather than providing detailed definitions of the above, appropriate reference to any existing concepts that aid the pursuit of defining 'mastery' will be used where necessary.

The NCETM describe mastery in what could initially be considered as simple terms- to have 'confidence and competence in mathematics' (2014:1). I will adhere to this definition throughout due to its clear and understandable nature. Despite its simplicity, in order to achieve the aforementioned status, it is important to acknowledge the terminology stated in the literature when referring to 'mastery' in order to shed light on what 'confidence and competence' is. In order to develop a coherent and well-established understanding of the term 'mastery', it is logical to identify some of the recurring themes found within the literature. These themes are problem solving, 'deep' knowledge and structure.

The term 'problem solving' is rife amongst the exiting literature and it is this phrase that must first be discussed. Traditionally, as outlined by Bell (1993), mathematics teaching has concentrated on providing a 'method of problem solution and then providing students with the opportunity to apply the method to a range of problem situations of similar context'. In order for this to occur, Shield and Dole (2012:186) stated that learning opportunities needed be carefully crafted in order to allow students to 'develop understanding of the structure of mathematical problems' which allows for them to 'transfer their mathematical knowledge to

unfamiliar, but related contexts'. Vergnaud (1983:129) and Xin (2012:3) also spoke of developing learners understanding of 'structural links' thereby allowing them to develop a greater understanding of the 'mathematical relationships' present within a particular problem. For the purposes of this dissertation, a detailed depiction of how a child might go about solving a problem is not necessary. However, it is important to establish what 'problem solving' is. It could be suggested that Watson and De Geest's (2005) interpretation of problem solving as applying current knowledge to many contexts and revealing relationships and connections to other concepts appears to support the assertions of the aforementioned authors. In regards to specific components which make up 'problem solving', the sheer amount of variation amongst the literature makes it difficult to find some form of consensus of what it is. For example, Charlesworth and Leali (2012:373) considered problem solving to consist of four separate but interlinked processes: reasoning, communication, connections and representation. Whereas Muir *et al* (2008, 229) considered problem solving as requiring learners to interpret information, plan and work methodically, check results and try alternative strategies. It does not appear necessary or particularly useful to attempt to create a definitive 'list' of what problem solving is in regards to the skills it requires as it appears there is not a general consensus across the present literature. What I believe can be said is that it is not unreasonable to suggest that there is much overlap between the different definitions. What may be easier to define is what problem solving is not. It would appear that existing literature confirms the assertions of Sakshaug and Wohlhuter (2010:397) in that problem solving is not a 'teacher-centred classroom' and also is not studying a topic or asking a question or doing an exercise in order to pass a test (Herrera, 2005).

In addition to the discourse surrounding problem solving, much of the literature based on the topic of 'mastery' makes an additional reference to term 'deep' when discussing its fundamental principles, as does the NCETM. It is therefore at this point that a depiction of

what the term ‘deep’ means is established in order to continue to develop a thorough understanding of what mastery is.

The concept of children developing a deep understanding of a particular mathematical topic is certainly nothing new, both within the UK and across national borders. In the UK, the Cockcroft Report (1982), entitled ‘Mathematics Counts’, spoke of the need for children to ‘consider more deeply the structure which underlies the work which is being done’ and the fact that teachers should provide those who are ready with the chance to think ‘deeply and critically’ in order to deepen their mathematical knowledge and understanding. In the United States, the National Council of Teachers of Mathematics (2000) created a set of standards for teachers to follow in light of contemporary research which focussed on leaners developing ‘deep conceptual understanding and procedural fluency’ (Schoenfeld, 2015:184).

The concept of ‘structure’ has once again appeared when talking about what constitutes mastery. Boonen *et al*’s (2016) definition of deep knowledge as individuals having the ability to ‘construct a rich and coherent mental representation containing all solution-relevant elements’ once again gestures towards the need for individuals to have a deep understanding of the fundamental structures of mathematics in order to, as Boonen *el al* state, ‘construct’ knowledge thereby allowing them to demonstrate a deep understanding of a particular topic. It might be suggested that in order for this, what could be termed as, ‘construction of structures’ to take place, the process of ‘becoming aware of the relationship between things and their meaning" (Evans, 1978:390) appears to be particularly important when developing deep understanding. In addition, Bishop’s (1988) notion of deep understanding as the transformation from understanding ‘ways of doing’ to ‘ways of knowing’ could also be said to be of relevance when considering the characteristics of someone who has ‘mastered’ a particular facet of mathematics.

Leithwood *et al* (2006:12) offers two separate yet interlinked conceptions of deep understanding- the *correspondence conception* and the *performance perspective*. It is important to recognise these particular facets of deep knowledge as they shed light on how mastery might be 'judged'. Nickerson's (1985, in Leithwood *et al*, 2006) view of the former suggests that deep understanding is achieved when there is a 'perfect match' between what is in the head of the learner and what is in the head of the 'designated expert'. The two perspectives must be aligned in order for deep knowledge to have been acquired. In order for deep understanding to be achieved from a performance perspective, certain capabilities or dispositions would need to be exemplified or performed by the learner for the expert to then 'credit' the individual with having achieved deep understanding. However, as McTighe and Wiggins (1999) state, performance, regardless of the means by which it is judged, can be influenced by a myriad of factors and variables thereby potentially making it hard to evaluate the depth of an individual's understanding. It is also important to acknowledge that what the teacher may use to judge or credit the learner with, may not necessarily demonstrate deep understanding but merely an individual's *view* of what deep understanding is from their own perspective. What this 'expert's' view might be could in fact exemplify a 'surface level' of understanding opposed to a 'deep level' of understanding (Entwistle & Entwistle, 1992:3). This raises the issue of teacher subject knowledge and the need for, as the NCETM state, 'deep structural subject knowledge of mathematics' on the part of the teacher so that adequate opportunities are designed that allow an individual to demonstrate deep understanding.

The use of 'deep' is, as mentioned, rife amongst the literature examining what mastery could be considered to be. Another term which appears to have overlap the themes contained within the term deep knowledge is 'robust knowledge' (Richey & Nokes-Malach, 2014) which consists of learners acquiring 'deep, connected and coherent knowledge'. Richey and Nokes-Malach (2014:185) considered 'deep' knowledge to consist of a learning

having the ability to demonstrated knowledge 'across a variety of domains'. This appears to support the beliefs of Chi and Ohlsson (2005) regarding deep knowledge as having the ability to identify features that are 'common to the structure of many problems across different domains'. Connected knowledge can be regarded as linking separate pieces of information to one another thereby allowing for abstract principles to be related to specific problem features (Nokes-Malach & Mestre, 2013). Ohlsson and Rees (1991:110) also stated that connected knowledge allowed for leaners to apply the procedural skills which had been previously learnt into new or novel situations. This is, as Hiebert and Lefevre (1986:263) state, at the core of being procedurally 'flexible'. Coherent knowledge is considered to be 'consistent and free of contradictions' (Richey & Nokes-Malach, 2014:185). In order for knowledge to be coherent, Chi (2008) believed an individual would need the ability to replace or modify inaccurate beliefs with ones coherent to the existing 'deep, structural knowledge' that was previously held (Novick, 1988). This is in contrast to those with less coherent knowledge who are potentially less able to identify inconsistencies in their own knowledge and fail to revise their own beliefs in light of new evidence (Chinn & Brewer, 1993).

It appears reasonable to assert that there is much overlap between the different definitions which could be used to describe mastery. The term is undoubtedly broad but there appears to be many commonalities, as have been identified, within the literature.

