How Does Parental Attitude to Mathematics Affect the Mathematical Engagement of Children?

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Abstract

This case study considers the correlation between parental attitudes to mathematics and the mathematical engagement of their children. It is set within the context of an urban primary school on the south coast of England and focuses on a class of year 1 children and their parents. Although observations and school policy were utilised to create additional depth to the researcher’s understanding of the setting, the primary research method was through questionnaires issued in pairs to children and their parents. These were completed and returned anonymously to increase the validity of responses against participants responding as they thought the researcher would expect.

The key attitudinal areas considered were usefulness of mathematics, enjoyment of mathematics and mathematical self-efficacy. Participants were also asked to indicate gender to facilitate analysis of trends in responses on this basis, in consideration of the current drive by the UK Government to encourage females into science, technology, engineering and mathematics (STEM) education and careers.

Overall, positive attitudes to at least one of the key areas investigated were recorded by a high proportion of respondents. Some correlation between parental and child attitudes was apparent. Additionally, an interrelationship between the areas studied was also evident through analysis of the findings.

Literature Review

Societal attitudes towards mathematics

Some people relish mathematical activities and are passionate about engaging in new mathematical thinking, with 29% of 2013 school leavers choosing to study mathematics at A-level (Ofsted, 2015), whilst others report being nervous or even fearful in relation to mathematics (Tobias, 1993; Chinn, 2011; Bird, 2014; Haylock, 2014; McNeill, 2014; Boaler, 2015). Tobias (1993) describes mathematics anxiety as negative associations with mathematics which manifest in physical attributes, such as tension and anxiety and which can interfere with computational ability and problem solving skills to such an extent that self-confidence is lost. The effects of this can be experienced in a range of daily experiences as well as in academic circumstances (Curtain-Phillips, No Date).

It appears that it can be difficult for those feeling one way about mathematics to understand the attitude of those who do not share their outlook. Haylock (2014) relates negative emotional memories, of student teacher interviewees, in connection to mathematics. In many cases these were reinforced by teachers who were unable to comprehend the difficulties faced by their pupils.

Social factors, including direct experiences and interactions with significantly influential individuals, are considered to have causal implications on the development of children’s attitudes, perceptions and values. A wide range of studies dating back almost 50 years have found this interrelation between experience and attitude to hold true for pupils’ mathematical
outlook (Zimbardo & Ebbesen, 1970; Trianidis, 1971; Eccles and Wigfield, 2002; Leaper et al., 2012; Rice et al., 2013; Jameson, 2014).

Peer pressure has an impact on education, particularly for children and young people, and a high level of influence on pupils’ individual attitudes to their mathematical learning (Topping and Bamford, 1998; Crosnoe et al., 2008; Leaper et al., 2012; Rice et al., 2013).

As life experiences and peer influence can have both positive and negative impacts upon a child’s mathematical attitude, it becomes clear that teachers and their pedagogy are crucial in the moulding of pupils’ positive mathematical experiences (Gates, 2001; Koshy, 2001; Ollerton, 2009; Rickard, 2013; Haylock, 2014; OECD, 2014; Witt, 2014; Boaler, 2015).

The importance of mathematical engagement

Societal expectations (Crosnoe et al., 2008; Swinson, 2013; Sax et al., 2015), perceived usefulness of subjects (Tocci and Engelhard, 1991; Eccles and Wigfield, 2002) and self-efficacy (Bandura, 1977; Bandura, 1994; Jameson, 2014) have been indicated to impact pupils’ motivation and achievement. Results from wide scale research by Tocci and Engelhard (1991) across America and Thailand, indicate positive relationships between: usefulness of mathematics in society, gender equality in mathematics, achievement in mathematics and attitudes towards student’s own mathematical learning. This final aspect has been argued to be cyclical in nature; increased confidence enabling persistent engagement, leading towards achievement and thus increasing confidence (Chinn, 2011; Boaler, 2015).

Significant within the wide range of mathematical attitudes uncovered was a gender difference in mind-sets, with girls less likely to consider mathematical studies and careers to be a masculine domain than their male counterparts. This demonstrates a substantial shift in cultural attitudes in the generation between Hill’s (1967) assumed masculinity of mathematics; however, current analysis (Crosnoe et al., 2008; Ceci et al., 2009; Ceci et al., 2011; Rice et al., 2013; Swinson, 2013; OECD, 2014; Ofsted, 2015; Sax et al., 2015) still indicates a vast international gender gap in take up of Science, Technology, Engineering and Mathematics (STEM) courses and careers.

