Routledge
Taylor & Francis Group

Journal of Research in Childhood Education

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/ujrc20

A Pilot Math Anxiety Storybook Approach to Normalize Math Talk in Children and to Support Emotion Regulation

Dominic Petronzi, Gail Schalkwyk & Rebecca Petronzi

To cite this article: Dominic Petronzi, Gail Schalkwyk & Rebecca Petronzi (2023): A Pilot Math Anxiety Storybook Approach to Normalize Math Talk in Children and to Support Emotion Regulation, Journal of Research in Childhood Education, DOI: 10.1080/02568543.2023.2214591

To link to this article: https://doi.org/10.1080/02568543.2023.2214591

Published online: 28 Jun 2023.

JOURNAL OF RESEARCH IN CHILDHOOD EDUCATION
https://doi.org/10.1080/02568543.2023.2214591

A Pilot Math Anxiety Storybook Approach to Normalize Math Talk in Children and to Support Emotion Regulation

Dominic Petronzi [a], Gail Schalkwyk[b], and Rebecca Petronzi [a]

[a]University of Derby, Derby, England; [b]Northumberland Inclusive Education Services, Northumberland, England

ABSTRACT

Research and education stakeholders in the United Kingdom (UK) acknowledge math anxiety as a detriment to learning math and associated with performance deficits, avoidance, and limiting career opportunities. Support approaches and strategies have typically focused on instruction and emotion regulation, but not necessarily in younger children using a more sustainable resource, such as a targeted storybook approach. Therefore, in this qualitative study, children age 6–7 years ($N = 15$) across two UK primary schools took part in 1:1 discussion surrounding engagement with a math anxiety storybook approach. Following reflexive thematic analysis, three global themes were identified: [A] Math Application: (1) counting and (2) mathematical language; [B] Strategies: (1) social learning and (2) resilience and self-regulation; and [C] Emotive Responses: (1) perceptions of self and math and (2) success and happiness. Overall, our findings suggest that children successfully engaged with a storybook approach – with integrated math problems – that normalized math talk in a non-judgment-based environment and led to more positive perspectives of math and more resilient approaches and solutions. We discuss these findings in relation to developing emotion regulation using a sustainable and flexible resource.

ARTICLE HISTORY
Received 26 October 2022
Accepted 21 April 2023

KEYWORDS
Emotion regulation; math anxiety; math education; storybook; strategies

Mathematics anxiety (MA) is a pervasive global issue (Dowker et al., 2016; Luttenberger et al., 2018) and labeled a performance-based anxiety in view of empirically supported negative correlations with mathematics attainment (Ashcraft & Moore, 2009). Recent work in this area has identified a neural threat response to math stimuli – reflecting pain and fear – when highly math anxious individuals (HMIs) are simply presented with a math problem (Pizzie & Kraemer, 2017) or merely numbers (Batashvili et al., 2020). As an emotional problem, MA places the individual in a cognitively passive state (Luo et al., 2009) and particularly impacts those whose ability is already poor (Witt, 2012), including those with dyscalculia – an important but less prioritized area in learning math (Kunwar, 2021).

Comprehension and application of mathematical concepts is a key part of education and may define the career opportunities available to an individual (Ashcraft, 2002; Rahim & Koeslag, 2005). Indeed, MA is negatively related to wanting to pursue future study or work involving math (Ahmed, 2018) and can therefore steer pupils away from certain careers and opportunities. Indeed, OFSTED (2021) considers a lack of success in the subject as contributing to the development of MA and reflects the deficit theory (Carey et al., 2016). Despite this being a pertinent issue, MA research has implicated several influential factors (e.g., Petronzi et al., 2017) and more recently (within an educational context) has concerned practitioners' own worries and contempt for math (Foley et al., 2017) and student

CONTACT Dominic Petronzi d.petronzi@derby.ac.uk University of Derby, Kedleston Road, Derby DE22 1GB

perceptions of educator competency as a key predictor of student mathematics confidence (Lau et al., 2022). There continues to be widespread underachievement in mathematics, linked to MA and avoidance (Organisation for Economic Co-operation and Development [OECD], 2013), and a "wide" attainment gap exists between the lowest and highest achievers and disadvantaged and advantaged students (OFSTED, 2021). Indeed, there is an emerging trend toward examining interventions to address MA in younger populations (see Petronzi et al., 2021 for a review).

Research implicates the significance of early classroom experiences and their contribution to negative math attitudes for some pupils (e.g., Rubinsten et al., 2018). Paying closer attention to the MA of younger children, "teachers can influence pupils' resilience and beliefs about their ability to succeed, by ensuring all pupils have the opportunity to experience meaningful success" (Department for Education, 2019, p. 26). To address this, many schools, for example, avoid dismissive feedback by adapting their marking policies to influence a growth mind-set (Dweck, 2008), place more focus on time to discuss and reflect with a teacher (Elliott et al., 2016), and implement an active, accurate, and ongoing assessment to inform daily adaptations, including interventions (such as exploration-based games; Jeffrey, 2019) that provide access to learning rather than "catch-up" and deepens conceptual understanding. Adding to this, the Education Endowment Foundation (Clark et al., 2021) advise the use of, for example, storybooks (as implemented in the current research) and games to promote mathematical exploration of key concepts that may "transform pupils' … beliefs about learning" (Department for Education, 2019, p. 17). Given our understanding of the cognitive implications of experiencing math anxiety (limited working, e.g., attentional resources and tracking information; Carey et al., 2016), emotional implications (Justicia-Galiano et al., 2016; Luo et al., 2009; Young et al., 2012), and bi-directional relationship between anxiety and performance that can lead to an affective drop in performance (Ashcraft & Moore, 2009), it is proposed that prior to implementation of math instruction approaches, emotion regulation must be accounted for first in order for a child to be ready to learn.

Strategies designed to encourage emotion regulation have been successful in reducing math anxiety in older children or adults (e.g., expressive writing (Park et al., 2014) and focused breathing (Brunyé et al., 2013)). However, little work has been conducted with younger children in a bid to tackle MA, despite research showing that MA can be prominent in children as young as 4 years old (Petronzi et al., 2017, 2019). As such, this study proposed a child-friendly storybook approach to promoting children's reflection on math experiences and normalizing math talk for the purpose of identifying emotional responses identified with math anxiety. This strategy follows similar principles of reflection, for example, bibliotherapy (Wilson, 2009) that provide a framework for discussion, emotional responses, and a change in feelings toward a specific threat. More recently, Buckley (2020) detailed the importance of picture books to engage in follow-up discussions and activities with students to focus on the experiences of the characters and to link these to their own emotions. This aligns with principles of metacognition to limit, for example, self-imposed lower attainment goals in math, lower confidence, avoidance, and a reluctance to trial different approaches.

The current research aimed to trial a storybook approach to normalize math talk and qualitatively analyze feedback from children age 6–7 years (UK, Year 2) regarding their math feelings and reflections during and following engagement with this resource.

