Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences (2017)

Procedia
Social and Behavioral Sciences

www.elsevier.com/locate/procedia

7th International Conference on Intercultural Education "Education, Health and ICT for a Transcultural World", EDUHEM 2016, 15-17 June 2016, Almeria, Spain

# The mathematics anxiety: a transcultural perspective

Antonio Coronado-Hijón

*School of Education University of Seville-St. Pirotencia, s/n-41013 Seville. Spain*

**Abstract**

The results of relevant cross-cultural research related to academic performance have shown that the field of mathematics learning is the one with higher rates of school failure in relation to other areas of learning.
Mathematics learning can produce stress for some students and it is also shown that this anxiety about mathematics learning has a strong correlation with performance in this area.
The aforementioned studies show relevant variables- both in terms of gender of students and teaching strategies- in attitudes coping mathematical tasks by the students.
Therefore it is highlighted the scope of mathematics as the one with the highest percentage of students with problems in their learning at international and transcultural level, and the role that academic resilience can develop toward this difficulties through an interactive process between development factors and socio-educational context.
Keywords: Math anxiety; learning difficulties; formative assessment; transcultural analysis.


Peer-review under responsibility of the organizing committee of EDUHEM 2016.

*Keywords:* Resiliencia académica; dificultades de aprendizaje; análisis transcultural; desarrollo de competencias; educación emocional.

## 1. Introduction

The construct of mathematical anxiety have a long way, and continues to attract the interest of research as an important influence on math performance ((Ramirez, Chang, Maloney, Levine & Beilock, 2016).

According to the obtained data about academic performance studied in relevant cross-cultural research as the Programme for International Student Assessment (PISA), belonging to Organization for Economic Cooperation and Development (OECD) or the Trends in International Mathematics and Science Study (TIMSS), mathematics learning show the higher failure percentage facing the rest of learning areas. Concretely the average of students with


Peer-review under responsibility of the organizing committee of EDUHEM 2016.

mathematics learning difficulties reached 7% of the population of students from 50 countries which took part in the TIMSS 2011 study (Mullis, Martin, Foy & Arora, 2012). According to PISA 2012 study (OECD, 2013a) 23% of students didn't reach the basic level (level 2) in mathematics evaluation.

Education on mathematics is influenced by multiple factors interfering in the teaching and learning process. Focusing on the factors referred to students, we must cite McLeod (1988) pioneer studies. McLeod drew a distinction between attitudes, beliefs and emotions, which constitute the so-called mathematical affective domain.

Maths can generate negative emotions such as anxiety and stress and it is shown that this anxiety strongly correlated with performance in this area (OECD, 2013b), as "a feeling of tension and anxiety that interferes with the manipulation of numbers and solving mathematical problems" (Leppävirta, 2011).

## 2. Methodology

This paper aims to conduct a transcultural educational analysis of the mathematics anxiety through a systematic review work from the data obtained in the most important international research in this area.

### *2.1 Databases*

- The Programme for International Student Assessment (PISA) 2012.
- The Trends in Mathematics and Science Study" (TIMSS) 2011.

## 3. Results

The most important transcultural study on math anxiety is the Programme for International Student Assessment (PISA) 2012. This study has provided the most comprehensive empirical study of mathematics skills developed in school that has never been available before.

PISA 2012 measured the anxiety of students towards maths through questionnaires and the answers provided to questions about how they felt when they were planning math exercises, when valued their future performance in math class and they tried to solve maths problems. 59% of students in OECD countries reported frequently fidget with the belief that it would have difficulty in math class; 33% he reported to be very tense at math homework; 31% said get very nervous in front of solving math problems; 30% said they believed unable to solve a math problem; and 61% expressed concern about school failure in mathematics.

In all countries at least one third of the students reported frequently fidget believing that would have difficulty in mathematics learning.

It is emphasized the variable course level as relevant. According to this idea other studies (González-Pienda et al., 2006; Maloney, Risko, Ansari & Fugelsang, 2010; Warrington, Younger & Williams, 2000) reveal that as long students advance within school they develop more negative attitudes towards mathematics learning. The inferred relationship may be that as students diminish their confidence in mathematics performance it can concatenate a low interest in this learning content, causing negative feelings and emotions which can generate a significant level of anxiety towards mathematics learning tasks (Valle et al., 2006).

Regarding to gender differences women showed higher anxiety levels to mathematics tasks than men in the most of participant countries in the PISA 2012 study (least than nine of them). This gender difference became at least 20 percentage points in some countries.

In 38 of the 65 countries participating in the study girls perform worse in math compared to boys. In the OECD countries girls show an average performance 11 points lower than boys. However, this difference between the average of 15 year-old boys and girls reveals even greater differences between more and less able students. In most countries, even girls who performance better obtain less performance than boys who have higher mathematics competencies and abilities.