Contrarily, several studies (Kurtz-Costes et al., 2008; Else-Quest et al., 2010; Cvencek et al., 2011; Gunderson et al., 2012; OECD, 2014) indicate higher self-efficacy regarding the study of mathematics among boys than girls, whilst acknowledging their comparable grades in mathematics tests. Peer opinion has been identified as an important motivator across all study areas, with research (Crosnoe et al., 2008) suggesting that this effect may increase exponentially in non-gender-traditional subjects. Low self-ability belief in female students is proposed as a contributing factor in the gender gap in further STEM academic study and related careers (Halpem et al., 2007; Leaper et al., 2012). The British Government are attempting to address this within schools, industry and culture (Swinson, 2013) and have tasked the Women’s Business Council to work with education and business sectors to determine proposals for tackling the gender gap. It is advocated that

“the choices young women make about education and careers are shaped by the interplay between cultural messages, peer and parental pressures, people they meet from the world of work and their individual self-determination.” (Swinson, 2013)

Attitudes to mathematics are not left behind at the school gates, but taken through into adulthood (Cockroft, 1982). Recent data shows that a concerning 30% of pupils leave school without achieving grade C or above in GCSE mathematics (Ofqual, 2016), while it is estimated that 45% of British adults have the equivalent mathematical knowledge of primary school pupils (OECD, 2016). This has an impact on industry. Up to 50% of employers in 2008
(Kounine et al., 2008) experienced difficulties finding the required numeracy skills in school leavers and the issue appears to persist (CIMA, 2015; CIMA, 2016). It is, therefore, important that educators consider what aspects influence these low attainment figures and what more can be done to redress the situation.

Research indicates connections between socioeconomic background, educational achievement and future life chances (Belsky et al., 2007; Fiscella and Kitzman, 2009; Carpentieri et al., 2009; Wilkinson and Pickett, 2010; OECD, 2014) with the average lifetime pay gap between each level of qualification (e.g. GCSEs to A levels/A levels to Degree) being around £100,000 (HM Government, 2011) and a far greater disparity at the extremes. With only 75% of children from the lowest socioeconomic backgrounds achieving “the expected level by the time they leave primary school, compared with 97% of the richest children” (HM Government, 2011, p. 35) and this gap widening by the end of secondary school, the cycle of social inequality is compounded. Two of the implications of these issues on teaching are:

- Teachers need to support all pupils in reaching their full potential to close this socioeconomic gap and enable social mobility
- Many of these pupils’ parents will not be confident in their own ability to support their child’s mathematical learning.

**The impact of parental attitude on children’s engagement in mathematics**

Many parents feel ill-prepared to support their children in their mathematics learning (Chinn, 2011; Boaler, 2015), recalling with fear their own school mathematics lessons (Haylock, 2014). Real-life mathematics, however, is used daily by the majority of these same parents, although very little of this will require the formal notations and computations focused on in schools (Lamibić and Lipkovski, 2012; Boaler, 2015). It is, therefore, conjectured that if teachers can enable parents and pupils to see the connections between the mathematics of their home lives and the mathematics taught in the classroom, some of this anxiety could be addressed. If parents can be encouraged to engage in real-life mathematical discussion with their children, positive attitudes to the subject can be nurtured. In 1967, Hill suggested that high parental expectations and the child’s desire to please have a greater correlation than the personal attitude of the parent towards mathematics. Recent research (Eccles and Wigfield, 2002; OECD, 2014) reported similar findings, relating children’s mathematical motivation and self-efficacy to the behaviour and expectations of their parents.

Analysis by Ginsbur-Block et al. (2010) of a range of studies shows a wide array in the affect size of parental involvement on children’s achievement, with variations depending on the manner of involvement. Discrepancies in the effectiveness of strategies were also found across pupil age groups and socio-economic factors.

