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A mixed methods study exploring lower key stage 2 children's self-concept and risk taking in mathematics

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Abstract

Problem solving and reasoning are known to present rich mathematical opportunities where knowledge can be applied, and mastery developed. However, many children appear to lack the resilience and perseverance necessary for these tasks and may set low goals. The main aims of this study were to explore the factors that impact on children's self-regulated learning (SRL) so that they may influence future pedagogy. A literature review revealed positive associations between SRL and mindset, self-concept and self-efficacy, and a mixed-methods study was proposed to investigate these involving a small group of lower key stage 2 children in a one form entry English primary school.

Chapter 1 – Introduction

In England, the National Curriculum has described mathematics as ‘essential to everyday life…[and] employment,’ (DfE, 2013, p.3). It is acknowledged to be a core subject, taught daily in primary schools and forms part of the statutory assessments for the end of key stage 1 and 2. Its key aims are stated as developing fluency, mathematical reasoning, and problem solving, including ‘persevering in seeking solutions’ (DfE, 2013, p.3).

Through an extended literature review, this dissertation seeks to investigate the responses of children, particularly those aged between 7 and 9, to challenging tasks in mathematics, and explore the factors that may have a direct or indirect effect. The review is structured into four key areas: self-regulated learning, agency, motivational concepts such as self-efficacy, and pedagogy. Relevant studies will be examined alongside conceptual papers and the work of some prominent theorists then examined and used to frame the study. This includes Dweck’s work on growth mindset (Haimovitz and Dweck, 2017), alongside Bourdieu’s notion of ‘habitus’ (Bourdieu, 2000, cited in Costa and Murphy, 2015) in the formation of identity. Key to the conceptual framework is Bandura’s triad of reciprocality (Bandura, 1986, cited in Zimmerman, 2000) which the researcher will seek to link to the interplay of factors that influence children. The proposed small-scale investigation seeks to provide further, situated research on this topic within a local primary school, adopting a pragmatic paradigm and using a mixed methods approach to collect a range of data.

This study seeks to address two interlinked research questions:

- ‘How do children in a lower key stage 2 classroom respond when faced with challenging mathematical problems?’
- ‘What factors impact on children's choices to take risks and persevere with challenging mathematical problems in a lower key stage 2 classroom?’

The rationale behind this choice of topic is multi-dimensional. Firstly, during the researcher's teaching career, many children have been observed to display a poor self-concept in mathematics, even at key stage 1 (KS1), which has sometimes appeared to lead to task avoidance or displays of anxiety. Furthermore, many children have appeared to lack resilience in the face of difficulties and even those who perform well in arithmetic will often be seen to avoid taking risks, particularly in problem solving. This could indicate that many children still appear to hold what Muller and Dweck (1998) call a 'fixed mindset', where intelligence is perceived as an unchangeable trait, despite many schools encouraging a 'growth mindset' ethos. This may hold some children back from developing their skills to a higher level and since there is considerable pressure on schools to perform well in end of key stage assessments, research in this area seems valuable. Other research studies, for example those by Guay, Marsh and Bovin (2003); Marsh and Martin (2011); and Lohbeck, (2018) have already made links between self-concept and mathematical literacy.

Through focussing on a small number of case study children in the qualitative phases of this research proposal, it is hoped that light can be shined into these areas, providing richer detail of a socio-cultural nature that can be compared to a wider statistical survey of children in years 3 and 4. This addition of a qualitative element appears absent from many related studies and may therefore contribute valuably, albeit on a small scale, to the field. Meanwhile, the quantitative aspect will give a broader sample of data where correlations can be investigated, that may lead to areas for future research.

This research topic relates to a number of module themes from across the masters pathway including pedagogy, assessment, identity and the role of agency. The research initially focussed mainly on the constructs of self-concept and self-efficacy in relation to mathematics from the learner's perspective, but has increased in scope after TMA02 to address the role that pedagogy plays in more detail, reflecting the researcher's conception of knowledge as a dynamic, socially created phenomenon.

This draws particularly on the theories of Vygotsky (1978) regarding the role of scaffolding and more knowledgeable others.

The proposed setting for this research is a one-form-entry primary school in the East of England that has a recent history of underperformance in mathematics at key stage 2 (KS2). Children mostly work individually on mathematics and while reasoning tasks are used frequently, they are normally short in duration. Although children are normally offered a choice of levels to attempt, they are usually sat in ability groups. Whilst this is a small, localised sample, whose findings may not represent those found in another context, it is hoped that the study could add to a wider body of knowledge and inform future pedagogical decisions by the researcher and within the setting.

Within this proposed setting, the researcher is currently positioned mainly as an outsider, however since some supply teaching is still offered to the school, there is an element of insider knowledge which allows for a greater understanding of context and a degree of rapport established with staff and some pupils.

Chapter 2- Literature review – the topic

At the outset of this literature review, this paper sought to explore the definition of self-concept and how it may relate to motivation, with a focus on learning behaviours such as taking risks and persevering with difficult tasks in a primary mathematics context. Research questions and key search terms were thus generated initially from these aims and then widened or adjusted as additional themes emerged.

The review endeavoured to adopt a systematic approach to searching for relevant literature, whilst remaining broad enough to allow the identification of other useful key concepts. Initial searches were conducted from the Open University main library database using the search terms ‘self-concept’, ‘attitude’, ‘resilience’ and ‘risk taking’, and later, ‘growth mindset’ and ‘self-efficacy’ emerged as salient terms. In reviewing relevant pedagogies and seminal theorists, ‘Piaget’, ‘Vygotsky’, ‘Bruner’, ‘Foucault’, ‘Bourdieu’ and ‘Maslow’ were searched for, alongside the terms ‘dialogic’ and ‘exploratory’. To narrow the results, the search terms ‘math*’ AND ‘primary’ were also used on most occasions.

In addition, two specific educational electronic databases were searched: the British Education Index and Education Research Complete. In the former, terms used, were ‘self-concept OR self-efficacy AND math*’ and ‘mindset AND math*’. In the latter, terms used were ‘self-concept OR self-efficacy’, ‘mindset’, risk taking’, ‘anxiety, ‘grit’ and ‘identity’. Each of these was narrowed further by ‘math* AND primary’. In addition, citation searches were employed as appropriate, and Google Scholar used to help locate additional papers.

‘The focus of the literature search was on peer reviewed journal articles produced since 2015 however on occasions, older literature, government policy and research papers, and chapters of edited books were examined with caution to help define key concepts, illustrate current guidance, or where relevant studies were sparse. For all results generated, titles and abstracts were perused, and articles generally excluded

if they were unrelated to education or focused on higher education. Furthermore, priority was given to studies that had focused on primary pupils in UK schools,' (Burrell, 2021, pp.1-2) which revealed a potential gap in the literature.

The term self-regulated learning emerged when researching learning behaviours, such as perseverance and will be explored first, followed by a definition of what the author understands as 'agency'. Finally, aspects that may underlie the behaviours and attitudes experienced in a mathematics classroom will be considered under the broad categories of motivation and pedagogy. It is hoped that these themes will give insight into how children may be encouraged to develop a more positive mathematical self-concept and take risks to challenge themselves which may in turn lead to improved mathematical achievement. Furthermore, this review seeks to highlight any gaps in current research.

2.1 Self-regulated learning (SRL)

SRL is a term that can be used to describe the cyclical process of monitoring, judging, and reacting to one's own behaviour (Bandura, 1991). Several models have developped including that of Zimmerman (2000), who described SRL as 'self-generated thoughts, feelings, and actions that are … adapted to the attainment of personal goals,' (p. 14). These behaviours were proposed to include task analysis, attention focussing, self-experimentation, and self-evaluations, situated within three phases: forethought, performance, and reflection. Zimmerman based his model upon social cognitive theory, viewing self-regulation as 'an interaction of personal, behavioural, and environmental triadic processes' (Bandura, 1986, quoted in Zimmerman, 2000, p. 13). It is proposed that the themes discussed in this paper may form parts of this triad. For instance, mindset may be classed as a 'personal' aspect and pedagogy as an 'environmental', with each exerting a reciprocal influence.

Of particular interest to the research questions in this paper are the SRL behaviours of goal setting, perseverance, and resilience.

Goal setting is thought to be influenced by several factors including mindset, which will be explored later in this chapter. Of particular interest are the factors that may motivate children to set themselves challenging, yet achievable goals requiring a degree of risk to be taken. In this context, taking risks is defined as setting learning goals and taking subsequent action, that may be perceived by the child as presenting a possibility of failure or difficulty.

Perseverance can be defined broadly as demonstrating determination and tenacity and this paper supports the definition of Wilburne and Dause (2017) who explain the term as 'continuous concentration and focus…even when faced with obstacles,' (p. 39). Miele *et al*. (2020) have further explored the concept and explained how it can be considered at three levels: as a general trait, 'a domain-specific construct…, and as a domain-specific behaviour,' (p. 2). The author will remain mindful of differing constructs and address these in chapter 5.

Another key concept seemingly closely related to perseverance is resilience. This can be defined as the 'capacity to recover quickly from difficulties,' (Lexico, 2021) which could be considered essential when persevering with a task, particularly one at a level of challenge. Ofsted (2019) notes that academic resilience may also refer to the extent that children not only 'recover from setbacks,' but also to how they may overcome disadvantages including 'low prior attainment or social background,' (p. 38). Within the proposed research, this paper wishes to take an inclusive view to the range of children studied as regards levels of attainment and socio-economic and cultural backgrounds. Therefore, it can be expected that a broad spectrum of potential obstacles or disadvantages may be faced.

2.2 Agency

Agency could be reasoned to underpin all actions and decisions made, by both pupils and teachers and several theorists refer to its role in influencing motivation, SRL and pedagogy. For instance, Rainio (2007, p. 150) notes that agency can be thought of as both 'a prerequisite for, and ...an outcome of meaningful, engaged and motivated learning'. Furthermore, both Bandura (1977, 1986, 1997, cited in Muenks,

Wigfield and Eccles, 2018) and Zimmerman (2000) highlight the importance of personal agency in determining courses of action taken and related SRL behaviours.

Agency has been defined in different ways, from being either an ‘innate’ quality (The Open University, 2018), or a ‘capacity’ (Leat, Reid and Lofthouse, 2015, p. 271) to deliberately pursue a course of action according to personal identity, values, and goals (Frost, 2006). Biesta and Tedder (2007) further assert that agency results 'from the interplay of individual efforts, available resources and contextual or structural factors…’ (p.137). It is the view of this paper that, as Biesta and Tedder (2007) and Pajares (1996) posit, all actions are affected by sociocultural influences and therefore agency is inextricably linked to and affected by these. For example, teachers may demonstrate agency in extending the time spent exploring a mathematics problem beyond what is usually timetabled, or in adapting a lesson to the interests of a specific groups of learners. It is likely that this freedom may be exercised by staff when they feel empowered and confident to make their own decisions, thereby encouraging and reinforcing their 'agentic capacity' (Priestly, Biesta and Robinson, 2014, p. 7). The possible positive effects on motivation of such shifts in pedagogy will be explored later in this chapter.