Method

Design

The research aligned with interpretivism, and therefore applied a qualitative methodology, with core characteristics including giving participants an opportunity to express themselves and their experiences (Burton & Bartlett, 2009) with a wider aim of directing future MA approaches and understanding individual perceptions of the world (Streubert & Carpenter, 2007). Participants' perspectives were obtained through one-to-one readings of a children's storybook, during which reflective

questions were asked, and therefore most closely aligns with semi-structured interviews. This data collection method allows the researcher to follow a schedule of questions to encourage elaborated responses and explore novel perspectives, being led by the participants' experiences, perspectives, and attitudes (Cridland et al., 2014).

The research used reflexive thematic analysis (RTA) as the analytical method, in accordance with the guidelines of Braun and Clarke (2006, 2019), which they describe as "patterns of shared meaning underpinned or united by a core concept" (Braun & Clarke, 2019, p. 593). They also note that themes should not be regarded as waiting to be identified and that they are instead dependent on theoretical assumptions, the data, and the skill of the researcher. Braun and Clarke (2019) emphasize that these are not rigid or linear stages, meaning that a researcher may need to, for example, move back to other stages if the analytic process requires this. Moreover, they reiterate the importance of reflection and engagement with the data. Indeed, the "process" requires thoughtful engagement with the data and the analytic process and this was adhered to as part of the current data analysis. Given the pilot study approach of this project, RTA was chosen to support the identification of broader patterns as the foundation for subsequent inquiry and led to pertinent themes of how children felt about math, their reflections, and actions when engaging with the storybook.

RTA was complimented by an inductive approach that allowed data to naturally inform, rather than imposing preconceived categories or frameworks (Moretti et al., 2011) given that targeted MA storybooks have not widely been tested.

Finally, a phenomenological epistemology was most suitable for the aims, data collection method, and focus of the research, and allowed for understanding and interpretation of children's lived experiences and personal perspectives, attitudes, and reflections surrounding math (Paley, 2017; Smith et al., 2009) and to develop meaning.

Participants

The research employed a purposive sampling technique and volunteer sampling for one-to-one discussions with children ($N = 15$; 8 females & 7 males), as this was dependent on parents providing consent for their child. Sample demographics included children (fluent in English and age 6–7 years; Year 2) from two different primary schools located in Northumberland (England) and was inclusive of non-special educational needs (SEN) children and children already diagnosed with dyscalculia and/or dyslexia who were previously and currently working with a specialist SEN math teacher (see Table 1 for further participant information) and a trusting and supportive rapport had been established.

Table 1. Participant details pertaining to SEN status, attainment level, and CMAS-UK scores.

Participant	SEN Dyslexia/ Dyscalculia	Gender	Attainment Level (Working at)	CMAS-UK Score & (Mean; 1 = lower anxiety; 3 = higher anxiety)
School 1				
1	No	Male	Greater Depth	19 (1)
2	No	Male	Expected Level	30 (1.58)
3	No	Female	Expected Level	35 (1.84)
4	No	Male	Greater Depth	23 (1.21)
5	No	Female	Expected Level	38 (2)
6	No	Male	Expected Level	24 (1.26)
12	No	Female	Expected Level	28 (1.47)
13	Yes	Male	Not Expected Level	39 (2.05)
School 2				
7	No	Female	Expected Level	34 (1.79)
8	No	Female	Expected Level	38 (2)
9	No	Male	Not Expected Level	39 (2.05)
10	No	Male	Expected Level	34 (1.79)
11	No	Female	Expected Level	44 (2.32)
14	No	Female	Greater Depth	30 (1.58)
15	No	Female	Expected Level	33 (1.74)

Materials

The storybook

The MA storybook (20 pages in length, illustrated pages & written in rhyming verse) belongs to a wider series of research-informed children's books ('Whoopsie Doodle Little Noodle) and is a self-published series (Amazon Kindle Direct Publishing) of which the author has full ownership. The book aims to normalize math talk and promote more positive attitudes. As our previous qualitative and scale development work (Petronzi et al., 2017; 2019) included children age 4–7 years (and the findings have been incorporated into this), the book is targeted at the early years of formal education to promote a positive trajectory. This book aims to address math conceptually and acknowledge key components of MA, such as self-efficacy, math resilience, the value of math, and building intrinsic motivation. In addressing these, known issues such as the no-attempt error (Chinn, 2012) and avoidance may be reduced and encourage children to persevere. The storybook is based on the learnings of the protagonist (Noodle) who demonstrates worry about math when she encounters three math-based situations at home (problem #1 is based on counting, addition, and division; problem #2 is based on counting and fractions; and problem #3 is based on counting, addition, and division) and, with the support of her family, learns methods for approaching math problems and begins to demonstrate more positive attitudes as she grows in confidence. As the storybook is already based on math issues, this can limit hesitation in children.

During its development and feedback-gathering stage, the storybook was reviewed by teachers, SEN teachers, children, and parents across several schools for appropriateness. Generally, children found the storybook engaging and the nature of the story led to naturally occurring discussion about the character's feelings. This was highlighted as a positive by primary care providers who also emphasized the importance of the images in terms of further encouraging children in maintaining focus and engagement, as well as the consistent positive message surrounding "having a go" at math. Approaching the issue of math anxiety by means of a storybook was also viewed as favorable in terms of starting a discussion about math feelings. In the current research, the storybook was reviewed by the headteachers of the participating schools and the specialist SEN math teacher.

Children's math anxiety scale (CMAS-UK; Petronzi et al., 2019)

The Children's Math Anxiety Scale UK (CMAS-UK) consists of 19-items (see Table 2) that refer to day-to-day numeracy situations that may cause anxiety for children, typically age 4–7 years. The items of the scale are issued on a 1:1 basis for younger children, and groups of five for children age 6–7 years. For each item, children can place a circle around the face that describes how they feel in relation to the situation (happy, score = 1; uncertain, score = 2; sad, score = 3). The responses to the 19 items should be added together to provide a final score for each child (minimum score is 19 and the maximum is 57). To support understanding of an individual's level of MA, a mean score can be created by dividing their total by 19. There are no set labels for representing the mean scores, but a mean close to one indicates little-to-no MA, whereas a mean closer to 3 would indicate a high level of MA. This scale has been shown to reliably measure the MA of children ($\alpha = .87$) with a significant negative correlation with math performance (Petronzi et al., 2019).

Table 2. Example items from the CMAS-UK.

Example Items
Item 3: *If I make a mistake in numeracy, I feel . . .*
Item 7: *When I see lots of numbers, I feel . . .*
Item 10: *Listening to the teacher in my numeracy class makes me feel . . .*
Item 15: *If I don't finish my numeracy work in class, I feel . . .*

Table 3. MA storybook standardized questions and events.

Storybook Questions	Events & Problems to be Solved within the Story
Page 6 How do you think Noodle feels about math? Why do you think she feels like this? Have you ever felt scared about math?	The main character presents as nervous about math.
Page 7 Why does Noodle start to sneak away? Have you ever tried to avoid math before?	The main character presents as nervous about math.
Page 9–11 How do you think Noodle feels now? Why do you think this? What did Leo suggest to help Noodle feel better?	Solving problem #1.
Page 12 How did Noodle feel? Why? What does Noodle think about math?	The main character has helped solve the problem.
Page 16 How does Noodle feel about math now? What has Noodle started to do that has made her feel better?	The main character again presented as nervous about math and then helped to solve problem #2.
Page 17 How is Dad feeling about his math problem? What does Noodle do to help him?	The main character observes someone else feeling nervous about math and then helps to solve the problem #3.
Page 20 What would you tell someone who felt worried about math? Do we think Noodle is scared anymore? Why? What could you do when you feel worried about math?	The child reflects on what has happened in the story.

