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**Which qualities did aspiring teachers value in their 'best' mathematics teachers?**

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**Abstract**

When aspiring mathematics teachers were asked to describe one of their own mathematics teachers who had made an impact on them it was found that personal attributes such as empathy, caring and commitment to their students were mentioned most often. This study uses Gossman's categories of 'teacher as teacher' and 'teacher as person' to analyse the descriptions of best teachers given by people who were being interviewed for the Post Graduate Certificate in Education in Secondary Mathematics at our Institution. The aim of this study is to add to the growing body of literature which indicates the value of teachers' personal attributes and how important these can be for student motivation and confidence in mathematics. These attributes are hardly mentioned in lists of teacher competencies compiled as part of Government standards for teachers. We expected that aspiring mathematics teachers, since they are most likely to have been successful at mathematics themselves, would feel positively about mathematics and their mathematics teachers. However a surprising finding from the data was that even successful students occasionally experienced disaffection.

**Keywords**

Word; qualities, personal attributes, mathematics, student teachers, motivation, competencies

**Introduction**

The project reported here came about after a discussion concerning a writing task that Post Graduate Certificate of Education (PGCE) students undertake as part of the interview process for the Secondary Mathematics PGCE course at our University. The title of the writing task is 'Describe a mathematics teacher who had an impact on you. What was it that made them special'? We were struck by the way that the interviewees, who have themselves been successful in school mathematics and at least competent in undergraduate level mathematics, viewed their school mathematics teachers. Overwhelmingly, they described

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teachers by referring to personal attributes such as the teacher being caring and supportive, being approachable, or having a sense of humour. When describing their teaching styles it was to say that these teachers made mathematics fun and relevant.

We thought it would be interesting and valuable to analyse the messages which these aspiring teachers were giving us about the people who probably inspired them to become teachers of mathematics themselves. What exactly makes someone a mathematics teacher who has such an impact on their students? Which attributes do they have which make them special?

### **Literature Review**

When adults are asked to look back to their school days and identify their 'best' teacher they are often likely to refer to the personal attributes of their teachers rather than describe the way they taught their subject. This was certainly borne out by Gossman's analysis of a weekly article entitled 'My Best Teacher' (published in the Times Educational Supplement; a weekly newspaper for teachers published in the UK), (Gossman, 2011). Two categories of comment were identified: the teacher-as-teacher which includes attributes such as commitment, motivating students, being a good leader, encouraging an open and trusting learning environment in their classroom, and the innate personal characteristics (teacher-as-person) such as being caring, supportive, encouraging and having a good sense of humour.

As researchers in mathematics education we are particularly interested in teachers of mathematics. Mathematics is the school subject which most seems to cause learners stress and anxiety which continues into adulthood (Ollerton, 2006). However, on a positive note Ollerton marvels at how teachers in school often do build good relationships and classroom cultures where there is mutual respect and where pupils can feel able to learn.

Kaasila *et al.*, (2007) interviewed primary education students in Finland about their school experience of learning mathematics. One student felt that their mathematics achievement worsened when they got to secondary school as a result of the teachers who taught them. This student reported being scared to answer questions in class and of feeling underrated by the teacher. These experiences in school coloured this student's views of their mathematical ability well into further education. Another student in the study who felt positively about the school experience rated their secondary mathematics teacher as an inspiring role model who taught for understanding. This gave the student teacher the confidence to develop an understanding of the mathematics studied in school and later to feel confident when themselves teaching mathematics to primary school children.

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It is not hard to understand why students would value highly a teacher who helped them understand their mathematics work. We would argue that a good classroom teacher should know their students well enough that they can plan appropriate learning activities for them and can anticipate possible problem areas. Ainley and Luntley (2007) refer to attentional skills and attention-dependent knowledge which can help teachers to do this. Attentional skill is the ability to react in the moment to the feedback the teacher receives from the students. Attention-dependent knowledge helps teachers do this by knowing the students; how they learn, difficulties they often experience, the students' character traits which affect their learning. Attentional skill and attention dependent knowledge allow teachers to use their own subject and pedagogical knowledge to meet the needs of the students during their mathematics lessons. There is a suggestion that there is a relationship between teachers having these skills and student motivation and engagement (Ainley and Luntley, 2007). In many ways we might expect this to be the case because teachers who know their pupils and are attuned to their needs would seem more likely to be effective teachers, resulting in pupil confidence.