However, there are many potential constraints to teacher agency. In England, as Watkins and Mortimore (1999) suggest, a major challenge emanates from the influence of government policies, Ofsted inspections and performative models of teacher competence and accountability. This accountability or performance culture (Priestly, Biesta and Robinson, 2014; Leat, 2014), can result in teachers feeling a loss of power to make more creative decisions, since they may perceive that these choices are not supported (Hofmann & Rainio, 2006, cited in Rainio, 2007)

This level of teacher agency is also likely to influence pupil agency. Where staff feel able to make informed individual choices in their classroom practice, then it could be hypothesized that they may feel more confident to allow pupils an increased amount of choice and freedom in their learning. This could be evident in classroom practices

such as pupils choosing their level of task, deciding whether to use concrete resources, or recording in multiple ways

2.3 Motivation

Motivation appears to be essential both in influencing SRL behaviours and in creating the drive that underpins agency. It is therefore included in this review as a theme which may be instrumental in encouraging children to embrace challenge and take risks in the classroom.

Colman (2008) defines motivation as ‘a driving force… responsible for the initiation, persistence, direction, and vigour of goal-directed behaviour.’ For many years, it tended to be considered an objective concept, whereby it was believed behavior was controlled solely by external reinforcement (Watson, 1917; Skinner, 1953, both cited in Ryan, 2019). However, this view was challenged by Rotter (1954), who suggested that the expectancy and perceived value of these external reinforcements represented important mediating factors. It is these factors that continue to be dominant in contemporary theories of motivation and the study has widened to include more subjective, psychological aspects which Wentzel and Miele (2016, p. 1) describe as ‘desires, goals, needs, values and emotions.’ It is suggested in this paper that these may include self-concept, self-efficacy, and mindset.

2.3.1Self-concept

Franken (1994, cited in Erdogan and Sengul, 2014) and Oyserman (2001) suggest the importance of self-concept as an antecedent of motivated behaviour, as do Pajares and Schunk (2005, cited in Martin, 2010). Furthermore, Guay, Marsh and Boivin (2003) and Marsh and Martin (2011), have also suggested a reciprocal pattern between academic self- concept and academic performance. Therefore, this appears an important concept to consider when striving to improve children’s attitudes towards mathematics and increase their attainment.

It has been defined in several ways and is sometimes used synonymously with the terms self-esteem (Martin, 2010), self-worth or even self-efficacy (Gorard, See and Davies, 2012), particularly when discussing global as opposed to academic self-concept. The definition used within this paper, is that of perceptions of oneself (Gorard, See and Davies, 2012), which the researcher feels are all shaped by experiences and interactions (Shavelson et al., 1976, cited in Marsh and Martin, 2011).

Although several studies have explored the role of self-concept in education, few appear to have been conducted with primary-aged children, particularly in the UK. A rare relevant example is that of Dowker, Bennet and Smith (2012), which focussed on children in KS2 at two English primary schools and explored attitudes, feelings of anxiety, self-rating (or self-concept) and performance in mathematics. The study investigated a modest yet reasonable sized sample of 89 children, representative of both genders, across two age groups (Year 3 and Year 5). The key findings were that attitudes to mathematics were mainly positive and that, of the variables assessed, self-rating correlated the most strongly with performance, particularly for the older children. It should be noted that schools were in ‘middle-class’ areas which reported above average performance in mathematics, therefore caution should be exercised when generalising to other schools; however, it offers a useful comparison when contrasted to the below average performing school identified as part of this research proposal.

These findings of generally positive attitudes to mathematics at a young age and a link between self-rating and academic performance are also supported by a more recent study by Dowker *et al.* (2019) of KS1 children from England. Interestingly, the same links to performance did not seem to be true of the Chinese children surveyed, which may indicate a mediating effect of culture; however, only fairly small samples of children were included. Furthermore, another international study in Canada by Kaskens *et al.* (2020) did suggest an apparent positive effect between self-concept and achievement in primary-aged children, using a much larger sample (n=610 children) and a longitudinal design, which could be posited to add a greater degree of validity to this positive correlation. However, whilst all the studies explored the effects of self-concept on mathematics achievement, they only investigated or

reported a positive association with arithmetic, not problem solving, indicating a relevant area that would benefit from further research which has helped to shape the direction of the research questions in this paper.

2.3.2 Self-efficacy

Alongside self-concept, Zimmerman (2002); Pajares and Schunk (2005, cited in Martin, 2010); Klassen and Usher (2010); Roney, Rose and McKeown (2019); and Schunk and DiBenedetto (2020), also refer to the strong influence of self-efficacy in motivating SRL. Indeed, within socio-cognitive theory, self-efficacy is purported to be a primary driver of SRL and motivation (Bandura, 1986, cited in Pajares, 1996). However, it appears to be under-explored in primary age contexts, as noted by Lau *et al.* (2018) and thus appears a further useful construct to consider within the first research question.

Self-efficacy has been defined as 'people's judgment of their capabilities to organize and execute courses of action required to attain designated types of performance,' (Bandura, 1986, p. 391, quoted in Alhadabi and Karpinski, 2020, p. 523); or more simply, as a belief that one can achieve a specific task (Gorard, See and Davies, 2012).

Klasen and Usher (2010) cite several researchers (Schunk, 1995; Bandura, 1997; and Pajares & Urdan, 2006) who suggest that self-efficacy 'powerfully predicts' SRL behaviours, which in turn may positively influence academic performance. Schunk and Usher (2019) illustrate this suggestion, noting that self-efficacy could often be linked to greater 'competence' (p. 16) since highly self-efficacious people often set challenging goals, persevere well, and display resilience. In a US study of undergraduate students, Pajares & Miller (1995, p. 222) suggested that self-efficacy beliefs may be better predictors of future performance than actual ability since they are likely to influence how people will use 'the knowledge and skills they have,' impact the amount of effort expended, and the way difficult setbacks are faced. These proposed links to SRL behaviours also seem to be supported by the findings from more recent, large scale studies by both Roney, Rose and McKeown (2019) and Usher *et al.* (2019) which appear to show a positive correlation between self-

efficacy and effort regulation. It will be of interest to compare these findings to the proposed study however, since all three studies were situated in the US and only Usher *et al.* (2019) sampled any primary-aged children.

One relevant example from the UK, was that of Chamorro-Premuzic *et al.* (2010), who assessed a large sample of children for cognition, academic achievement, and self-efficacy as part of a longitudinal study. They found that self-efficacy judgements and achievement at age 9 predicted those at aged 12, which the authors suggested was evidence of both insight at an early age, and a demonstration the 'self-fulfilling …effects of self-beliefs' (p. 385).

2.3.3 Mindset

Within the initial literature search, growth mindset soon emerged as another personal construct that may provide motivation for SRL and taking risks, with Mueller and Dweck (1998), Dweck (2006, cited in Jaffe, 2020) and Duckworth (2016, cited in Jaffe, 2020) all reporting positive associations. It has been proposed that people hold either an 'entity' or 'fixed' mindset, wherein they believe their abilities are predetermined, or an 'incremental' or 'growth' mindset, whereby they attribute effort to improvement (Mueller and Dweck, 1998; Wigfield *et al*., 2019; Yeager and Dweck, 2020).

Although Roney, Rose and McKeown (2019) found that self-efficacy had a greater effect on SRL than mindset, both demonstrated positive correlations. Furthermore, Ommundsen *et al.* (2005, cited in Roney, Rose and McKeown, 2019) propose that those with a growth mindset are also more likely to demonstrate higher academic self-efficacy. Whilst the study first mentioned focussed on children in Key Stage 3 and 4, it is believed relevant to this paper as it is a recent UK based study with a large sample set. However, one must be mindful as to whether similar findings would be obtained with younger children. For example, Covington (1984) suggests that younger children generally equate worthiness and ability with trying hard and tend not to perceive ability a stable trait until at least late childhood (Bromley, 1979; Livesley & Bromley 1973, cited in Covington, 1984).

A recent paper by Warren *et al.* (2019) appears however, to dispute this view of mindset being irrelevant to the study of younger children. It studied a large sample of Year 5, pupils across 14 UK schools, exploring the relationship between growth mindsets and attainment and found that, for most, there was a positive correlation, reflecting the findings found in other international studies. Interestingly, this finding was not supported for those with free school meals status (FSM) or an identified special educational need (SEN), although the study acknowledges the need for a more longitudinal study to further explore these sub-groups. Nevertheless, this presents a disparity between the findings of Claro *et al.* (2016) who, in a nationwide study of 10th graders in Chile, appeared to demonstrate positive across all socioeconomic groups. This must be considered in the light of context however as Claro *et al.* (2016) studied much older children, in a very different cultural context.

There are however some challenges to current mindset research. Boyd and Ash (2018) suggest that much of what is reported regarding mindset is very generic and needs to be more 'domain specific' (p. 216). Also, not all studies have reported positive effects on motivation and subsequent performance, such as the series of studies of 9-13-year-olds in China by Li, Yue, and Bates (2019). Although these findings may be explained by the cultural differences, the authors do note that the literature points to mindset not generally being affected by ethnicity.

2.4 Pedagogy

As previously suggested, it is this researcher's view that children's beliefs are constructed socio-culturally, therefore a key classroom influence in the development of these could be speculated to be pedagogy since this can be described as as 'a dynamic process informed by theories, beliefs, and dialogue… realised in the daily interactions of learners and teachers,' Leach and Moon (2008, p. 6). Watkins and Mortimore (1999) suggest it encompasses teaching styles, classroom organisation, use of assessment, and relationships with learners.

It is proposed in this paper that, as Bandura suggests, pedagogy (as an environmental factor) is likely to assert a reciprocal influence on the behaviour, motivation, and identity of children. Therefore, several aspects will be explored to analyse how it may contribute positively to children's beliefs and behaviour. However, it must first be recognised that although pedagogical decisions are partly driven by teachers' beliefs, such as the types of knowledge and goals of education that are valued (Alexander, 2008; Leach and Moon, 2008), they will also be shaped by the agency teachers have or perceive. Currently in England, the content of mathematics taught at primary level and the type of knowledge prioritised are influenced by two dominant factors: the national curriculum, and a culture of performativity and accountability.

Firstly, the national curriculum (DfE, 2014), a statutory document, stipulates programmes of study which local-authority maintained schools must adhere to. Whilst pedagogy is not specified beyond a statement that 'teachers can develop exciting and stimulating lessons' (DfE, 2013, p.6), teachers must demonstrate sufficient coverage of the prescribed content and would be accountable to Ofsted.

Secondly, it could be argued that all primary state schools are constrained by statutory summative assessments. Leat (2014) and Priestly, Biesta and Robinson (2014) both refer to an accountability or 'performance culture' in English schools, wherein due to pressures to demonstrate performance on tests, teachers often feel compelled to focus on key, assessed areas of mathematics and test format practice. Ofsted has recently reported this practice as 'curriculum narrowing…sometimes… manifested as intensive, … test preparation' (Ofsted &Spielman, 2018). Consequently, despite a shift in the updated curriculum to a teaching for mastery approach (NCETM, 2014), children may continue to have fewer opportunities to become familiar with deep problem-solving tasks where they may develop confidence and learning strategies.