A contextual illustration of the current mathematics curriculum viewed from the perspective of a classroom practitioner may shed light on the challenges faced by teachers regarding the implementation of 'mastery'. Whether or not 'mastery marking' can mitigate these challenges will be examined in the results section. It is important to acknowledge how the curriculum impacts upon teachers and the effect this can have on their ability to implement and embed mastery into their own practice. The first potential problem for classroom practitioners is what will be termed curriculum coverage. Leithwood *et al* (2006) stated that mathematics

curriculums are often ‘teeming with things to be covered’. A possible illustration of this is that the current Year 5 mathematics curriculum is made up of 51 separate objectives which, depending the perspective and particular context of the practitioner, need to be taught, assessed and evidenced. It would of course be overly simplistic to view these 51 statements as separate entities with no relation to one another because, as the NCETM (2014) state, mathematics is a series of interconnected ideas and that making connections between areas of study reduces the amount of mathematics to learn. However, how practitioners ‘plan with, adapt, or ignore’ (Dietiker, 2015:285) the content contained within the curriculum is a point to consider. How teachers ‘make sense’ (Breyfogle *et al*, 2010) of the content of a mathematics curriculum has an impact on their thinking as they begin to construct the classroom ‘culture and environment’ based upon their interpretation of the curriculum as they see it (Ball & Cohen, 1996). Therefore, it could be suggested that if a teacher failed to acknowledge or did not have the subject knowledge to make use of the interconnectedness of mathematics, the prospect of teaching 51 objectives may be a challenging one. If a teacher takes this particular perspective, it could be suggested that Molina’s (2016:32) assertion that a ‘simple yet deep’ approach which has the potential to allow for deeper understanding of a particular concept to be developed may possibly not be achieved. Molina uses the example of writing definitions for mathematical concepts, stating that an individual who has mastery of a particular topic is far more equipped to produce a concise and simple definition. This is opposed to those whose understanding is weaker due to their tendency to produce a ‘complex or shallow’ definition. However, this example clearly has its limitations as there is the potential for ‘parroting’ by children as this may not demonstrate mastery but in fact simply the ability to regurgitate what their teacher has told them. However, the ‘more is less’ ethos is something Leithwood *et al* (2006: 12) prescribe to in their assertion that deep understanding can only be achieved when both pupils and teachers have the time and space to, for example,

apply, explain and evaluate a particular area of study. Again, this could be said to once again highlight the potential difficulties faced by practitioners if they do not feel that they have the 'time and space' due to coverage of curriculum content.

Another potential issue, exemplified by Skemp (2012:335), is that the speed at which content has to be taught, assessed and evidenced by the teacher and learnt by the pupil, can lead to those with 'mathematical difficulties' (Jordan *et al*, 2003: 109) having a 'surface' level of understanding opposed to a 'deep' level of understanding (Skemp, Ibid:334). In the short term this has implications in regards to children's opportunities to develop mastery of their particular year group curriculum. However, it could be suggested that the effects of this speed and thereby potential lack of opportunity to develop mastery has wider, long-term implications. For example, a school using the traditional method of 'setting' by attainment, as my own context does, can lead to, as Watson and De Geest (2005:210) state, 'those with most problems in learning being grouped with others who also have problems' which may contain a 'disproportionate number of those from disadvantaged social, cultural and racial groups and those whose first language is not English'. I would concur with the assertions of Boaler (2016) as this raises issues of 'equity and engagement' within education. The impact setting has on the intervention will be examined later.

My own experiences as a classroom practitioner would support this conflict present in the education system. The concept of setting is often, from personal experience, ingrained into what many teachers view as best practice due to their belief that it allows children of lower attainment to receive the 'support' they require whilst higher attaining children receive the 'push' they require. This clearly flies in the face of the ethos underpinning mastery, as stated by the NCETM (2014). However, working in a school which does 'set' children according to their ability, primarily judged through assessment results, and having traditionally always achieved significantly above national average in regards to SATs results

for mathematics, to extrapolate the merits of using a mastery approach in which all children have the opportunity to master their curriculum (NCETM, 2014:1) and make this explicit to both experienced and newly qualified teachers is undoubtedly a challenging task. Having said this, a slow, progressive approach which gradually builds in particular elements of a mastery approach is something which potentially mastery marking may make a positive contribution towards.

This literature review has examined the existing research on both written feedback and mastery. Where appropriate, relevant reference will be made to pertinent themes or specific points identified within the literature that are significant in the pursuit of answering the research questions.

Methodology

Description of the intervention

A relevant, select number of Wylie and Lyon's (2015:140) 'five strategies' for effective formative feedback will now be used to describe the theoretical basis of the intervention. The process as a whole will be referred to as mastery marking throughout the piece (Figure 1). The word 'mastery' is being used in this context to describe the underlying principles outlined by the NCETM in regards to the approaches underpinning mastery teaching. It does not exclusively refer to tasks that demonstrate mastery but instead should be viewed a convenient term to use in regards to what the project is trying to achieve and its links to the NCETM's 2014 document. The use of the term 'bubble' will also be used at particular points as this is how it is referred to by both children and teachers at present within my school. For example, a green bubble would be a mastery task whereas an amber bubble would be a consolidation task. The use of the term 'bubble' is in line with the schools own marking

policy as what is traditionally referred to as 'next step' marking is referred to as 'bubble marking' as a child friendly term.

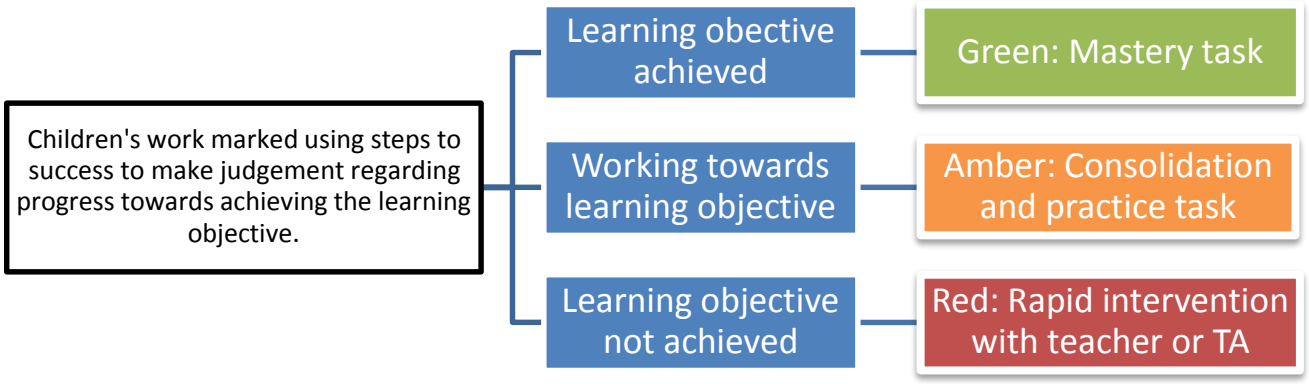


Figure 1- the process of mastery marking.

Step 1- clarifying and sharing learning expectations.

A learning objective and 'steps to success' were given to students at the start of each lesson to 'judge' a child's learning. This is in line with current practice within the school as this is present within the school's teaching and learning policy. The use of a learning objective and steps to success can be said to adhere to Bransford et al's (2000) view that a goal-directed approach to learning using scaffolding can:

- motivate the learner
- simplify the task to make it more manageable and achievable
- provide some direction to help the learner focus on achieving the goal

'Direction' is something Shute (2008:157) adheres to stating that it can 'signal a gap between a current level of performance and some desired level of performance'. Locke and Latham (1990, in Song & Keller, 2001:6) agree with this assertion stating that when this gap is 'resolved' it can lead to higher levels of motivation. Wylie and Lyon (2015:139) also found 'criteria-specific templates' can serve as an 'anchor or guide' for the assigned task which, as

Johnson and Johnson (1993:139) state, reinforces the need for comparisons to be made between actual performance and some established standard of performance.

Step 2- engineering effective learning tasks that elicit evidence of learning.

Task design is not the focus of this dissertation, however, it is important to recognise the fact that unless the 'elicitation of evidence' takes place, it could be difficult for written feedback to be effective as 'quality evidence regarding student thinking and misconceptions' (Wylie & Ciofalo, 2009:) may not have been gathered.

Step 3- Providing feedback that moves learners forward

At this point, the mastery marking will begin. Teachers will use the steps to success they have provided to 'guide' their judgement of the child's learning in that particular lesson. As figure two depicts, if the child has met all the steps to success, they have therefore achieved their learning objective. This was signified with ticks in all the boxes and a stamp that states 'You've achieved your learning objective'. The teacher will then provide the pupil with a green bubble in which a task is present that allows the pupil to demonstrate mastery. These tasks will be taken from the NCETM's 'Teaching for Mastery' documents or alternatively from the White Rose Maths Hub schemes of learning documents. Teachers have been asked to use these documents in order to support them as opposed to hinder them or take away their autonomy in regards to task creation. I thought it appropriate to use the available documents as teacher generated tasks may not elicit mastery. The resources stated above should in practice be the best resources to use due to the expertise of those who produced them. This is not to say that participating teachers could not have produced their own tasks of equal or better quality. However, for the purposes of this project, it appeared to make sense to use what was available and suitable for the intervention.



Figure 2- 'Learning objective achieved' exemplar.

If a child has achieved some but not all of their steps to success, they will receive a stamp saying 'You're working towards your learning objective'. The teacher will then provide an amber task that focuses on addressing the specific step that was not achieved in the lesson. The teacher will decide what task should be given in order to address the 'misconception that needs clarification' (Chan *et al*, 2014:101). Figure 3 exemplifies this. The concept of achieving 'some' of their steps is undoubtedly a subjective term as one teacher's judgement regarding what constitutes 'some' may differ from another. To mitigate this as best as possible, guidance was given to the participating teachers that if one or two steps were not achieved then an amber task should be provided. This was a principle used to make my own judgements. A degree of teacher judgement will be used throughout this project due to the subjective nature of marking. The use of steps to success can be viewed as a way of teachers trying to accurately assess which particular area of the learning objective may not have been

achieved. This is by no means perfect but did appear to be useful when trying to create a coherent set of guidelines for the participating teachers.

