

Math Anxiety and Goal-Oriented Intervention for Children (MAGIC)

Marc Colomer, Paula Muñoz, Marta Herranz, Frank Sabaté, Eudald Correig

Introduction

Math anxiety is a psychological response that affects both children and adults, characterized by feelings of stress and fear when participating in math-related tasks (Krinzinger, Kaumann, & Willmes, 2009, Lyons & Beilock, 2010). Various studies have shown that as early as the beginning of elementary school, students can exhibit math anxiety (Gunderson, Park, Maloney, Beilock, & Levine, 2018). This anxiety often increases during the schooling years, especially in the transition from elementary to middle school (Levine & Pantoja, 2021).

Numerous studies have identified a negative relationship between students' math anxiety and their math competency (Ashcraft & Krause, 2007; Suinn, Taylor & Edwards, 1988). This relationship is complex; some theories suggest that the anxiety may result from poor math performance, or it may be a cause of this poor performance, or there may be a reciprocal interaction. Furthermore, math anxiety may have a different influence depending on gender. We see it, for example, in the results of the PISA 2022 tests. Both in Spain as a whole and in many of the OECD countries, girls reported higher levels of anxiety than boys.

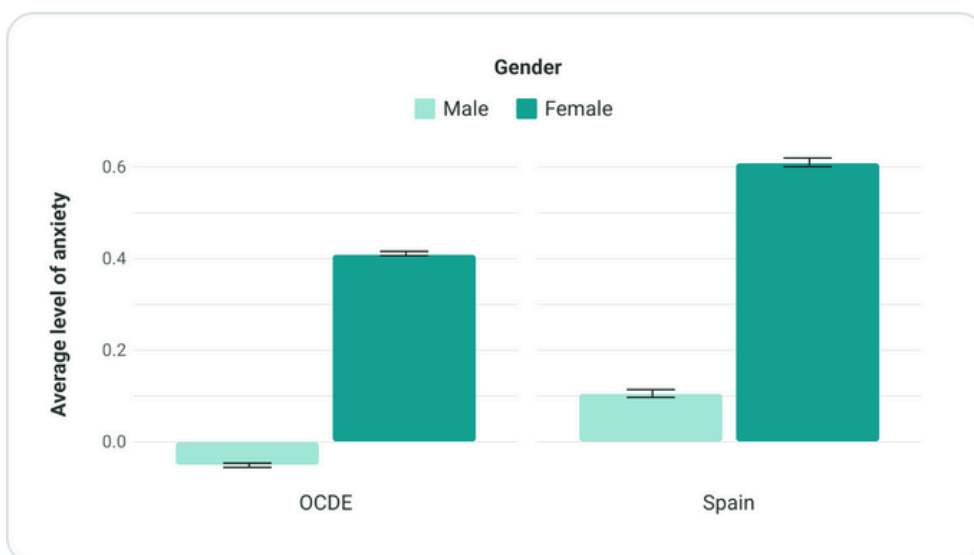


Figure 1. PISA 2022 tests: level of math anxiety in Spain and the OECD by gender of participants.

Interventions that focus on fostering a growth mindset and challenging gender stereotypes have been shown to be effective in reducing math anxiety and improving math performance, especially in middle school (Blackwell et al., 2007). These studies focus on letting students discover the fundamental factors that influence the learning process, such as practice, error, and the phenomenon of brain neuroplasticity. The end goal is to create the belief that one's abilities are not fixed, but rather they depend on practice and learning opportunities throughout one's life.

The MAGIC Study

The main idea of our research is to develop and evaluate an educational program for third grade students that reduces their math anxiety and increases their math motivation. Additionally, the program's influence will be analyzed according to the gender of the participants, with the hypothesis that it will be particularly beneficial in reducing the math anxiety of girls.

Unlike other studies, which have mostly focused on the middle school years, this study focuses on 8 and 9 year-old children. In previous studies led by the Innovamat Team, we had already detected a relationship between math anxiety, math motivation, and mathematical performance in these ages. Moreover, we've already seen that girls have greater math anxiety than boys. For this reason, we have chosen to focus on these ages because the earlier we intervene in the socio-emotional aspects related to math, the more opportunities we will have to generate profound changes that are long lasting.

The study involves 13 schools, of which approximately half of the classes participate in the intervention and the other half are the control group, meaning they continue with their normal activities without any modifications. The intervention consists of conducting 5 sessions in the tutoring classroom, led by the tutor. The aim in these sessions is to (1) break students' expectations about what it means to do math and who can be a good at math; (2) work on the importance of error when facing a difficult challenge; (3) reflect on the fundamental role of practice in the learning process; (4) discuss the types of mindsets that exist; and (5) gather all the acquired knowledge to put it into practice.

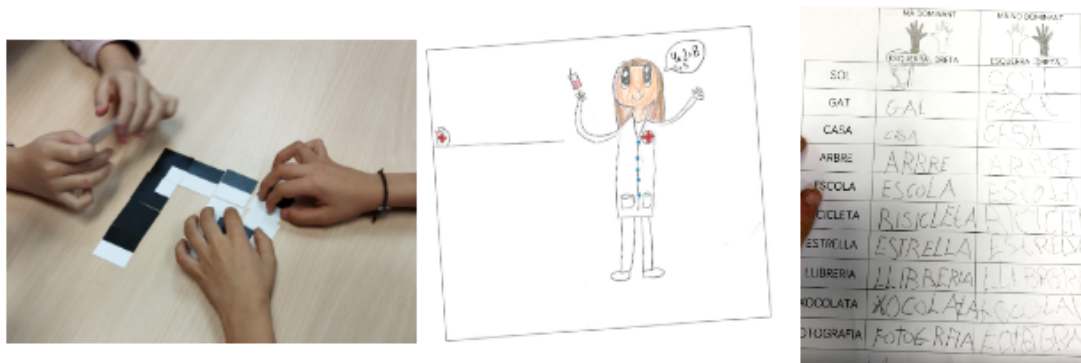


Figure 2. Examples of student work during the pilot study sessions.

To evaluate the effectiveness of the intervention, all students will take a test before and after the intervention where they will be asked questions about their motivation and anxiety towards math. This will allow us to see if there has been any improvement in the aspects studied that is specific to the intervention group, in relation to the control group. If so, we can affirm that there is evidence that the program we developed is an effective tool in improving students' socio-emotional relationship with math.

References

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

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child development*, 78(1), 246–263.

Elizabeth A. Gunderson, Daeun Park, Erin A. Maloney, Sian L. Beilock & Susan C. Levine (2018) Reciprocal relations among motivational frameworks, math anxiety, and math achievement in early elementary school, *Journal of Cognition and Development*, 19:1, 21–46, DOI: 10.1080/15248372.2017.1421538

Krinzinger, H., Kaufmann, L., & Willmes, K. (2009). Math anxiety and math ability in early primary school years. *Journal of Psychoeducational Assessment*, 27(3), 206–225. <https://doi.org/10.1177/0734282908330583>

Levine S.C. & Pantoja, N. (2021). Development of children's math attitudes: Gender differences, key socializers, and intervention approaches. *Developmental Review*, 100997 (62). <https://doi.org/10.1016/j.dr.2021.100997>

Suinn, R. M., Taylor, S., & Edwards, R. W. (1988). Suinn Mathematics Anxiety Rating Scale for Elementary School Students (MARS-E): Psychometric and normative data. *Educational and Psychological Measurement*, 48(4), 979–986. <https://doi.org/10.1177/0013164488484013>