Whilst some studies have reported no evidence of a link between parenting and children’s academic achievement (Scarr, 1992; Annunziata et al., 2006) an extensive range of research literature (Tocci and Engelhard, 1991; Marchant et al., 2001; Melhuish et al., 2001; Guay et al., 2003; Cox, 2005; Lucas, 2006; Whalley, 2007; Winter et al., 2009; Christenson and Reschly, 2010; Downer and Myers, 2010; Ginsbur-Block et al., 2010; Reschly and Christenson, 2012; Rice et al., 2013; Glueck and Reschly, 2014; Jameson, 2014) supports Hill’s findings that parental values are a major factor influencing the educational achievements of children.

Home-school partnerships could be considered to be underpinned by the socioecological approach represented by Bronfenbrenner (Bronfenbrenner, 1994; Psychology Notes HQ, 2013), where the development of the child is interconnected with the relationships they form. In the case of home-school partnerships, the 2 microsystems (of the child’s family and of the school system) combine to create a united mesosystem. This is an example of the whole being greater than the sum of the entities involved as the mesosystem incorporates additional
connections, such as the interaction between teachers and parents (Christenson & Reschly, 2010; Downer & Myers, 2010; Reschly and Christenson, 2012).

The UK Government’s 1997 White Paper, ‘Excellence in Schools’ led to the introduction of home-school contracts, designed to be “powerful statements of intent” with the aim of engaging “parents in raising pupils’ achievements” (DFEE, 1997, p.55). The impact has been positive as it has been found to enhance pupils’ engagement and achievement in mathematics and across the whole curriculum (Lucas, 2006; Whalley, 2007; Winter et al., 2009; Boaler, 2015).

A variety of parent involvement strategies have demonstrated potential to improve the mathematical engagement of pupils, including supportive parenting, parent initiated communication with teachers, participation in school governance and time spent with the child. Considering the fear of supporting their children in mathematics reported by Chinn (2011) and Boaler (2015), all efforts made by schools to engage parents with mathematics should be seen as positive. Parents also influence their child’s mathematical learning by providing supportive atmospheres for home-learning (Moran et al. for DfES, 2004). Swanson (2011) considers supportive parents to be effective in providing positive responses to their child’s natural curiosity and nurturing a sense of security in their academic explorations.

Whilst it appears there is consensus regarding a relationship between parental involvement and student achievement, Hong et al. (2010) caution that although reciprocity is evident, the directional causality is not. Therefore, it is possible that parents take an involved interest in their child’s education because that child is a high achiever, as suggested by Desforges and Abouchaar (DfES, 2003).

**Good practice in involving parents**

Recent longitudinal research (Froiland and Davison, 2016) suggests that student mathematics achievement is indicated by parental expectations, self-efficacy and expectation and peer interest and that of these factors, parental expectation is the strongest predictor. As parental expectations and involvement are such key factors in pupils’ mathematical engagement, it is important for educators to value and promote good home-school relationships. Although the evidence relating to the effectiveness of individual methods is not robust, the overarching agreement between researchers and the DfE (2010) for best practice is that parental engagement and involvement strategies should be carefully targeted and purposeful.

Increasing parental involvement in school-based mathematical events could be argued to bridge the gap for parents who lack confidence in their mathematical ability to engage with their children’s learning. This strategy builds upon Vygotsky’s social constructivist learning theories (Holzman, 2009; Cooper, 2012) by enabling both parents and pupils to interact with mathematics puzzles and activities, organised and supported by teachers, and has also resulted in improved pupil engagement (Topping and Bamford, 1998; Whalley, 2007; Feiler, 2010; Ginsbur-Block et al., 2010; Ofsted, 2011). An additional benefit is the opportunity to introduce parents to mathematical materials and methods which their children use regularly, leaving them in a more confident position to support their child’s learning at home (The Mathematical Association, 1987; Reschley and Christenson, 2012; Boaler, 2015).

It should also be remembered that parents often see a different side to their child, as such support between parents and schools should be two directional. The white paper ‘Review of Best Practice in Parental Engagement’ advocates home-school communication as a reciprocal process and recommends that

“parental engagement requires active collaboration with parents and should be pro-active rather than reactive. It should be sensitive to the circumstances of all
families, recognise the contributions parents can make, and aim to empower parents” (DfE, 2010, p.10).

Above all, the primary focus of parental engagement should be on improving the mathematical outcomes of the children involved.