Alongside the ability to be able to respond appropriately to students' questions and feedback it is also important for teachers to provide a supportive atmosphere for learning. Ryan and Patrick (2001) carried out a study of the perceptions of eighth grade students from three ethnically diverse schools in Midwestern United States. Important findings from this study showed that when the pupils viewed their teacher as supportive and willing to help them, they were more engaged in their learning and less likely to be off task or disruptive. This agrees with the findings of Ainley and Luntley since a supportive teacher who is willing to help pupils does sound like a teacher who has the attentional and attention dependent skills. Ryan and Patrick found that the classroom climate which the teacher provided was also an important factor. Where everyone's ideas and contributions are respected and no-one feels that they will be teased, or belittled then pupils are more likely to report feeling motivated and confident.

It is clear that an effective teacher of mathematics has not only skills in mathematics subject knowledge and in how to teach it but they also need the personal attributes and abilities which have been described in the literature outlined above. However lists of competencies and standards which teachers are expected to meet in many countries, including the UK, make little mention of these personal attributes and abilities (Ainley and Luntley, 2007, Evans, 2011). This focus on competencies and behaviours rather than the personal attributes of teachers has clearly been a developing trend over many years. A study by Hargreaves, (2000, p.811) points to the neglect of the emotional dimension in the classroom in the 'increasingly rationalised world of educational reform'. Under this reform schools are increasingly being driven by results and performance targets and the emotional aspects of teaching are being side-lined.

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In our view this seems very short sighted since teaching is a profession which involves working with young people. Troman, Jeffrey, and. Raggii (2007) refer to the psychic rewards for teachers and pupils who may gain immense satisfaction from the teacher-pupil relationship and what can be achieved through this relationship, such as turning difficult or demanding pupils around. He also cites evidence (Webb and Vulliamy, 2006, p.39 cited in Troman, Jeffrey, and. Raggii, 2007) that national testing has had an 'increasingly deleterious' effect on the primary curriculum. Thus we can conclude that an important aspect of the teaching repertoire has been disincentivised by the development of a performative ethos within schools.

Individual schools, however, do appear to desire personal attributes in the teachers they employ. Sanders (2002) undertook a study in England and Wales of the requirements that schools give for mathematics teachers as written in job specifications for new mathematics teacher posts. It is interesting to note that the schools in Sanders' study identified more requirements regarding personal qualities for the mathematics teacher they hoped to appoint than for their qualifications, or professional skills. However, most of these personal qualities appeared to relate to the ability to work collaboratively with other teachers (admittedly an important skill) rather than how the teacher would relate effectively to the pupils they taught.

In summary, the literature suggests that effective teachers of mathematics need skills above and beyond the ability to deliver the mathematics curriculum. There is a need for mathematics teachers to provide a level of emotional support to their pupils to enable them to learn in the subject which causes anxiety to so many (Ollerton, 2006).

### **Methods**

During the interview process for the Secondary Mathematics Post Graduate Certificate in Education (PGCE) at our Institution the applicants are asked to write a short essay in order that we might check skills such as grammar, punctuation and spelling. The title of the essay is 'Describe a maths teacher who had an impact on you. What was it that made this teacher special'? The theme of the writing task is also used as the basis of a question in the face to face interview with the aim of encouraging the applicant to explore their understanding of what makes a good teacher of mathematics.

Scripts were collected for the successful candidates for the academic year 2010 – 2011 (n = 29), and from all applicants for the PGCE course year 2011-2012 (n = 46). All were of approximately one handwritten page. There was a mix in terms of gender and cultural considerations. Relevant statements and segments of the narrative in each response were marked and transcribed. These were then

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organised into categories which emerged iteratively and inductively (Thomas 2006).

### **Results and analysis**

The initial readings of the essays indicate that teachers' personal attributes appeared more important than their style of teaching, or even their competence as a teacher. There were no comments in the essays saying things like 'my teacher always planned sequences of lessons using challenging learning objectives appropriate to the subject being taught' which is an amalgam of some of the subsections of Q22 in the Professional Standards for Teachers Qualified Teacher Status in England used from September 2007 until September 2012 (TDA, 2011).