What Burnard (2006) terms personal knowledge, such as resilience and creativity, is less apparent in the national curriculum or statutory assessments, however it is

argued in this paper that it is this understanding of the self, that may encourage children to develop positive attitudes and feel confident to take risks (Gerver, 2010).

It could be proposed that a more experiential classroom, such as that anticipated by Piaget, where children are able to choose their own learning and approach may lead to a deeper level of engagement, perseverance, and satisfaction. This child-led approach is recognized as good practice within the Early Years Foundation Stage (EYFS) (DfE, 2021), and is becoming more common place within KS1(Hood, 2013; Early Excellence, 2020) through the addition of continuous or enhanced provision. It occurs less frequently with older children; however, some schools are exploring the benefit of offering increased opportunities for independent enquiry (Nexus Education, 2021).

This approach to pedagogy also gives children a high degree of ownership or autonomy over their learning which Ryan and Deci (2020) propose, as part of their self-determination theory (SDT), may lead to identified or even intrinsic motivation and more positive emotions. Although unable to provide evidence of a direction of causality, this proposal appears partly supported by a German study of 12-year-olds by Tsai *et al.* (2008) who found that those who were given greater autonomy tended to be more engaged and interested and displayed increased effort. A further benefit of promoting children's autonomy is discussed by Schweinle, Meyer and Turner (2006) in a medium sized study of US children in the upper KS2 age group. They suggested that it may encourage greater self-efficacy, however, they also emphasized the strong mediating factor of feedback and suggested that work offered should be of the optimal level of challenge. This appears slightly contradictory therefore since 'optimal level' infers that children would not be given complete autonomy of choice.

Although, Piaget's approach appears to have many positive benefits to fostering children's independent learning and motivation, other prominent theorists, including Bruner and Vygotsky place a much greater importance on the social environment,

including the use of language and the role of peers and adults in constructing and mediating knowledge. More recently, reflections in the field of science teaching by Driver (2015) have also noted both the positive benefits of peer discussion, and the key role played by teachers in guiding the construction of learning and overcoming misconceptions. In consideration of the author's epistemological beliefs, which are most aligned to Vygotsky's (1978) social-constructivism, this paper suggests therefore that child-led 'discovery' learning alone may not be the most effective strategy in creating an effective learning environment.

Vygotsky placed great emphasis on the role of language in learning and self-regulation, considering it the 'foundation of thought' (McLeod, 2020), and Lewin (1926, cited in Vygotsky, 1978) proposed that children are driven to seek solutions to problems and will use speech to break them down. This advocating of social interaction whilst learning has influenced contemporary dialogic learning practices which many believe have a positive effect on thinking skills (Reznitskaya and Gregory, 2013). In considering the characteristics of effective pedagogies, Husbands and Pearce (2012) further emphasize this role of dialogue in developing 'higher-order thinking and metacognition' (p.12), making this exploration of dialogic practice in the classroom particularly relevant when considering how to encourage SRL behaviours in mathematical problem solving. Unfortunately, discussion of dialogic pedagogy at a whole class level is constrained due to the limited scope of this paper; however, its role at a small group level will be further explored.

In a paper submitted to the Qualifications and Curriculum Authority (QCA) during the review of the primary curriculum, CUREE (2008) reported on a range of evidence that indicated improvements in learning when engaging in guided group work. One of these was a report by Bell, Cordingley and Goodchild (2010) which noted 'the impact on pupil motivation and learning of structured dialogue in group work and of collaborative learning,' (p. 3) following analysis of 64 research reviews. Further evidence was also presented from Wegerif *et al.* (2004) and Kutnick, Ota & Berdondini (2008) who both completed studies with KS1 children, indicating its usefulness across the age range. There are limitations to these sources however as

neither study explicitly used mathematical problem solving as a context and although the latter utilised a large sample (n=980), Wegerif *et al.* (2004) only studied an unspecified number across three schools. Furthermore, the reviews analysed by Bell, Cordingley and Goodchild (2010) must be considered with caution as few specific details of the original sources were detailed, and some were published up to two decades ago or internationally.

In England, children are frequently seated in groups in primary classrooms, however there is a notable disparity in the quality and frequency of group work (Blatchford *et al.,*2009; Kutnick, Ota & Berdondini, 2008). At times, they may often simply be working side by side on individual tasks or set a collaborative task without further guidance. Mercer and Littleton (2007) noted that children 'do not naturally know how to work collaboratively,' an assertion supported more recently by Ofsted (2019), who postulated that group work is only effective when children are prepared in advance and supported in structured tasks.

In observations of British classrooms, Mercer (1995, p. 296) noted three distinct kinds of talk found: 'disputational…cumulative…[and] exploratory.' It is suggested by Mercer and Littleton (2007, cited in The Open University, 2019) that it is through this 'exploratory talk,' where 'partners engage critically but constructively with each other's ideas,' (Mercer,1995, p. 296), that children may develop a better understanding of their learning and become more engaged and interested**.** A study of 64 lower KS2 children in England by Wegerif, Mercer and Dawes (1999) found that it helped improve groups to reason and the children involved showed improved individual scores in a non-verbal reasoning test. Whilst this study is now a little old and only included a modest sized sample, it could indicate a possible benefit to children's mathematical problem solving.

Vygotsky further believed that children are motivated to learn when they are supported to work within the zone of proximal development (ZPD) (Odom, 2016), an area between that which may be achieved independently and that which a child may

'achieve with guidance and encouragement from a skilled partner' (McLeod, 2020). Vygotsky referred to this partner as 'a more knowledgeable other' (MKO), who may engage in 'collaborative dialogue,' (McLeod, 2020) either through modelling behaviours or providing instructions or prompts before gradually withdrawing support. In the context of this paper, an area of challenge or risk for a child when approaching a task and setting a goal could be considered a ZPD. This scaffolding by a MKO could be evident in different ways: a teacher could provide written, verbal, or concrete prompts to help a child get started or overcome difficulties; or a more skilled peer could be assigned to work alongside a less confident child. This scaffolding can also be linked to the use of formative feedback, which has been suggested to increase motivation (Wong, 2017), aid meta-cognition (McCormick and Murphy, 2008) and help to develop self-regulation (Siegesmund, 2017) in future learning.

Other important pedagogical decisions made by teachers, that affect whether children can work in their ZPD, or in collaboration with more skilled peers, concern the type of grouping encouraged in the classroom and the level of agency granted to children regarding task choices. There is a growing body of evidence that children should not be constrained by ability groups, including findings from the Independent Primary Review in the UK (Alexander, 2010, quoted in Boaler, 2013) which concluded that 'no consistent effects of … setting, [were found] on attainment, although there can be detrimental effects on social and personal outcomes' (p. 290). This supported findings of a large-scale study by Boaler (2010, cited in Boaler, 2013) in both UK and US classrooms and a study of KS2 children in England by Nunes *et al*. (2009), although they did note a small improvement in mathematical reasoning for children in the top ability set. Despite these findings, 37% of primary schools in England reported that they had introduced or improved setting in 2015 to try to raise the attainment of disadvantaged pupils (MacLeod, 2015). This may be due to a lack of consistency in official advice, since in 2005 a government white paper advocated setting by ability as good practice in addressing individual needs (DfE, 2005).

One suggestion to counter setting activities by perceived ability levels is that teachers could set open ended tasks where there may be multiple solutions or methodological options, giving children a sense of autonomy and agency (Sullivan *et al.,* 2020) and allowing them to work in their ZPD (Vygotsky, 1978). Another similar idea is to present 'low threshold, high ceiling,' (LTHC) tasks where children are all able to access a starting point but can then interpret or stretch the problem in numerous ways and thus encounter individual challenges to be worked through (NRich, 2019). These types of tasks will be reflected in the proposed study.

Chapter 3 Literature review – The conceptual framework

3.1 Philosophical framework

This research is framed by a social-constructivist world view (Vygotsky, 1978), whereby 'social phenomena' (Grix, 2002, p. 177) are thought to be continually changing as they are interacted with. The researcher aligns with a relativist ontological position in which 'people perceive and interpret social facts...within multiple realities (Corbetta, 2003, p. 25), supported by a subjective, pragmatic epistemological view, wherein knowledge is influenced strongly by differing perceptions and life experiences (Kaushik and Walsh, 2019). However, it is also conceded that some more fixed elements of reality may exist within the natural sciences, which could include fields such as neuroscience, wherein probable truths might perhaps be established. Therefore, this researcher finds themselves drawn to the pragmatist philosophical position and paradigm, which would reflect the view of Dewey, (1933, cited by Morgan, 2014) that all actions are inseparable from context, and support the use of a mixed methods approach to capture data in ways that appear most appropriate to the questions.

3.2 Key concepts and theories

As mentioned in chapter 2, several studies have demonstrated a positive correlation between attainment and self-concept in primary mathematics (Dowker, Bennet and Smith, 2012; Dowker *et al.,* 2019; Kaskens, Jarise *et al.,* 2020). It could be hypothesized that it is this positive self-concept that makes children more likely to challenge themselves and therefore learn at a higher level which Guay, Marsh and Boivin (2003), who studied a large group of Canadian KS2 aged children, purported to have a reciprocal effect. This proposition appears to be supported by Maslow's theory suggesting a hierarchy of needs (1943) that led to motivation. He asserted that once basic needs are met, including that of esteem, which could also be

described as self-concept, all people have the capacity and motivation for self-actualisation. Maslow (1968, p. 25) defined this as an 'ongoing actualisation of potentials, capacities and talents,' which in the context of this proposed study could be observed through children choosing to challenge themselves and work in the ZPD (Vygotsky, 1978). Although the validity of Maslow's theory has been criticised due to his use of a very subjective biographical analysis on a small, unrepresentative sample, it still appears a relevant framework to consider when exploring motivating factors in this study and helps to establish self-concept as a key theme to explore.

Maslow (1943) separated his 'esteem' needs in two ways: through notions of confidence and mastery, and through the recognition from others. These appear to link to Bandura's sources of self-efficacy: 'mastery experience…vicarious experience…social persuasion…[and] physiological states' (1997, cited in Lau *et al.*, 2018, pp. 605-606). Bandura posited that the first of these was likely to be the most influential, however at least two subsequent studies with children of KS2 age have disputed this, which may indicate that the impact of the sources of esteem differ according to the age of the students. Lau *et al.* (2018) surveyed a wide sample of children in US schools, measuring their level of self-efficacy, the influence of the four sources, and their perceived level of self-regulation. Findings suggested that in this study, social persuasion, not mastery experience, appeared to be the most influential, a finding reflected in Maslow's belief that this is a stronger drive of esteem in children (McLeod, 2020a). Although Usher and Pajares (2006) measured general academic self-efficacy rather than mathematical in their US study, they too noted this finding, albeit only in relation to girls. Lau *et al.* (2018) suggest that a mixed methods approach may help to obtain a deeper understanding in this area and this research hopes that sources of self-efficacy and self-concept may become clearer by using interviews to interrogate a sample of quantitative data in greater depth.

