Addressing Mathematics Anxiety: a case study in a High School in Brazil

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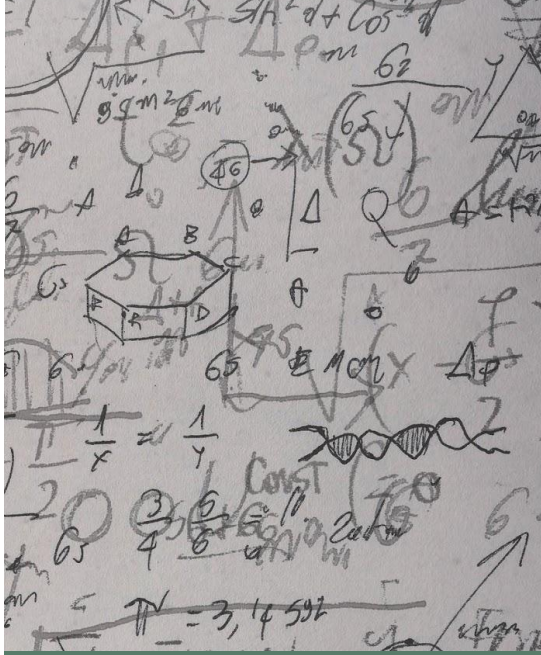


Overview

- Introduction & Context
- Study
- Methodology
- Results & Discussion
- Conclusion

Introduction

Mathematics Anxiety

Introduction

Mathematical Resilience

Introduction

Interventions

Many actions and interventions have been tried to address mathematics anxiety, including mindfulness, managed breathing and writing (Carmo, et al., 2020).

Introduction

Trauma-informed practice

A model that is grounded in and directed by a complete understanding of how trauma exposure affects service user's neurological, biological, psychological and social development.

Scottish report (Homes & Grandison, 2021)

Introduction

Anxiety-informed mathematics teaching

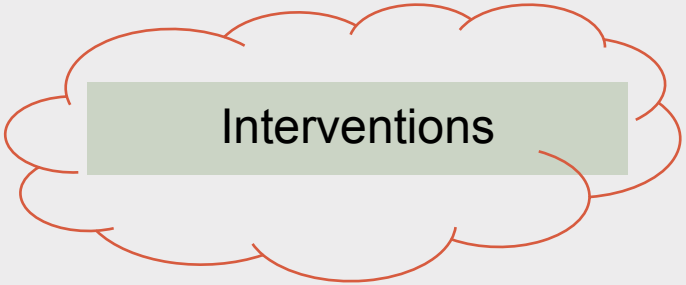
the necessity to adopt practices that raises awareness of anxiety, recognizes MA in learners and seek to resist causing further harm;

the establishment of a safer teaching environment promoting MR and enhancing achievement in mathematics.

Based on Scottish report (Homes & Grandison, 2021)

Introduction

Mathematics Anxiety



Mathematical Resilience

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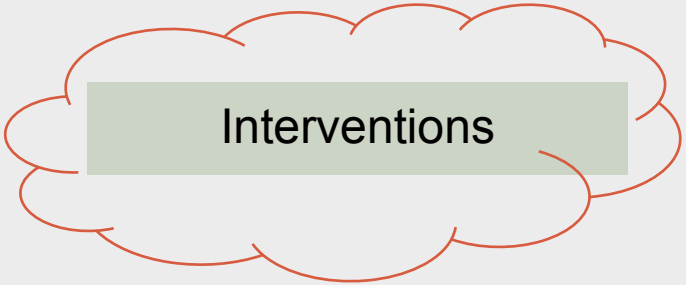

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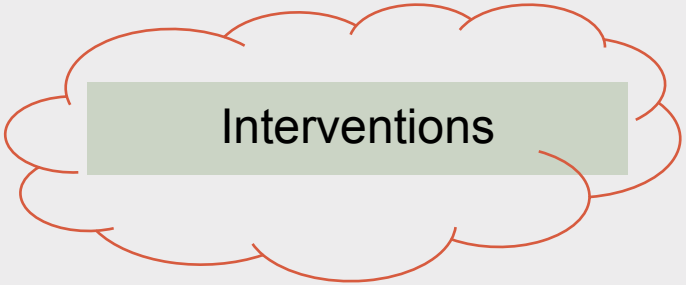


