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Teachers' perception and beliefs regarding mathematics anxiety among Year 3 and Year 4 students in Mexico

Beatriz Ruiz¹

¹Universidad Iberoamericana, México; beatriz.ruiz@correo.uia.mx

This study aims to investigate the emotional dimension of maths anxiety among children by exploring the perceptions of value and beliefs about maths held by Year 3 and Year 4 teachers at a primary school in Mexico City. These perceptions and beliefs can influence the presence of maths anxiety in their pupils during crucial years, as they lay the foundation for understanding key maths concepts used in later years. Four teachers participated in semi-structured interviews, providing insights into their perspectives on maths anxiety. Preliminary findings indicate two prevalent concerns from the teachers' viewpoints: children's lack of motivation to learn maths and their belief that maths is a difficult subject they cannot grasp. Despite the school's supportive environment, including socio-emotional support, economic resources, and maths learning facilities, negative attitudes towards maths persist.

Keywords: Maths anxiety, maths beliefs, maths perceptions, self-efficacy, motivation.

Introduction

Maths anxiety is a multifactorial construct, the complexity of which has not been fully understood (Mammarella et al., 2019). It generates blockages and negative attitudes towards learning maths from the first years of primary education, and its presence affects academic performance, produces demotivation, and in the long run, leads to avoidance of learning tasks or topics that involve maths (Ashcraft, 2002; Dowker et al., 2016). In Mexico, the phenomenon is little studied and understood. According to Richardson & Suinn (1972), maths anxiety consists of “a feeling of tension and anxiety that interferes with the manipulation of numbers and the resolution of mathematical problems in everyday and academic situations.”

In preparation for this research, I conducted an extensive literature review about mathematical anxiety and its two defining dimensions. On the one hand, the cognitive dimension where the executive function is directly affected and can be associated with the learning of mathematical concepts or topics that require greater use of working memory and attentional control (Ashcraft & Kirk, 2001). On the other hand, the emotional dimension - the focus of this work - considers socio-emotional skills including self-regulation and perceived self-efficacy (Kaskens et al., 2020; Luttenberger et al., 2018). This derives into intrinsic motivation, which can interact with mathematical anxiety (Karamarkovich & Rutherford, 2021).

The motivation for studying this construct at the Year 3 and 4 primary level, is that there is increasingly compelling evidence that mathematical anxiety is generated in the early years of primary school. According to Maloney et al. (2015), the presence of mathematical anxiety in adults has been observed when performing simple numerical tasks, such as counting and estimating magnitudes, which leads to the assumption that anxiety was generated when learning basic numerical knowledge, and not with complex mathematical tasks. In fact, researchers indicate that mathematical anxiety is generated before reaching the sixth year of primary school (Guzmán et al., 2021).

Furthermore, it is relevant to emphasise the lack of evidence concerning mathematical anxiety in contexts beyond the United States and Europe, as underscored by Caviola et al. (2017). Mathematical anxiety is culturally influenced, and its manifestation in response to challenging concepts does not uniformly manifest across all school contexts (Lau et al., 2022). Nonetheless, a notable gap exists in the literature concerning the study of mathematical anxiety in children from Latin American countries, which is the motivation for this research project.

The emotional dimension of maths anxiety

There is a close interrelationship between the cognitive and emotional factors involved in learning maths and generating anxiety, which affects mathematical performance (Barroso et al., 2021; Hembree, 1990; Namkung et al., 2019). This situation results in overall poor academic performance (Rossnan, 2006), affecting pupils' levels of interest, value, self-concept, and self-esteem (Gabriel et al., 2020). Therefore, the development of certain socio-emotional skills could provide children with the tools to face anxiety during a maths task.

Regarding the emotional dimension of maths anxiety, a cyclical behaviour has been observed in which a pupil who experiences continuous failures develops great insecurity, which in turn generates anxiety. This cycle negatively affects both maths performance and pupil anxiety (Dowker et al., 2016). The reciprocal model proposed by Pekrun (2006) explains this behaviour, where control and value evaluations towards learning can predict academic anxiety, affecting performance.