A key theory that has helped to shape the research questions and methodology of this study is Bandura's socio-cognitive theory, discussed by Schunk and DiBenedetto (2020). Within this theory, a notion of triadic reciprocality is suggested to explain how self-efficacy, a personal influence, may exert a bi-directional effect on

the positive behaviours of SRL in the pursuit of goals. In turn, these may both be reinforced and influenced by 'environmental' factors such as comparison to peers or adult feedback. This theory appears to align with the researcher's subjective position and epistemological view of knowledge as socially constructed. The research questions seek to explore how this framework might be reflected in a primary mathematics context and present an opportunity both to explore and challenge Bandura's theory by adopting a pragmatic stance.

Bandura (1986, cited in Michaelides, 2008) also reasoned that when people slightly over-estimated their capabilities or efficacy, then they were likely to feel more driven to succeed and hence would perhaps set higher goals and choose more thought-provoking tasks. Conversely, he suggested that those with lower self-efficacy were less likely to feel motivated to take risks or challenge themselves and as a result, might miss out on potentially useful experiences. This seems to suggest that improving children's self-efficacy may impact the SRL and subsequent achievement of all children regardless of ability. However, Gorard, See and Davies (2012) contest this idea somewhat as they suggest that it may be actual competence, not the belief of it (or self-efficacy) that is key and that improving competence will in turn improve confidence. On balance, it appears that self-efficacy is likely to be an important influencing factor on children's decisions and therefore will be included in this study.

A more recent theorist that has also had a considerable impact on the framing of this research is Carol Dweck. Her studies alongside others, regarding the impact of a growth mindset on self-efficacy and SRL appear to add a further dimension to Bandura's theory. For instance, in a study of American upper KS2 aged pupils, Mueller and Dweck (1998) found that when teacher praise focussed on intelligence rather than effort, pupils developed more of a fixed mindset and showed less persistence following subsequent failures. Although the task was not clearly a mathematics problem, it could be hypothesised that findings may be generalisable. Elliot and Dweck (2013, cited in Roney, Rose and McKeown, 2019) propose that mindsets held can lead to different foci in the classroom. It is suggested that those with a growth mindset are likely to see learning and improving as intrinsically

important and therefore may demonstrate more positive SRL behaviours such as setting more challenging goals, taking risks, and demonstrating greater resilience and perseverance**.** Conversely, those with a fixed mindset are more likely to want to be seen as competent in comparison to others and may therefore use self-protective strategies, as suggested in Covington's (1984) self-worth theory, such as setting goals that are either very low, or unobtainably high.

Although mindset is an individual attribute, it is likely influenced through social and environmental factors such as the ethos or culture within a classroom as noted by Haimovitz and Dweck (2017), which could also influence children's identities as learners and mathematicians. Lave and Wenger (1991, cited in Martin, 2010) and Hickey and Granade (2004, cited in Martin, 2010) describe identity as a socio-cultural conception based on participation in communities of practice, groups with shared goals and language, which Grootenboer and Edwards-Groves (2019) note, has an interactive nature that evolves over time.

It is proposed that the formation of what is perceived by a child as mathematical identity could be linked to the idea of 'impressionistic knowledge' discussed by Leach and Moon (2008, p. 3). They suggest that through pedagogy, children form individual opinions on subjects. This influence was also earlier noted by Lampert (1990, p. 31, quoted in Schoenfeld, 2016, p. 10) who suggested that beliefs about mathematics 'are acquired through years of watching, listening, and practicing.' It could be argued therefore that a child's mathematical self-concept relates directly to what they believe quantifies a mathematician in their context. Bourdieu's idea of habitus, whereby social settings shape the beliefs and practices of an individual (Bourdieu, 2000, cited in Costa and Murphy, 2015), may partly offer an explanation regarding how notions of identity and self-concept appear to be linked to choices made, such as which level of challenge to attempt or how to deal with setbacks.

Although focussed on children with a special educational need (SEN), Warren *et al.* (2019) suggested that pedagogical choices could be a factor that shape mathematical identity or self-concept. They propose that children may interpret a 'label' of SEN, as an 'implied… [lack of] potential' (p. 746), which alongside other

practises and discourses, may lead to a more fixed mindset and shape their perceived identities as mathematicians. It is proposed in this paper that these practices might include teacher comments (Johnston, 2004, cited in Grootenboer and Edwards-Groves, 2019), ability grouping (Boaler, 2005) and other restrictions on task choices. These potentially divisive practices were also analysed by Alderton and Gifford (2018) who drew on the ideas of Foucault in their case study of an English primary pupil with SEN and three of her teachers. The findings suggested that pressures of accountability and inclusion may influence teachers to 'monitor, label and assign within-child deficits… [marginalising them] through power relations embedded in pedagogies' (p. 65). Discourse was analysed at a high level of detail which, if replicated in this study, could add usefully to the exploration of factors that impact on children's choices and self-concept. However, within a small-scale study it would also be likely to present an ethical issue since teachers could be easily identified, which could lead to subsequent negative consequences.

As stated in the previous chapter, the constructivist theories of Piaget, Bruner and Vygotsky have all influenced the researcher's views of how pedagogy may influence the development of children's self-concept and SRL. One particular influence emerges from Piaget and Bruner, who emphasized the need for children to be acknowledged as active learners and given the opportunities for discovery learning, trying things out and constructing their own knowledge, leading to what Piaget termed the 'accommodation' of new information (McLeod, 2019; McLeod, 2020b). This principle aligns with the researcher's view of knowledge being subjective and constructed in combination with a learner's prior experience and context.

However, it is also recognised that some of the ideas from these theorists conflict and these areas of disagreement have also helped to shape this conceptual framework. Piaget believed in four separate stages of cognitive development (1951; Inhelder & Piaget, 1958) which determined the learning experiences that he felt children were developmentally ready for, whereas Bruner (1966) felt that these stages represented a more gradual, overlapping development of skills and that it was experience and appropriate instruction or scaffolding that determined what a child

could be capable of rather than a specific age band. Alongside Vygotsky (1978), Bruner (1978, cited in McLeod, 2019) placed emphasis on the role of the adult or more skilled peers on the level of learning that children could accomplish. This potentially transformational role of a MKO in scaffolding a challenging task is a factor that this author believes likely to influence children's choices to take risks and persevere.

Bruner (1966) further proposed that children should be taught fundamental principles and experience a spiral curriculum incorporating three stages of thought processing: enactive, iconic, and symbolic. This method is evident in the style adopted by the White Rose Maths scheme, currently popular in many English schools, whereby a concrete, pictorial, abstract approach is recommended to build competency with new concepts (White Rose Maths, 2021). It is proposed that allowing children continued opportunities to access concrete and pictorial prompts during mathematics as a scaffold for learning may enhance understanding, support confidence building and increase feelings of self-efficacy.

However, several papers, both contemporary and more historic, such as Pintrich and DeGroot (1990) and Schunk and Usher (2019) also draw attention to the numerous other influences on SRL behaviour, such as task value and interest, outcome expectations and having the required skills. This proposal hopes to identify and explore some of these factors in more detail in a situated context, using qualitative aspects to gain a deeper insight, which appears to be missing from most published research.

3.3 Positionality and methodology

Positionality, or 'how we see ourselves and others' (Cohen, Manion and Morrison, 2017, p306) can refer to the characteristics that shape a person and that impact upon how the world is experienced (Thurairajah, 2019) such as nationality,

language, cultural beliefs, world view and insider or outsider status. Alcoff (1988, cited in Acevedo *et al.,* 2015) describes how individuals have multiple, constantly changing identities situated in different contexts which links to the researcher's relativist ontological position. Bettez (2015, cited in Cohen, Manion and Morrison, 2017) notes that these have an influence on all stages of research and thus Thurairajah (2019) and Cohen, Manion and Morrison, (2017) note the importance of a researcher remaining reflexive or mindful of how these may affect bias.

The researcher's position is multi-faceted and situated on the continuum between insider and outsider. In relation to the topic and research questions, the researcher holds insider knowledge of teaching mathematics to the proposed age group within the English national curriculum and furthermore has a background knowledge of the school, staff, and pupils in the proposed setting due to an ongoing role as a supply teacher. However, due to a lower demand for supply work during Covid and the researcher recently changing career, it is likely that relationships between researcher and pupils will be less well established, placing them more into an outsider position. Furthermore, during the observations the researcher would adopt an overt non-participant observer role. This more outsider status could present the advantage of a lack of preconceived bias towards the children, and for some children may make them more candid. However, it may also mean that consent would be harder to obtain and that the setting may feel they are being scrutinised. It will be important to manage power relations with other staff, especially if seeming to challenge their values (Costley, Elliott, and Gibbs, 2010).

As an adult, it must be acknowledged that children will likely equate the researcher as holding a position of power, especially due to the researcher's dual role as a teacher. It is acknowledged that, as Cohen, Manion and Morrison, (2017) suggest, there will be a need to establish rapport, trust, and sensitivity with the research participants to help them to feel confident to act more naturally during the observed lesson and to engage and be more honest in their answers during both the survey and interview stages. Bettez (2015, cited in Cohen, Manion and Morrison, 2017, p 306) proposes that a 'meaningful connection' should be established. As Barley and

Bath (2014, cited in Cohen, Manion and Morrison, 2017) note this may require the researcher to spend some time in the classroom before commencing the proposed study so that children become familiar with their presence.

It is recognised by the researcher that the proposed study would reflect a number of different personal identities that affect the motivation for the research: that of a masters student completing an academic paper; of a primary teacher, wishing to improve their own practice; and that of a further education lecturer, wishing to inform their knowledge to share with future childcare and education workers. Furthermore, the researcher is mindful of their own identity and self-concept as a mathematician and how this may influence evaluation of data (Cohen, Manion and Morrison, 2017).

Moss (2016) further notes paradigmatic position as an aspect of positionality. This has already been acknowledged at the start of this chapter and exerts a strong influence on the methodology of this study. The proposed methodological approach will adopt a pragmatic position and use a mixed-methods design. This will allow an exploration of some of qualitative gaps noted in the literature, such as that by Krinzinger, Kaufmann and Willmes (2009); Lau *et al.* (2018); and Kaskens *et al*. (2020) and compare this richer data to wider statistical findings.

The methodology has been informed by the researcher's relativist ontological position which aligns with the suggestion of Cohen, Manion and Morrison, (2017) that mixed methods research allows the world to be both considered and made sense of in multiple ways. This is further supported by the pragmatist research paradigm which generally acknowledges that there may be multiple realities and that the 'workability' (Johnson *et al.,* 2017, p. 12) of theories should be the driving force. Tashakkori and Teddie (1998, cited in Kaushik and Walsh, 2019) also suggest that pragmatism advocates using whatever approach works best to answer the research questions.

Both research questions could be answered using only qualitative data, however due to the difficulty in observing and interviewing large numbers of children, it was felt that an additional quantitative survey may produce useful supplementary data across a wider sample. This could also then increase the reliability of the data collected as 'methodological triangulation' (Cohen, Manion and Morrison, 2017, p. 43) would be able to take place, and if findings were consistent, this could also strengthen the validity. In addition, it is hoped that an initial quantitative strand could inform 'purposive' (Cohen, Manion and Morrison, 2017, p. 44) sampling for the qualitative strands, as will be detailed in chapter 5.