Standardized question schedule

In this research, children were read the MA storybook on a one-to-one basis with a specialist SEN math teacher. Using a standard question schedule (see Table 3), each child was asked a series of questions (e.g., How do you think Noodle feels about math? Have you ever felt scared about math?) at key points in the story in response to the actions of the protagonist and other characters, to encourage them to reflect on the story and their own feelings and experiences. The questions were created by the researchers (also the authors of the MA storybook) with an understanding of the purpose and design of the story. To increase the validity or "trustworthiness" of the devised questions, the SEN math specialist reviewed them in terms of their appropriateness, relevance, and terminology, and confirmed the validity of the storybook.

Procedure

The study comprised four stages: [1] A math children's book was developed based on key research findings and themes within the area of MA. [2] Upon completion, the book was reviewed by practitioners (and other stakeholders) to ensure age-appropriateness and that it aligns with key issues in math education. [3] Prior to engagement with the math storybook, each child completed the Children's Math Anxiety Scale-UK (CMAS-UK; Petronzi et al., 2019) on a one-to-one basis to obtain an anxiety measure to support the understanding and context of comments and feedback, and attainment level was also provided by the SEN math specialist. [4] Following this (within the same sitting), the SEN math specialist (currently working within the participating schools) read the book to the children on a 1:1 basis and a series of standardized questions were verbally asked during the reading of the storybook to encourage reflection on the story and personal feelings and experiences. Discussions were audio recorded only. Following data collection, the audio recordings were transcribed verbatim and analyzed according to the principles of reflexive thematic analysis.

Table 4. Aggregated coding examples for some of the research questions.

Question	Examples Codes (aggregated for table example)
How do you think Noodle feels about math? Why do you think she feels like this?	Child recognizes different emotions that the character is feeling. Child seems to relate the emotions of the character (e.g., fear and sadness to their own experiences). Child links emotions of the character to known factors of math anxiety (e.g., fear of failure). Child is self-critical but performance is not impacted (working at expected level) but highest anxiety of the group. Anxiety not yet affecting performance?
How do you help yourself to not feel scared?	Child considers the teacher as a support method. Try (& take time) => counters avoidance by not rushing. Child considers breathing techniques (example of self-regulation). Child demonstrates avoidance (e.g., go to bed and watch tablet & pretend it's my favorite thing). Child alludes to the deleterious anxiety model (i.e., worry causes performance deficit). This is perhaps situational worry about math and is supported by the child previously implicating a math quiz.
Have you ever tried to avoid math before?	Avoidance => child states that they have tried to avoid school. Child agrees with learning from our mistakes. Child sees math as a competition and claims to finish first. Child who said no to feeling scared about math (earlier) also says no to having tried to sneak away, showing some consistency of response.
How do you think Noodle feels now? Why do you think this?	Child recognizes changing emotions and can identify reasons for this. Child links being happy to being more secure with math.

Analytical strategy

The analysis process followed the six stipulated stages (Braun & Clarke, 2006, 2019): [1] familiarization with the data and a detailed understanding of the content; [2] production of an initial list of codes; [3] theme generation through refocusing the analysis and sorting codes; [4] theme refinement, with some becoming redundant; [5] identification of themes that best encapsulate the data, through further refinement; and [6] establish a full set of themes and report data. Adherence to this process led to the findings of three global themes. The initial stages of reflexive thematic analysis led to a codebook, and these were considered and refined during the subsequent stages of analysis. For each transcript, the coding process transitioned from simple descriptive points to more latent insight, whereby points of interest were further considered and linked to theories and understanding of math anxiety where applicable, with caution surrounding over-interpretation (see Table 4). It was considered that code saturation had been achieved whereby no additional ideas or perspectives were identified (Hennink et al., 2017) and, therefore, the sample size was also deemed sufficient.

Ethics

The research was cleared through the university Research Ethics Committee and adhered to the British Psychological Society ethical guidelines.

Results

The analysis presents key reflections and math talk from children's engagement with the MA storybook and is formatted to show questions asked at specific points in the story and various responses to them. Pertinent extracts from each child are accompanied by contextual information. Initial points of interest were identified in each of the transcripts, and these were reflected upon in accordance with reflexive thematic analysis and the suggested stages of this analytical method. The initially identified codes deemed as representing math experiences, reflections, and engagement with the storybook were categorized and developed. However, to increase trustworthiness, the assumptions and interpretations of the data were further questioned in the later stages of analysis (Braun & Clarke, 2019). Indeed, we advocate for the importance of deep engagement with the data

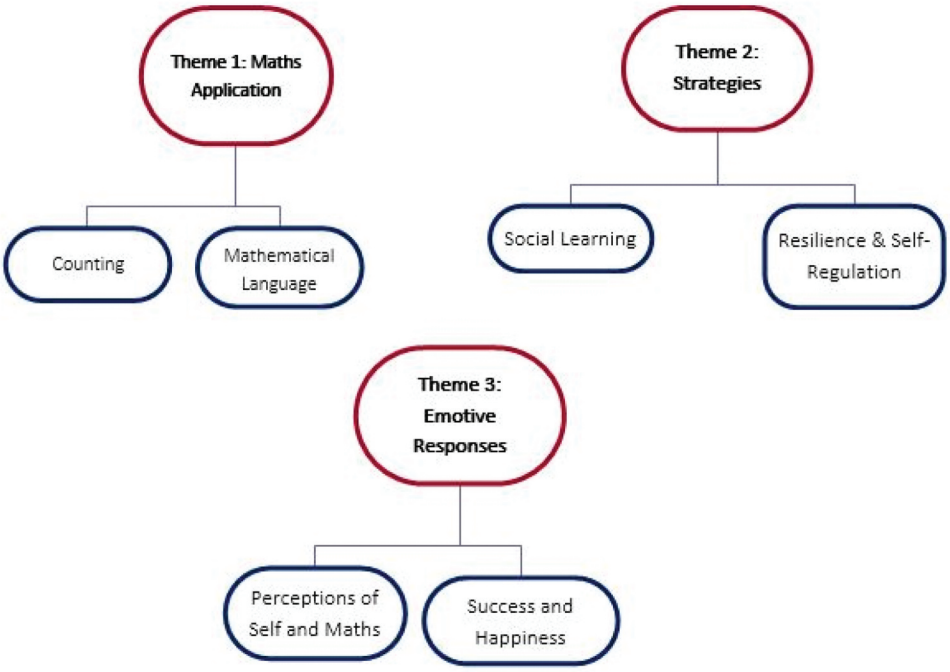

Figure 1. Thematic map of the identified global and organizing themes (children age 6–7 years; Year 2).

and analytic method (Braun & Clarke, 2019) and embrace the central role of the researcher in producing knowledge. There have been many suggestions surrounding theme conceptualization within qualitative research, and our approach aligns with Attride Stirling (2001) who suggested that thematic networks might be conveyed using three core types of themes: [1] global theme, [2] organizing themes, and [3] basic themes. The analytic process resulted in three global themes as capturing the discussions in their entirety: [A] Math Application: (1) counting and (2) mathematical language; [B] Strategies: (1) social learning, (2) resilience, and (3) self-regulation; and [C] Emotive Responses: (1) self-perception, (2) success and happiness, and (3) perceptions of math (see Figure 1).

