**The contribution of teacher confidence to 'excellent' mathematics teaching**

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**Abstract**

This research had two drivers: the persistent demand by policy makers for educators to achieve 'excellence' in teaching without defining what is meant; the paradoxes encountered by teachers across education who need to reconcile their personal and professionalism identity, and the political agenda. The research question was 'How is excellence in primary mathematics teaching perceived by primary mathematics teacher educators?'. Four different mathematics educator groups were interviewed producing narrative and mind-maps. An interpretative, thematic approach to analysis was adopted to explore understandings and beliefs. One outcome was three interwoven and interdependent themes - confidence, knowledge and supererogation - which contribute together to create excellent teaching in primary mathematics. The research showed that excellence is an aspirational ideal, embodied in the child who is the product of excellent teaching. This paper explores the role of primary school teachers' confidence in teaching mathematics, capacity for improvement and the potential impact on the pupils.

**Key words:** confidence; mathematics; excellence; teaching

**Introduction**

Context

The impetus for this research arose through increasingly irritation at the persistent rhetoric and demand by policy makers for educators to achieve 'excellence' in teaching whilst not defining what is meant or agreeing on the means by which to achieve it. 'Excellence' is a quality attracting adjectives such as 'outstanding', 'extremely', 'exceptional' and therefore is about being better than good; it is approaching perfection. It is an emotive term and is subject to being defined by external criteria and social change; for example a teacher deemed excellent in 1965 may not be assessed as excellent in 2014 and vice versa. In addition, there was an awareness of the paradoxes encountered by teachers at all levels of education who create their identity through a need to reconcile their personality and life stories, their professionalism and the political agenda. The study endeavoured to determine - from the perspective of the particular groups of people who form the participants - what is meant by excellence in primary mathematics teaching and does not attempt to determine how to achieve it.

Research approach and methods

The focus of this enquiry was to determine understandings and beliefs through a variety of sources including empirical data drawn from four groups of respondents with different experiences and expertise in primary mathematics. The research used a qualitative, interpretative paradigm in which the nature of the enquiry was explorative, creating access to the respondent's professional, social and cultural worlds and the knowledge, skills, cognition and emotions that contributed to their identity (Yin, 2009). Thus it was possible to examine the context and the individual that contributes to professional identify as well as the nature of knowledge about excellent teaching: who creates it, how it is created and how this is known (Fenstermacher, 1994). The analysis adopted a nondualist stance in which 'person and social world are internally related to one another, mutually constituting' (Packer & Goicoeches, 2000:234) (agent and object, producers and products and 'the known and the knower are interdependent' (Maykut & Morehouse, 1992:12).

Ethics

The ethics for this research were in accordance of the guidance given by British Educational Research Association (BERA) (2011). Approval and ethics release was sought through the

relevant channels and granted. Participants were given opportunities at any time in the process to ask questions, clarify understanding and withdraw.

**Review of the literature**

Culturally, it is acceptable to admit dislike for, anxiety about and incompetence in mathematics (Harris, 2012) with feelings of confusion and lack of confidence. Haylock & Manning (2014) identified guilt as prevalent amongst those adults who feel, by dint of their other successes, they ought to be confident; this includes primary teachers who have responsibility for the early stages of pupils' mathematics learning. Suggate *et al,* (1998:x) similarly commented that "mathematics has a troubled place in the emotions of many highly intelligent learners". They conjectured that one reason for this adult view of mathematics, regardless of success, was that perhaps they did not learn to struggle when they were learning, being subjected to mathematics which was made safe in order to pass the examinations. Mathematical engagement is as much influenced by attitude towards the subject as by understanding (Jackson, 2008). Haylock and Manning (2014) speculated about the connection between anxiety about mathematics and the tendency to present it as non-creative with success achieved through rote learning. After all, English as a subject, for example, is not viewed as just grammar and spelling but as a subject that actively engages creatively with life (Turner, 2013). There is a particular kind of understanding held about the subject (Suggate *et al,* 1998) with Haylock & Manning (2014) pinpointing three myths which pertain about mathematics: it is difficult, it is only for clever people and it is a male domain. Primary teachers may well hold one or more of these beliefs and yet need to counter perpetuation in the pupils they teach.