**Methodology**

**Case studies**

Case studies are a useful research tool, enabling researchers to establish parameters. By comparing a range of studies, exploring different cases representing specific dimensions within a theory, a stronger overview of the field of study can be developed. Case studies enable readers to relate to research as they create familiarity with the context in which the research was set (Wilson, 2009). Whilst they have the potential to be criticised for possible subjectivity by the researcher, this can be countered by the inclusion of a variety of sources of evidence (O’Leary, 2004; Taber, 2007).

This case study features a year 1 class within the bounded system of an urban primary school in the south of England. It attempts to address subjectivity concerns by employing quantitative data from questionnaires, qualitative data obtained through observations and objective information taken from document analysis. Consent was obtained from the ethics board of the university which the researcher represents and from the school head teacher, in the role of gatekeeper.

The focal areas of the research are to establish attitudes towards enjoyment of mathematics, usefulness of mathematics, self-efficacy of mathematics and whether there is a correlation between a parent’s attitude to each of these areas and that of their child.

**How the sample subjects were selected**

In order to ensure the sample subjects selected were as representative as possible of wider society it was decided to include the entire class as a cluster sample. It is acknowledged that the pupil population of this class is not totally representative of the national average. Therefore, local comparisons were sought, which reduced variations between the study group and the local population (figure 1). In relation to the high number of pupils with special educational needs or disabilities (SEND) it is recognised that within small sample groups, low percentages are commonly misrepresented – for example, one pupil from a sample size of thirty represents 3.3% - higher than either of the averages indicated in this category.

![Figure 1](image-url)
Although, the case study class consists of an atypical population, it was considered by the researcher that collecting responses from the entire class would provide a more authentic overview as there are a variety of factors which could not easily be negated by reducing the class size to include only ‘representative’ opinions. This ‘all-inclusive’ selection aimed to minimise coverage error (O’Leary, 2004) although it is to be expected that some elements of society would not be represented in a sample of 30 families. Additionally, the anonymity of responses renders the researcher unable to draw any conclusions linking to background from this research.

**Questionnaires**

To establish insight into the mathematical attitudes of children and their parents, it was apparent that the most effective method would be to ask directly. As it would not have been practical to interview many parents individually, it was decided that utilising a questionnaire would enable information from a wider sample group to be obtained (Wilson, 2009). The greatest benefit of questionnaires over interviews is the ability to ensure anonymity, which could be argued to increase the likelihood of honest responses (Taber, 2007).

Taking into account the voluntary nature of questionnaires, it was deemed necessary to include the whole class regardless of their representation of wider society, as it was anticipated that some prospective participants would decline to respond. Due to this prospective non-participation bias (O’Leary, 2004; Bell, 2010) the widest possible starting sample was desirable. When considering the findings, it is equally essential to acknowledge that whilst the data are representative of the respondents in this particular case study, the numbers are insufficient to provide generalisation. The research was, however, carried out with the intention of eliciting transferable data with which to inform the future practice of the student teacher researcher (Taber, 2007).

It was considered that using a Likert scale (O’Leary, 2004; Bell, 2010) would provide the greatest likelihood of busy parents finding time to complete a questionnaire. A five-point Likert scale was chosen to obtain greater clarity in the results. The benefits of this type of response, in addition to achieving a higher response rate, are that the data are easily understood and that they make qualitative data quantifiable and comparable (Wilson, 2009). Also, with the high proportion of families for whom English is an additional language, the responses are simple to select. The questionnaire given to the children also used a Likert scale, however, for simplicity, this one was a pictorial three-point scale. To reduce ambiguity, the questionnaires included an extra option for participants to use for any statements of which they were unsure.

Previous research into students’ attitudes towards mathematics was carried out by Fennema and Sherman (Fennema and Sherman, 1977; Inter-American University of Puerto Rico, 2016; Doepken, Lawsky & Padwa, no date). Although some of their questions relate to societal attitudes which have undergone extreme changes, particularly in respect to mathematics and gender, Fennema and Sherman’s approach is still relevant today. The subscales used at the time were: a confidence scale, a usefulness scale, a scale that measured mathematics as a male domain and a teacher perception scale. For this research, the focus was altered to consider self-efficacy, enjoyment and usefulness of mathematics. Although the questions have been adapted, the approach taken, utilising equal measures of positive and negative statements has been used in this research. The purpose of measuring both positive and negative attitudes is to establish the accuracy and reliability of the data collected (O’Leary, 2004; Wilson, 2009; Bell, 2010), for example if a strong agreement was indicated as the response to pairs of contradictory statements, it would be necessary to discount this data as being unreliable.