Global theme 1 – math application

As shown by the CMAS-UK scores, the participating children varied in their self-reported MA, and some scored higher for this measure, despite working at an expected level in math. The second question (page 6) asked children if they had ever felt scared about math, to which four children said yes. Three of these children obtained medium to high mean scores for the CMAS-UK, indicating higher anxiety. This initial gauge of math feelings seemed to be consistent with later questions and discussion points (to be discussed later in the results). However, the MA storybook seemingly provided children with an opportunity to engage with math and to demonstrate their understanding (or to become involved), even though the resource did not explicitly request their participation in this way. Despite CMAS-UK scores and responses to having previously felt scared about math, 10 of the 15 children (including those who had previously felt scared about math) independently aimed to resolve the math problems within the story. Buckley (2020) previously outlined picture books as promoting follow-up discussions and activities, although the MA storybook encouraged the active application of mathematical strategies and language.

Counting

Counting is a complex and important process for the age of the children in this research. It is a concept that underpins other mathematical skills, including addition and subtraction, and an understanding of number order allows for the comparison of number sizes. In learning this skill, several errors are typically encountered, such as counting an item twice or using the same number (name) twice (Maclellan, 1993), and may still be a basis of some concern. Engagement with the MA storybook showed that many children were able to apply their counting skills (e.g., when counting sweets equally for problem #1), or were prepared to attempt to solve the problem (and support the main character in the story) and therefore provided an opportunity – away from a formal classroom setting – to use their individual math ability, discuss possible solutions, and, in some cases, amend strategies. The following extracts demonstrate this across varied participant information, particularly attainment level and CMAS-UK scores.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"So that is 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 . . . Then, 13, 9, 13, 12, 11." [Child noticing numbers from the calendar image.] *"So, 8, 12, 16, 20 . . . "* [Child helping the main character to solve problem #1].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P13	Yes	Not Expected	39 (2.05)

"1, 2, 3, 4, 5, 6, 7. We'll get two each, no, 3 each." [Child helping to solve problem #2].

For some children who previously indicated some fear of math and self-reported higher MA, rather than counting or applying mathematical understanding, they independently engaged with the story by saying numbers and symbols that they noted within the illustrations of the storybook.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P11	No	Expected	44 (2.32)

"1, plus, 9, 6." [Child noticing numbers and symbols].

The series of problems also encouraged some children to recite and apply their knowledge of multiplication and, in other instances, children seemed to respond to important messages within the story (to not feel scared), which possibly encouraged their participation. This observation is seemingly supported by another child (P6, below extract) responding positively to a core message within the book that emphasizes trying not to be worried, working together, and being aware of your feelings (promoting self-regulation). This could be interpreted as the storybook in this pilot study supporting emotion regulation to allow children to focus more on tasks (Ashcraft & Krause, 2007) or the problems within the story (i.e., counting, addition, division, and fractions).

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P10	No	Expected	34 (1.79)

"4, 5, 6, 7 . . . " [Child counting after the main character is told to not feel scared about math].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P6	No	Expected	24 (1.26)

" . . . even if it's a test or a contest, still, it's (math) ok."

Mathematical language

Building on engagement with the math storybook generally, and in response to the series of problems within the story, some children (again, covering a range of CMAS-UK scores) also engaged with mathematical language. The words used by children focused on problem-solving and gave insight about how children applied their math knowledge and understanding, and subsequent discussions of strategies arose from this. In some instances, children's problem-solving was again not explicitly requested, suggesting that many were comfortable taking part.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P7	No	Expected	34 (1.79)

"Five. So, Sophie is putting it into quarters. Five quarters . . . She's missing three people [. . .] We're doing fractions." [Child helping to solve the second problem in the book].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P8	No	Expected	38 (2)

"Sort them out into piles of four." [Child helping to solve the third problem in the book].

In previous works, Ashby (2009) identified that children failed to understand the wider practicalities of math, although the storybook approach seemed to encourage contributions and thinking about the application of math more widely. In other cases, a child applied their learning from a previous problem in the story when solving the third problem (counting and division) and another child demonstrated engagement with trial-and-error thinking and discussion.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P5	No	Expected	38 (2)

"I think he like put them into piles like with the food." [Child applying knowledge from the second problem in the book].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P5	No	Expected	38 (2)

"It might be a divide or a takeaway . . . probably a divide."

Finally, a child, with low self-reported MA appeared to draw attention to their own ability and positive engagement with the problems in the story ("helped and counted like me") as a form of self-affirmation that can promote confidence in the subject.

Global theme 2 – strategies

The MA storybook promoted reflection of strategies that children have or could use when doing math to "help yourself to not feel scared" and the range of suggestions is comparable to MA research findings, including seeking support (educators and family members); trying and taking time (which counters the no-attempt error, Chinn, 2012); use of the concrete pictorial abstract approach (CPA), such as counting on fingers and number squares; and asking others (peers) for help as a coping strategy (Petronzi et al., 2017). Two children also discussed breathing techniques (Brunyé et al., 2013) and how this supports their thinking about a math task, which refers to the debilitating anxiety model (Carey et al., 2016).

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"I try to take in 10 deep breaths and remember in my head what the math things were. So, then I think I get some right, but some of them wrong because I get worried."

One child also divulged their avoidance of math (which can be useful for an educator to be aware of) while another (CMAS Score = 30, 1.58) indicated a growth mind-set by "pretending it's [math] my favorite thing."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P12	No	Expected	28 (1.47)

"Well, I just go to my bed, and I just watch my tablet."

Children indicated a link between feeling happy with math and having a secure ability, which was framed around receiving help from friends and helping others, learning that math is not "boring" through applying mathematical concepts (in the book), increasing understanding, and having a go. The storybook could be viewed as reinforcing these ideas and children's perspectives again covered a range of CMAS-UK scores and attainment levels.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P1	No	Greater Depth	19 (1)

"Very happy about his math because he's helped the boy." [in response to problem #1].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P13	Yes	Not Expected	39 (2.05)

"Happy . . . because now she knows it's not boring." [In response to problem #1].

Supporting the purpose of the math storybook, children were also receptive to the positive messages within the story and recalled different approaches to math, and some expanded on the ideas within the story (e.g., singing songs, asking educators for support, learning from mistakes and "having a good go" ["because you might get it right"], writing down feelings (linking to expressive writing), and, in accordance with emotion regulation, remaining calm and not being worried). Another child seemed to take reassurance from a character in the book, stating that they sometimes struggle with math and drew on this point in their response to not worry because the character had said that they "get mixed up, too."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"To learn from your mistakes . . . and nobody will be mad." [Repeats a sentence from the book].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P14	No	Greater Depth	30 (1.58)

"You don't have to be worried to do it because we all get it wrong sometimes."