Hence teachers need to acknowledge and address the nature of mathematics as well the mathematics for themselves and for the children they teach (Kelly, 2004). Not only does the current focus in mathematics arise from the contemporary social stance but also the image of mathematics presented and understood as envisaged by public and political perceptions (Ernest, 2008; Restivo & Collins, 2010). The nature of mathematics affects how it is learned and therefore should influence how it is taught. Hart and Allexsaht-Snider (1996) commented that the way the mathematics curriculum is presented to pupils as a collection of disconnected parts, each taught discretely, does not reflect children's holistic view of the world (a position highlighted in the Williams review (2008)); Williams stressed that mathematics is not a simple subject that can be easily separated into sections. This was previously espoused by Krutetskii (1976) who was clear that isolating aspects of mathematics would limit the potential to achieve optimum success. Targeting teaching on specific aspects of mathematics may bring improvements but Mason (2012:31) noted with concern that it is commonplace for the "successful completion of routine tasks [to be] taken as evidence that students know how to do something". Previously, Williams (2008) had warned that it is indeed possible to improve attainment this way but the offset was a reduction in engagement and enjoyment in mathematics.

Williams (2008), and later Wiliam and Thoresen (2009), recommended that schools pay more attention to embedding the cognitive aspect of mathematics. Although Williams (2012:9) asserted that "mathematics education is not an enigma" he did not pursue the implications this carried or identify any limitations or dilemmas for the teacher. He believed that we know how to teach primary mathematics well but the English approach is too timid; "we aren't teaching students to swim – we're teaching them to play in rock pools" (*ibid*:26). This was endorsed by Boaler (2014:1) stating that children "do not make conjectures, or learn creatively. Instead they sit watching teachers demonstrate standard methods, which they are forced to reproduce". One possible outcome of this is the view of the pupils that school mathematics is not interesting and has no purpose or use (D'Ambrosio, 2010), thus perpetuating the prevalent cultural view of mathematics. Skemp (1976:14) described

"instrumental" and "relational" learning, and Askew (1997:3) "transmission" and "connectionist", terms still in use. However, Askew *et al* (2010) were clear that these apparently polar opposites (and subject of continuing debate) may be successfully combined. This was confirmed by the extensive study of Nunes *et al* (2012) which concluded that while mathematical reasoning was a better indicator of future achievement than rote learning of arithmetic skills, arithmetic makes a "smaller, but nevertheless significant and independent contribution" (p152). Pupils need to establish an affiliation with mathematics otherwise "relational understanding will remain at arms-length, fragmentary and disconnected" (Mason, 2012:33).

The National Numeracy Strategy (NNS) (DfEE, 1999) was oriented around an assumption that primary teachers are not competent or confident in mathematics or mathematics teaching (Hardy, 2007). These teachers have been part of at least twelve years' mathematics education before their teacher training (for which they need to demonstrate basic competency in mathematics) so their subject knowledge should be secure. However, as Jackson (2010) concluded, the majority of primary trainee teachers are insecure with a negative image of mathematics, even though they have GCSE grade C or higher. They experience anxiety and fear, the weight of expectations, with worries about teaching and learning styles and language, inhibiting learning about pedagogy (Haylock & Manning, 2014). Unfortunately, Cotton (2013) remarked, this is insufficient as good subject knowledge supports confidence in the teacher and in turn, will transmit that confidence to the pupils.