**Anonymity**
In administering the questionnaire with year 1 pupils, the researcher initially considered working with small groups to support the process. However, as it was intended that both parents and pupils should have the option to respond anonymously, the ability to consider the connection between parental and child perceptions of mathematics would have been extremely limited. It was, therefore, decided that child and parents’ questionnaires should be sent home together. The potential here for parents to influence the responses of their children is acknowledged. To address this, a covering letter reinforcing the importance of honest, individual responses and the anonymity of the questionnaires was enclosed. Each family was provided with an envelope in which to place all completed questionnaires and a ‘post box’ was set up in the classroom to prevent identification.

Observation

To enable an in-depth understanding of the case study, the researcher also utilised participant observer strategies of data collection. These included observing the class; working with pupils; assessing pupils’ performance through questioning and examination of their work; reflective evaluations of the effects of a variety of pedagogical strategies implemented; and informal discussions with the class teacher. These observations provide a qualitative aspect which triangulates data by considering alternative perspectives. Whilst for the majority of research objectivity is sought to reduce bias, when employing participant observations, the experience brought by the observer adds a further dimension. This is underpinned by Heidegger’s ‘being-in-the-world’ notion of phenomenological enquiry (Wilson, 2009) which highlights how enlightenment and understanding are cultivated from subjective biases developed through experiences. Therefore, the researcher’s subjectivity adds a beneficial depth of insight to the study.

Document analysis

The final dimension to this research, to establish deeper contextualised familiarity, was the application of document analysis. This provided essential consideration of: the school’s approach to the mathematics curriculum; the baseline mathematical attainment of the focus class; the type of home learning promoted for mathematics; and the degree to which parental involvement is encouraged. To this end, pertinent documentation from the school was obtained, including long term plans, mathematics procedural policy, home learning policy, most recent Ofsted report and class data.

Through the combination of methods of research undertaken, the researcher has attempted to gain a broad perspective which allows for both thematic and statistical analyses (O’Leary, 2004; Wilson, 2009; Bell, 2010).

Analysis of Findings

General findings

Of twenty-nine sets of questionnaires given out, 41% (12) were completed and returned. This falls just above the parameters of the typical 30-40% response rate to internal surveys (Fryrear, 2015), possibly as a result of considering the customer loyalty aspect to which Fryrear refers. This was established by waiting until a strong enough relationship had been developed between the researcher and the parents for them to feel emotional motivation to complete the research questionnaire. Given the proportion of pupils who speak languages other than English at home, this was considered a successful return rate for this initial research. If there are sufficient indications for further research, it would be recommended that a much larger sample be used at that stage.
Having analysed the results, one child has coloured the smiley face for all questions. Statements were designed to test for validity of responses by using a combination of positive and negative statements (e.g. “I find maths hard” and “I find maths easy”). Therefore, this respondent has effectively negated their responses, thereby culminating in a completely neutral overall response to their attitude to each theme.

The statement at the top of the questionnaire asked children to colour the face which indicated how they felt about each statement, rather than specifying the meaning of each icon. Therefore, it is possible that this child was indicating an overall positive attitude to mathematics, however, it is more likely to indicate lack of comprehension. As the questionnaires were completed anonymously, this is impossible to determine. I have recorded the overall neutral response and disregarded this from my analysed data. This was not an outcome that I had anticipated, having not encountered this in my test group and if the research is repeated in future I will ensure that the instructions are less ambiguous.

As expected after reading the variety of literature available (Tobias, 1993; Chinn, 2011; Bird, 2014; Haylock, 2014; McNeill, 2014; Boaler, 2015; Ofsted, 2015; Curtain-Phillips, No date), a wide range of attitudes were expressed through the questionnaire responses received. What I had not expected was that the overall response was positive, with only two individuals submitting responses which did not display a positive attitude towards any area of mathematics considered. When the child whose responses negated themselves, rendering all attitudes neutral, is excluded (b), this leaves only one response from the twenty-four received (k) which is completely negative (see figure 2). An overwhelming 71% of respondents demonstrated some degree of positivity towards all areas of mathematical attitude considered (see figure 2). This appears to reflect the positive relationships between areas of mathematical attitudes suggested by Tocci and Engelhard (1991), Chinn (2011) and Boaler (2015).