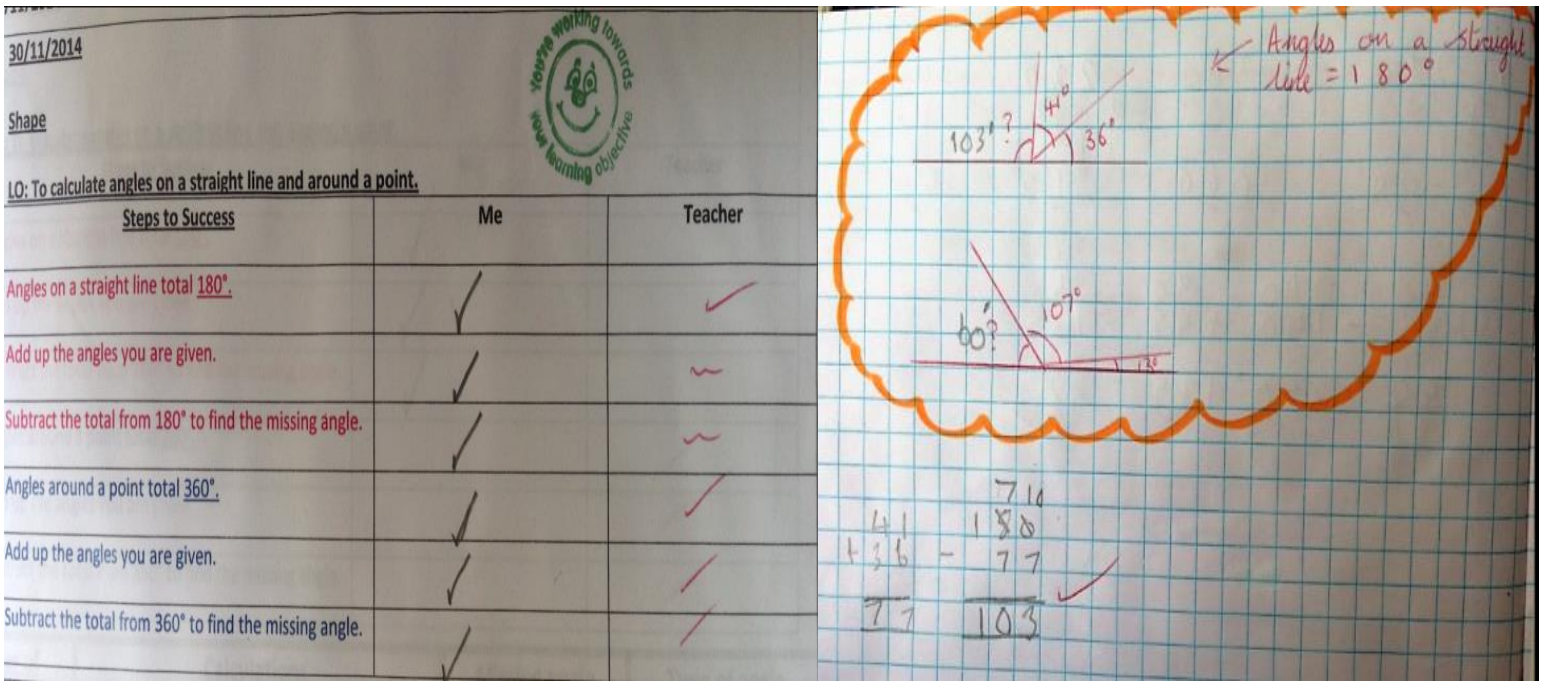


Figure 3- 'Working towards learning objective' exemplar

A child who achieved none or possibly one of their steps will be judged as to have not met the learning objective. If this is the case, the child will receive a stamp that states 'You've not yet achieved your learning objective'. The teacher will then provide a red bubble that simply states 'intervention' inside it, as shown in figure 4. The teacher or teaching assistant will then work with these children at the start of the next lesson in order to try and address the misconceptions. Once again, a certain amount of subjectivity and teacher judgement will be present in regards to the appropriate task they should receive when working with a particular child or group of children. A point to acknowledge here is that when working with a group all the children may not have the same misconceptions. In this situation a 'best fit' approach will be used in order to provide adequate support. Again, this has its limitations. However, at

present, these rapid interventions are not taking place so it could be suggested that some form of support may be more beneficial that the current lack of intervention.



Figure 4- 'Learning objective not achieved' exemplar

It is vital to acknowledge the potential pitfalls that this method may have. The criticisms stated above paint a picture of the difficulties in providing feedback which is 'specific, simple, descriptive, and focused on the task' (Fluckiger, 2010:137) and, as previously stated, a best fit approach which embeds some of the key themes identify by the NCETM was the aim of the project.

Step 4- providing the opportunity for engagement with feedback

Fluckiger *et al* (2010:138) states allowing time for giving and receiving feedback is key to 'enhancing teaching and learning' in the classroom. The fact that this opportunity is given the following lesson is critical in the 'remediation process' (Oyedej, 1994:224). This is because

‘timely opportunities to correct deficiencies’ (Goldfarb and Morrison, 2014:268) can be said to be, as Mason and Bruning (2001) state, ‘superior’ compared to delayed feedback. With this in mind, both teachers were asked to designate time at the start of the following lesson for children to complete their mastery marking. It was suggested they gave ‘sufficient’ time for children to complete the task they had been set. Again, it is important to acknowledge the subjective nature of ‘sufficient’. Having said this, I felt it inappropriate to specify at particular time frame as I felt this may restrict teachers and fails to acknowledge their own teacher judgement and knowledge of their class.

Data collection

Small scale, action research took place over the course of two school terms. A mix of qualitative research methods were used to gather information in an attempt to answer the research questions. Particular constructs related to written feedback identified in the literature review were used to inform much of the qualitative research that took place. A combination of qualitative methods were chosen in order to gain an insight from all the participants involved and to provide enough data to answer the research questions as comprehensively as possible. The data gathered was examined from my perspective as a teacher and classroom practitioner framed by the research questions posed earlier in the piece

Participants

Two Year 5 teachers and I used the mastery marking approach for three half terms or seventeen weeks in total. Teacher A had been teaching for five years and was in a middle management position whereas teacher B was less experienced and had begun their NQT year at the start of this academic year. When referring to the groups of children taught by the different teachers, group A will correspond to teacher A and group B will correspond to teacher B. I will refer to my own group as group C.

Ninety children from Year 5 were subject to mastery marking and also participated in a whole class discussion around the topic of marking. The children involved came from a range of ethnic backgrounds with over half of the children eligible for free school meals. The ninety children involved were taught in three separate classes by myself and teachers A and B. All three classes consisted of thirty children. The classes of teachers A and B were both mixed ability groups with children judged by assessment results and teacher judgement to be of lower attainment alongside children of middle attainment. My own class is viewed as the higher attaining set and consisted of children placed in that group according to their assessment results being comparatively higher to other children in the year. Assessment results and teacher judgement was used at the start of the academic year to choose which children were allocated to each set. At this point it is important to briefly acknowledge the growing discussion around ability setting and the implications this may have on the project. As the purpose of the research was not to look at the effects of setting, I will not look to justify the merits for or argue against setting by ability within school. However, an acknowledgement of the possible effect this may have on the written feedback provided and the possible difference between the sets must be stated.

Whole class discussions

I conducted these with each of the three groups within the year. The same questions were asked to each group to ensure parity. Discussions took place at the start and end of the data collection cycle to examine the changing perspectives, if any, the children had. 'Brief, open-ended' questions (Muzzatti & Agnoli, 2007:479) were used in an attempt to 'tap-into' (Strand and Winston, 2008:252) the perspectives of the children. An informal conversation style was taken due to its 'flexibility' and 'spontaneity' (Cohen *et al*, 2011:409) and the ability to move on or explore in greater depth particular responses. However, I was unable to transcribe all responses in their entirety due to, as Cohen *et al* (Ibid:413) state, the fact that data

organisation can be difficult during informal conversations. Transcribed recordings of what the children said will be italicised.

No assertions will be made regarding the comments being made by individuals as representative of the whole group. Having said this, if a general theme emerges from the responses of those who answered the questions, this will be used to make a subjective interpretation of the overall opinions of those who spoke. Clearly this has its limitation but due to the number of potential respondents, for the purpose of this piece, it appears to be a reasonable approach for this study.