Through their relationship with their pupils, teachers' own embedded beliefs and motivation will contribute to the way the pupils view mathematics (Mason & Johnston-Wilder, 2004). It is rare for teachers to see themselves as mathematicians (Turner, 2013) but Mason (2012:37) was clear that children's appreciation of mathematics is enhanced if teachers are "being mathematical *with* as well as *in front of* them". The recommendations of ACME (2008) - for a curriculum that allows teachers to make decision about teaching strategies to accommodate the needs of each individual - assumed the capabilities of teachers to use this self-determination effectively. If this supposition is unfounded, as observed by Jones and Mason (2012), then teachers without confidence or conviction to promote or cope with the unexpected or unintended consequences will regress into safe, limited territory. Pedagogically under-confident or under-competent teachers are reluctant to permit pupil freedom, and are unlikely to include aesthetic aspects to their teaching (Betts & McNaughton, 2004) so reducing pupil engagement (Brown, 2010). Cotton (2013) found there is agreement that a good teacher will anticipate errors and misconceptions, support learners coming to new concepts, generate probing questions, deal with unexpected questions and help pupils to make connections.

Creative approaches to teaching not only make learning more relevant and enjoyable for the pupil but it has been shown that they may develop understanding to a more advanced or deeper level than with less engaging approaches with the mathematics being taught through meaningless activity (Nooriafshar, 2004). This is particularly so when combined with teaching that recognises that individual needs may vary during the lesson as well as in longer time spans (Lev-Zamir & Leikin, 2011). Mason, (2012) proposed taking this further towards pupil generated learning using a problem solving approach through experiential learning which not only improves pupils' mathematics skills but the independence gained contributes to enhanced confidence. When blended with the encouragement of intuition and idiosyncratic methods, experiential approaches will enhance understanding and flexibility, building on a post-modernist pedagogy (Izmirli, 2011) that creates children who do not just want to know "what to do next" but "how you know what to do next" (Mason, 2012:32). This ploy has the dual aims of developing understanding and promoting enjoyment, with the second achieved by using content as a vehicle rather than as the driver (Williams, 2012).

However, this approach places great demands on the competence and confidence of the teacher; confidence enables teachers to deal with any inconsistencies or idiosyncrasies they meet (Brown, T. 2010).

Provision of long term professional development (CPD) that addresses poor or inconsistent mathematics subject knowledge and pedagogical subject knowledge, is central to improvement, with a view to enhancing teacher confidence and attitude (Williams, 2008; Ofsted, 2012). One role of staff development is to provide opportunities for improving mathematics teaching through endeavouring to create better understanding of the subject (Turner & McCullouch, 2004). As a result, teachers should develop improved confidence and so enable more effective teaching. De Geest (2011:78) found a range of benefits in CPD including widening views, "deep thinking", "confidence" and "courage". As Mooney *et al* (2014:78) observed, "a teacher who has had to work and think hard to overcome their own lack of understanding and mathematical self-esteem can often prove to be a more empathetic teacher than one who has rarely had to question their own mathematical understanding".

It is evident that attitudes to, and confidence in, mathematics have direct implications for teachers and pupils. Orton (1992) concluded that through all the changes, it is the teachers who have the central role, not the curriculum, classroom or policies. The good teacher knows what contributes to effective, relevant learning in primary mathematics to ensure that it is the best possible environment in which the pupils can thrive (Orton, 1992; Askew *et al*, 2010). Brown (M. 2010) concurred, acknowledging that for all the swings most schools have continued with the basics (number work, tables, bonds), commenting that "the combined good sense and inertia of the teaching profession has substantially damped the pendulum swings […] and no doubt will do so again" (p23).

**Findings and Discussion**

The findings show that a key feature of excellent teaching is confidence. The respondents believed that teaching choices made by the excellent teacher arise from justifiable (as opposed to deluded) confidence, revealed through several modes and derived from a range of sources. One way in which confidence is pivotal is when making decisions. Respondents from all groups expressed beliefs that the excellent teacher has confidence, with certainty, to reach decisions that result in the best outcome in any circumstance or situation they encounter. For example, the respondents believed that confidence permits the teacher to make mistakes and acknowledge if they do not know; to know when pupil learning is good and when it is not (and what to do); to be flexible, creative and be prepared to take on challenges and risks. This is much as Alexander (2004) recommended. The experienced management respondents acknowledged that lack of the necessary confidence is one limitation to achieving excellence; however there was also the view that confidence can be improved by practice. Those who were managers accepted that despite having a willingness to try, under-confidence may prevent even the cooperative teacher from succeeding.