Chapter 4 – Research proposal

The research title: ‘A mixed methods study exploring lower key stage 2 children's self-concept and risk taking in mathematics,’ was generated from the initial purpose of the research which was to explore how children could be encouraged to challenge themselves in mathematics and become more perseverant and resilient learners. This emerged from encounters with numerous young children during the researcher’s professional practice as a primary teacher and tutor, who reported that they were ‘no good at maths’ or appeared to lack the grit to overcome difficulties. It is acknowledged that in isolation, the findings from this study will have limited generalisability, however it is hoped that they may contribute to a wider body of evidence, inform future pedagogical decisions within the classes studied and allow the researcher to reflect on their own practice.

Through reading around the topic, the researcher was able to group the characteristics of ‘grit’ (perseverance and resilience), with the setting of goals and other positive learning behaviours into the term SRL. Mindset, identity, self-concept, and self-efficacy all then emerged as important influences on SRL and were found by several studies including Alderton and Gifford (2018); Aunola, Leskinen and Nurmi (2006); and Rattan, Good and Dweck (2012) to be influenced by the pedagogical choices of teachers and the classroom ethos that was promoted. This was further suggested in Bourdieu’s notion of habitus (2000, cited in Costa and Murphy, 2015) and through Bandura’s idea of triadic reciprocality (1986, cited in Zimmerman, 2000), which helped to provide a conceptual underpinning to the study that resonated with the researcher’s philosophical beliefs. The work of Boaler (2005; 2013) also provided thought provoking perspectives that shaped this topic. Pedagogy and the agency that enables or constrains it therefore became a clear topic to review, particularly given its practical application to engender positive future changes.

In considering this topic, the researcher generated two key research questions.

RQ1: ‘How do children in a lower key stage 2 classroom respond when faced with challenging mathematical problems?’
RQ2: ‘What factors impact on children's choices to take risks and persevere with challenging mathematical problems in a lower key stage 2 classroom?’

Although, the main principles of these questions remained constant, a few details have been refined. Initially they referred simply to ‘mathematics’, but this was narrowed to ‘challenging mathematics problems’ to focus the scope of the research and also to provide a different perspective from some of the studies reviewed such as Dowker, Bennet and Smith (2012); Dowker *et al.* (2019); and Kaskens *et al.* (2020) which focussed more on arithmetic. There are conflicting definitions of problem solving, as noted by Schonefeld (1992), but within this paper it is understood to define tasks that require interpretation, reasoning (Francisco and Maher, 2005) and perseverance. Furthermore, the wording of the second research question initially referred to ‘tasks’ rather than ‘problems’ and this was changed to avoid any ambiguity.

The other main adjustment was to the age range. Initially the questions considered the primary years in general, although it was felt early on that there was a gap in the literature for a further British study on KS1 children, particularly incorporating qualitative data. As the review progressed however, the researcher chose to compromise and focus on lower KS2 as while still appearing an under-researched area, it was felt that children of that age may give more considered responses to surveys and interview questions. Furthermore, there is a body of evidence that suggests that self-concept (Thomaes, Brummelman and Sedikides, 2017) and self-esteem (Magro *et al*, 2019) are judged more realistically at this age, and that conceptions of self-efficacy grow more stable (Lau *et al*, 2018).

In the early stages of planning this research, until shortly after TMA01, a third question investigating the impact of a growth mindset intervention had been

considered, influenced by the work of Dweck and Leggett (1988) and Mueller and Dweck (1998). However, it was later decided to omit this question since it was felt by the researcher to better suit a more longitudinal design, focussed more narrowly on mindset as opposed to exploring a range of factors.

A further question considered after the completion of TMA02 was:

> *'To what extent do theories of motivation explain children's self-regulating behaviours as observed and reported in a Lower Key Stage 2 mathematics classroom?'*

This was influenced by the large amount of literature regarding motivation theories that had been encountered during the review such as self-determination theory (Ryan and Deci, 2020) and situated expectancy-value theory (Eccles and Wigfield, 2020). However, it was decided after early feedback to not include this question as it would widen the scope of the research too much. Through its omission, a greater opportunity was available to consider the role of pedagogy on SRL, thus potentially providing more practical outcomes from this paper.

The nature and wording of the final research questions invite an exploratory design to be constructed for the research and whilst they could feasibly be answered using only quantitative data through the testing of hypotheses, the researcher was initially more drawn to an interpretivist paradigm in support of their epistemological beliefs about the socially constructed nature of knowledge. After extensive reading and consideration, it was decided to adopt a pragmatic position and use a mixed methods approach to combine the benefits of both and provide a more robust set of findings.

Chapter 5 – Research design, research methods and methods of analysis

5.1 Research design

As discussed in chapter 3, a pragmatic, mixed methods approach will be taken for this study to provide breadth and depth to findings and reflect the 'changing and integrated nature of the world,' (Cohen, Manion and Morrison, 2017, p. 49). A multi-phase approach is proposed, using an explanatory, sequential design (Cresswell and Clark, 2011, cited in Cohen, Manion and Morrison, 2017) to fully explore the research questions.

5.2 Research methods, sampling and ethics.

In the initial phase, quantitative data will be collected through a survey in the form of a questionnaire. This will be followed by a qualitative phase where a small number of the children who had been surveyed will be observed as they complete two mathematical problems, using a case study approach. Finally, after a short period of analysis, a second qualitative phase will be conducted using interviews with the case study children to allow reflection on the data collected in the previous phases.

Except for the interviews, the study would be carried out in children's classrooms to increase familiarity and comfort and to reduce anxiety or atypical behaviour from children. Furthermore, the researcher would ensure that they had attended several prior mathematics classes to build up a degree of rapport with the children and become familiar. Through this period of 'habituation' (Cohen, Manion and Morrison, 2017, p.561), observer effects would likely be reduced, and children's trust gained so that they are more likely to share their thoughts during interview (Johnson, Hart and Colwell, 2014). This will also give the researcher a better understanding of normal interaction (Coffey, 1999, cited in Johnson, Hart and Colwell, 2014) which will be

especially important if time has not recently been spent in these classes professionally, as the researcher would then take on a more 'outsider' presence.

Prior to collecting any data, ethical considerations must be addressed covering the areas suggested by Stutchbury and Fox (2009) and in keeping with the ethical appraisal form (Appendix A). Transparency and honesty must be always maintained and all relevant codes of practice such as from British Educational Research Association (BERA, 2018) adhered to. Firstly, after gaining consent from the setting gatekeeper and relevant class teachers (Appendix J), opt-in consent would then be sought from parents or guardians of all children in the year 3 and 4 classes (Appendix I). To encourage maximum participation, consent will be obtained separately for the quantitative and qualitative phases. Assent from the children should then be sought to demonstrate a respect for their voices and participation, and all parties made aware that consent/assent may be subsequently withdrawn. It will be important that assent is re-sought by the researcher at each stage of the study and that non-verbal cues are monitored, such as a child getting distressed, since these may indicate a lack of consent (Skanfors, 2009, cited in Johnson, Hart and Colwell, 2014). To ensure that consent is informed, appropriately worded information would be provided outlining the reasons for the research and the proposed storage and distribution of data, alongside a sufficient opportunity to ask questions (Oates, 2019) (Appendicies F,G, H). It should be ensured that any child without consent is not unfairly disadvantaged and be given an appropriate alternative activity. University templates have been adapted to create consent forms and information letters (The Open University, 2020b).

Confidentiality would be assured, subject to any safeguarding concerns, and children reassured that any comments made would not be misrepresented. Survey responses and subsequent records would be anonymised once case study children were chosen, with children being assigned a random number upon electronic data input. In accordance with the GDPR (EU, 2018) and the Freedom of Information Act (2000), original paper copies would be destroyed, and audio recordings deleted once transcribed or if a participant withdrew. All electronic records would be held securely

on a password protected device and only used for the purposes stated unless additional permission was sought. Once transcribed, participants would have the right to review their individual data if requested.

It is proposed that the study would take place at a point mutually agreed with the class teachers in the spring term once children are settled which would allow time for a pilot study in the autumn term using a different class. The survey would be carried out towards the end of a week, allowing the researcher a few days to analyse the data sufficiently to select case studies, before carrying out observations early the following week during normal lesson times to avoid disruption. Follow up interviews would then be administered as soon as possible, to aid recall.

5.2.1 Phase 1

Two questionnaires (see Appendices B and C) are proposed to collect data regarding children's mindset; effort regulation; mathematical self-concept; and self-efficacy. An initial analysis of the first questionnaire will inform the purposive sampling for the case study method proposed for the qualitative phases, and later analysis of both will aim to model correlations, strengthen validity of findings through 'methodological triangulation' (Cohen, Manion and Morrison, 2017, p. 43) and suggest some generalisations.

The questionnaires would be given to all children for whom consent and assent had been obtained, likely generating a reasonably sized sample. This would allow subsequent descriptive statistical analysis to be conducted which Opie (2004) suggests requires a minimum of around 30 respondents.

Different options were considered for collecting this data. Many of the studies read used data from established surveys where construct validity of the questions had already been tested such as the Academic Self-Regulation Questionnaire (SRQ-A)

or Self-Description Questionnaire I (SDQ-I). However, it was decided that to appropriately address the research questions, and include a measure of mindset, a more tailored approach needed to adopted.

A study by Roney, Rose and McKeown (2019) influenced the structure of this phase since their research aims were similar. However, although this was a UK based study, data was collected from a much larger sample (n=1448) of secondary-aged children. Therefore, adaptations needed to be made to suit the proposed age group and nuances of the research questions.

To measure perceived perseverance and resilience it was decided to use the effort regulation scale from the MSQL (Pintrich and De Groot, 1990). However, the researcher adapted this for KS2 aged children by rewording some of the questions and changing the Likert scale from seven points to five. Maths was also specifically referenced in the statements to elicit what Miele *et al.* (2020, p. 3) termed 'math-specific' as opposed to 'domain-general…self-perceived perseverance'. Data regarding mindset was also collected, using Dweck's three-item growth mindset scale (Dweck, Chiu and Hong,1995), complemented by a further multiple-choice question from Mueller and Dweck (1998). It was felt that this second question may be clearer for a younger child to express their goal orientation and likelihood to take risks and may therefore provide an extra measure of reliability.

Important to the topic of this study and the selection of the case study participants was the inclusion of a question to measure mathematical self-concept using a five-point Likert scale. Whilst it is recognised that using a single question may reduce reliability, and that rating scales rely on differing interpretations of categories (Cohen, Manion and Morrison, 2017), it is proposed that this should still provide an indication, which can later be further interrogated.

Finally, a question regarding self-efficacy (Appendix C) was constructed using the recommendations of Bandura (2006). It is proposed that to be valid, this question would be answered separately in context, after the children had been introduced to each mathematics problem. The wording followed Bandura's advice to use 'can' rather than 'will' (p. 308) to ensure that capability rather than intention was emphasised, and smiley faces were avoided to discourage emotional associations. Furthermore, a ten-step interval scale has been used in accordance with Bandura's thoughts regarding reliability.

In constructing the questionnaires, Opie's (2004) advice has been followed, ensuring an inviting layout, with clear instructions on how to complete each section. Furthermore, it is proposed that this would be read out to all children, with answer methods explained, to avoid any difficulties in accessing the written wording. In doing so, the researcher must be mindful not to create a threatening or pressuring presence (Burton and Bartlett, 2005). A pilot study would further enhance this design and reveal any ambiguities.