Focus group

The two teachers involved were asked to participate in a focus group activity at the start and at the end of the project in an attempt to gain an insight into their opinions regarding written feedback, mastery and the intervention. Brief transcriptions of the answers provided were taken in note form. A semi-structured approach was used during the focus groups. Participates were encouraged to develop and expand upon their answers at certain points so that they had the opportunity elaborate on what had been said. A select number of questions asked during the first focus group were asked at the end of the project to gather any changes in answer that may be significant in terms of answering the research question. The reason for selecting specific questions was due to time constraints in regards to administering the focus group. Transcribed recordings of what the teachers said will be italicised.

Analysis of marking

Teachers A and B were asked to complete one example of mastery marking each week over the course of three half terms between spring 1 and summer 1. No guidance was given regarding which day this should be done. The only guidance given regarding when the

marking should take place was that it should be done following the teaching of an objective from the national curriculum. Teachers agreed to allow me to collect data from their books in the form of photocopies of children's work and the marking provided by teachers. This data was collected at the start, midway and end of the project. The data that was collected at the start was prior to teachers being asked to begin the intervention. This was done to examine teacher's current marking before beginning the project so a comparison could be made with their marking at the end of the intervention. Examples were collected from the books of five children from each set. These children were chosen by the teacher using the criteria of one boy of middle attainment (1), one girl of middle attainment (2), one pupil premium child of middle attainment (3), a child of lower attainment (4) and a child of higher attainment (5) in the context of their own group. This was to discourage teachers picking a particular group of children and also to ensure as best as possible a cross section of the attainment and socio-cultural status of the children across their group was represented. Teachers A and B were asked to use a mix of their teacher judgement and assessment results to pick which children 'fitted' into each of the specified groups. The same criteria were used to pick five children from my own group. The numbers above will be used when discussing each child's work and will be matched the either the letter A, B or C depending on the teacher.

It would be inaccurate to assume that the criteria stated above gives a 'complete' view of the children in each class as there remains a high level of subjectivity in regards to which children were picked by the teachers. Their interpretation of the term higher, middle and lower attainment has an impact on their choice and therefore the data I have collected. However, for the purposes of this project, the selection criteria stated above will provide an adequate representation of the children within each group.

Ethical considerations

There are potential implications due my role as a teacher, colleague and researcher which must be acknowledged in order to highlight the potential difficulties of completing the research project. The collaborative element of the research comes with its own issues due to my relationship with the participating teachers. It is this 'relationship' which may have influenced their decision to agree to participate in the first instance. There may have also been a certain degree of pressure felt by the teachers to participate for multiple reasons. As a close colleague working with the participating teachers on a daily basis, they may have felt that not agreeing to participate may have damaged the working relationship we currently had. Also my role as a middle leader (mathematics co-ordinator) may have also exerted pressure on the teachers involved. An element of top-down superiority could have been a strong influencing factor for teacher B due to their relative lack of experience and the requirement to pass their NQT year. In addition, they may have also completed the task with either less or more enthusiasm/rigour due to the fact that I know them. In order to mitigate these potential issues around power relationships, it was made explicit to the participating teachers that this was a research project which had no implications in regards to motoring or performance management. The degree to which they participated would not be fed back to their respective performance managers. The only person who would be made aware of the *outcomes* from a teaching and learning perspective but not the *level of participation* in regards to the project would be the head teacher.

Results

This section will state the findings from the two focus groups, the whole class discussions and the analysis of marking. The focus group data has been grouped into three separate subheadings- marking, mastery and the intervention- as these were the three topics discussed during both focus groups. Whole class discussions have been separated into two sections as these were conducted at the beginning and at the end of the intervention. The marking

analysis has been separated into three sections so that a depiction of the results at the three separate stages (start, midpoint and end) could be identified.

Focus group- start of the project

Marking

In regards to why marking was important, teacher A stated that it was about '*getting children where you want them to be*' but also, on a more pragmatic level, it was something that had '*just got to be done'*. Both teachers talked of the need to evidence progress and to fulfil monitoring requirements. Both agreed that an apparent lack of time to do marking which was tailored to the individual child's current level of understanding was an issue.

Both agreed on what constituted '*best practice'* in terms of how to mark. '*In an ideal world*' each child's book would be thoroughly marked, errors identified and a next step should be given which is tailored to the specific needs of the child. Children should be given the chance to complete their next step '*as soon as possible'*.

Mastery

Both spoke of '*problem solving'* as being the best way to describe mastery. When asked to elaborate on this they spoke of using and applying in the form of word problems. They found it difficult to articulate anything that differed greatly from the aforementioned statements. Teacher A said '*I don't think I've used it enough yet to know what it really is'*. Teacher B agreed stating that they 'needed to get grips with it'.

In regards to their thoughts of whether or not mastery was something new, teacher A stated:

> *Maths is maths. I think it's more to do with the way it's packaged rather than it being anything new. I can't see it being much different to anything we've done before.*

Teacher B believed that they didn't have '*enough experience'* to make a comparison to any existing or previous pedagogical concepts.

At this point, the process of mastery marking portrayed in figure 1 in the methods section was explained to the teachers.

The intervention

The question *'How do you think the mastery marking approach can be used?'* was interpreted differently by both teachers. Teacher A viewed this as to how they might go about ensuring that there is evidence in their books. Teacher B spoke more of what the results might be for the children they teach.

Teacher A stated they would ensure that a lesson was taught in which children could '*self-assess'* their own work. They explained that the content could be marked by the children themselves at the end of a lesson. When asked why they would do this, the teacher explained that it was to '*save them time'* so that they could '*focus on doing the marking properly rather than ticking answers'*. They also said that this would take place on Wednesday's as they had time after school to complete their marking.

Teacher B spoke of the fact that it will allow them to manage which tasks to give to their children more easily. They also stated that it would help them complete pupil tracker data as '*if they get a green then I'll just say they've achieved that objective'*.

Teacher A believed its strengths were that it made the administrative element of marking easier as they would find '*one green bubble task for all the kids who needed it'* and that it meant they '*wouldn't write the same thing over and over again'* as they could just print one task off and stick it into the children's books. They also spoke of their teaching assistant having a clear role as '*they'll be working with the red bubble kids'*.

Teacher B believed that the colours would be '*easier for the kids to understand'* and that it was akin to a '*traffic light system'*. It was also believed that there was evidence of mastery style tasks taking place in their classroom and that at present they '*found it hard'* to know when and where to fit these in.

In regards to its weaknesses, teacher A raised concerns regarding the prospect of some children in their group never getting a chance to demonstrate mastery. Teacher B believed that some children might receive red bubbles '*all the time'*. Teacher A furthered this concern stating that if their books were to be moderated and there were a significant number of red bubbles, this may reflect badly on their teaching. In order to mitigate these unforeseen concerns, it was made clear that the project was in no way linked to performance management.

The main potential barrier foreseen by both teachers to contest with was time. Teacher A believed that it '*made sense'* but implementing it effectively '*might be hard'*. Teacher B thought that it would '*take some time to get used to'* before they were confident using it.

Focus group- end of the project

Marking

Once again, in terms of why marking was thought of as important, both spoke of the need to fulfil monitoring requirements through adhering to the schools marking policy. Teacher A stated that mastery marking had made them '*refocus'* on the importance of marking and the impact of '*good quality feedback'*. When asked what good quality meant, teacher A said '*specific'*. Teacher B agreed with teacher A regarding the fact that their marking had become '*more focussed'* since beginning the project. Prior to beginning the intervention, teacher B believed they had been '*marking for the sake of it'* and had forgotten about its importance from a teaching and learning perspective.

Mastery

Responses around what they thought mastery was included '*fluency, reasoning and problem solving'* (Teacher A). When asked where these words had come from, teacher A stated that the mastery materials they had been using spoke of these three words throughout. In response to the question 'what do they mean?', teacher A believed that:

> *Fluency is working efficiently and quickly, reasoning is being able to explain and to generally 'talk maths' and problem solving is using what you already know in different contexts'.*

Teacher B's own words were '*I'll agree with that I think'*.

The intervention

Both agreed that its strengths were that their marking had become less generic and more specific. It meant they were actively thinking about mastery and were conscious of making sure that they had given children the opportunity to demonstrate mastery. Teacher A stated it had developed their understanding of what mastery was. Teacher B confirmed they were now using the mastery documents for '*challenge tasks'* during a lesson and for homework.

Teacher A thought that '*thinking of the right thing for the amber kids to do was hard*'. Teacher B agreed and believed that they didn't yet have the '*experience or expertise'* to know what to do for each child and their particular misconception. Teacher A felt it was slightly '*demoralising'* for certain children who didn't received green bubbles very often.