<u>Confidence revealed</u>

Thus teacher confidence may be reflected in their attitude to challenge. Truss (DfE, 2014:4) observed that the new curriculum "places much more emphasis on core arithmetic – giving competence and confidence", representing another swing in what the policy makers felt was important. As a consequence, teachers from China were to be brought in for their "can-do attitude" to show English teachers how to have high expectations and support the struggling children. The views expressed by the respondents very much reflected the 'can-do attitude' but they did not limit it to core arithmetic, exhibiting a broader view. Another observation by the respondents when endeavouring to raise standards is the possibility that some

teachers lack the confidence to be seen to be fallible. This included the conceivable situation in which a teacher may need to acknowledge that the child may be mathematically more able than they are.

Teacher confidence was also discernible in the views of respondents from all four groups who recognised the need to be accountable, noting that all their teaching is done with an eye on the targets. The difficulty, the respondents acknowledged, is that they have to reconcile short-time and long-term targets and to achieve this, they need confidence. The respondents were comparing the undoubted success of achieving the targets in a short time to the potential offered by taking an unknown amount of time with an outcome that may vary from the intention. Ofsted's outstanding criteria from both 2009 and 2013 use words that may be ascribed to mainly short-term progress although this is not quantified. The Ofsted 2009 criterion had expectations that might have encouraged aspirational teaching, requiring "striking" impact with "exceptional' progress whilst the 2013 criteria requires more prosaic "notable" impact with "rapid" and "sustained" progress. Between them, the respondents noted that their targets might range from just being able to answer a question, through ticking the boxes to show the aims of the lesson have been met, to the importance of the results at the end of the year. This short-term view could be considered as knowledge through content, which is generally not embedded and so is transient, as identified by Skemp (1976). However, more than this, the respondents recognised that the excellent teacher, despite constrained agency, needs to have the confidence to go beyond the short-term targets. In particular, the experienced, management respondents felt that the excellent teacher has a long term view of success for the child but needs to temper that with the need to achieve tangible, measurable results in the shorter term.

The respondents did not present views of tangible targets beyond school, seeming to accept the standardised tests that would judge their pupils' progress. However, they knew they needed to prepare their pupils for a future that will require increasing mathematical adeptness, as identified by National Numeracy (2012), regarded by the respondents as a long-term target. They would have preferred teachers and managers to have the confidence to set goals of knowledge through understanding or "comprehensive learning" (Romero & Mari, 2011:1), demonstrated through application. Kloosterman (1996) stated that for motivation that has intrinsic value, the teacher needs to set appropriate goals and the confident teacher is able to adjust those goals to ensure best possible progress by the child. This teacher knows that some learning may take longer than intended or a different route from that which is conventional or planned in the short-term. This supports the need promoted by Alexander (2004) for the teacher to work with the natural learning instincts of the children, creating an education which pursues high-standards but which has more breadth and humanity than previously.

Another belief from the respondents was that the teacher must relay their confidence to the children. This resonates with comments from Aldrich (2005) that, additional to knowledge, the excellent teacher needs the confidence to enthuse and the ability to inspire and inject joy into the learning. Respondents from all four of the groups made observations that indicated that the confidence and potentially resultant flexibility of the excellent teacher is enhanced in an inclusive classroom. For example, the teacher needs to be able to listen to the children and know if what they are saying is valid or not, including mistakes from which all can learn. Here it is alright for anyone, pupils and teacher, to admit they do not understand and to know that using self-help strategies are not just legitimate, but desirable. This fallibility possessed by the confident teacher is a point of strength, not weakness; even if the teacher does not understand in the first instance, they have the confidence to work with the children to clarify and then help them and move them on: the teacher has the

confidence to think, 'ok that's fine'. Confidence that arises from strong subject knowledge provides the excellent teacher with flexibility in the way they teach in their classroom.