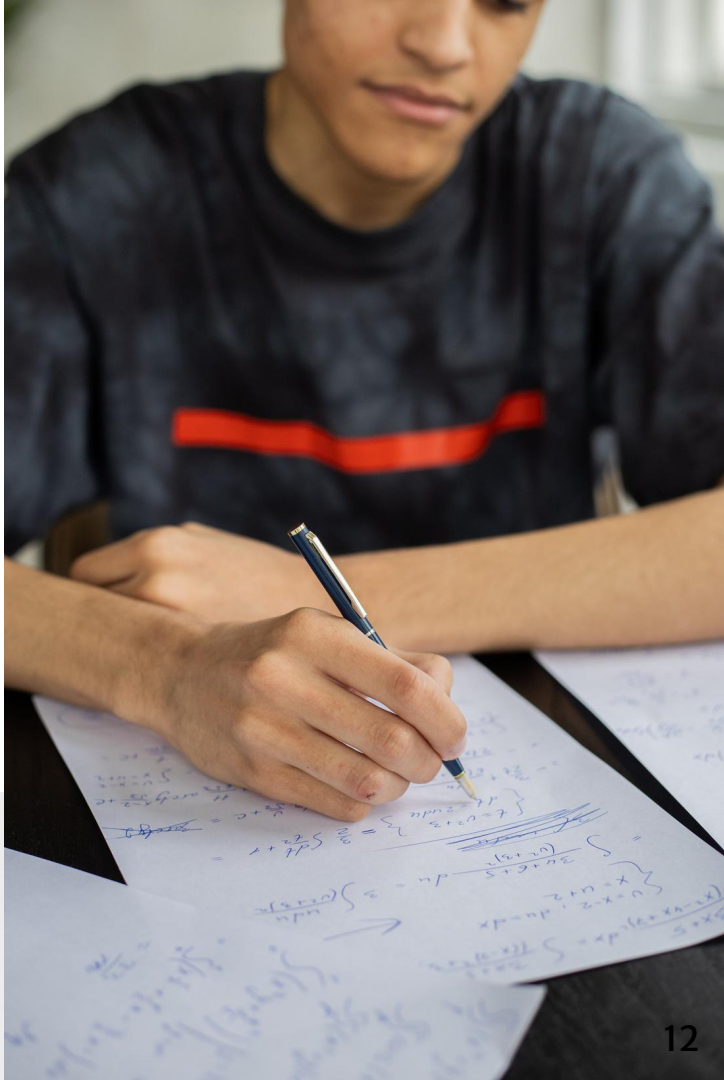
Anxiety-informed mathematics teaching

Mathematical Resilience

The need to include emotions in Mathematics and Science Education has been reinforced by many authors (Hart, 1989; Damasio, 1994; McLeod, 1992, 1994; Gómez Chacón, 2000; Hidalgo et al., 2013)

and underpins the necessity to introduce strategies to develop MR and solve a mismatch.

Mismatch Pedagogy of mathematics teachers X what anxious learners need to thrive when learning maths



Context

- the prevalence varies widely - about 30% in UK (Dowker, 2016) and around 49% in Brazil (OECD, 2013);

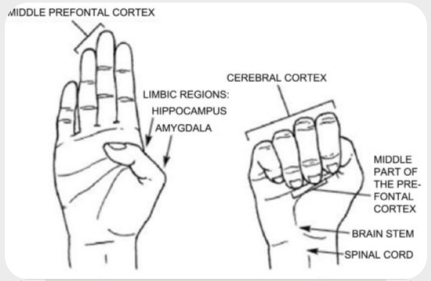
- in general, higher-level anxiety is associated with lower-level achievement (Ma, 1999).

- In Brazil, there is high maths anxiety and lower-level achievement (OECD,2013);

Emotional factors play a large part in mathematical performance and MA plays a particularly large role