In this sense, there is broad support in the literature to use as a theoretical framework the Cognitive-Motivational Model of Achievement Emotions (Pekrun et al., 2018) and the Control-Value Theory (Pekrun et al., 2007). Pekrun et al. (2007) identify two types of appraisals that precede emotions related to achievement. The first type is subjective control over the achievement of the activity, such as expectations of success or self-concept beliefs, perception of the ability to perform an activity successfully and beliefs related to these abilities, self-concept expectations, and self-efficacy. The second type of appraisal is the subjective value assigned to the task and its results, such as the importance given to that activity. Therefore, maths anxiety may appear with deficient control appraisals facing a very high subjective value with respect to the mathematical activities involved (Gabriel et al., 2020).

Likewise, the Control-Value Theory implies that to generate positive achievement emotions, pupils must have positive beliefs about their abilities, thus avoiding anxiety. Self-efficacy beliefs about their ability to complete specific tasks are considered control valuations (Gabriel et al., 2020). Similarly, Bandura (1993) points out that perceived self-efficacy operates through a pupil's convictions to regulate their learning, which determines their academic goals and motivation to achieve them.

From a socio-epistemological point of view, Cantoral et al. (2015) identify that, in school mathematical discourse in teaching, the visible, such as curricula, classroom presentation, and pupil materials, is as important as the invisible, such as teachers' and pupils' beliefs and conceptions about maths. Therefore, it is essential to consider teachers' beliefs and perceptions, as their ways of seeing, working, and developing mathematical thinking may differ according to cultural context and affect their pupils' learning.

The study of maths anxiety in early school years is relevant because it elucidates its relationship with academic performance and facilitates the design of early interventions to reduce anxiety and enhance future maths outcomes (Ramírez et al., 2013). It is important to note that not all topics in maths generate anxiety in pupils. Ching (2017) finds that the impact of maths anxiety on performance is more noticeable when more working memory resources are required to solve mathematical problems. Examples of such problems include two-column calculations involving carrying or borrowing operations, multi-step problems that require sequential operations to derive a solution, as well as problems involving mixed fractions or factoring (Ashcraft & Kirk, 2001). Furthermore, Álvarez-Montesino et al. (2018) observed anxiety among Year 2 pupils in Spanish-speaking contexts upon introducing multiplication. Identifying complex, potentially anxiety-inducing topics is essential.

Research Objective

This investigation is part of a more extensive study investigating math anxiety and its two dimensions. Following Creswell's (2014) mixed-methods framework, we employ an exploratory sequential design that combines qualitative insights with quantitative data. This qualitative study represents the initial stage of the exploratory research, concentrating on teachers at a primary school in Mexico City.

The central inquiry seeks to determine, given their potential unfamiliarity with the construct of maths anxiety, the teachers' implicit beliefs and perceptions about behaviours and emotions in their Year 3 and Year 4 students, and in themselves, which might indicate the presence of this phenomenon.

Methods

Semi-structured interviews were conducted in one school in Mexico City. All teachers from Year 3 and Year 4 participated: two from Year 3 and two from Year 4. The teachers' average age was 48.5 years ($SD = 12.7$ years). All teachers were female and work full-time at the school. The school consists of three groups per year, averaging 20 students per group. Each teacher manages two groups, dedicating half a day to each group. Furthermore, teachers handle all core subjects, which are taught in Spanish.

Prior to the interviews, participants provided personal details including their name, education level, teaching experience, and maths training. Each 40-minute interview was conducted individually and recorded with consent. Teachers were assured of the confidentiality of their personal information and its use solely for research purposes.