Social learning

In discussing math strategies, several children referred to social learning in the subject and considered this from differing perspectives, corresponding to previous knowledge of social coping strategies for children (Petronzi et al., 2017). For example, one child felt nervous about having done math work alone, contrasted with another child who indicated that being able to help others was self-assuring and seemingly affirms a secure ability.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"I get nervous, and I don't know the answers when I've done them alone."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P1	No	Greater Depth	19 (1)

"Very happy about math because he's helped the boy."

Moreover, in response to the main character addressing math problems (with support from others), all children believed that the main character became "happy," "calm," and "confident" about math. At this stage in the story, children perceived the main character as more confident and able to apply their learnings and teach/support others, reflecting mastery learning.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P1	No	Greater Depth	19 (1)

"[Happy] *Because she's helped dad, she's helped Sophie and Leo."*

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P8	No	Expected	38 (2)

"No, [main character not scared anymore] *because he listened to Leo and gave it his best try."*

Analysis also revealed some consistency of ideas, such as one child discussing the main character as learning from the other characters and later stating that they could ask the teacher for support, showing that some children place a high value on social support, and this may have been reaffirmed by the storybook.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P5	No	Expected	38 (2)

"I would tell them that it's ok to be scared and they can see the teacher or an adult."

However, although acknowledging social support within the story, a child also alluded to math success as being based on independence and "effort."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P11	No	Expected	44 (2.32)

"I would put all my best effort, try to do it, and if I get a question wrong, I just go back to my table and do the question again."

Resilience & self-regulation

Analysis identified some implicit links with resilience surrounding children's reflections and discussion of math, which were again promoted through the storybook approach. These centered on attempting work (leading to more enjoyment) and three children also used the word "started" when discussing the main character's emotions and engagement with math, showing recognition of math ability as emerging and developing. Although the lower CMAS-UK scores of the below extracts suggest that some children may have already developed a more resilient approach to math, the storybook also reinforced this.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P6	No	Expected	24 (1.26)

"She doesn't like math because she doesn't know math. But, when you give it a try, it's actually really good."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"She started to count and feel happy."

When considering what children would say to someone who was struggling with math, other examples of resilience were more explicit surrounding not giving up and demonstrated a growth mind-set approach to math, which had been reinforced throughout the story. This suggests that children are receptive to positive math messages and discussion opportunities, as shown by two children who reported medium-high CMAS-UK scores, of which one (P8) had previously felt scared about math.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P8	No	Expected	38 (2

"Keep on trying and if you get it right, you've done it."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P15	No	Expected	33 (1.74)

"Try and try and never give up. Just keep on trying, never give up."

In thinking about how to respond when feeling scared about math, some children also referred to self-regulation strategies, specifically breathing techniques (Brunyé et al., 2013). Interestingly, two of these children had self-reported medium-high CMAS-UK scores and were not working at an expected level, suggesting that the storybook had a positive influence.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P9	Yes	Not Expected	39 (2.05)

"Just take a big deep breath."

Global theme 3 – emotive responses

Previous research has linked emotional responses to MA (Luo et al., 2009; Young et al., 2012) and math stimuli, including math problems and numbers (Batashvili et al., 2020; Pizzie & Kraemer, 2017). Therefore, it can be postulated that the series of problems within the MA storybook evoked emotions in some children, which were discussed in response to questions and children were able to recognize and label the emotions of the character at different stages of the story. Negative emotions attributed to the character early in the story were framed around fear, a lack of confidence, not liking math, math being "hard," not having a secure ability in the subject ("not that good at math"), and not knowing what do. However, as the character grew in confidence and successfully solved problems, children's perceptions of the character's emotions positively developed (e.g., feeling happy due to receiving help, attempting work, and learning that mistakes are normal), suggesting an influence of the storybook.

Perceptions of self and math

In responding to the first question in the storybook (the main character's initial feelings about math in response to problem #1 – counting, addition, and division), children seemed to be somewhat introspective and suggestions were potentially based on their own feelings at that time, supported by a child who explicitly framed this around their perceived ability.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P11	No	Expected	44 (2.32)

"I don't know, probably sad because she's not good at it, like me."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P14	No	Greater Depth	30 (1.58)

"Worried because she's not that good at math."

Moreover, when children were asked if they had previously tried to avoid math, this was used as an opportunity to either highlight ability (e.g., *"I'm always the first one to finish, and we're always finished at the same time"*), demonstrate a sense of competition associated with math (e.g., Petronzi et al., 2017), or express concerns. Analysis also revealed consistency in responses from the first question (about feeling scared about math) and having tried to avoid math, whereby those who had not felt scared did not avoid math and contrasted with those who had felt scared about math.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"Probably. To be honest, I have [avoided math].

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P8	No	Expected	38 (2)

"Normally I go for the toilet, I sneak away."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P11	No	Expected	44 (2.32)

"Yes, I have even tried to avoid school and sneak away in every hard lesson."

A child also considered that it is only through doing math work (rather than avoiding it) that we understand whether we have been successful and counters the no-attempt error (Chinn, 2012), although this also implicated the right or wrong nature of math ("if you don't have a go, you don't know if it's good or bad," P12).

Success and happiness

Conversations surrounding the storybook revealed that children associated being happy with a secure ability in math, and more positive emotions were expressed in response to a range of factors, including the main character receiving help with math, increased understanding when the main character had made effort with math, and when reciting positive messages from the story such as "It doesn't matter if you get it wrong." Some children (e.g., P9 & P12, below) also indicated that completing a math task reduces worry.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P7	No	Expected	34 (1.79)

"That math is fun . . . and that it's also easy."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P9	No	Not Expected	39 (2.05)

"Some math is scary, but if you do all of it you won't be scared."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P12	No	Expected	28 (1.47)

"No because she's learnt some math and now, she's not afraid."

Children perceived success as leading to happiness or feeling better about math when discussing the main character, although in reference to themselves, children indicated that success in math is not immediate and is a learning process. At the later stages of the storybook, this was seemingly linked to effort and resilience, and children with medium to high self-reported MA were more positive in their responses.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P10	No	Expected	34 (1.79)

"The first time I started math I did [felt worried] . . . but I have a go . . . there is stuff that is very hard and then I keep trying and then I manage to do it."

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P11	No	Expected	44 (2.32)

"I would put all my best effort, try to do it, and if I get a question wrong, I just go back to my table and do the question again."

Another child (P4) alluded to the deleterious anxiety model of worrying about math causing a performance deficit (Carey et al., 2016). However, the same child previously referred to math quizzes as causing particular concern and supports MA as being both concept- and situation-specific.

Participant	SEN Dyslexia/Dyscalculia	Attainment Level	CMAS-Score
P4	No	Greater Depth	23 (1.21)

"I try to take in ten deep breaths and remember in my head what the math things were. So, then I think I get some right, but some of them wrong because I get worried at some times and it's a big one."