Interventions to build MR using 3 tools

GZM



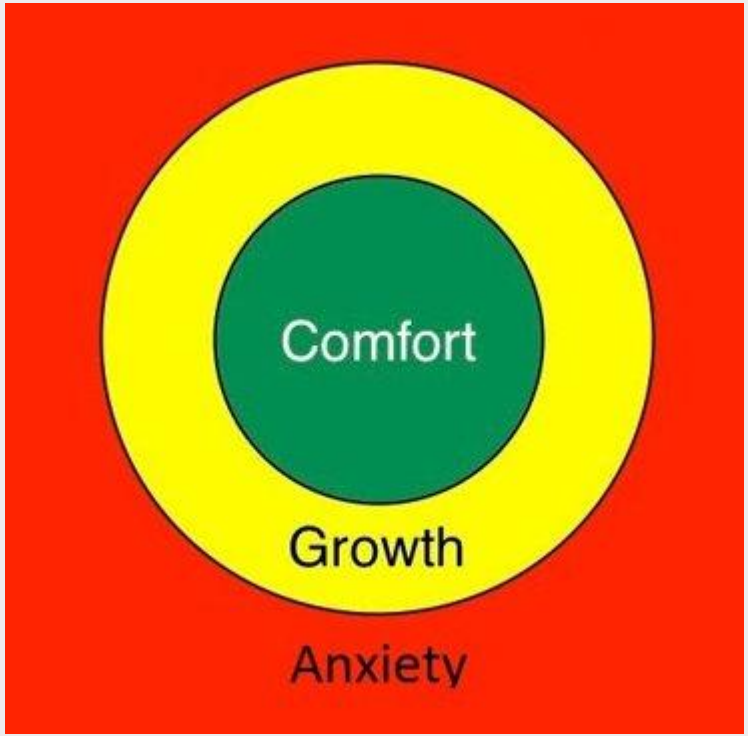
HMB

Relaxation Response

The Growth Zone has 4 elements

Value
Autonomous Motivation
(Ryan & Deci, 2017)

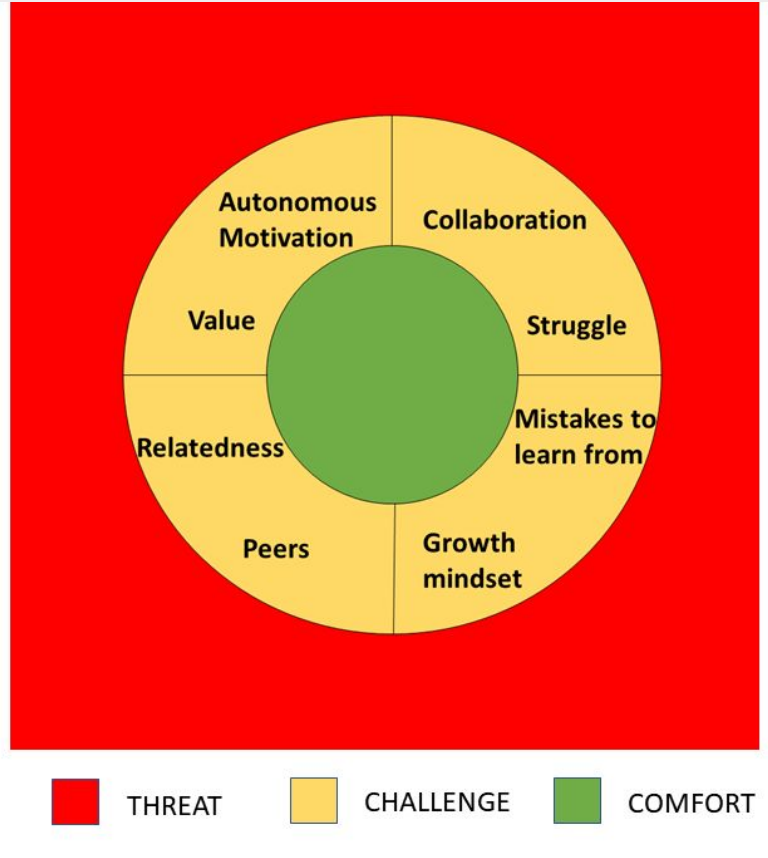
Growth mindset
Prevalence of fixed mindset in Maths teaching and learning
(Dweck, 2006)