Given the privileged position of these students, a surprising finding is that there is evidence here of disaffection. Since these respondents can be considered successes by most standards, and they are being asked to describe positive role models, this is perhaps unexpected. If these people experience disaffection, it suggests that disaffection may run deeper than many researchers have hitherto accounted for. This is not to say that the expressions of disaffection are extremely strong or deep rooted, but they are there nonetheless.

Some of the comments relate to experiences of self-doubt or lack of confidence:

'(another teacher)...was often grumpy and snappy...he would get annoyed which made me feel stupid, which discouraged me to ask for help in the future' (A1, female).

'No matter how hard I tried I just could not get my head around the subject' (R, male).

Other comments related more to the behaviour of teachers or the nature of the task itself. Teachers who presented themselves as bored, or boring ('endless sums') turned students off mathematics. Students also showed an acute and negative sensitivity to teachers who prioritised attention on quick and vocal students, whilst ignoring those who took more time, and needed help, as illustrated by the comment below:

'Some of my teachers spent more time helping those that excelled....and left those who found it difficult to get more and more behind and were often left struggling...' (A, female).

In a number of these accounts there is evidence of disengagement, of not liking maths, of struggling, anxiety, low confidence and of doubting one's own ability. Two conclusions can be drawn from this. One is that, over a school career, many (even most) pupils will experience disaffection to some degree. The second

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conclusion is that one of the reasons for the respondents choosing certain teachers as role models is precisely because they make a substantial impact in terms of providing positive experiences, changing attitudes and beliefs. They change the way that pupils think about maths and about themselves and their competence. In a sense the negative message is the fragility and volatility of pupils' relationship with mathematics, but on the other hand, there is strong evidence that that fragility can be turned around and overcome.

In addition to evidence of disaffection, a number of clear themes were identified. However, they in turn can be supraorganised into two broad categories and they are broadly consistent with Gossman's teacher-as-person and teacher-as-teacher. They are discussed here in turn.

### **The teacher-as-person**

#### *Enthusiasm/passion*

This is the theme that carried the most (volume) and the most vivid evidence. Enthusiasm is the expression of general positivity and energy in their approach to teaching, and in their relationships with pupils. This positivity is contagious and clearly motivates the students.

'I really liked her optimistic attitude to life .every time I came to a lesson she would be happy and smiling, full of energy and enthusiasm' (K, female).

'Superman... (he) seemed to have a fantastic unmatched energy.... (it) was contagious' (Y, female).

The passion is related but slightly different in that it is specifically a passion for the subject itself. It seems clear that if a teacher loves the subject and is able to show and communicate this, it has a powerful effect on students. One of those effects is admiration for the teacher, but another is to attract students to this world which is clearly so interesting. There are also quite a number of statements that indicate, to the effect that 'I would not be here today if it were not for this passion.'

'The excitement he had for the subject would be kept in my heart for ever' (H, female).

And whilst this 'global' passion for the subject is clearly influential, it also translates to the level of topic or even individual task. We see evidence here that inspiring teachers are able to make specific topics interesting by demonstrating their own affinity for its interest or relevance.

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'Every lesson he would get excited about today's mathematical problem and how beautiful the solution would turn out to be...he said you have to have a love for your subject' (M, male).

'What made the lessons more special was the fact that she was passionate about mathematics...it shone through her teaching' (S, female).

### *Human/Caring*

There are a number of threads within this theme. One is about showing that you are human and individual as a teacher, just like the rest of us. Sharing interests, foibles and enthusiasms seems to shift students view of them from being teachers (role/objectified) to human beings.

'He was always active in extra-curricular activities which gave us the opportunity to get to know him better' (C, female).

There is a related aspect, which reflects the bi-lateral nature of the relationship, and that is about recognising and acknowledging the humanity and individuality of the pupils. Probably the most often-mentioned attribute is 'approachable'.

'He was very approachable and treated us with respect....the rapport we had was special...where many teachers still treated us like children' (Z, female).

'He had a keen interest in my hobbies so out of classroom hours.....we would talk on a personal level...to me this made him special' (P, male).

Being approachable takes away the fear so often associated with learning mathematics, so that students know they will get support, and they can tell the teacher if they do not understand. Closely related to this is the notion of caring. This again, is about willingness to give help when needed, and is also associated with patience. This goes beyond the mere behavioural interaction to convey a genuine sense of 'unconditional regard' (Rogers).

'He had faith in me when I had lost faith in myself' (F, female).