Discussion

The current study explored feedback from children age 6–7 years (UK, Year 2) regarding their math feelings and reflections during and following engagement with a storybook approach to MA. The study aimed to normalize math talk and generally discover the extent of pupil engagement with this format in accordance with this pilot study and to explore children's perspectives. The storybook encouraged children to apply their math understanding and ability, discuss strategies, reveal emotive responses, and explain reasons for these that could impact their engagement in math lessons and situations. Pertinent findings and implications are considered surrounding: [1] the storybook and emotive responses, [2] math understanding and engagement, [3] normalizing math talk and emotion regulation, and [4] the utility of a storybook approach. We end the discussion by considering limitations and future directions, and outline concluding points.

The storybook and emotive responses

The storybook generally encouraged all children to independently implement their individual math knowledge and understanding in varying ways. In some cases, this was relative to to their self-reported MA and attainment level and, in other cases, in contrast to these measures whereby in the latter stages of the story, children with medium to higher CMAS-UK scores expressed more positive math perspectives, suggesting some influence of the positive messages and problem-solving opportunities within the story. This may indicate an extent of emotion regulation that led to more cognitive capacity (Ashcraft & Krause, 2007) and enabled children to partake in the problems within the story. Previous works have attested to the effectiveness of expressive writing ahead of math tasks to better manage math anxiety (Park et al., 2014) although the storybook approach could be regarded as an "expressive discussion" and is a more scaffolded and supported format for younger children. In accordance with Buckley (2020), children focused on the experiences of the characters and linked these to their own emotions to provide a framework for understanding their own feelings.

Math understanding and engagement

In response to questions and discussions with the specialist SEN math teacher, children were encouraged to count (a crucial and complex process for children age 6–7 years) and apply

mathematical terminology and knowledge of mathematical processes, in addition to considering strategies that can be used when doing math, with some demonstrating critical thinking. The storybook, aligning with Education Endowment Foundation suggestions of this approach (Clark et al., 2021), could be viewed as having promoted social strategies through shared exploration and problem-solving, with the specialist SEN math teacher. Placing more focus on discussions and reflections (Elliott et al., 2016), this approach appeared to encourage active participation and seemingly contributed to children asserting more positive emotions and increased understanding of the main character. Moreover, resilience and self-regulation approaches to math were implicitly alluded to by children, both with lower and higher CMAS-UK scores, including children who had (and had not) previously felt scared about math, suggesting that the storybook message of persistence and learning may have had a positive influence, regardless of underlying worries and ability. Several questions surrounding the storybook required children to reflect on their feelings and behaviors surrounding math, and these questions supported the identification of children who are seemingly more and less secure with their math ability and implicated avoidance. Indeed, this is a well-reported associate of math worry and anxiety (e.g., Dowker et al., 2012; Haase et al., 2012; Petronzi et al., 2017). Children alluded to more positive math emotions because of doing more math, although children also acknowledged a learning process associated with the subject, perhaps in acknowledgment of other aspects of math (e.g., being linked to intelligence, hierarchy in class). Furthermore, and regardless of self-reported CMAS-UK score or attainment level, all children's responses became more positive and solution-based, even for those who had previously said that they had felt worried about or avoided math.

Implications

Normalizing math talk and emotion regulation

The storybook approach aimed to normalize math talk with children to promote more positive perspectives and emotion regulation regarding math. This research advocated emotion regulation prior to implementation of math instruction approaches to provide children with a more secure base in which to engage with math. Emotion regulation approaches have been efficacious in previous works with students (e.g., Brunye et al., 2013, Park et al., 2014) and qualitative data in this study suggests that a storybook format can support this in younger children. Overall, these findings suggest that a storybook approach to primarily support emotion regulation and provide opportunities for math-based discussions generally promoted more positive perspectives and may provide practitioners with beneficial insight, particularly as there was some consistency in response to specific questions (e.g., previous concerns about math, avoidance, and how a child might respond when feeling concerned). Similarly, in cases where children were self-critical, but their attainment level did not necessarily indicate an adverse impact of this (working at expected level or greater depth), this implied that some may be in the early stages of math anxiety development and their performance is yet to be adversely impacted and could again be crucial insight for an educator. However, it is important to avoid claims of the storybook entirely leading to more positive perspectives and suggestions of correlation; indeed, subsequent quantitative work is required to establish significant effects of the storybook approach. Nonetheless, the data that we have presented in this pilot work has shown the importance of an approach to math learning and math attitudes that allows children to engage with and discuss math using a non-judgment-based resource and be recipients of consistent positive messages.

The utility of a storybook approach

Previously tested approaches that are based on intensive math instruction sessions are typically resource intensive, not sustainable in the long term, and require participants to engage with more

math that may increase MA. Moreover, the practical application of some targeted strategies is dependent on resources, including time, funding, and curriculum demands. However, a storybook approach can minimize deviation from typical day-to-day activities and can complement the adopted math scheme of the school and provide an opportunity for children to reflect on both areas of enjoyment and barriers to promote and normalize math talk. This approach may further limit a sense of exclusion and peer evaluation, and a whole-class approach can be implemented whereby all children, regardless of math ability, can reflect on and apply the principles of the storybook. The approach also may support schools in focusing more on key priorities, such as emotion regulation and mental well-being, and a simple-to-use resource can minimize the gap between disadvantaged and advantaged students (OFSTED, 2021). Indeed, the storybook can also encourage a cohesive learning environment as the talk and reflection opportunities will allow pupils to discuss and share ideas and feelings, as opposed to often-segregated ability tables. Discussions between children will further support the role of the teacher in identifying and meeting the needs of pupils and may be an approach that can be more widely adopted across year groups and subjects, particularly if consolidatory age-appropriate activities are developed. Moreover, research has shown that negative math attitudes can transfer from parent/carers to child (Gunderson et al., 2012) and performance in math can be limited in cases where parents/carers hold their own anxieties toward math (Maloney et al., 2015) and, thus, the storybook can also encourage positive math interactions with parents/carers in the home environment.

Limitations and future direction

The results of this pilot study are not without limitation. First, we acknowledge the inherent methodological limitations surrounding subjectivity associated with qualitative-based research, in addition to the limited geographical scope and breadth of the work. Therefore, the study could be replicated to include a larger, more diverse group of young children. Moreover, although the MA storybook was developed based on MA literature and insight from teachers, the current research only explored children's engagement with the storybook. Indeed, triangulation (Turner & Turner, 2009) could be used in subsequent work to build on current insight, and the storybook implementation also could obtain parents and teacher insight (as well as child perspectives) to provide a more comprehensive viewpoint of the value and impact of the storybook. Additionally, we also suggest the use of content analysis whereby the overall global, organizing, and basic themes be guided by frequency, providing some rigor to the interpretation process. While some of these may initially be regarded as important, content analysis offers a systematic coding process of quantifying qualitative data obtained in focus groups and interviews and extracting and classifying important phrases and themes (as well as trends and patterns) into an efficient number of categories based on frequencies within the transcript (Webb & Kevern, 2001). Content analysis frequency encourages omission so that other high-frequency themes take precedence. As stated by Hammarberg et al. (2016), the intention is to establish consistency (reliability) in our results whereby in similar contexts, other researchers would identify similar patterns. We suggest that the inclusion of frequency mitigates potential researcher bias and overinterpretation, while focus groups also could be implemented with children to encourage wider discussions and ideas. Finally, taking a more quantitative perspective and using the storybook as an intervention approach with research and control groups in several schools across a wider area of the UK, a factorial multiple analysis of variance can be used to detect any changes in MA scores and math attainment at pre and post participation with the storybook, and supplementary activities also could be tested.