A semi-structured interview guide was developed, organised into eight sections. Each section includes several questions related to the variables of the model and/or theory based on the theoretical framework. The first section collects information on the academic programme, hours dedicated to maths lessons, and the specific resources used. The second section focuses on teaching methods, strategies, technology usage, and homework, aiming to identify elements that contribute to student motivation based on the Cognitive-Motivational Model (Pekrun et al., 2018). These sections provide insights into the context of maths lessons according to each teacher. The third section explores challenging concepts in maths, drawing from teachers' experiences and observations of student difficulties and anxiety. In the fourth section, teachers' appraisals of maths and their self-efficacy in teaching the subject are examined, referencing Control-Value Theory (Pekrun, 2007) and self-

efficacy concepts (Bandura, 1993). The fifth section delves into the perceptions and beliefs that teachers hold regarding children's learning of maths, providing initial insights into the mindset and perspectives teachers have on specific aspects of teaching maths, influenced by Bandura's theory. The sixth section focuses on student motivation and perceived self-efficacy, aligning with the Cognitive-Motivational Model (Pekrun et al., 2018). The topic of maths anxiety is introduced in the seventh section, where the teachers' knowledge and observations of its presence among students are explored. Finally, the eighth section raises important questions about the role of parents in maths learning and their active participation in supporting their children throughout the entire learning process.

The interviews were transcribed in their entirety, and a qualitative content analysis was undertaken. This analysis involved creating matrices with rows representing different interviewees and columns for specific themes or questions. Responses from each interviewee were entered into the matrix's corresponding cells, providing a structured visualisation for comparing responses across themes. The analysis process began with open coding, identifying and labelling relevant themes and emerging concepts from the teachers' responses. This was followed by axial coding to explore relationships among the themes. Additionally, a comparative analysis was conducted to see differences and similarities in the teachers' perceptions and beliefs about maths anxiety. Descriptive narratives were developed, and relevant quotes from the teachers were presented to illustrate the participants' experiences and perspectives. The results pertain specifically to the sampled teachers and the school context in Mexico City.

Results

In the subsequent section, the primary ideas, thoughts, and comments shared by the teachers during the interviews are summarised. Selected quotations of relevance are included for context.

Starting with the pedagogical approaches employed by both, Years 3 and 4, teachers allocate 60-90 minutes daily for maths instruction, adhering to both the official curriculum and an internally designed programme. They supplement learning through laboratory visits and a digital maths platform for individual work. Classes typically begin with a discovery activity to understand concepts, incorporating questions to activate prior knowledge. Practical concepts are prioritised, and student progress at individual paces, often collaborating in pairs or trios. The teachers employ didactic strategies centred on practical activities, individual and collaborative work, and question-driven instruction.

When discussing their own perceptions, teachers from Years 3 and 4 shared the sentiment that maths was not particularly challenging for them. Yet, certain concepts, like equivalent fractions or algebra, were identified as demanding. For example, Teacher J from Year 3 shared: "There were instances when I felt apprehensive about teaching algebra." Teacher V from Year 3 shared a personal journey:

I used to really dislike maths, but after taking a course on maths and art, I realised how they relate to everything. The knowledge I gained from that course is something I apply in my class, and I truly enjoy it.

In the context of teachers' beliefs, educators from both Years 3 and 4 believe that by emphasising meaningful learning experiences, real-life connections, and the understanding of abstract concepts,

maths becomes more accessible and relevant to students. They also believe that this approach can promote pupils' confidence and enjoyment. Feedback from Teacher N of Year 4 suggested a prevailing cultural sentiment: "In Mexico, there's a perception that maths is challenging. We aim to change this viewpoint amongst pupils." All the interviewed teachers held the idea that children can learn at a consistent pace. However, concerning prevailing myths or beliefs, they express ambivalence about the notion that certain children might inherently have a unique talent for mathematics.

Interestingly, the term "maths anxiety" was unfamiliar to teachers. However, Teacher J of Year 3 remembered: "When they asked me for the algebra class, I do freeze up, and I even stopped teaching first-degree equations... There, I have indeed felt mathematical anxiety."

Focusing on students, teachers had observed behaviours that could indicate discomfort or unease related to maths, such as nervousness, distraction, requests to change subjects and frequent visits to the toilet at the start of maths class, as Teacher O of Year 4 expresses: "It could be those kids who go to the bathroom, or those who stand up and talk and talk."