![Venn diagram representing positive attitudes to themes considered in mathematical questionnaires](image)

**Figure 2**

**Analysing questionnaires**

The questions within the questionnaires have been assigned to explore one of the three key focus points of this research (see figures 3 and 4). The other key aspect of analysing the questionnaires was in identifying a means of comparing adult and child data obtained via
different Likert scales. Positive statements were rated from 5 to 1 on the adult scale, 3 to 1 on the child scale, and negative responses were rated from 1 to 5 and 1 to 3 respectively.

The general statements designed to identify whether mathematical aptitude was considered innate was disregarded from the findings as it was not considered to add to individual's opinion of their own mathematical ability. Therefore, the self-efficacy and usefulness of mathematics questions garnered a minimum score of 6 from both adults and children with a maximum of 30 for adults and 18 for children. The midpoints of 18 (adults) and 12 (children) represent the neutral line. These scales were used to draw graphs (see figures 5 and 6) which were subsequently superimposed (see figure 7) to allow for comparison. As Likert scales do not provide measurable quantification (a score of 4 does not represent double a score of 2), rather a sliding scale from minimum to maximum depending on individual interpretation, this overlay
was useful in indicating the extent to which parents’ attitudes and those of their children were similar. When the data was input in this way on graphs using excel, the neutral line became 0 and the range of 12 became a scale from 6 down to -6 (as seen in figures 8, 9, 10 and 11). The enjoyment of mathematics scale included only 4 questions so the scale was adjusted accordingly. It was necessary to create an alternative method for comparison as normal parameters for analysis are not compatible with Likert scales. Additionally, the z score or standard deviation methods, normally employed for comparing and analysing different data sets (ResearchGate.net, no date), are not suitable for use with this size sample.

**Self-efficacy in mathematics**

Within this group of focal questions, greater ambiguity in response by pupils appears to have been an issue as two children directly negated their answers between pairs of questions, e.g. “I find maths easy/hard” and “I am good/not good at maths”. It is possible that this reflects the wide and varied nature of the mathematics curriculum. Additionally, responses to two of the questions by two adults and one child demonstrate that a positive self-efficacy in mathematics is not dependent on being better at this than other subjects. An example of this is participant G whose response reflected a strong self-efficacy across the first four questions (16 out of 20). However, when the final two statements “I am better at maths than at other subjects” and “Most subjects I can do well, but I just can’t do maths” (both of which the respondent disagreed with) were included, an overall neutral score was recorded.

Correlation between parent and child positive and negative attitudes was hard to establish at only 55% (see figure 8), with examples both of parents having positive but child having negative attitudes and of the parent having negative attitude but their child’s being positive. Although not a direct contradiction of the literature, this does little to support assertions from Hill, (1967), Eccles and Wigfield (2002) and the OECD (2014) that the personal attitude of parents has the greatest impact on motivation and self-efficacy of the child.
Research suggests that children who use and see mathematics used at home regularly will have a higher confidence level in mathematics (Ginsbur-Block et al., 2010; Lambić and Lipkovski, 2012; Boaler, 2015) and this theory appeared to hold true as 89% of pupils who responded with a positive self-efficacy also reported that they and/or their parents “use mathematics at home a lot”.

**Enjoyment of mathematics**

An overall enjoyment of mathematics, particularly mathematical puzzles and problem solving was demonstrated by the responses to this aspect of the questionnaires (see figure 9). Interestingly, several respondents indicated positive attitudes regarding the enjoyment of mathematics although their responses demonstrate a preference for other subjects when asked about mathematics as a favourite/least favourite subject. There were examples of both adult and child respondents for whom this was the case, with children who enjoy mathematics likely to indicate a neutral response to these statements. However, three adult respondents, who enjoy mathematics overall, gave negative responses to the statement “Mathematics has been my favourite subject”, although these were all in the disagree rather than strongly disagree category.
The most surprising sets of responses came from candidates c and g. Respondent c recorded a negative self-efficacy and a neutral attitude towards the usefulness of mathematics but responded with a positive enjoyment of the subject. Candidate g, meanwhile, had very positive scores for self-efficacy and usefulness of mathematics but indicated largely neutral feelings towards the enjoyment of mathematics, with their preference for other subjects determining an overall negative response in this category.