5.2 Phase 2

Following a brief, focused period of analysis of the questionnaires, a mixture of purposive and random sampling would then be used to select children to be used as case studies for the second phase. A case study approach would be adopted which, it is hoped, would generate rich descriptions illustrating how abstract ideas such as self-efficacy might be influenced and experienced by selected individuals (Cohen, Manion and Morrison, 2017) leading to 'fuzzy generalisations' (Bassey, 2009, cited in Costley, Elliott, and Gibbs, 2010). Furthermore, it is hoped that this observation would help to capture the 'moment-to-moment changes' discussed by Schunk and DiBenedetto (2020, p. 6) that occur when researching aspects of motivation.

To select the sample for the case study, two lists would be made for each class, with any children for whom consent/assent was not obtained omitted. In discussion with the class teachers, children with a significant cognitive or behavioural special educational need, may also need to be omitted if they cannot access the level of the mathematics task or remain in the classroom. One list would include children who has scored themselves as a 1-3 on mathematical self-concept, and one for scores of 4-5. A child from each class that reported a lower and a higher level of self-concept would then be selected at random and additional children noted, in case of absence or attrition. This use of purposive sampling should allow potential differences to be observed in the reactions of children with different levels of self-concept to challenging mathematical problems and a richer breadth of data to be gained during interview. Concurrently, by including an element of randomness, selection bias on the part of the researcher will be reduced, although some characteristics of the sample, such as gender, may then be less well distributed.

It is proposed that the mathematics lessons to be observed would follow a structure similar to that explored by DeCaro and Rittle-Johnson (2012); Loehr, Fyfe, and Rittle-Johnson (2014); and Sullivan (2016), where children are first given an unseen problem to explore independently before a period of instruction or joint reflection on possible strategies, followed by a consolidation task to apply and practice new learning. This structure was chosen as it appears to draw on Piaget and Bruner's experiential approach of 'discovery learning,' enhanced by subsequent scaffolding which the literature review has suggested may be beneficial in promoting self-concept and SRL. This approach was described in a review on PISA data by the OECD (2014) as the 'use of cognitive-activation strategies,' and was positively associated with 'students' drive,' and perseverance, albeit in consideration of older, internationally based children.

To imitate this structure, the children would be first given an unseen problem, 'Find the difference' (NRich, 2021a) to explore independently following some initial brief instructions. In this problem they would have to use reasoning and perseverance to place numbers 1-6 in a pyramid and would be given prompts for how to extend it,

such as using a different set of consecutive numbers or increasing to a pyramid of ten. A period of joint reflection on possible solutions and strategies would follow this after around thirty minutes. The following day, a second problem ‘Magic V’s’ (NRich, 2021b) would be presented, where children would need to use similar reasoning skills and perseverance to place numbers 1-7 on a V, ensuring each arm made the same total. Once again, prompts for extension would be provided to ensure choices of challenge were made visible. On this occasion, the children would be asked to work with a peer, preferably one whom the class teacher considered a MKO, to explore Vygotsky’s (1978) theory regarding the benefits of socially-constructed learning.

For each mathematical problem, the two selected children from each class would be observed and detailed notes recorded on an observation sheet (Appendix D). To facilitate this, it will be important for the two children to be sat close enough that the researcher can observe both consecutively. It is acknowledged that in observing more than one child some detail may be missed, however it would be time consuming and potentially disruptive to conduct separate observations, and it was felt that the use of audio-visual equipment may be too distracting. The researcher would be noting choices regarding how tasks were approached, the use of resources or prompts, dialogue or help seeking from peers or teachers, SRL behaviours and task avoidant behaviours such as wandering. Observations of body language and non-verbal cues such as yawning, or sighing would also be recorded where possible and the researcher would need to try to remain objective in their recording (Liu and Maitlis, 2010).

Whilst the researcher proposes to assume the role of overt non-participant observer to observe interactions in real time, from an ethical perspective they may need to engage with the children should they become upset when struggling with tasks.

5.3 Phase 3

For the second qualitative phase, semi-structured, in depth interviews would be conducted with the case study children that had been observed. An interview question schedule (Appendix D) has been created which would provide a structure and ensure that key areas were discussed, however it is proposed that the researcher would use this as a guide rather than a script so that data can be co-constructed (Silverman, 2001, cited in Roulston, 2010). As Marvasti and Freie (2017) suggest, this type of interview should allow for flexibility in how questions are phrased and followed up to elicit greater detail according to individual responses.

It is proposed that this interview stage would allow children to explain and elaborate on choices that they made during the tasks and when completing the survey, in addition to potentially revealing other factors relevant to RQ1 that the researcher had not anticipated. This would offer insight into children's beliefs and behaviours and help to mitigate assumptions being made by the researcher (The Open University, 2020). As Hesse-Biber (2010) suggests, this would support the researcher's view of multiple social realities and 'lived experiences', (p. 141) and provide an opportunity to illuminate and understand these.

It will be important to ensure that the children feel comfortable and safe with the researcher and not under pressure to answer should they feel uncomfortable. Ethically, assent should once again be sought and the interview should take place in a 'secure, neutral and comfortable' (Johnson, Hart and Colwell, 2014, p. 37) space at a time that will not disadvantage them. It is proposed that this could be a quiet space in the school library during some individual reading time. If possible, an audio recording of these interviews would be made which would then be transcribed before analysis, enabling a greater flow during the interview and ensuring accuracy. However, if consent is not given for this, then clear field notes should be taken.

The researcher will need to be mindful of the likely power imbalance during the interview and be cautious to display neutral body language and not influence or lead participants (Burton and Bartlett, 2005). A group interview may have helped reduce

this power imbalance; however, it was felt that this may have discouraged some children from talking honestly about potentially sensitive issues (Marvasti and Freie, 2017).

5.4 Data analysis

It is proposed that data analysis would take two main phases: quantitative and qualitative, before being findings are compared to assess whether credible inferences can be drawn through a consistency of findings. This would provide 'methodological triangulation' (Cohen, Manion and Morrison, 2017, p. 43) and strengthen the validity of any conclusions suggested. In terms of generalisations, it must be acknowledged that the choices on the questionnaire are all subjective and will vary across the sample, however it is hoped that this is where the qualitative aspect will reveal 'subtle nuances' (Hesse-Biber, 2010, p. 456).

For the quantitative data, descriptive statistics could first be used. Range and modal scores could be found for effort regulation and self-concept, and fixed or growth mindset could be established. Cross-tabulations or Spearman's rho could then be used to explore associations between these. Since self-efficacy scores are to be collected as ratio data, means and standard deviations can be found, and the Pearson product moment r can be used to investigate correlation between the two measures (preceding each task). It would be hypothesized that children would feel more efficacious about the second task, having had more scaffolding.

For the qualitative data, although a deductive approach could be taken based on the topics from the literature review, it is the opinion of the researcher that an inductive approach will be preferable to reveal patterns (Mills, Durepos and Wiebe, 2010) that might otherwise not have been imagined or may have been excluded due to personal bias or assumptions. However, the researcher should remain mindful of the research questions to guide this analysis. Observation notes and interview

transcripts should be analysed thematically, and data coded, reviewed, and compared. Links should then be explored to the quantitative data.

Postscript – Narrative critical reflection

Writing this dissertation has been an insightful and rewarding journey, both personally and academically. At the outset of the module, I knew that I would be looking to take the EP route due to difficulties in getting access to my setting during Covid, however I did not have a clear topic in mind to research and I found it very difficult to choose. I believe this was because at the time I was working in a supply teaching role, so I found it a challenge to see a direct practical outcome. Consequently, I made it a PDP target to keep a list of potential professional outcomes and actively sought to maintain my motivation through discussion with peers and others(Appendix K). I made lists of topics that interested me and conducted some initial searches and reading for some, including growth mindset and continuous provision in KS1. Whilst both topics were interesting, I felt that growth mindset needed a narrower focus and that I had insufficient professional knowledge of continuous provision to cover this effectively as an EP, especially as there appeared few relevant studies. I also felt that it may not be sufficiently useful in another role. After an initial phonecall with my previous tutor, I decided to focus on risk taking in maths and on reflection, I am happy with this choice, as professionally I have been able to discuss some of the concepts in my new role.

Another option that may have been equally, if not more motivating might have been to further explore the possibility of completing an SSI within my other supply school as I could have discussed with the headteacher what may be beneficial to the school, as well as of interest to me, which may have then given me a clearer direction. However, this would have also presented the problems of disruption due to Covid.

Building on feedback from my previous EMA regarding developing my critical engagement with ideas and synthesizing studies read (Appendix K), I ensured that I read widely around each of the topics chosen and made notes in my OneNote file including key points, limitations, data collection methods used and sample sizes,

before comparing the studies from each group and observing where there were differences or similarities. I was then able to search by key words when writing my chapters and I was pleased with my organisation, which I had been gradually developing over the previous modules. However, the sheer volume of material that I had read meant that I felt somewhat overwhelmed when I came to write chapter 2 and I found it difficult to decide what to include or leave out. As a result, my structure was somewhat confusing, and I had not included sufficient information on pedagogy or supported my work with any of the major theorists such as Piaget. This lack of a clear argument was noted by my tutor in my first section of feedback and whilst it was initially disheartening to feel that it needed a considerable amount of reworking, this gave me the direction that I needed to get back on track and clarify my focus. I looked back at my chapter plan and considered what needed to be covered to keep the chapter balanced and how topics would be supported by chapter 3. Starting to write the next chapter helped to focus both sections as I was able to see a more coherent progression of ideas.

Looking ahead to any future research, I believe it will be important to reflect on the successes and difficulties encountered and ensure that I have formed a clear argument at the outset of writing that supports my research questions.

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Appendix A
E822 Ethical Appraisal Form

Masters: Education, Childhood and Youth

NB: it should be noted that The Open University is unable to offer liability insurance to cover any negative consequences students might encounter when undertaking 'in-person' data collection. It is therefore very important that you follow appropriate research protocols not least in seeking Gatekeepers' permissions to undertake any data collection within your setting and adhere to ethical principles for the safety of yourself and your participants.

Because ethical appraisal should precede data collection, this form should be included with TMA02 for those developing a Small-Scale Investigation and included as part of the submission for the EMA for those submitting an Extended Literature Review and Research Proposal.

Section 1: Project details

a.	Student name	Susannah Burrell	
b.	PI		
c.	Project title	'A mixed methods study exploring lower key stage 2 children's self-concept and risk-taking in mathematics.'	
d.	Supervisor/tutor	Dr Ray Chatwin	
e.	Qualification	Masters in Education	☑
		Masters in Childhood and Youth	☐
f.	MA pathway (where applicable)	Learning and Teaching	

g.	Intended start date for fieldwork	January 2022
h.	Intended end date for fieldwork	January 2022
i.	Country fieldwork will be conducted in *If you are resident in the UK and will be conducting your research abroad please check www.fco.gov.uk for advice on travel.*	England

Fill in section 1 of this document with your personal details and brief information about your research.

For section 2, please assess your research using the following questions and click yes or no as appropriate. If there is any possibility of significant risk please tick yes. Even if your list contains all "no" you should still return your completed checklist so your tutor/supervisor can assess the proposed research.