Again, potential barriers to using mastery marking were issues surrounding monitoring and the number of each particular colour a child received appeared to be the most pressing. Both continued to believe children with red bubbles would reflect negatively on

their teaching. Teacher A went on to say that there might be a temptation to '*massage'* the content within books so that no child had only red or amber bubbles.

Whole class discussions

Discussion at the start of the project

'*Why do you think teachers mark your work?'* led to answers from children in groups A and B differing from group C. Group A and B stated '*to make you get better'* and to '*show you what you've got wrong and what you should do next*'. One particular child thought that '*it makes you feel bad when you've got lots wrong'*. The question was then posed to the class whether or not they thought getting things 'wrong' was part of learning. Those who answered believed being 'wrong' was normal and that it only becomes a problem when you get '*everything wrong all the time*'. Conversely, group C stated being wrong was '*bad'* and showed '*you didn't understand something so you haven't learnt enough yet'*. Group C also appeared to recognise a commitment on the part of their teacher to mark their work; '*if miss doesn't mark our work she'll probably get in trouble'.*

Whether or not marking was important, a number of children in groups A and B were critical. One asserted '*I don't read it anymore*' whilst another said teachers should concentrate on '*making lessons fun'*. Group A believed that marking wasn't done regularly enough to make a difference- '*Sir doesn't do it that much anyway so it's probably not that important*'. Group C differed greatly as a much more, what might be termed, 'positive' tone was portrayed. Many said it was '*very important'* and without it they '*wouldn't know how to get better*'. When asked why 'getting better' was important, a justification based upon their belief that if they didn't get better they '*wouldn't do well in tests'*. When asked if this was important, a unanimous '*yes*!' was cried with one child stating '*I feel happy when I do well in tests*'.

'Do you like the way your teacher marks your work?' provoked responses such as '*I don't really understand what it means*' (Group A), '*I don't know'* (Group B) and '*sometimes it's good but sometimes it's just lots of writing*' (Group C). Group A expressed a dislike of the inconsistencies present within their marking as different coloured pens were used- '*sometimes it's red, sometimes it's green and sometimes it's blue'*, and that they didn't know which day they were going to have their work marked as group A said that having it on '*a special day*' would be better.

'Do you get time to read and respond to what your teacher has written?' looked to examine whether or not there were 'opportunities to act on feedback' (Heron, 2011:282). Responses from groups A and B appeared to suggest an inconsistent amount of opportunity for a response to be given to a written piece of feedback. From my analysis of marking prior to beginning the intervention, my findings would appear to concur with this. Groups A and B provided answers that portrayed an inconsistent amount of time given to responding to marking- '*we get a bit of time at the start of some lessons but not a lot. Sometimes I don't finish it'* and '*sometimes we don't even look at it because we've got to do homework and stuff'*.

Discussion at the end of the project

'How has your teacher been marking your work?' appeared to show an understanding of the fundamental principles of mastery marking. Group A stated '*they use colours to show us how we've done'*. When asked what the colours meant, answers included '*green means you're ready for a really tough challenge*', '*amber means you need to practice a small part of the lesson but not everything*' and 'red means you were really stuck'. Responses from group B were similar, for example, '*Green is a challenge question'* and '*amber is to practice what you've been doing*'. One interesting difference between groups A and B was that group B said that a red bubble was given if '*you needed lots of help because you got everything*

wrong'. Group A stated that it was '*usually sir'* who worked with them if they got a red bubble. Group B said that it was either '*miss or (teaching assistant's name)*'.

Responses in regards to the green bubble also indicated a general consensus amongst children that these signified a '*challenge'* or '*tough challenge'*. When asked to explain what a 'challenge' was, group A stated it was something that '*makes you think hard'*. When asked what they meant by 'think hard', a child defined it as something which '*means you get stuck but you solve it eventually*'.

Responses from group C were similar through their assertions that green was '*a challenge*' or '*something tough'*. One child said that you were a '*master'*. When asked what they meant by this, they thought '*you are better than other people'*. This once again potentially highlights a belief that success is related to performance in relation to other or specifically being 'better' than others. Following this comment, the children were asked whether or not they compared their colour bubble to their peers. Group C agreed that this was something they did before they had even read the comment. Groups A and B were less forthcoming in comparing their bubble to others through responses such as '*sometimes'* and '*not really'*.

'Do you get time to do your bubble marking?' appeared to suggest that children in groups A and B had received comparatively more time to act upon their feedback than they did before the intervention began. A child from group A stated '*now we get like 10 minutes at the start to do it'*. Another from group B said '*Miss gives us time now so we can do our bubble better*'. When asked 'when do you get time to do your bubble marking' children said it was '*usually the next lesson*'. This would be considered by Goldfarb and Morrison (2014:268) as a positive step in avoiding any delays in correcting 'errors or deficiencies' through regular and timely 'formative evaluation'. A child from my group C said '*I like having more time because I can talk to my friends about how to solve the question*'. It could be stated that the

apparent increase of time being provided to children, in their own opinion, is a positive change brought about as a result of the intervention. 'Do you like your teacher marking your work this way?' led to responses such as '*I like it because I know what the colour means'* (Group A), '*yes because the colours make it easy to understand'* (Group B) and '*yes because if I don't get a green it makes me want to work hard so I can get a green next time*' (Group C). A child from group A stated that they didn't like it because '*if I don't get green I get annoyed and it makes me think I didn't do very well*'.

Analysis of marking

Start

The marking provided to pupils before the intervention began varied between the two groups. Teacher A's books were marked after each lesson and after one lesson each week a 'next step' was given. It can be said, that when providing a next step for children, teacher A gave what might be termed a blanket next step i.e. all the children received the same task regardless of their achievement in relation to their steps to success. For example, a child who had not achieved their learning objective (LO) was given the same task as a child who had achieved the LO.

Teacher B's marking was similar to that of teacher A in that a generic next step was given to all children regardless of their achievement in relation to the steps to success. The marking frequency of teacher B was less than that of teacher A as it appeared that a next step was not given once a week.

The next step given to most children often consisted of giving children what might be termed 'more of the same' with little chance to apply fluency, reasoning or problem solving skills. For example, teacher B provided all the children in their class for a lesson based on the

learning how to add two or more five digit numbers with a next step which consisted of adding two six-digit numbers.

Midway

Data analysis at the midway point showed that the mastery marking approach was being used once a week by teacher A but less frequently by teacher B. Teacher A's books showed a mix of all three colours being present within their marking and possibly more significantly a mix of all three colours in each of the children's books. For example, child A5 (higher attainment) had two green tasks, two amber tasks and one red task. This mix of colours was the case for all the selected children across all three groups apart from one exception. Child C5 (higher attainment group, higher attainment) had only green tasks in their book at the midway point of the intervention.

Teacher A's children all had the same number mastery marking examples in their books (five). The green tasks were taken from the mastery documents specified in the methods section. Amber tasks had been created by the teacher and were given to children who had, using their own teacher judgement, been considered to be working towards the learning objective. Using the steps to success the teacher had given to the children, the amber tasks had appeared to be created by examining which step had not been ticked and then an appropriate task was provided which was thought to address the 'misconception or misunderstanding' (Wylie and Lyon, 2015:142). Red tasks (rapid interventions) were also present in the book and were allocated to children who had been deemed to have not met the learning objective. It appeared that every time a red task was given to a child, the teacher led the rapid intervention the following day. There was no evidence at this point of teaching assistants working with children who had received a red task.

Teacher B's books had a differing amount of examples of mastery marking in each book. The number of mastery marking examples present in the five children's books ranged

from two to five. In regards to the tasks being given by teacher B, all the green tasks had been created by the teacher as opposed to using the mastery materials previously discussed. The tasks that had been created continued to fall into what was previously termed as 'more of the same'. Both amber and red tasks were present in the children's books. It was also clear that the guidance given regarding which colour to give using the steps to success to guide their decision appeared to have been followed.

End

Teacher A's books contained one example of mastery marking each week since the midpoint data collection. The five children's books once again contained examples of all three different coloured tasks. Green tasks were again taken from the mastery materials agreed upon in addition to tasks taken from another websites that the teacher believed to be useful. Amber tasks were created using the steps to success to guide what needed to be done in order to address any misconceptions present. Red bubble rapid interventions remained as being led by the teacher opposed to the teaching assistant.

Teacher B's use of mastery marking had increased and become more regular compared to the data collected at the midpoint. Examples of all three colours were present across all five children's books. Green tasks were now being taken from the designated mastery materials. Amber tasks were created using steps to success to guide what task should be completed. It also appeared that red task rapid interventions were being led by both the teacher and the teaching assistant.

At this point it appears to make sense to display the amount of each particular coloured bubble each child received over the course of the intervention.