Conclusion

This article has presented children's perspectives surrounding their engagement with a MA storybook approach. We have found that children, irrespective of math attainment level and self-reported MA, all actively engaged with the story and the integrated series of problems. Crucially, our findings show that known aspects of MA were identified by some relative to their personal experiences, and discussions of these were encouraged through the book, although all children indicated more positive perspectives and approaches to math after reading through the storybook. This suggests that children are receptive to positive messages integrated within this resource and encouraged more growth-based and resilient strategies, particularly in response to encountering any subsequent math difficulties. This approach has provided and shown the value of opportunities to normalize math talk to build toward emotion regulation in children.

This work advocates a storybook to addressing math anxiety as an engaging, sustainable, and simple to implement approach for educators, either as a standard whole-class approach or as a more targeted intervention for children who are demonstrating early signs of difficulty with math, with the primary aim to open discussions about feelings and to receive positive messages about the subject. The findings have shown that discussions centered on a storybook allow children to use and trial their math knowledge in a non-assessment-based environment. Moreover, the storybook enables educators to explore how a child is feeling about the subject and potential underlying factors, while the child is given an opportunity to talk about math to normalize it and minimize emotive responses that are associated with math anxiety, such as shame and guilt. This may encourage the child to more independently seek support and maintain a positive student-teacher relationship.

Finally, to develop this work beyond a pilot exploration, we have considered research developments surrounding wider perspectives, including primary care providers, and implementing the storybook as a targeted intervention approach in a quantitative pre/post design study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This project received no specific funding from internal or external bodies.

ORCID

Dominic Petronzi http://orcid.org/0000-0002-3872-2725
Rebecca Petronzi http://orcid.org/0000-0001-7460-2264

Author contributions

We note that DP is the lead author, with equal second authors of GS and RP. Contributions are as follows: DP conceived of the project and was principal lead. GS and RP contributed to early project development. Ethical approval was sought by DP and RP. Material set up and study administration was led by DP and GS. GS led data collection. Manuscript writing was led by DP with input from RP and reviewed by GS. All authors provided approval for the final paper submission.

References

Ahmed, W. (2018). Developmental trajectories of math anxiety during adolescence: Associations with STEM career choice. *Journal of Adolescence*, *67*(1), 158–166. https://doi.org/10.1016/j.adolescence.2018.06.010

Ashby, B. (2009). Exploring children's attitudes towards mathematics. *Proceedings of the British Society for Research into Learning Mathematics*, *29*(1), 7–12.

Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *American Psychological Society*, *11*(5), 181–185. https://doi.org/10.1111/1467-8721.00196

Ashcraft, M. H., & Krause, J. A. (2007). Working memory, math performance and math anxiety. *Psychonomic News Bulletin*, *14*(2), 243–248. https://doi.org/10.3758/BF03194059

Ashcraft, M. H., & Moore, A. M. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychoeducational Assessment*, *27*(3), 197–205. https://doi.org/10.1177/0734282908330580

Attride Stirling, J. (2001). Thematic networks: An analytic tool for qualitative research. *Qualitative Research*, *1*(3), 385–405. https://doi.org/10.1177/146879410100100307

Batashvili, M., Staples, P., Baker, I. S., & Sheffield, D. (2020). The neurophysiological relationship between number anxiety and the EEG gamma-band. *Journal of Cognitive Psychology*, *32*(1–6), 580–585. https://doi.org/10.1080/20445911.2020.1778006

Braun, V., & Clarke, V. (2006). Using reflexive thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2019). Reflecting on reflexive thematic analysis. *Qualitative Research in Sport, Exercise & Health*, *11*(4), 589–597. https://doi.org/10.1080/2159676X.2019.1628806

Brunyé, T. T., Mahoney, C. R., Giles, G. E., Rapp, D. N., Taylor, H. A., & Kanarek, R. B. (2013). Learning to relax: Evaluating four brief interventions for overcoming the negative emotions accompanying math anxiety. *Learning & Individual Differences*, *27*, 1–7. https://doi.org/10.1016/j.lindif.2013.06.008

Buckley, S. (2020). *Using picture books to reduce math anxiety*. ACER Discover. https://www.acer.org/au/discover/article/using-picture-books-to-reduce-math-anxiety

Burton, D., & Bartlett, S. (2009). *Key issues for education researchers*. Sage.

Carey, E., Hill, F., Devine, A., & Szücs, D. (2016). The chicken or the egg? The direction of the relationship between mathematics anxiety and mathematics performance. *Frontiers in Psychology*, *6*, 1987. https://doi.org/10.3389/fpsyg.2015.01987

Chinn, S. (2012). *Beliefs, anxiety and avoiding fear in mathematics*. Child Development Research.

Clark, A., Henderson, P., & Gifford, S. (2021). *Improving mathematics in the early years and key stage 1*. Education Endowment Foundation. https://educationendowmentfoundation.org.uk/education-evidence/guidance-reports/early-math#:~:text=Improving%20Mathematics%20in%20the%20Early%20Years%20and%20Key,on%20what%20children%20already%20know%20More%20items. . .%20

Cridland, E., Jones, S., Caputi, P., & Magee, C. (2014). Qualitative research with families living with autism spectrum disorder: Recommendations for conducting semi structured interviews. *Journal of Intellectual & Developmental Disability*, *40*(1), 78–91. https://doi.org/10.3109/13668250.2014.964191

Department for Education. (2019). *ITT core content rramework*. Author. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/974307/ITT_core_content_framework_.pdf

Dowker, A., Bennett, K., & Smith, L. (2012). Attitudes to mathematics in primary school children. *Child Development Research*, *2012*, 1–8. https://doi.org/10.1155/2012/124939

Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: What have we learned in 60 years? *Frontiers in Psychology*, *7*, 508. https://doi.org/10.3389/fpsyg.2016.00508

Dweck, C. S. (2008). *Mindset: The new psychology of success*. Random House Digital.

Elliott, V., Baird, J., Hopfenbeck, T. N., Ingram, J., Thompson, I., Usher, N., Zantout, M., Richardson, J., & Coleman, R. (2016). *A marked improvement? A review of the evidence on written marking*. Education Endowment Foundation.