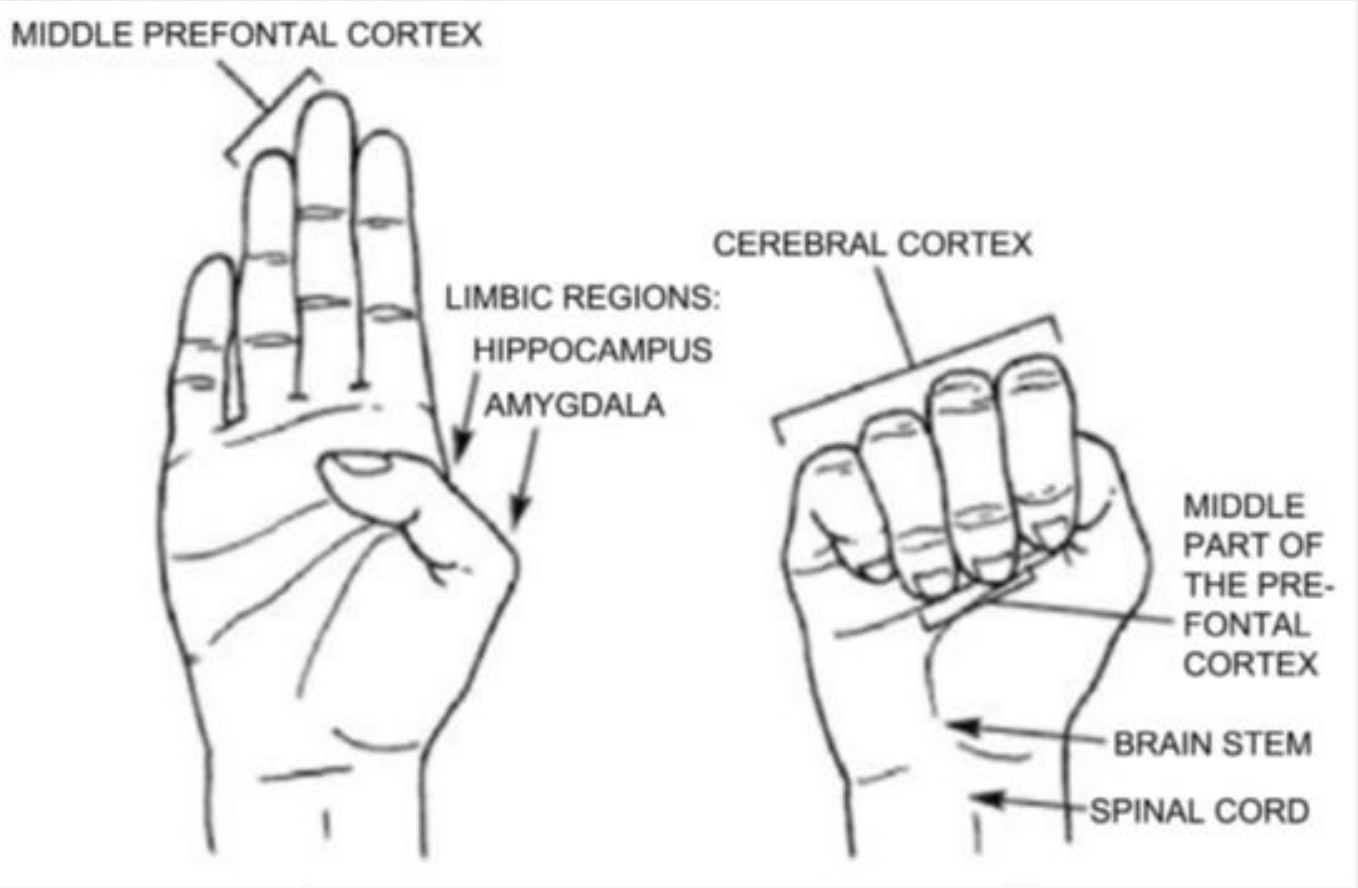
Struggle
need for persistence when meeting challenges; perseverance includes recruiting support when needed
(Williams, 2014)

Relationships
Group work increases relatedness
(Cousin et al. 2019)

The Enhanced GZM (Pará & Johnston-Wilder, 2023)



HMB - The Hand Model of the Brain *(Siegel, 2010)*



Benson's Relaxation Response (Benson, 1983)

Study

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An intervention to promote MR in a public high school in Brazil;

Students in 2nd year of ICT-based course in Statistics (N=32; 9 males; 23 females aged 15 to 17); Duration: 16 weeks

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The qualitative data analyzed using deductive latent thematic analysis (Clarke & Braun, 2017).

Working with subjective experiences and using the **Mathematical Resilience Framework**.