'He would take some time to visit each member of the class to ensure everyone understood' (J, male).

Another common theme to these narratives is 'respect'. Being treated fairly, as an equal and as an adult all seem to be important.

'She was very patient and respectful. She was kind but fair and very supportive of all her students' (S, female).

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'He treated the students as adults and classes were quite relaxed in atmosphere which allowed the class to express themselves and ask questions' (S, male).

### **The teacher-as-teacher**

A number of the themes address issues of how mathematics is taught and presented to students. These themes are not procedural or competence based descriptions. They define strategies, styles, or ways of being a teacher that excite interest and engagement, or somehow draw the student into the world of mathematics.

#### *Real World Interest*

'She had a unique way of relating all the topics she taught to real life situations...she always made the lessons very relevant by explaining clearly why we were learning to do certain problems and why it would help in real life' (S, male).

The real world issue is one that clearly has significance for students. There seems to be a number of components to this. Firstly, it triggers interest and engagement. By relating to things we know it can 'humanise' and 'concretise' the mathematics. It is also related to passion and enthusiasm in that students see teachers using maths to illuminate the objects of their own interest (e.g. sport).

'He was an avid cricket fan and he tried to introduce it into all the topics he taught ... I remember learning angles and thinking of a cricket bat hitting a ball....I realised maths is a tool to understand the world around me ... this revelation gave me a love for the subject like never before' (J, male).

A further issue is that it seems to impact on the felt sense of purpose and utility – by seeing and working with these examples and contexts, I come to see why maths is important.

'...like for trigonometry using distances between local places...and always football teams when doing probability' (C, female).

#### Clarity of explanation

'(He) had an amazing ability to simplify the most complicated of disciplines and explain them in such a way that is easily understandable' (R, male).

This theme is so simple and self-evident, yet it is referenced time and again in the essays. The emphasis here is on the giving of information and explanations. Making ideas clear and concise, getting things on the right level for the students, offering step by step explanations, are all seen to be important aspects of what makes a good teacher.

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'He was clear and precise when speaking to the class. These good communication skills helped keep the class interested, even on monotonous tasks' (A, male).

On the other hand, there is less evidence here that more dialogic modes of communication are available or valued as much as the skills of exposition, cited above. However, skills related to checking understanding, prompting and challenging (see ahead) are in evidence.

'She asked me concise questions to understand my way of thinking' (S, female).

'He explained topics slowly and clearly, taking time to ensure that everyone understood by continually asking for feedback' (A, female).

### *Fun*

On one level, the injection of a sense of fun can appear to have a simple justification and value in the teaching repertoire. This is that fun makes it more interesting, and this in turn leads to higher engagement. A good sense of humour ('which always helped') is cited as important in many texts.

'He was a humorous character which helped make all his lessons enjoyable and interesting' (A, male).

But fun is more than that. It encourages a different motivational state or orientation and a qualitatively different way of experiencing the world – one in which excitement, curiosity and doing things for their own sake rather than for the answer or the outcome is important. It is not just that it increases engagement – it actually facilitates a qualitatively different kind of engagement.

'She was approachable with a fantastic sense of humour ... she managed to completely change my view of maths from being a dull subject to being a fun subject' (P, female).

### *Variety of methods*

'... but had us absolutely enthralled when he occasionally deviated from the main topic and explained some magical concept to us. The number pi....circled the room on the walls...the entire class was always gobsmacked when he recited it from memory' (M, female).

This theme has a number of subtle threads within it. Variety adds stimulus, and this is valuable in its own right. Variation to 'standard' pedagogy based on exposition and textbook exercises alleviates boredom. The use of creative means of engaging students excites interest. Thus using variety is motivationally enriching (Ollerton, 2006).

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'Her lessons were never boring as she always had a variety of games and activities planned...this really helped me and others to engage with the material and learn to enjoy maths' (S, female).

'She frequently did a variety of tasks to engage us more such as: artistic and creative activities, use of ICT and practical experiments' (M, male).

Other methods also have the advantage of embodying the mathematics, and, unlike textbooks or worksheets, they involve students in 'doing'.

'... (he) ... brought colour and interest to the subject. Teaching wasn't just about the blackboard but 'hands on' experiences...' (S, male).

'...good use of diagrams, colour and examples...He did his best to make the lessons interactive and as enjoyable as possible' (M, male).