These gender differences are particularly concern in relation to motivation and confidence in mathematics learning. From 30% of students who reported their beliefs about inability to solving mathematical problems, 25% were boys and 35% girls.

More descriptively the cited results showed that in a situation of equal performance, girls show less perseverance and openness in resolving problems, lower levels of intrinsic and instrumental motivation to learn mathematics, lower self-confidence and higher levels of anxiety at math's tasks than boys on average.

In this study the girls also showed higher percentages in internal causal attributions to failure in mathematics rather than external causes. A not adapted attributional style is frequently associated to different internalizing character problems that reduce motivation and generate aversion and anxiety toward homework. A student who feels failed to their difficulties in order to learn, can form a low level of self-expectations, poor persistence at tasks and little confidence in their ability to overcome problems, which makes further increase their academic failure (Coronado-Hijón, 2004).

Special importance has the factor referred to the self-expectations of student achievement in relation to academic resilience (Coronado-Hijón & Paneque, 2015), understood as the ability to recover and successfully overcome the risk factors of learning difficulties.

The transcultural study TIMSS 2011, led by the International Study Center at Boston College (USA), coordinated by the consortium of institutions responsible for the design, management, and research, formed by the IEA Secretariat (Amsterdam), the IEA Data Processing and Research Center (Hamburg, Germany), the National Foundation for Educational Research (England), Statistics Canada and the Educational Testing Service (USA), made the first and most important proposal of operations and measurable definition of the construct academic resilience and did so specifically, in relation to the mathematical learning (Mullis et al., 2012).

In the "Trends in Mathematics and Science Study" (TIMSS) 2011, (Mullis et al., 2012) participated 261,000 students from 63 countries. The study population was constituted in representative samples of students in 4th and 8th grades of basic education from the participating countries.

Based on the concept that an academically resilient students is the one that has academic success despite their unfavorable circumstances, this study identifies these as those who score at or above the International Reference Average TIMSS 2011 mathematics (475). The choice of this international indicator of school success is justified by its standardization in all education systems and for allowing a descriptive reference in terms of specific skills and abilities.

The International Association for the Evaluation of Educational Achievement (IEA), independent international consortium headquartered in Amsterdam, produced a report coordinated by Erberber et al. (2015), using data from the mathematical performance of students from the International Study of Trends in Mathematics and Science Study (TIMSS) 2011, (Mullis et al., 2012) in its $8^{th}$ grade, in order to identify the academically resilient students subgroup in each education system and the factors which help within academic resilience.

Regarding the latter, high educational expectations of students were shown the strongest and most consistent indicator of academic resilience, followed by the assessment of mathematics by themselves and the consequent attitudes towards their learning.

But these differences between genders show considerable variation according to different countries, which reveals that the strengths and weaknesses in these academic issues are not inherent in gender *per se*, but socially acquired and strengthened.

In relation to the context variables, the study also revealed that the probability that a student presents math anxiety has a strong relationship with the attending center and especially with the level of their curricular level in this area compared with the other students. On average students who achieve a sufficient yield in mathematics and are enrolled in schools where most of students are better than they are, normally get more nervous about mathematical tasks than those who have similar performance but study in centers where most students show worse than them.

Another significant context variable that was showed refers to teacher support, measured by the frequency with which the teacher highlighted student's achievements, advising them about their strengths and weaknesses or modeling them learning their responses. Among the students with similar performance in mathematics from 65 countries, in 39 of these countries they stated that when teachers used these teaching methods math anxiety was lower.

Similarly, students who reported that their math teachers use instructions to guide their learning and continuous and formative assessments presented good levels of perseverance, opening in problem solving, and readiness, both

academic and professional, towards mathematics . However, these teaching strategies are not widespread: only 53% of students reported that teachers often presented them problems they had to think for a long time, and 47% stated that teachers often presented them problems for which they could not find formulas resolution immediately.

## 4. Discussion and Conclusions

From a cross-cultural perspective, we can conclude that math anxiety is an alarming problem for policy and education systems, in both macro-level and microstructural level due to its prevalence.

In general educator should be worried about their student's anxiety towards mathematics tasks.

From the same cross-cultural perspective, it has been also studied the overcoming of these difficulties in mathematical learning within the research of academic resilience, understood as the ability to recover and overcome successfully facing the risk factors of learning difficulties.

Promoting resilience to the math anxiety requires an early identification of contextual mechanisms and resilient development in each case as well as a holistic and ecosystem approach.

Among the individual factors of resilience development, achievement self-expectations are shown as the strongest and most influential variable. The style of causal attribution which takes students to their difficulties could be improved and educational interventional.