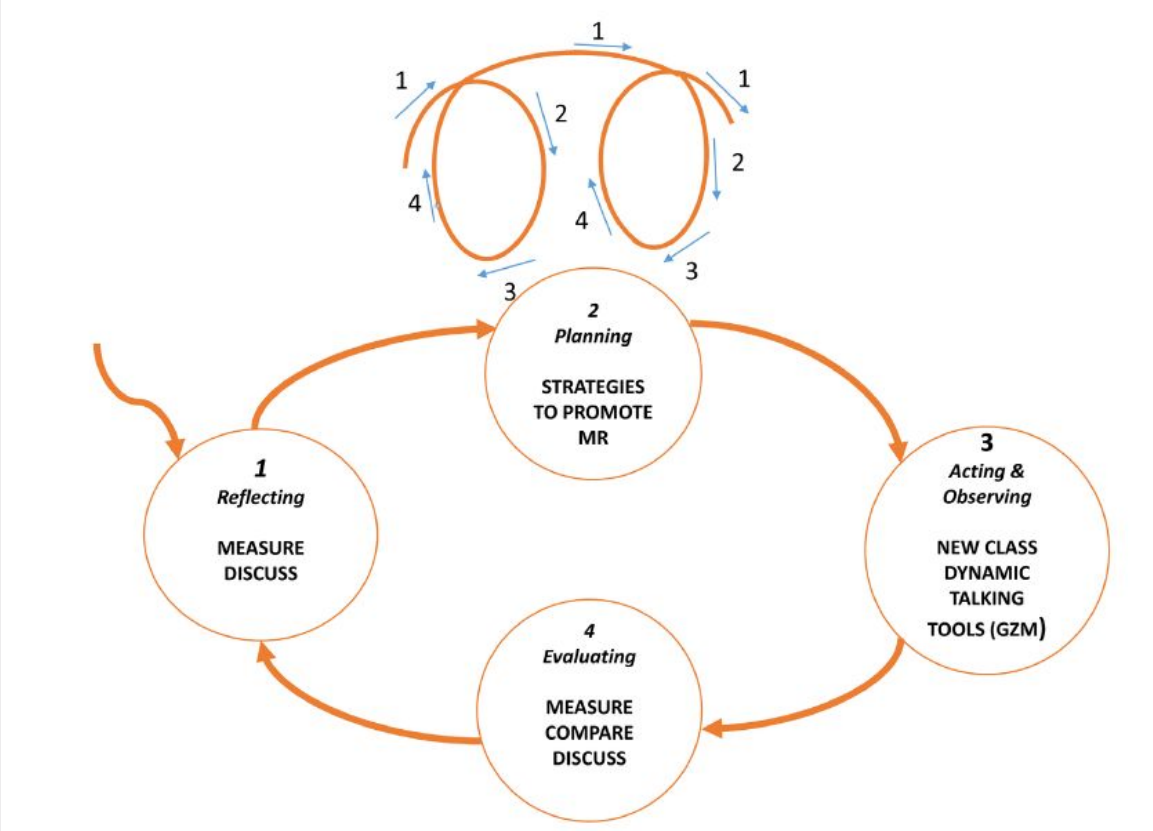
Main objectives

1. Assess the level of MA of students who had previously regressed in Mathematics;

2. Implement tools and **strategies to bring psychological safety, collaboration, relatedness, growth mindset and autonomous motivation** towards learning mathematics;