'He would use diagrams, pictures and apply maths to the real world which made maths very interesting for me and made me eager to learn' (P, male).

It also works on the level of cognitive development in that a number of the comments here suggest that the variety itself is the use of different representations which builds the possibility of enhancing understanding.

'She helped to make maths interesting to me by teaching it in different ways. The use of colours and diagrams really helped me to visualise what I was doing which improved my understanding and enjoyment' (P, female).

'It is interesting to see that variety is also used in the 'diagnose and fix' mode, when teachers feel the need to eliminate misunderstanding or aid deeper understanding, as illustrated in the comment: 'She gave alternative ways to look at questions' (C, female).

There is also a reciprocity in that it appears that teachers who themselves use a variety of methods may be more inclined to encourage and allow use of non-standard methods in their students.

'...acknowledged a new approach or a different method by a student' (Y, female).

Two other themes were evident in the data. One related to the sense of order and **discipline** in the classroom. This is construed positively and is seen as contributing the conditions in which learning can take place.

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'The classes were always very disciplined environments, allowing the students to concentrate on our work' (S, male).

'In some respect quite strict... (but)...I don't think I ever heard him shout once!' (C, male).

Another theme related to the notion of **challenge**. Good teachers, according to these accounts, set high expectations ('He constantly pushed me further') and set tasks at or just beyond the current competence of the students.

'She was a firm believer in understanding how and why things worked. It was her strategy to get us to think our way through problems and understand what we were doing

She encouraged me to think for myself rather than dictate the method. I understood very clearly...I saw the purposes of the mathematical topics I was being taught' (S, female).

We can see from these comments that the favoured mathematics teacher (of our interviewees) is a rounded personality, creative, caring and a good leader as well as being enthusiastic about mathematics. We explore this further when we ask our interviewees to talk about their experience of being taught mathematics by this teacher during the face to face interview for the Secondary Mathematics PGCE course. Since we are looking for the ability to observe and to reflect on what they have observed (as we consider these to be qualities which will help them develop into good teachers) we try to encourage them to unpick exactly what it was that their best mathematics teacher did that made them so effective. We also hope that our PGCE students aspire to become these kinds of teacher.

### **Conclusion**

Looking over two years' worth of essays we were struck by the fact that many of the comments concerned a description of personal attributes such as being supportive, had a good sense of humour, was committed to their students, how they never made anyone feel stupid or inadequate, etc. What emerges from these essays is that the mathematics teachers who had an impact are those who engaged their pupils at an emotional level to support them in the learning of mathematics.

We can see from this data the richness and multi-dimensional nature of students' relationship to learning mathematics, and the pivotal role played by the teacher in framing this experience. We can see evidence here of aspects of the socio-cultural nexus in mathematics classrooms that influence students in a positive way including: the nature of mathematics as presented; the human

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aspects of teacher-student relationships - the teacher is human and worth knowing, and she values and respects me; pedagogy – varied, clear and grounded in the real world; the experience – fun, enjoyment and positivity; the social environment – supportive, respectful.

The evidence here also further supports the literature (referred to above) that suggests that characterisations of teacher competence in a technical, behavioural and performative frame (such as current competence frameworks) gives a distorted and impoverished view of what inspirational teachers actually do. The data also provides evidence of how teachers can influence the motivational and emotional climate in a mathematics classroom in addition to the cognitive-conceptual frame.

Given these conclusions it is clear that when considering what makes a good teacher (so that we can recruit potentially good teachers into initial teacher education courses) we need to look at the whole person and investigate whether they are flexible enough to respond to students' needs. Core beliefs and personal attributes affect the kind of teacher someone becomes and we need to look for qualities such as empathy, compassion, understanding, caring, tolerance and flexibility (Korthagen, 2004). These attributes lie at the heart of the teacher's identity yet as we have seen they are substantially ignored on policy-driven lists of competences that teachers must meet (Ainley and Luntley, 2007). Perhaps the education community needs to engage in a dialogue about which characteristics are desirable in a good teacher encompassing the personal attributes described above and which go above and beyond the ability to plan and deliver the curriculum. Finally, the data is a contribution to the literature in that it focusses specifically on the environment for learning mathematics, rather than the more general case addressed by most studies. Future research might focus on how beginning mathematics teachers learn to employ their personal attributes in order to develop an effective learning environment for their pupils.

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