Section 2: Ethics Assessment		Yes	No
1	Does your proposed research need initial clearance from a 'gatekeeper' (e.g. Local Authority, head teacher, college head, nursery/playgroup manager)? Yes, headteacher.	☐ √	☐
2	Have you checked whether the organisation requires you to undertake a 'police check' or appropriate level of 'disclosure' before carrying out your research?[1] Yes, a DBS which is held by the researcher.	☐ √	☐
3	Have you indicated how informed consent will be obtained from your participants (including children less than 16 years old, school pupils and immediate family members)? Your consent letters/forms must inform participants that they have the right to withdraw from the study at any time.[2] Yes. Information letters will be sent out to parents/guardians and children explaining the aims of the study and their right to withdraw at any time. Consent will then be obtained from parents/guardians and assent will be sought from the children at each stage of the study. The headteacher will also complete a gatekeeper consent form for teachers of the school to be involved and the class teachers will complete a consent form for observations to be carried out in their classes.	☐ √	☐

[1] You must agree to comply with any ethical codes of practice or legal requirements that maybe in place within the organisation or country (e.g. educational institution, social care setting or other workplace) in which your research will take place. If required an appropriate level of disclosure ('police check') can obtained from the Disclosure and Barring Service (England and Wales), Disclosure Scotland, AccessNI (Northern Ireland), Criminal Records Office (Republic of Ireland), etc.

[2] This should normally involve the use of an information sheet about the research and what participation will involve, and a signed consent form. You must allow sufficient time for potential participants to consider their decision between the giving of the information sheet and the gaining of consent. No research should be conducted without the opt-in informed consent of participants or their caregivers. In the case of children (individuals under 16 years of age) no research should be conducted without a specified means of gaining their informed consent (or, in the case of young children, their assent) and the consent of their parents, caregivers, or guardians. This is particularly important if your project involves participants who are particularly vulnerable or unable to give informed consent (e.g. children under 16 years, people with learning disabilities, or emotional problems, people with difficulty in understanding or communication, people with identified health problems). There is additional guidance on informed consent on the Masters: Education and Childhood and Youth website under Project Resources.

4	Will your proposed research design mean that it will be necessary for participants to take part in the study without their knowledge/consent at the time (e.g. covert observation of people in nonpublic places)? If so have you specified appropriate debriefing procedures? [3] No	☐	☐ √
5	Does your proposed design involve repetitive observation of participants, (i.e. more than twice over a period of more than 2-3 weeks)? Is this necessary? If it is, have you made appropriate provision for participants to renew consent or withdraw from the study half-way through? [4] No	☐	☐ √
6	Are you proposing to collect video and/or audio data? If so, have you indicated how you will protect participants' anonymity and confidentiality and how you will store the data? Audio data is proposed to be collected during interviews. The recordings will be stored on a password protected device, and once transcribed, they will be deleted. If participants withdraw their data will be permanently deleted immediately. Anonymity will be protected at all stages of research and participants will be given pseudonyms	☐	☐ √
7	Does your proposal indicate how you will give your participants the opportunity to access the outcomes of your research (including audio/visual materials) after they have provided data? Once transcribed, participants will be given the opportunity to listen to a reading of the transcription and note any disagreements if wished. Observation notes will also be made available to review upon request, but only for their individual data. The final report will be made available to the setting.	☐	☐ √
8	Have you built in time for a pilot study to make sure that any task materials you propose to use are age appropriate and that they are unlikely to cause offence to any of your participants? Yes, a small pilot study could be carried out in the autumn term with children from the year 5 class or from a LKS2 class at an alternative school.	☐	☐ √
9	Is your research likely to involve discussion of sensitive topics (e.g. adult/child relationships, peer relationships, discussions about personal teaching styles, ability levels of individual children and/or adults)? What safeguards have you put in place to protect participants' confidentiality? The research may prompt discussion about ability levels or emotions of children. Interviews will take place on a 1:1 basis so children do not have to share sensitive information in front of their peers. All questionnaires will also be kept confidential. Children's levels of self-concept will not be shared with others when case study participants are chosen.	☐ √	☐
10	Does your proposed research raise any issues of personal safety for yourself or other persons involved in the project? Do you need to carry out a 'risk analysis' and/or discuss this with teachers, parents and other adults involved in the research? No	☐	☐ √
11	Will financial inducements (other than reasonable expenses and compensation for time) be offered to participants? No	☐	☐ √
12	Will the study involve recruitment of patients or staff through the NHS or the use of NHS data? No	☐	☐ √

If you answered 'yes' to questions **12**, you will also have to submit an application to an appropriate National Research Ethics Service ethics committee (http://www.nres.npsa.nhs.uk/).

[3] Where an essential element of the research design would be compromised by full disclosure to participants, the withholding of information should be specified in the project proposal and explicit procedures stated to obviate any potential harm arising from such withholding. Deception or covert collection of data should only take place where it has been agreed with a named responsible person in the organisation and it is essential to achieve the research results required, where the research objective has strong scientific merit and where there is an appropriate risk management and harm alleviation strategy.

[4] Where participants are involved in longer-term data collection, the use of procedures for the renewal of consent at appropriate times should be considered.

Appendix B –Questionnaire

Name: **Class:**

A) For each statement, tick the column that best shows how much you agree.

						
	1 Strongly agree	2 Agree	3 Mostly Agree	4 Mostly disagree	5 Disagree	6 Strongly Disagree
You have a certain amount of intelligence, and you really can't do much to change it.						
Your intelligence is something about you that you can't change very much.						
You can learn new things, but you can't really change your basic intelligence.						

Dweck, C. S., Chiu, C. and Hong, Y. (1995, p. 269)

B) Which of these types of problems would you like to do? (Tick ONE)

Problems that aren't too hard, so I don't get many wrong.	
Problems that are pretty easy, so I'll do well.	
Problems that I'm pretty good at, so I can show that I'm smart.	
Problems that I'll learn a lot from, even if I won't look so smart.	

Mueller and Dweck, (1998, p. 35)

C) Use the scale below to show how true you feel each statement is for you.

	Not true at all true		**Sometimes true**		**Very**
	1	2	3	4	5
I work hard to do well in maths even if I don't like what we are doing.					
I often feel so lazy or bored in maths that I give up before I finish.					
When the maths work is difficult, I give up or only do the easy parts.					
Even if I find the maths task boring, I manage to keep working until I finish.					

Adapted from MSLQ (Duncan *et al.* 2015, p. 27)

D) How much do you agree with this statement?

					
	1 Strongly agree	2 Agree	3 Mostly Agree	5 Disagree	6 Strongly Disagree
I am good at maths					

Thank you very much for completing this questionnaire.

Appendix C – Self-efficacy questions

Name: **Class:**

A) Please rate your level of confidence in solving this maths problem today:

I cannot do this at all. 		Quite sure I can.							Very sure that I can. 	
0	1	2	3	4	5	6	7	8	9	10

Name: **Class:**

B) Please rate your level of confidence in solving this maths problem today:

I cannot do this at all. 		Quite sure I can.							Very sure that I can. 	
0	1	2	3	4	5	6	7	8	9	10

Appendix D – Observation record

Child A	(mins)	Child B
	0	
	5	
	10	
	15	
	20	
	25	
	30	
	35	

Child C	(mins)	Child D
	0	
	5	
	10	
	15	
	20	
	25	
	30	
	35	

Appendix E - Interview question schedule

(Greeting, share aims of the interview, and confirm assent)

1. Last week when you completed the questionnaire you said you _____ when thinking about the statement 'I am good at maths'. Can you explain why you think this? (use survey as prompt)

2. In your classroom, what do you think is most important: that you try hard in maths, or get that you get answers correct? What makes you think that? Probe response to mindset question B (Appendix A) on survey. (use survey as prompt)

Moving on to thinking about the two maths problems that you worked on in class… (show visual prompts)

3. Why did you give yourself a _____ when you considered how confident you felt about solving the first maths problem? (use task and survey as prompts)

4. Did you find the first task tricky in places? (use task as prompt)
   If no… Did you decide to make it harder? Why/why not?
   *If yes…*How did you feel when you got to a tricky bit? What did you do?

5. Why did you give yourself a _____ when you considered how confident you felt about solving the maths problem on the second day? (use task and survey as prompts)

6. Did you find task 2 easier or harder? Why? What did you do when you got to a trickier bit this time? (use task as prompt)

Thinking about problem solving in maths in general…

7. Do you prefer to work on your own, or with others? Why?

8. What things do you find helpful to get started or when you get stuck?

(Thank participant for their time.)

Appendix F - Letter to setting gatekeepers

Dear [enter name]

I have been studying on the Masters module 'E822: The Multidisciplinary Masters Dissertation: Education, Childhood and Youth' at the Open University in the Faculty of Wellbeing, Education, Language and Sport. As part of my studies, I have planned a Small-Scale Investigation and I would like to request whether I could carry this out in your setting. This would involve data collection using interviews, observation, and questionnaires and I can provide and discuss further details about these methods.

Information collected from all participants will be kept confidential, de-identified to remove identifying features of individuals and the setting, and stored securely on password protected devices. Original notes and digital files will then be destroyed. I confirm that no information leading to the identification of your setting or the individual participants will be included in my report or in any related publications. If there is a disclosure of a safeguarding nature during data collection, then, as will have been explained to the participants in advance of data collection, this will be immediately passed to the setting Designated Safeguarding Officer. Please could you confirm how best to contact them.

Your setting's and participants' involvements are voluntary. You can withdraw permission for the study to take place until a week after data has been collected. Your colleagues and children/young people in the setting who are invited to provide data as participants can also withdraw their consent and request destruction of data collected up to a week after each form of data collection has taken place. I will respect these wishes. In this situation, assuming there is time, I would like your support in contacting alternative participants to collect sufficient data for my research.

The University have produced a Dissertation Ethical Agreement Form which I submitted with my dissertation. If you are happy for me to develop a study on the basis outlined above, I would like to discuss this with you to further explain my plans. This would allow me to explain more about my studies and these requests, including the timeline and processes and protocols for ethical research in this setting. Please suggest a suitable date and time or guide me to the most appropriate person to consider these requests.

Yours sincerely

Susannah Burrell

Consent form for gatekeepers

Please indicate YES or NO for each of the questions below and then return the form to Mrs. S. Burrell via the school office

Thank you for your help.

Have you read the information about the study?	YES	NO
Have the nature and aims of this study been explained to you?	YES	NO
Do you understand what this study will involve?	YES	NO
Do you understand how data will be collected from the observation?	YES	NO
Are you happy with how data will be stored?	YES	NO
Have you asked all the questions you want?	YES	NO
Have you had your questions sufficiently answered?	YES	NO
Do you understand that you can withdraw your consent up to a week after all data has been collected?	YES	NO
Are you happy for your setting to take part in the study?	YES	NO

If any answers are 'no' feel free to ask for further information. However, if you **don't** want to take part, please just let the researcher know (as soon as practical) and **don't** sign your name.

If you consent to allow the setting to participate, please write your name and today's date. You can withdraw consent up until the week after all data collection by letting me know.