3. Evaluate qualitative and quantitative data BEFORE and AFTER intervention;

4. Discuss the results with the student participants, giving them experience of Statistics in real world.

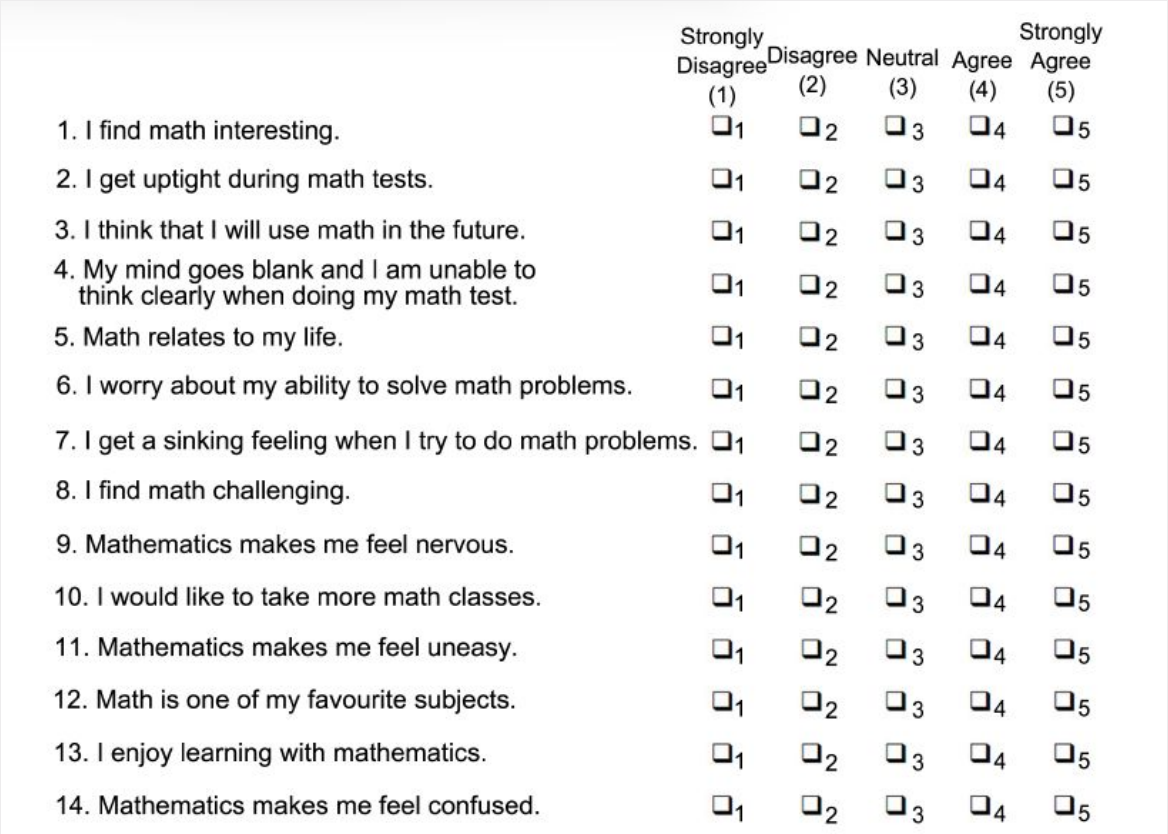


Methodology schema (Participatory action research cycle)

Reflecting phase

1. Study of scales to measure MA and discussion of what scale to be used;

2. Studying and understanding of the 3 tools;



	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
1. I find math interesting.	❑1	❑2	❑3	❑4	❑5
2. I get uptight during math tests.	❑1	❑2	❑3	❑4	❑5
3. I think that I will use math in the future.	❑1	❑2	❑3	❑4	❑5
4. My mind goes blank and I am unable to think clearly when doing my math test.	❑1	❑2	❑3	❑4	❑5
5. Math relates to my life.	❑1	❑2	❑3	❑4	❑5
6. I worry about my ability to solve math problems.	❑1	❑2	❑3	❑4	❑5
7. I get a sinking feeling when I try to do math problems.	❑1	❑2	❑3	❑4	❑5
8. I find math challenging.	❑1	❑2	❑3	❑4	❑5
9. Mathematics makes me feel nervous.	❑1	❑2	❑3	❑4	❑5
10. I would like to take more math classes.	❑1	❑2	❑3	❑4	❑5
11. Mathematics makes me feel uneasy.	❑1	❑2	❑3	❑4	❑5
12. Math is one of my favourite subjects.	❑1	❑2	❑3	❑4	❑5
13. I enjoy learning with mathematics.	❑1	❑2	❑3	❑4	❑5
14. Mathematics makes me feel confused.	❑1	❑2	❑3	❑4	❑5

MAS-R scale questionnaire used in the intervention (Bai et al., 2009: p. 189)

Planning Phase

1. Application of the Revised MAS-R scale (Bai et al., 2009) – BEFORE MEASURE - 28 students were suffering from high or very high Mathematics Anxiety;

2. Introduction of the Growth Zone Model to the students in week 2;

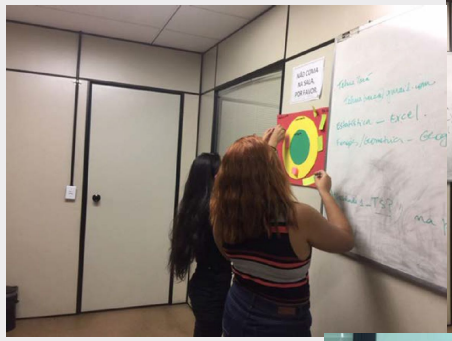
3. Students were taught how to use long out-breaths to trigger the relaxation response. Sometimes, “a permission to have a break” was used.