Foley, A. E., Herts, J. B., Borgonovi, F., Guerriero, S., Levine, S. C., & Beilock, S. L. (2017). The math anxiety-performance link: A global phenomenon. *Current Directions in Psychological Science*, *26*(1), 52–58. https://doi.org/10.1177/0963721416672463

Gunderson, E. A., Ramirez, G., Levine, S. C., & Beilock, S. L. (2012). The role of parents and teachers in the development of gender-related math attitudes. *Sex Roles*, *66*(3), 153–166. https://doi.org/10.1007/s11199-011-9996-2

Haase, V. G., Julio-Costa, A., Pinheiro-Chagas, P., Oliveira, L. F. S., Micheli, L. R., & Wood, G. (2012). Math self-assessment, but not negative feelings, predicts mathematics performance of elementary school children. *Child Development Research*, *2012*, 1–10. https://doi.org/10.1155/2012/982672

Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative research methods: When to use them and how to judge them. *Human Reproduction*, *31*(3), 498–501. https://doi.org/10.1093/humrep/dev334

Hennink, M. M., Kaiser, B. N., & Marconi, V. C. (2017). Code saturation versus meaning saturation: How many interviews are enough? *Qualitative Health Research*, *27*(4), 591–608. https://doi.org/10.1177/1049732316665344

Jeffrey, A. (2019). *CPA teacher resource: An introduction*. Oxford University Press. https://cdn.oxfordowl.co.uk/2019/10/11/12/49/39/cdd3d7ae-8145-4c14-97e6-bd96747cb355/Numicon_CPA_Primary_Intro.pdf

Justicia-Galiano, M. J., Pelegrina, S., Lechuga, M. T., Gutiérrez-Palma, N., Martín-Puga, E. M., & Lendínez, C. (2016). Math anxiety and its relationship to inhibitory abilities and perceived emotional intelligence. *Anales De Psicología/Annals of Psychology*, *32*(1), 125–131. https://doi.org/10.6018/analesps.32.1.194891

Kunwar, R. (2021). Impacts of dyscalculia in learning mathematics: Some considerations for content delivery and support. In S. Misciagna (Ed.), *Learning disabilities—neurobiology, assessment, clinical features and treatments*. IntechOpen.

Lau, N. T., Hawes, Z., Tremblay, P., & Ansari, D. (2022). Disentangling the individual and contextual effects of math anxiety: A global perspective. *Proceedings of the National Academy of Sciences*, *119*(7). https://doi.org/10.1073/pnas.2115855119

Luo, X., Wang, F., & Luo, Z. (2009). Investigation and analysis of mathematics anxiety in middle school students. *Journal of Mathematics Education*, *2*(2), 12–19.

Luttenberger, S., Wimmer, S., & Paechter, M. (2018). Spotlight on math anxiety. *Psychology Research and Behavior Management*, *11*, 311–322. https://doi.org/10.2147/PRBM.S141421

Maclellan, E. (1993). The significance of counting. *Education 3-13*, *21*(3), 18–22. https://doi.org/10.1080/03004279385200281

Maloney, E. A., Ramirez, G., Gunderson, E. A., Levine, S. C., & Beilock, S. L. (2015). Intergenerational effects of parents' math anxiety on children's math achievement and Anxiety. *Psychological Science*, *26*(9), 1480–1488. https://doi.org/10.1177/0956797615592630

Moretti, F., van Vliet, L., Bensing, J., Deledda, G., Mazzi, M., Rimondini, M., Zimmermann, C., & Fletcher, I. (2011). A standardized approach to qualitative content analysis of focus group discussions from different countries. *Patient Education & Counseling*, *82*(3), 420–428. https://doi.org/10.1016/j.pec.2011.01.005

OFSTED. (2021). *Research review series: Mathematics*. https://www.gov.uk/government/publications/research-review-series-mathematics/research-review-series-mathematics

Organisation for Economic Co-operation and Development. (2013). *OECD skills outlook 2013: First results from the survey of adult skills*. OECD Publishing.

Paley, J. (2017). *Phenomenology as qualitative research: A critical analysis of meaning attribution*. Routledge.

Park, D., Ramirez, G., & Beilock, S. L. (2014). The role of expressive writing in mathematics anxiety. *Journal of Experimental Psychology Applied*, *20*(2), 103–111. https://doi.org/10.1037/xap0000013

Petronzi, D., Hunt, T. E., & Sheffield, D. (2021). Interventions to address mathematics anxiety: An overview and recommendations. In S. A. Kiray & E. Tomevska-Ilievska (Eds.), *Current Studies in Educational Disciplines* (pp. 169–194). ISRES Publishing.

Petronzi, D., Staples, P., Sheffield, D., Hunt, T., & Fitton-Wilde, S. (2017). Numeracy apprehension in young children: Insights from children aged 4-7 years and primary care providers. *Psychology and Education*, *54*(1), 1–26.

Petronzi, D., Staples, P., Sheffield, D., Hunt, T. E., & Fitton-Wilde, S. (2019). Further development of the Children's Mathematics Anxiety Scale UK (CMAS-UK) for ages 4-7 years. *Educational Studies in Mathematics*, *100*(3), 231–249. https://doi.org/10.1007/s10649-018-9860-1

Pizzie, R. G., & Kraemer, D. J. (2017). Avoiding math on a rapid timescale: Emotional responsivity and anxious attention in math anxiety. *Brain & Cognition*, *118*, 100–107. https://doi.org/10.1016/j.bandc.2017.08.004

Rahim, M., & Koeslag, M. (2005). Math anxiety in junior/intermediate preservice teachers. *Alan Regerson Reform, Revolution and Paradigm Shifts in Mathematics Education*, 194–198.

Rubinsten, O., Marciano, H., Levy, H. E., & Cohen, L. D. (2018). A framework for studying the heterogeneity of risk factors in math anxiety. *Frontiers in Behavioral Neuroscience*, *12*, 291. https://doi.org/10.3389/fnbeh.2018.00291

Smith, J. A., Flowers, P., & Larkin, M. (2009). *Interpretative phenomenological analysis: Theory, method and research*. Sage.

Streubert, H. J., & Carpenter, D. R. (2007). *Qualitative research in nursing: Advancing the humanistic imperative* (4th ed.). Lippincott Williams & Wilkins.

Turner, P., & Turner, S. (2009). Triangulation in practice. *Virtual Reality*, *13*(3), 171–181. https://doi.org/10.1007/s10055-009-0117-2

Webb, C., & Kevern, J. (2001). Focus group as a research method: A critique of some aspects of their use in nursing research. *Journal of Advanced Nursing Science*, *33*(6), 798–805. https://doi.org/10.1046/j.1365-2648.2001.01720.x

Wilson, S. (2009). "Better you than me": Mathematics anxiety and bibliotherapy in primary teacher professional learning. In R. Hunter, B. Bicknell, & T. Burgess (Eds.), *Crossing divides: Proceedings of the 32nd annual conference of the mathematics education research group of Australasia* (Vol. 2 ,pp. 603–610). MERGA

Witt, M. (2012). The impact of mathematics anxiety on primary school children's working memory. *Europe's Journal of Psychology*, *8*(2), 263–274. https://doi.org/10.5964/ejop.v8i2.458

Young, C., Wu, S., & Menon, V. (2012). The neurodevelopmental basis of math anxiety. *Association for Psychological Science*, *1*(10), 1–10. https://doi.org/10.1177/0956797611429134