The competent students in a resilient explanatory style has a tendency to explain learning difficulties with external, temporary and specific attributions, while those who show a pessimistic explanatory style, developed mostly internal, permanent and global attributions for failures and errors in learning. The way to explain learning outcomes influences motivation to achieve academic goals as well as overcoming the difficulties encountered.

The fact that in some countries students are in a majority believing that their success is due mainly to their work and effort rather than an inherited intelligence indicates that education and social context may be relevant to cause a difference in terms of instilling values that promote good educational performance.

Some contextual factors related to the school and its teachers have also demonstrated a significant correlation to overcoming math anxiety. Concretely, ongoing and formative assessment strategies such as advising students about their strengths and weaknesses as students and modeling the most effective learning tasks to help them reduce their anxiety level.

According to gender differences and due to the fact that girls have a lower level of confidence in their own abilities, education systems, teachers and families should develop more effective strategies to strengthen the self-expectations of mathematical achievement of girls.

From the cross-cultural perspective, the report to UNESCO of the International Commission on Education for the XXI century, <The treasure within>, or Delors report (1997), noted that an emotional education is a necessary complement to cognitive development and a proactive pedagogy characterized for preventing problems and dysfunctional or maladaptive attitudes.

From the resulting perspective of the educational response for the promotion of mathematics academic resilience, it has to be included in the curriculum of formal education as an objective of Emotional Education, developed by working within curricular and interdisciplinary educational content, always from an ecosystem approach of the School Community.

## 5. Bibliography

Coronado-Hijón, A. (2004). Dificultades de aprendizaje y estilo atribucional. *Revista de Humanidades*, (*14*), 35-46. Sevilla: Universidad Nacional de Educación a Distancia (UNED).

Coronado-Hijón,A. & Paneque, M. (2015). Resiliencia al fracaso escolar y desventaja sociocultural: un reto para la orientación y la tutoría. En Jiménez, S. & Silva, C. (Cord.) *Trauma, contexto y exclusión: promocionando resiliencia*. Granada: Grupo Editorial Universitario (GEU)

Delors, J., Amagi, I., Carneiro, R., Chung, F., Geremek, B., Gorham, W. & STavenhagen, R. (1997). *La educación encierra un tesoro: informe para la UNESCO de la Comisión Internacional sobre la Educación para el Siglo Veintiuno*. UNESCO.

Erberber, E., Stephens, M., Mamedova, S., Ferguson, S., & Kroeger, T. (2015). Socioeconomically Disadvantaged Students Who Are Academically Successful: Examining Academic Resilience Cross-Nationally. Policy Brief No. 5. International Association for the Evaluation of Educational Achievement. http://www. iea.nl/policy_briefs.html

Gonzalez–Pienda, J.A., Núñez, J.C., Solano, P., da Silva, E.H., Rosario, P., Mourâo, R.,& Valle, A. (2006). Olhares de género face á matemática: uma investigaçao no ensino obrigatório español. *Estudos de Psicología, 11*(2), 135-141.

Leppävirta, J. (2011). The Impact of Mathematics Anxiety on the Performance of Students of Electromagnetics. *Journal of Engineering Education*, *vol. 100*. 3, 24-443.

Maloney, E. A., Risko, E. F., Ansari, D., & Fugelsang, J. (2010). Mathematics anxiety affects counting but not subtilizing during visual enumeration. Cognition, *114(2*), 293-297.

McLeod, D. B. (1988). Affective issues in mathematical problem solving: Some theoretical considerations. *Journal for Research in Mathematics Education*, *19*, 134-141. doi: 10.2307/749407

Mullis, I.V.S., Martin, M.O., Foy, P. & Arora, A. (2012). *TIMSS 2011 international results in mathematics*. Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.

OECD. (2014). PISA 2012 Results in Focus: What 15-year-olds know and what they can do with what they know. Paris: OECD

OECD (2013a). *PISA 2012 Results: What Students Know and Can Do*. 4 vols. Paris: OECD.

OECD (2013b). *PISA 2012 Results: Ready to Learn: Students' Engagement, Drive and Self-Beliefs, (Volume III)*, PISA, OECD Publishing, Paris.

Ramirez, G., Chang, H., Maloney, E. A., Levine, S. C., & Beilock, S. L. (2016). On the relationship between math anxiety and math achievement in early elementary school: the role of problem solving strategies. *Journal of experimental child psychology*, *141*, 83-100.

Valle, A., Regueiro, B., Piñeiro, I., Sánchez, B., Freire, C., & Ferradás, M. (2016). Actitudes hacia las matemáticas en estudiantes de Educación Primaria: Diferencias en función del curso y del género. *European Journal of Investigation in Health*, *6*(2), 119-132.

Warrington, M., Younger, M. & Williams, J. (2000). Student attitudes, image and the gender gap. *British Educational Research Journal*, *26*(3), 393-407.