Furthermore, teachers noted that in Year 3, students often find division, fractions, and problem-solving challenging, especially problems involving consecutive operations. Teacher J mentioned, "Year 3 children are terrified towards division," while Teacher V observed, "The lack of proficiency in multiplication tables contributes to these challenges" and has incorporated daily multiplication table practice. In Year 4, students face difficulties in learning fractions, including concepts such as simplification, equivalent fractions, and division. Teachers from both years observed these learning challenges consistently across different batches of students.

Additionally, teachers shared observations on students' attitudes towards maths. Teacher J noted signs of apprehension in students concerning certain mathematical concepts. Additionally, some teachers observed that not all students had internalised multiplication tables, prompting discussions on teaching methods and understanding.

To counter these challenges and motivate Year 3 students, teachers use various strategies. Challenging topics are introduced gradually, often coupled with positive reinforcement. One method they employ is "entry passes" to engage students. Teachers in Year 4, however, noted a trend of decreasing student interest over generations.

Focusing on the role of parental involvement, Year 3 teachers observed that some parents apply pressure concerning homework and sometimes use methods differing from class teachings, causing confusion. Year 4 teachers highlighted gendered remarks from mothers perpetuating maths stereotypes, such as, "I'm bad at math, but dad's good." Teacher N pointed out a parental mindset: "Parents deem it unnecessary to spend time on math, thinking it's inherently difficult and hence avoid pressuring their children to learn."

Discussion

The interviews provide important initial insights into the perceptions and beliefs of teachers. Both Years 3 and 4 teachers allocate a significant portion of their teaching time to maths, underscoring its importance. Yet, despite the emphasis on the subject and employing enjoyable strategies, they acknowledge the persistent fear students harbour towards maths, disliking the subject, and facing

difficulties that they don't experience in other subjects. These observations align with the evidence presented by Ramírez et al. (2013), and Mammarella et al. (2019), where the presence of maths anxiety can explain this behaviour.

Teachers exhibit a general confidence in their mathematical capabilities but recognise areas that present challenges when teaching, suggesting potential gaps in their teaching methodologies or resources. It should be noted that the teachers are unfamiliar with the term “maths anxiety,” but they recall situations where students ask for permission to go to the bathroom or request to study other subjects at the beginning of maths class. These avoidance behaviours align with the maths anxiety-related behaviours described by Ashcraft (2002).

The teachers observe a lack of motivation, which is reported as apathy and disinterest, negative emotions that may stem from perceptions of lack of control, and negative value beliefs. Therefore, the Control-Value Theory (Pekrun, 2007) provides a suitable framework for study (Karamarkovich & Rutherford., 2021).

Parental attitudes are another significant factor influencing students' experiences with mathematics. Some parents deem it unnecessary to dedicate time to maths, viewing it as intimidating and not worth the effort. Such attitudes could arise from parents' own experiences of maths anxiety. This may contribute to them transferring their maths anxiety to their children, as supported by the research of Schaeffer et al. (2018).

To the author's knowledge, an extensive literature review has not revealed any previous research exploring this construct in a Mexican population of children in Year 3 and Year 4. It is important to note that, as a qualitative study, the results cannot be generalised due to the small sample size and the focus on only one school in Mexico City. Nevertheless, the study provides significant findings regarding the beliefs and perceptions held by teachers for future research.

Conclusion

The results provide valuable insights into the emotional aspect of maths anxiety in children from the perspective of teachers. Specific mathematical concepts that hinder their learning were also identified. Furthermore, it was confirmed that maths anxiety is an unfamiliar construct for teachers, but they acknowledged its importance in benefiting their students. The next step in the research will involve investigating the beliefs and perceptions of students regarding their mathematical abilities and the experiences that generate negative attitudes.

Identifying factors behind maths anxiety allows educators to craft improved strategies, enhancing learning and mitigating its adverse effects. By studying the Mexican context, this research highlights distinct cultural nuances. The overarching goal is to foster both enthusiasm and motivation for maths, especially for children who self-exclude early due to such anxieties.

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