The respondents believed that teachers' embedded beliefs and motivation will contribute to the way the pupils view mathematics, reflecting the views of Mason and Johnston-Wilder (2004). Teachers with the confidence to develop their relationship with their pupils as well as expose their own enthusiasm and creative engagement with learning will enrich the learning potential of their pupils. Several respondents remarked that teachers without confidence or conviction to promote or cope with unexpected or unintended consequences will regress into safe, limited territory.

The more experienced respondents thought that the excellent teacher has the confidence to design a creative pedagogy that will provide opportunities to promote engagement and independence. This, they suggest, is achieved through the children finding it out for themselves, joining the dots and making connections, in keeping with the aims of the new National Curriculum (DfE, 2013). These acknowledge the interconnectedness of mathematics, requiring children to "develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems" (p3). To achieve these aims, the respondents believed teachers also need confidence to design a pedagogy that uses affective strategies in addition to cognitive strategies to draw in their pupils. Thus the pedagogical approach established by the confident teacher will contribute to the development of confidence in their pupils. One aspect of pupil confidence raised by a student teacher was the need to be aware of the impact of the affective response of the pupils. The example given was of an able mathematician who was 'terrified' by a potential public humiliation. This attack on self-esteem was noted as resulting in negative or anxious feelings towards mathematics.

Sources of confidence

The biographies of the respondents revealed that that mathematical confidence arises in different ways and at different times. Almost all had experienced times of reduced confidence in mathematics and there were various means by which they acquired their confidence, with conscious and unconscious acknowledgment of their individual dispositions framed by their pasts. In particular, it seems that it is possible to build on existing positive attitudes or to negate previous negative experiences though application of self-will and intent. Indeed, negative experiences, for the participants, were not a barrier but had the potential to create an evangelistic approach to mathematics teaching as they seized their personal agency with a determination that children should not have those experiences. The community to which the respondents belonged (or were about to join) provided them with the 'situated expertise' of their communities of practice, as identified by Wenger (1998). The agency they gained through their identified roles of teacher, manager and mathematics educator bestowed justifiable 'tacit knowledge' (*ibid*), acknowledging the status they had achieved within their community. This would offset the potential limitation arising from their culpability to that community making them "vulnerable to its power plays" (Wenger, 2010:9).

A teacher who has knowledge of the subject should be justifiably confident that he possesses understanding of the progress of the children's learning, conferring self-determination to the teacher to use what they believe are the best teaching strategies. This in turn positions the excellent teacher to make pedagogical decisions which the respondents agreed arises from confidence engendered by excellent knowledge of the subject. However, there was a slightly different view suggesting that if knowledge of the subject is absent, then the excellent teacher still possesses the confidence to be able to use pedagogy effectively. The student teachers admitted they were insecure about mathematics, having little

confidence in the security of their understanding from the GCSE studies. They realised this had to be addressed to avoid limiting their ability to learn mathematics specific pedagogy and to develop confidence that can be transmitted to their pupils (Cotton, 2013; Haylock & Manning, 2014). Their lack of confidence may have been compounded by the guilt teachers feel about their lack of mathematical confidence (Haylock & Manning, 2014) and the particular beliefs pertaining about mathematics (Suggate *et al,* 1998).

Staff development allows teacher to be both initiators and receivers (Alexander, 2004), reflecting Wenger's view that the exercising of power in communities of practice is "horizontal, mutual, negotiated, often tacit and informal" (2010:8). Despite this endeavour to include teachers in their own development, there are other barriers. One respondent view was that teachers' failure to improve may be based on apprehensions about their subject knowledge. The management respondents believed it is important for them to show their confidence by creating a collegial, supportive environment to which individuals felt they could commit, with a sense of cohesiveness and progression through the school, supported by a bank of accessible support materials. This was intended to contribute to better understanding and hence improved confidence and better teaching (Turner & McCullouch, 2004). However, the respondents recognised that confidence, trust and courage identified by De Geest (2011) as positive outcomes of CPD may not extend to all if teachers' security in current practices (noted by Mason, 2004) is questioned and challenged too far. The research did not show agreement that all teachers could become excellent. One reason identified that would militate against becoming excellent was lack of desire or intent, or even recalcitrance. This attitude may be instigated, perpetuated and exacerbated by lack of confidence and hence perhaps reversed or limited through development of confidence.