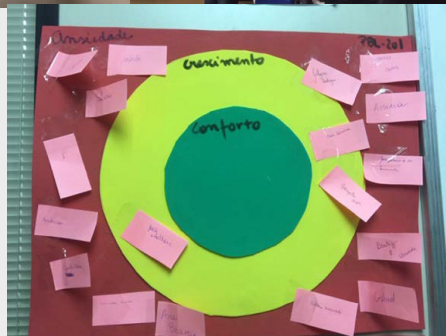
Acting and Observing Phase

1. The Hand Model of the Brain and the Relaxation Response were introduced;

2. Discussion was promoted with students and teacher (participatory) to understand the new dynamics of the class;

3. After six weeks, students were more participative and they felt safer asking questions, as demonstrated by observations and comments recorded in the field notes.





Evaluating phase

1. In the Evaluating phase (sixteenth week), the MAS-R scale (Bai et al., 2009) was applied again;

2. Possible to discuss the statistical BEFORE and AFTER results with the students.

Results

Quantitative Results

- Only 4 students (13%) scored less than 45 on the BEFORE measure;
- the AFTER-measure indicated that 7 students (22%) scored less than 45;
- evidence of MA was observed in both positive and negative questions. There was some improvement in positive questions:

1. I find math interesting;
10. I would like to take more math classes;
13. I enjoy learning mathematics.

These improvements indicated increased motivation within mathematics.

Quantitative Results

- In negative questions:
  9. Math makes me feel nervous;
  14. Math makes me feel confused;
  there was a decrease, indicating a small reduction in anxiety level (less nervous and less confused);

- these small-scale quantitative results indicate the potential for this kind of intervention;

- sample is small makes it difficult to obtain *p-values* lower than 0.05 even if the intervention is effective;

- it is recommended a study with a larger and more diversified sample to assess the impact of the tools.

Qualitative Results

- The qualitative data were analyzed using **deductive latent thematic analysis**;
- working with **subjective experiences** and using a pre-existing framework: **the Mathematical Resilience Framework**;
- we looked for evidence of **anxiety, psychological safety, growth mindset motivation and value, struggle, and relatedness**.

Qualitative Results

Mathematics Anxiety

Evidence of Anxiety and underlying experience such as feeling lost in data.

WN: "I am nervous when facing numbers".

ESP: "I get so nervous in math tests that I always forget to sign my name on the test".

VMS : "lost and confused in math classes" and "I always do math tests as fast as I can to get rid of it".

MV and JR: "get lost in math explanations because it is too much information".

Qualitative Results

Psychological Safety

Students expressed positive comments about the rhythm of the class, as a consequence a safer environment was established.

LS: "I feel myself capable of doing these classes, however I am not capable in normal math classes".

MCR's story: She was encouraged to think for herself, and she succeeded in doing the exercise.

Qualitative Results

Growth Mindset

In their prior experience learning mathematics, students demonstrated a fixed mindset. *Students experienced growth in their study of mathematics.*

MCR: "I feel less dumb in your class".

AAM: "...today I have less difficulty in the subject".

BR: "I am still confused however there is some progress".

Qualitative Results

Motivation And Value

We identified data which we categorized as related to motivation to study mathematics and perceived value.

PHD: "time passes so quickly here", indicating substantial motivation.

LGT: "after classes, I got more interested in the subject".

MCR: "I like your classes, sometimes I feel it a bit complicated, but I find it interesting".

CR: "I feel classes are more interesting and more useful".

Qualitative Results

Relatedness and Struggle

Relatedness was built into the intervention design in that students were encouraged to collaborate in groups and communicate if they experienced being in their red zone.

The teacher observed the learners forming informal discussion groups to find solutions to tasks they were struggling with (week 2);

Students were more participative and asked more questions (week 6).

Conclusions

- Sharing the results of the intervention with students played an essential role;
- statistics being used in a real problem that involved them;
- the intervention developed an environment of reduced anxiety, and increased empathy and motivation in class;
- it led to more positive attitudes towards Maths;
- the intervention enabled the creation of a safe, collaborative, empowering and autonomy-promoting learning space for the students involved.

Conclusions

- The sample was not big enough for robust statistical evidence of impact. in future, large-scale studies are desirable;
- the intervention was perceived to be successful based on qualitative analysis of field notes;
- fieldnotes showed learners' reports of anxiety and suffering towards mathematics **before** and reduced anxiety and suffering **after**;
- the data presented indicate that this kind of intervention can make a difference in the lives of students of mathematics in public schools in Brazil.

Thank you!

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