Your name _____

Date _____

The researcher to sign below:

Print name _____

Sign _____

Date _____

Appendix G - Information Letter for participants and parents/carers/guardians

I, Susannah Burrell would like your child to complete a short questionnaire during part of a maths lesson in their classroom on 20/1/22. I will then choose a small number of children to observe and interview as part of the second stage of my study. I would like the opportunity to observe your child in an activity led by [add activity leader's name] in their classroom on 23/1/22 and 24/1/22. I would then like to follow this up with an interview in the school library on 30/1/22. I have been studying for a Masters in Education with the Open University, and this research was planned during my studies.

What is the aim and focus of this study?

The aim of the study is to gain a perspective on the activities taking place in [add name of setting]. This is to focus on an aspect of education, childhood and youth studies as part of a small-scale investigation for a Masters qualification. The investigation is designed to contribute to knowledge and practice in my chosen area of specialism and the data collected is designed to help answer the questions: 'How do children respond when faced with challenging mathematical problems?' and 'What factors impact on children's choices to take risks and persevere with challenging mathematical tasks?'

Who is conducting the research and who is it for?

This interview follows my studies on the Open University Masters module E822 'Multi-disciplinary dissertation: Education, Childhood and Youth'. On this module I had an opportunity to design a small-scale investigation which will generate findings relevant to and of value to practice settings.

Why am I being invited to participate in this research?

Your child has been invited because they are part of the class that has been selected to take part in the study. Outline permission has been granted from senior leadership [include name of who signed the Dissertation Ethical Agreement Form] and the adult leading the activity to be observed.

If I take part in this research, what will be involved?

The questionnaire will be read out to the whole class and will only take 5-10 minutes to complete. After this, the researcher will group the responses and randomly select a small number of children, who have permission, to observe and interview as part of the second stage.

The observations will last for approximately 30-40 minutes and the time and place indicated above is one which has been negotiated as convenient to those in the setting. I will be sitting at the side of the space and will take notes about children's responses to the activities. For those involved it will not change the activity. The interviews will last around 20 minutes and will take place in the school library. The children will be asked to talk a little more about their responses to the questionnaire and share their thoughts about problem solving in maths. I would like to ask your consent to make an audio recording of our discussion so that I can refer back to what was said more accurately than would be possible just from my notes. If you do not wish to be audio

recorded, I will accept your wish, and rely only on my written notes. Only I will have access to the audio recording.

If you are reading this as a parent/carer/guardian, please explain this information to your child. A consent/assent form has been provided, and I ask that if participants (and parent/carers/guardians) are happy to be included in the study, to complete and return by 16/1/22. This will allow the activity leader and I to accommodate your wishes should you not want to participate in any part. It is possible to give consent only to the questionnaire stage if you/your child wishes. Audio recording will only take place during interviews and this can be changed to written notes if you prefer.

Will the data collected at the observation remain confidential?

Your participation will be treated in **strict confidence** in accordance with the Data Protection Act (2018). No personal information will be shared with anyone else. However, if you let me know anything during your interview which I consider means that you might be unsafe or have been involved in a criminal act, because this is a safeguarding concern, I will need to pass this information immediately to the organisation's Designated Safeguarding Officer.

I will type up questionnaires and my observation schedule notes and transcribe any recordings as soon as practical in a way in which all identifiable features will be removed. The original handwritten notes (and any audio record) will be destroyed, and the anonymised digital files stored on password protected devices. I plan to present my findings to relevant audiences, but I can confirm that neither you as an individual nor the setting will be identifiable in any of these reports and presentations.

What happens now?

If you require more information about this study, please contact me on sburrell@hotmail.co.uk by 15.1.22.

After reading this information sheet, please review and decide whether you want to complete and return the consent/assent form. Your or your child/young person's participation is entirely voluntary. You will have the opportunity to withdraw completely for up to a week after the study and, in this case, all data collected would be destroyed.

Appendix H - Information letter for teachers regarding observations

What is the aim of this observation?

I, Susannah Burrell would like to observe two children during maths lessons that you are leading, based on a lesson format that we would discuss in advance. I would like to ask whether this was possible and, if so, to negotiate a convenient place, date and time. I am studying for a Masters in Education with the Open University, and this observation is part of the design of my dissertation. My project is investigating the topic of self-concept and risk taking in maths.

Who is conducting the research and who is it for?

This observation is part of my studies on the Open University Masters module E822 'Multi-disciplinary dissertation: Education, Childhood and Youth'. On this module I have an opportunity to design a small-scale investigation which will generate findings relevant to and of value to practice settings. Outline permission has been granted from [include specific name or title of the Setting Gatekeeper].

Why am I being invited to participate in this research?

You have been identified as someone who might be prepared to allow your practice and practice setting to be observed to increase understanding about this topic.

If I take part in this research, what will be involved?

The observations would last around 30-40 mins each in a place and date which we will negotiate as the most convenient. I will share with you information about how I hoped that data might be collected through an observation schedule and an information sheet will be shared with those who will be present for the observed activity and their parent/carers/guardians. Those who have queries or concerns will be asked to contact me so that we might consider whether the observation should continue or not. We will need to agree a return date for any such responses, which will allow us to discuss how the wishes of these children and their parents/carers are best responded to.

What will the focus of the observation be?

The focus of the observation will be to find out about how children respond to challenging mathematical problems.

Will the data collected at the observation remain confidential?

Your participation will be treated in **strict confidence** in accordance with the Data Protection Act (2018). No personal information will be shared with anyone else. I will type up my observation schedule notes as soon as practical in a way in which all identifiable features will be removed. Any original handwritten notes will be destroyed after anonymised records are created and the anonymised digital files stored on password protected devices. I plan to present my findings to relevant audiences after analysis is complete. Neither you as an

individual, those observed or the setting will be identifiable in these reports and presentations.

What happens now?

After reading this information sheet, please review and complete the consent form. Your participation is entirely voluntary. You can withdraw, even after having given initial consent, up until a week after the observation and data collected during the observation will be destroyed in this case.

What if I have other questions?

If you have any other questions about the study, I would be very happy to answer them. Please contact me.

Appendix I - Research project consent and assent form

(to be completed by all participants and parent/carer/guardians)

Dear Parents/Carers/Guardians,

Please could you read these questions with your children and, if necessary, complete the replies for them.

Please indicate YES or NO for each of the questions below and return the completed form by 17/1/22 to Mrs. S. Burrell via the school office.

Have you read (or had read to you) the information about this project?	YES	NO
Has someone explained each stage to you?	YES	NO
Do you understand what this project is about?	YES	NO
Have you asked all the questions you want?	YES	NO
Have you had your questions answered in a way you understand?	YES	NO
Do you understand it is OK to stop taking part at any time?	YES	NO
Are you happy with how your data will be stored?	YES	NO
Do you understand that your and any other real names as well as any identifiable information will be removed from what will be shared?	YES	NO
Are you happy to complete the questionnaire?	YES	NO
Are you happy to be observed in the classroom and interviewed?	YES	NO
Are you happy for the interview to be audio recorded?	YES	NO

If any answers are 'no' you can ask more questions. But if you **don't** want to take part at all, please let me know and **don't** sign your name.

Please choose **ONE** of the following options:

a) If you **do** want to take part in all stages of the study, please write your name and today's date

Your name _____

Date _____

b) If you **do** want to complete the questionnaire but **NOT** be observed or interviewed, please write your name and today's date here

Your name _____

Date _____

Parents/carers/ guardians:

If you are happy for the child or young person you are responsible for (as their parent, carer or guardian) to participate, please could you also sign and date below.

I give permission for my child to *participate in all stages of the study/ to complete the questionnaire only. (*Please delete as appropriate)

Print name _____

Sign _____

Date _____

Return form to Mrs S. Burrell via the school office

Thank you for your help.

Appendix J - Observation consent form for teachers

Please indicate YES or NO for each of the questions below and then return the form to Mrs. S. Burrell via the school office

Thank you for your help.

Have you read the information about the planned observation?	YES	NO
Has the nature and aims of this observation been explained to you?	YES	NO
Do you understand what this observation will involve?	YES	NO
Do you understand how data will be collected from the observation?	YES	NO
Are you happy with how your data will be stored?	YES	NO
Have you asked all the questions you want?	YES	NO
Have you had your questions sufficiently answered?	YES	NO
Do you understand that you can withdraw your consent up to a week after the observation?	YES	NO
Are you happy to take part in the observation?	YES	NO

If any answers are 'no' feel free to ask for further information. However, if you **don't** want to take part, please just let the researcher know (as soon as practical) and **don't** sign your name.

If you consent to participate, please write your name and today's date. You can withdraw consent up until the week after the observation by letting me know.

Your name _____

Date _____

The researcher who will conduct the observation, to sign below:

Print name _____

Sign _____

Date _____

Appendix K - EMA reflection evidence grid

Category	Feedback received, targets achieved, and areas of development worked on	How did this shape my dissertation?
Knowledge and understanding:	1. **Feedback from previous EMA:** 'To begin your literature review by identifying and justifying the choice of themes to be considered, indicating how they can be linked to your topic and to each other.' 2. **Feedback from TMA02:** To make an explicit reference to the research paradigm that supports mixed methods. 3. **Feedback from draft submission:** To demonstrate knowledge of relevant seminal theorists and how they relate to the argument.	1. I made mind maps in my learning journal to consider how different themes could link to the topic and each other and explored literature from previous modules before searching the library database. I used these to structure my literature review and tried to make these explicit and clear. 2. I used the module materials as a starting point to research mixed methods in more detail before exploring pragmatism as a relevant paradigm and citing some relevant work including Dewey. 3. I redrafted some of Chapter 2 to ensure that Piaget, Bruner and Vygotsky helped to shape the section on pedagogy and developed the argument with Vygotsky in Chapter 3
Critical analysis and evaluation:	1. **Feedback from previous EMA:** 'Develop critical engagement with ideas further, building on the emerging contestation and comparison of ideas undertaken.' 2. **Feedback from draft submission 1:** To develop a clear argument through the chapter.	1. I read widely around each of the topics and collated a number of different studies and conceptual papers. I made notes about key points and where studies agreed or disagreed and tried to synthesise these in my literature review. 2. I reviewed my chapter plan and used the tutor feedback to try to focus my arguments such as the importance of the socio-cultural conception of learning. I scaled back some of the different theories of motivation so as not to conflate theories or confuse the direction.
Links to professional practice:	1. **PDP Target:** To consider how this research will benefit me professionally and how to stay motivated whilst doing an EP.	1. I considered research that I felt would be transferrable to other contexts and age groups so that the topic would remain valuable to me. I spoke to other peers in my tutor group about the dissertation which helped with motivation and in organising thoughts and with other teachers in my supply school and in my new role.

Structure, communication and presentation:	1. **Feedback from previous EMA:** To use more signposting, making explicit how the sections link together. 2. **PDP Target:** To learn new referencing system (Cite it Right)	1. I made a chapter plan in advance and referred to it each time. I also reread my work regularly and ensured that I added in signposts back to previous chapters or introducing what was to be included. 2. I spent time looking at the Cite it Right website and made important notes of changes in my journal e.g. only 4+ authors now change to *et al.* I recorded references carefully in my notes before creating a spreadsheet. Feedback from my TMAs was positive, so I continued checking carefully.