The research showed that there are some things that can be learned to move towards confidence: addressing poor or inconsistent mathematics subject knowledge and pedagogical subject knowledge, with a view to enhance teacher confidence and attitude, endorsing the views of Ofsted (2012) and Williams (2008). Supported by confidence, the respondents suggested that the teacher can then use knowledge of subject pedagogy so that planning is not constraining, freeing the teacher to draw on their knowledge of the individual needs of the children to be flexible for optimum success. One outcome will be that the teacher will enable pupils to develop "active mathematical identities that include self-belief as well as adaptive expertise" (Boaler, 2012:61).

Results of confident teaching

A concomitant result, in the view of the respondents, of teachers who are confident about teaching mathematics is pupils who confidently exploit their mathematical mastery to achieve success. This becomes self-perpetuating as confidence is supported through pupils acquiring control of the mathematics which in turn encourages persistence and enhances confidence, establishing a cyclical model. This corroborates the research of Izmirli (2011) who found that improved confidence is gained by the children establishing control through the development of intuition and idiosyncratic strategies. By this means, the respondents believed that children who gain confidence from excellent mathematics teaching will be more inclined to take the opportunities to be actively engaged with their education, rather than passively waiting to receive. Therefore this motivation engendered by pupil confidence is another key factor in pupils' progress, confirming the view of Mason and Johnston-Wilder (2004). The respondents believed that goals based on achievement though understanding will, with appropriate teaching, generate intrinsic motivation. Therefore the outcomes are likely to reflect the pupils' realistic capability, strengthen their confidence, enhance motivation and deepen their engagement and interest. Consequently, the potential for the children to progress through a meritocratic education is improved. Although the 2009

Ofsted criteria for outstanding teaching required pupils to be inspired and challenged, reflecting the views of the respondents, neither of these requirements is within the 2013 criteria. Interestingly, both sets of criteria opened with a circular definition saying that to be outstanding, teaching was to be outstanding (resulting in pupils making "exceptional progress" (Ofsted, 2013:32)).

**In conclusion**

The research highlighted several facets to teacher confidence and the contribution this makes to the quality of teaching. Teacher confidence is exhibited through a range of modes and encompasses pragmatism and compromise. This is enhanced within a community of professionals who have an underpinning confidence in teacher professionalism and knowledge of what is right. The research suggested that the confidence of the teacher plays a part in determining how they reconcile the various demands on their professionalism with their professional and personal identities.

The respondents indicated that confidence is located in the identity of the teacher and further, that the excellent teacher is proactive in that they subscribe to and have personal agency in the process of creating this identity. The research showed that this occurs within an ethos of collegiate co-operation which encourages and expects teacher and pupils to take risks, so contributing to and enhancing the development of confidence. This accommodates the important affective aspects of nurturing self-esteem and confidence in both teachers and pupils. The effect of lack of confidence on teaching is to limit and inhibit the teacher's thoughts, perceptions, and actions, resulting in the tendency for the under-confident teacher to retrench to a safe position. Consequently, pupils will experience reduced creative teaching and freedom to develop understanding and independence.

The confidence of managers in their teachers' potential to be excellent is another feature of the role of confidence in excellent teaching. The research indicated that lack of confidence possessed by teachers of primary mathematics may arise from weak understanding of the subject, limiting the teacher's ability to extend and enhance the children's progress, thus showing one route to improving confidence in teaching. Additionally, the manager's role in supporting the development of confidence may ameliorate any reluctance by the teacher to extend their comfort zone.

It is evident in this research that without confidence, excellence is not achievable. Confidence underpins and is underpinned by teacher identity, ownership and agency.

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