	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	C5
Green	5	4	5	2	7	3	3	3	1	4	7	5	7	5	12
Amber	5	6	4	8	4	3	3	2	4	2	5	4	6	6	1
Red	2	2	3	2	1	1	1	2	2	1	2	3	1	3	1

Figure 5- Amount of each colour individual children received in each group.

Analysis

Two separate sections have been produced- teachers and learners- to provide a sufficiently detailed analysis of the results. Within each section, themes have been identified that have particular relevance in regards to the research questions. To dichotomise teachers and learners would fail to acknowledge, from the perspective of Ashwin (2009:2), that these are in fact 'different aspects of the same processes in which students and teachers engage together'. This concurs with Trigwell and Shale's (2004:531) notion of 'collaborative meaning-making' as an awareness of what is happening in a particular situation evokes a 'particular response from a skilled teacher' (Case, 2015:629), otherwise known as 'pedagogic resonance' (Trigwell & Shale, 2004:532). However, using Case's (2015) critical realist perspective, it is possible to retain teaching and learning as 'distinct processes'. With this in mind, it appears reasonable to segment the two to comprehensively answer the research questions.

Leaners

Changing perceptions of marking

One of the aims of the intervention was to examine whether or not children's responses changed, if at all, regarding feedback. In light of this, each question that was posed to the children will be analysed.

Discussion at the start of the project

Why do you think teachers mark your work?

At the start of the project, it could be suggested that pupils demonstrated a simplistic understanding of the concept of feedback as an oscillation between where you currently are and where you need to be. This concurs with the views of Dixon and Haigh (2009:179) in regards to their depiction of feedback as identifying the 'learning gap *and* the actions necessary to close that gap'. However, it is also important to acknowledge at this early stage of data analysis that a child may be providing a 'learned response' and in some way may be providing a response they think the teacher may *want* to hear. This should be recognised but not dwelled upon as an analysis of what is said rather than what may be implied is the primary focus of the analysis. It is also important to address the potential disparity between the interpretation of feedback or, as Sadler (1998:79) states, failures in the 'communicative exchange' that have led to one party potentially having 'different understandings from another as to the meaning of the feedback'. Whether or not teachers own views of how feedback should be interpreted matched the views held by the children is impossible to say. The views teachers have regarding feedback will be examined later in the piece alongside the possibly disparity between teacher and pupil interpretation.

The use of term 'wrong' by the pupils could be seen as an interpretation of criticality being presented in their work, a feature Holmes and Papageorgiou (2009) thought of as a crucial element to effective feedback. However, when probed further, this particular child stated that 'it just makes you feel bad when you've got lots wrong'. The feedback this child has received up until this point could have, as Pitt and Norton (2016:4) suggest, had a negative impact on this particular child's self-efficacy in regards to their 'speculation and judgment' of whether or not they are capable of completing a particular action (Yu *et al,* 2015:702). As mentioned in the literature review, this clearly depicts the delicate balance

between providing feedback that points out areas for improvement in a sensitive manner whilst not dumbing down the need to highlight 'weaknesses at present' (Black and Wiliam, 1998). This response also appears to concur with the findings of Young (2000) regarding the sense of self being very closely linked to the emotional responses that one might have following feedback.

Do you think marking is important?

The reasons behind the first comment made by a child in teacher B's group, 'I don't read it anymore', could range from simplistic to deep seated beliefs being held by the individual pupil regarding their own ability or level of achievement. Kahu *et al's* (2015) assertion that prior experiences have shaped the child's pre-conceived conception of their achievement could be said to ring true with this individual. It could also be suggested that the negative effects of critical feedback have led to this particular child 'opting-out' as now their response to feedback is to ignore it rather than act upon it. Taylor *et al* (2003:357) would state this this is an example of 'self-handicapping' or avoidance behaviour. As Lemov (2012, in Chen *et al*, (2014:100) asserted, a 'no opt out' environment was crucial in the creation of a 'culture conducive to feedback' coupled with a 'warm and supportive teaching and learning context' (Dowden *et al*, 2013:358). Whether or not the children who made the aforementioned comments has had this could be debated. The responses above could also be suggested as an attempt to preserve self-efficacy through lack of engagement with the feedback given. This was something shared by other children within both groups A and B. However, an interesting point made by Duijnhouwer *et al* (2012:171) was the potential for self-efficacy to be 'susceptible to change, even after a single episode of particular teacher feedback'. This suggests that there is potential for change in regards to the responses children have when feedback is given. Having said this, it is important to recognise other possible explanations for this particular comment. It would also be reasonable to suggest their historical

relationship with feedback has been turbulent for a multiple of reasons. For example, the child may have decided that acting upon feedback has not led to improvement; teachers may have not given feedback regularly enough in the past to warrant attention being given to it in the present; it may have become a source of 'confusion' (O'Donovan *et al*, 2000); teachers may not have checked their responses to feedback in the past thereby potentially rendering it a fruitless exercise as there is no repercussion or reward for doing it. Again, the range of possible explanations highlights the complexity of feedback and in particular the potential for problems to occur if there is a lack of a 'shared understanding' regarding the positive impact feedback can have (Taras, 2002:503).

Responses from group C may point to a perception being held by these children that feedback is a necessity if they are to achieve their wider goal of success in tests which consequently leads to a favourable emotional response. An acknowledgement of group C's goal orientation appears to be of relevance here as it might be suggested that these responses point towards a performance goal orientation as there appears to be a desire to 'demonstrate ability' (Turner *et al*, 2003:358) through achievement on 'standardised tests' (Skaalvik and Skaalvik, 2013). It might also be suggested that groups C's responses regarding whether or not being wrong was negative could also display a performance goal orientation (Nicholls, 1984 & Dweck, 1986) due to their desire to 'demonstrate competence'. Responses from group A and B regarding whether or not being wrong was a 'bad thing' showed what could be considered a mastery goal orientation as it was considered 'normal' by the children who responded. Whether or not this displays some or any of Ames' (1992) characteristics of a mastery goal orientation (acknowledging effort, progress towards goal attainment and individual improvement) is debatable. However, what it does appear to highlight is the difference in importance group C attribute towards success in testing and the credence they give getting answers correct in relation to how they perceive their own ability.

Despite the groups appearing to have differing perspectives on the importance of marking at the start of the intervention, Harrison *et al's* (2015:232) acknowledgement of varying 'emotional reactions' individuals can have to feedback appear to be of great significance when considering a child's 'feedback processing capability' (Pitt & Norton, 2016:15). It might be suggested that individuals in group A and B have had their willingness to engage with feedback impeded through past negative emotional experiences whilst others in group C are in fact motivated by it due to their belief that a wider goal which can bring about a positive emotional response can be achieved through engagement with feedback. Archer and Hughes' (2011: 175) comment 'feedback can be helpful or harmful depending on how it is conveyed' appears to ring true when considering the responses of these children. It could also be suggested that the responses from group C may have come from the way in which feedback was 'sold' to them by their teacher. As these children are taught by me, my own views and opinions regarding feedback may have been expressed to the children both explicitly and implicitly. This may have had an impact on the responses of the children.

It is important to acknowledge the potential for a relationship between academic success and engagement with feedback. Whether or not the two have a symbiotic relationship is unclear. However, as mentioned numerous times before in this piece, effective feedback provided by an individual should 'focus on success and be immediate, specific, and actionable' (Chen *et al*, 2014:99) and if the learner then 'actively engages' (Shute, 2008:156) with the feedback there can be positive results in regards to closing the gap between 'current performance and desired performance' (Hattie & Timperley, 2007:93).

'Do you like the way your teacher marks your work?

Responses could be suggested to show some inconsistencies between the children's interpretations of the feedback in relation to the intended outcomes of the teacher. I believe that this statement could be deemed to be true as it is highly unlikely that a teacher would set

out to provide feedback which could be viewed as either confusing (Group A child), creates uncertainty or a lack of decisiveness in regards to its worth (Group B child) or inconsistent (Groups C child). Obviously different interpretations of the comments made by child could be made but when viewed from a practitioner's perspective, this appears to fit with the general tone of the comments made. It also appears to adhere to the assertions of Shute (2008:159) as comments that are either too long or too complicated can lead to learners simply not paying attention to it, 'rendering it useless' and that lengthy feedback can also 'diffuse or dilute' the intended message. It is also important to recognise that child B's comment, 'I don't know', could actually be due to the fact that no particularly strong opinions were held by this child regarding feedback.

Do you get time to read and respond to what your teacher has written?