As anticipated, a trend line was apparent (see figure 10) when graphing the correlation of results between self-efficacy and enjoyment of mathematics. This indicated that those who felt more confident in their mathematical ability were more likely to enjoy mathematics. This correlation reflects previous findings from a wide range of researchers (Zimbardo & Ebbesen, 1970; Trianidis, 1971; Bandura, 1977; Bandura, 1994; Eccles and Wigfield, 2002; Leaper et al., 2012; Rice et al., 2013; Jameson, 2014).
Figure 10

From the perspective of a student teacher, it would be beneficial to lesson plans if an inverse correlation could be proved, with enjoyment generating an increase of pupils’ confidence in mathematics. Although the researcher has not had the opportunity to test this robustly since gathering this data, reflections from mathematics lessons taught during the 10 weeks working with this class indicate that children grasped concepts more easily when they were learning and practising skills through games, puzzles and practical activities. This could be considered to support research indicating the importance of teachers in creating positive mathematical experiences (Gates, 2001; Koshy, 2001; Ollerton, 2009; Chinn, 2011; Rickard, 2013; Haylock, 2014; OECD, 2014; Witt, 2014; Boaler, 2015). An increase in engagement and achievement of learning objectives was observed during lessons which promoted collaboration. This could be considered to reflect the high level of influence peers have on individual attitudes to mathematics (Topping and Bamford, 1998; Crosnoe et al., 2008; Leaper et al., 2012; Rice et al., 2013).

Usefulness of mathematics

Many children were unsure whether their parents used mathematics, even when the corresponding parent questionnaire identified that they use mathematics daily including at home. In addition, children were more likely than their parents to consider that computers render mathematics pointless, ostensibly unaware of the mathematics involved in programming. Only 25% of paired responses, reported an equal or more positive attitude to the usefulness of mathematics in the child than in their parent (see figure 11). As 18 out of 30 would be the total score for a parent who selected neutral responses to all statements about the usefulness of maths and the lowest adult score was 20 out of 30, this implies that adults, on the whole, have a positive perception of the usefulness of mathematics. The neutral score for children would be 12 out of 18, which two children scored, although none scored an overall negative attitude to the usefulness of mathematics. This could be considered to reinforce that children often fail to see the relevance of what they are learning. Although one neutral child score (b) is to be disregarded, as previously discussed, the other in this section (c) was recorded by a child whose mother (C) returned a very positive score (29 out of 30) (see figure 11). As research indicates usefulness of subjects to have an impact on pupil
motivation and achievement (Tocci and Engelhard, 1991; Eccles and Wigfield, 2002), the overall positive response is encouraging.

Figure 11

The greater number of adults who consider mathematics useful, most of whom scored it as highly useful overall, appears to reinforce research connecting educational and mathematical achievement with future life chances (Belsky et al., 2007; Fiscella and Kitzman, 2009; NRDC, 2009; Wilkinson and Pickett, 2010; OECD, 2014).

Gender and attitude

Historic research demonstrated an attitudinal difference between genders in relation to mathematics. This case study built upon findings that mathematics no longer holds an assumed masculinity, but sought to investigate whether the continuing difference in mathematical attitudes encountered in earlier research (Crosnoe et al., 2008; Kurtz-Costes et al., 2008; Ceci et al., 2009; Else-Quest et al., 2010; Ceci et al., 2011; Cvencek et al., 2011; Gunderson et al., 2012; Rice et al., 2013; Swinson, 2013; OECD, 2014; Ofsted, 2015; Sax et al., 2015) still exists. This was done by asking all respondents to indicate their gender on their replies. The findings showed a comparable 79% of females and 80% of males enjoy mathematics, with a slight variation overall in self-efficacy, 80% of males having a positive self-efficacy whilst females demonstrated a slightly lower confidence level, with only 71% holding a positive self-efficacy, reflecting research by Halpern et al. (2007) and Leaper et al. (2012). The results, however, altered when separating adult and child data, where 100% of adult males reported positive attitudes in both areas, whilst 78% of adult females reported enjoying mathematics although only 67% had a positive self-efficacy. Within the child questionnaires, the female responses demonstrated a higher enjoyment and self-efficacy level with 80% positive responses in both areas compared to 71% in both areas for male children. This could be considered to demonstrate a reversal of attitude both between the two generations questioned.
in this research and between these findings and those from previous studies (Kurtz-Costes et al., 2008; Else-Quest et al., 2010; OECD, 2014), possibly as a result of the government’s recent focus on tackling the gender gap (DCMS, 2013; Swinson, 2013). However, it is necessary to urge caution in the reading of these results given the small-scale of this research.