The lack of opportunity or time to respond expressed by the children in groups A and B could be considered a barrier in the pursuit of closing the gap between current and desired performance because, as Fluckiger et al (2010:138) assert, allowing time for feedback to be acted upon in order to 'guide necessary improvement' is key in the enhancement of teaching and learning. Wylie and Lyon (2015:140) furthered developed this point stating that if children are not given the opportunity or time to responds to feedback, they will never have the opportunity to 'master' the content they have been taught. These points clearly depict the need to ensure time and opportunity to respond to written feedback is present for learners.

Discussion at the end of the project

How has your teacher been marking your work?

As depicted in the results, children appeared to display an awareness of what each colour meant in relation to their learning in a particular lesson. At this early stage it could be suggested that a 'shared understanding' (Sadler, 1998:82) has been established in regards to

the meaning of the different colours they received. However, it is important to acknowledge the fact that simply understanding what the colours meant does not necessarily mean that a 'student-centred pedagogy' (Guba and Lincoln, 1989) was in place within each of the teachers classroom or alternatively that 'student ownership' (Chen *et* al, 2014:96) was taking place in regards to their learning.

An interesting point to pick up one is the use of the terms 'wrong' and 'stuck' and the potential implications this has. The term wrong may be considered to be different from error. However, it is impossible to say what a child's interpretation of the two might mean without further research. What can be said, however, is that errors and more specifically the 'normalisation of error' (Lemov, 2010 in Chen *et al*, 2014: 100) is something which 'teachers need to explicitly discuss with students as mistakes are part of learning'. What must also be acknowledged at this point is the time between the teacher identifying these 'errors or deficiencies' (Goldfarb & Morrison, 2014) and the opportunity to act upon feedback to correct them. This will be looked at later in the data analysis.

There were some particularly interesting comments made by children regarding the green tasks they received. The statement from a group A child regarding a green task making them 'think hard' could be deemed as quite a telling statement in relation to what mastery is through the eyes of a child. In order to explore, clarify, practice and apply (Dury, 2014), 'thinking hard' may be a natural by-product of doing these particular procedures. On the other hand, 'thinking hard' does not necessarily mean that a question would require all or any of these particular skills to be called upon. Having said this, if the teacher involved provided only the mastery materials given to them when providing green tasks, it might be suggested that in theory one if not some of these skills would have needed to be called upon in order to answer the particular question they had been given.

Do you get time to do your marking?

The data collected appeared to suggest that, from the perspective of the learners, longer and more regular opportunities to respond to their marking were provided. As opportunities to respond to marking happened 'usually the next lesson', the feedback given as a result of the intervention was increasingly 'timely' (Halverson, 2010:131) which, according to Goldfarb and Morrison (2014: 12), had the potential to 'avoid delays in correcting errors or deficiencies'. However, the use of the term 'usually' could suggest that these opportunities were not always given the following lesson. The implications for this may mean that 'instant' identification of strengths and weaknesses (Foong *et al*, 2015:535) did not necessarily take place as time between the lesson being taught, the work being marked and then being given back to the children to respond to may have resulted in a possible 'delay' which Mason and Bruning (2001) would regard as being inferior in comparison to timely feedback. To specify the exact amount of time is difficult but an acknowledgment of the implications of the delay should be recognised.

Do you like your teacher marking your work this way?

This increasingly positive tone used by children in groups A and B appears to support Duijnhouwer *et al*'s (2012:171) idea of individuals being 'susceptible to change' in regards to the way they view feedback due to the apparent change in discourse used by children regarding the way they spoke of feedback following the intervention. The comment made by the child in group C suggested an almost aspirational element to the way they interpreted the feedback. Having not received a green task in a particular lesson, it appeared to make them want to 'work hard' the next lesson. When asked why this was, the particular child answered 'if my friends have green, I want a green to'. I would suggest that this demonstrates children using the colour they received as a means of comparison between their performance and their

peers. The comment made by another group C child, 'you are better than other people' when you got a green task, again highlights a potential belief that success was related to performance in relation to others or specifically being 'better' than others. This once again comes back to DeBellis and Goldin's (1997) comments about learners holding a 'deep, personal truth or commitment' to the judgement of ability being linked to their position in relation to others.

This use of the different colours to judge their own ability in comparison to others was not something I had anticipated. However, it could be suggested that it was naive to think in an education system that in the eyes of some could be said to be driven by marks, scores, sets and results that children wouldn't extrapolate some kind of way of judging their achievement in relation to one another via the colour they received. Therefore it could be said that, despite not having a mark or grade allocated to them in the traditional way, i.e. test score for example, the belief of some children that this *was* in some way a grade. This could actually diminish the value of the feedback because, as previously mentioned, Black and Wiliam (1998) state feedback is most effective when it focusses on 'individuals' strengths and weaknesses, preferably without any overall marks'. This self-allocation of a grade or status in relation to their 'position in the pack' (Galloway *et al*, 2004) may be detrimental to the purpose of feedback in its widest sense- closing the gap between current and desired performance.

Teachers

Data collected that concerns the teachers involved will be grouped using particular themes that have emerged through their responses during the focus group and my analysis of their marking.

Tasks- type, frequency and delivery

Type

Analysis which took place at the start of the project appeared to show a blanket next step was given which consisted of, what I deemed, 'more of the same' style tasks. It could be suggested that this type of blanket response given to a child, as Chen *et al* (2014:97) state, does not actually 'focus on student learning in relation to learning targets' as no 'specific goals' (Dixon & Haigh, 2009:175) are being set. This lack of specificity is inherently contradictory to the findings of many authors, as previously mentioned, and does, as Halverson (2010:132) asserts, fail to acknowledge the need for the identification 'specific outcomes' and there by the actions that need to be taken in light of this in order to effectively shape future 'teaching, learning and assessment processes' (Harlen & James, 1997). In addition to this, Leithwood *et al*'s (2006:12) assertion that deep understanding can only be achieved with sufficient time appears to ring true in this instance because, as previously observed during the examination of existing marking, the 'more of the same' marking style that was used which did not provide children with the opportunity to 'deepen' their understanding through 'application' (Watson & De Geest, 2005). In summary, time appeared to be a factor for teachers to contest with as, from their own perspective, the lack of it led to 'uniformity of teaching activities' (Goldfarb & Morrison, 2014) which could be viewed as failing to provide feedback which has an increased potential to close the gap.

Delivery

Analysis of the marking provided in regards to the red bubbles showed that teacher A always carried out the small group interventions. Possible reasons for this could range from issues with time, availability of staff, ability of staff or ability of children. However, it could be suggested that teacher A currently regards it as their 'role and responsibility' (Dixon &

Haigh, 2009:179) to lead the interventions for the children who had received a red bubble i.e. they potentially saw themselves as central to the 'teaching, learning and assessment process' (Harlen & James, 1997). The recommendations put forward by Blatchford *et al* (2015) concur with the actions taken by this particular teacher as their research showed that using teaching assistants (TA) as an 'informal teaching resource' for lower attaining children or using them to replace a teacher was not the most effective way of utilising a teaching assistant. Instead, using TAs to deliver 'high quality one-to-one and small group support using structured interventions' had a greater impact on progress. The degree to which this was taking place for children who received a red task is difficult to say without looking specifically at the instruction given to a teaching assistant prior to delivering these rapid interventions. Having analysed the rapid interventions of teacher B, it would appear that the tasks that the TA was asked to do consisted of redoing questions that the child had got incorrect during the lesson. It might be suggested that this, as teacher B termed, 'mopping up' following the lesson does not fit with Blatchford's idea of the 'structured intervention' due to its adhoc nature. My own experiences of using TAs to lead the rapid interventions were very similar to that of teacher B. From my own perspective, time was once again the biggest issue to contest with as rarely would I have the opportunity to send time with the TA in my class prior to the lesson. Instruction regarding what to do with the children who would be receiving rapid interventions often consisted of five minutes at the start of the lesson. Teacher B concurred with this stating that it was 'nearly impossible' to go through what needed to be done in enough detail prior to the lesson beginning. It might be suggested that this highlights the time precious nature of teaching as being one of the barriers to contest against.

Frequency

The meaning of the term 'frequency' will simply be regarded as how many examples of each colour did each child receive. The importance of looking at the frequency of mastery marking

is to answer the first of the research questions regarding whether or not it provides children with opportunities to have feedback that allows for the three different types of task.

The results in figure 5 suggest that the five focus children from each group received at least one instance of all three task types. The number of each different colour each child received varied across all three groups and within each group apart from B1 and B2. It could be suggested that as these children were both judged as being of 'middle attainment' by teacher B, therefore it may not seem unreasonable to see similar results between the two. However, this was not the case for groups A and C as A1 and A2 differed as did C1 and C2. The fact that the child from each group regarded as being of 'higher attainment' (A5, B5 and C5) received more green tasks than anyone else in the group is important to acknowledge. Whether or not the existing knowledge of the these children allowed for them to identify the 'structural links' (Vergnaud, 1983:129) in place between topics or that they could establish 'mathematical relationships' (Xin, 2012:3) more easily that others could be justifiable. It may also be a reflection on the perceptions held by us as teachers and the type of task that we felt these children 'should' be receiving due to their status, as allocated to them by us, as 'higher attaining individuals. It could also be down to the fact that as a result of ability setting within the school, these children may have had more opportunities in the past to 'problem solve'. Having monitored books across the school and across sets as part of my maths coordinator role, previous experience of the children who are exposed to 'problems' often appears to be the children in the 'top' set. This is a much wider issue and one which must be acknowledged as it could be suggested that these children have had greater exposure in the past to problem solving. It could therefore be proposed that mastery marking does not in fact break this trend of higher attaining children receiving more mastery tasks or opportunities to be fluent, to reason or to problem solve (DfE, 2014). The fact the higher attaining individuals received the most mastery tasks could in fact be said to conflict with the NCETM's aim of providing 'all

children with full access to the curriculum' as it does appear that in my own context not *all* children have full access to curriculum. As this project only focused on tasks given through written feedback, it is impossible to say whether or not the children in these groups have other opportunities to fulfil the aims of the curriculum through, for example, tasks during lessons or homework.

The amount of mastery marking each group received differed- group A twelve, group B seven (bar B3 who received six) and group C fourteen. It is clear that group B received less instances of mastery marking than groups A and C. Possible reasons for this are discussed in the *barriers* section.

Barriers- pedagogical content knowledge, NQT status and external pressures.

Pedagogical content knowledge

Responses around the creation of tasks which consolidate understanding (amber) revealed some potential difficulties regarding teachers' ability to formulate activities which address present misconceptions. As they stated it was difficult to think of tasks for the amber bubbles, they believed that this led to a greater amount of time being dedicated to these tasks and that it meant children were not receiving the correct task to address their particular misconception. This raises issues not of subject knowledge but of knowledge of ''how to teach'' the content (Hill *et al,* 2005). Using Shulman's (1986) transformational model as a means of analysing the issue, it could be said there is currently a barrier between how teachers own subject knowledge is transformed into pedagogical knowledge. It might be suggested that in order for this issue to be addressed, further research into ways and means of ensuring 'profound understanding of the mathematical content and knowledge of how children understand' (Murphy, 2011:189) would need to be carried out.

NQT status

It might be suggested that many of the 'issues' experienced by the teacher B during the intervention period were typical of someone with an NQT status. Roness' (2011:636) thoughts regarding the 'demanding complexity of the profession' could be said to ring true for teacher B. From the existing literature, their belief that they didn't have the 'experience or expertise' alongside a perennial concern regarding monitoring do not appear to be uncommon thoughts for someone at this stage in their teaching career.

Firstly, a number of findings regarding teacher's uptake of the intervention in relation to teacher A should be acknowledged. At the midway point of marking analysis, teacher B had not used the documentation given to them. There were also fewer examples of mastery marking in their books compared to that of my own and teacher A. It would not appear unreasonable to state that teacher B's struggle to cope with 'certain aspects of the teacher's role' (Chambers *et al*, 2010:113) manifested itself in the aforementioned. Having said this, analysis of marking at the end of the intervention showed a more regular use of mastery marking. It would appear that their belief that it would take time to 'get grips with it' was a fair assessment of themselves. Their use of the mastery materials also became a positive consequence of the intervention due not only its use for marking but also 'challenge tasks' and homework. It could therefore be asserted that Borman and Dowling's (2008) belief that NQTs could fare well with 'proper administrative support' appears to ring true in this case as the documents provided were used for additional purposes outside of mastery marking.

External pressures

Decramer *et al's*, (2013:352) view of increasing pressures around 'accountability, efficiency and effectiveness' within education appear to ring true from the responses given. The notion of accountability appears to be acknowledged by both teachers during the focus group

discussions due to their concerns regarding the implications of the different colours. Teacher A spoke of concerns regarding how their teaching may be perceived by others if a child had a large proportion of red tasks in their book. Despite the original intentions of the intervention as a marking system based on a formative model of constant evaluation, it could be suggested that teacher A held a belief that mastery marking could lead to 'quantifying teacher effects' and could be used as an 'evaluation system' which as a result may reward or punish the teacher involved (Cody, 2015:559). This appears to agree with the findings of Struyven and Vanthournout (2014:39) who found that teachers can view certain initiatives or new ideas as a 'treat' opposed to the way they were possibly intended to be received. It would appear that the assertions of O'Neill (2013:4) regarding both formative and summative assessment as possibly seeming 'simple and convenient', but can in fact lead to many 'complexities and difficulties' could be regarded as a point of great significance. This concern was something I had not anticipated to be so blatant but it appears to cement Agai-Demjaha *et al's* (2015) findings regarding there to be significant 'pressure' within the teaching profession as a result of accountability measures. Another comment which was equally revealing was teachers A's admission of the potential to, in their words, 'massage' the content within their books. What this might mean is debatable but once again it highlights a pressure present which was not considered prior to the beginning the intervention.

Another prevalent theme as a result of external pressures were issues around time constraints, something which Haggarty and Postlethwaite (2012) viewed as 'significantly restricting' when researching the pressures felt by teachers of limited teaching experience. Responses during the first focus group highlighted the ongoing issue that was a lack of time to mark using the 'best practice' model the teachers agreed on. They also raised concerns regarding whether or not they be able to complete mastery marking in the way they would want as a result of time constraints.

Future considerations and limitations

Going forwards, an attempt to 'marry-up' the formative nature of the marking with a summative measure of a child's attainment would be an interesting concept. Whether or not the amount of a particular coloured bubble present in a child's book could be used to make an accurate or informative summative judgement of a child's mastery of the curriculum over the course of the year is something which would require further research. The positive comments made by the teachers involved in regards to the different colours, as one termed, 'painting a picture' of a particular child could suggest there could be an opportunity for the amount of colours to be quantified and in some way formulate an idea of the amount of objectives mastered over the course of the year. It goes without saying that one lesson's worth of evidence is possibly insufficient in regards to making a sound judgement as to whether or not a particular skill or objective has been 'mastered' as this approach does fail to the interconnectedness of mathematics (NCETM, 2014). Another area which would require further examination is what should be done in regards to assessing the impact of rapid interventions in respects to who is best to deliver these and what should be done during these interventions. The responses of the children reflected a continued comparison of their ability in relation to their peers via the colour bubble they received. It would be interesting to investigate the impact of using one colour for all bubbles to see if this comparison stopped.

This project failed to examine the impact over a substantial time period due to time constraints and the intended focus of the piece differing from this particular aspect of the marking. However, it would be of interest to carry out a longitudinal study that possibly reassessed children on the content in which a red bubble was given after a specified period of time had passed. Another potential limitation of the project is the reliance on the teacher to develop tasks for both red and amber bubbles that would address any misconceptions

effectively. Task design and curriculum design would need to be examined in greater depth to answer these questions fully.

Conclusion

As a result of the intervention some children were given more opportunities to complete mastery style tasks. There were also examples of amber and red bubbles being present in the work of children who had not achieved their learning objective. There was also an increase in what might be termed the quality of the feedback given as it was more specific, timely and accurate. It appeared that the approach did allow more children to receive mastery tasks but it did not provide that opportunity for all children. However, it could be suggested that by not giving certain children a green task due to not achieving their learning objective, they were actually receiving feedback that was accurate and specific. To give these children a green task just to ensure that they had been exposed to mastery tasks could be argued as not meeting many of the descriptors for effective marking mentioned throughout the piece. The degree to which the two participating teachers followed the marking guidance provided differed. The impact of experience on a teacher's ability to effectively implement mastery marking is an important point to acknowledge. Participation in the project also raised their use of what might be deemed mastery tasks. Whether or not a comprehensive understanding of what mastery means was developed during the intervention took place was more unclear.

Children had an understanding of what the different colours meant in relation to their progress towards achieving the learning objective in a particular lesson. Opinions around mastery marking differed as some saw it as an aspirational tool due to their desire to want to receive a green bubble whilst other appeared to experience some negative emotions after receiving a particular colour. Comparisons were made by children in the higher attaining group through their use of the different colour they received to judge their performance

against their peers. This need to identify their ‘place in the pack’ was something which did not change during the intervention.

Teacher’s opinions did not alter greatly but an acknowledgement and recognition of the importance of quality feedback did seem to be made more explicit at the end of their participation in the intervention. What remained were concerns around external pressures in the form of monitoring, pedagogical content knowledge and levels of experience hindering teacher B’s ability to use mastery marking effectively. It would appear that these external pressures would need to be mitigated in order to provide teachers with opportunities and the time they required in order to provide effective feedback.

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