Although the direct findings of this research project do not indicate strong links between parental attitude and child’s engagement level, it is worth recalling that the overwhelming majority of study participants had a generally positive attitude to mathematics (figure 2), with 92% indicating a positive attitude to at least one attitudinal aspect examined. Thus, it could be surmised that the strong home-school relationship fostered by the research school through positive communication, parent support workshops in preparation for year 6 mathematics SATs and a community focused ethos all play a part in counteracting negative mathematical associations.

**Conclusion**

**Correlation between parental and child attitudes**

Focusing on the original research question, the vast research carried out previously indicates that there is a link between parental attitude and the mathematical engagement level of the child. This case study partially supports this concept as 83% of focus families exhibited positive attitudes to at least one aspect of mathematics considered by both parent and child. The correlation is considerably lower for each individual area, however, it is possible that the small sample size and some anomalous results, as discussed previously, have distorted the results. Therefore, if the findings from this research are to be built upon, it would be recommended that the sample size be vastly increased. To enable findings from prior research into the impact of parental involvement on children’s achievements to be investigated, an alternative method which removes anonymity would be required. It is for this reason that this theme was excluded from this particular research, with a view to examining this phenomenon separately in the future.

**Correlation between mathematical enjoyment and self-efficacy**

The apparent correlation between mathematical enjoyment and self-efficacy reveals one area for further research. The participant observations of the researcher and discussion with the class teacher indicate that enjoyment levels have some determining effect on pupil engagement and achievement. This would be more efficiently explored through a pre-post case study or a longitudinal case study. Should cause and effect be established in this manner, it would be recommended that the research be expanded to include an entire school, as a minimum, to determine whether the effect is transferable with children of different ages.

**Usefulness of mathematics**

One possible recommendation, drawn from this research, would be that the relevance of mathematical teachings be made more explicit to children as the responses demonstrated conclusively that this sample group of pupils had a very low attitude to the usefulness of mathematics (see figure 11). It is important to highlight that this small scale research should not be considered indicative of the wider community, especially given that the sample group were children of 5 and 6 years old. If the research had involved upper key stage 2 pupils or those in secondary school these results may have been considerably different, as Ginsburg-Block et al. (2010) identified research variations dependent on age and socio-economic factors. However, connections and applications which are obvious to the teacher are not always as apparent to the pupils. The necessity for comprehension is supported by the focus in the current National Curriculum (DfE, 2013) on relational understanding to develop pupils’
mathematical reasoning and problem solving skills. The mathematics purpose of study summarises mathematics as a:

highly inter-connected discipline [...] essential to everyday life, critical to science, technology and engineering, and necessary for financial literacy and most forms of employment. (DfE, 2013, p. 99)

When considered alongside prior research (Tocci and Engelhard, 1991; Eccles and Wigfield, 2002; Lambić and Lipkovski, 2012; Boaler, 2015) it should be considered good practice to ensure that pupils understand the applications of their learning.

Gender and attitude

With regard to the findings relating to gender and attitude, the initial indications of a more positive outlook by the next generation of females imply some degree of success in the strategies implemented by the DCMS (Swinson, 2013). Analogous to previous findings from this case study, caution should be inferred in drawing conclusions from small scale studies; rather these should be used in conjunction with other similar studies to inform future wide scale research.

Implications for future practice

From the researcher’s perspective, as a newly qualified teacher (NQT), it will be of vital importance to ground practice in research. This particular research reinforces the essence of curiosity and wonder which reflect good practice in engaging pupils with mathematics. The necessity is highlighted for all pupils, male and female, to be encouraged to develop a strong belief in their ability to engage mathematically with the world around them, as these positive attitudes extend into adulthood (Cockroft, 1982).
References


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