MATH AND SCHOOL ANXIETY: COMPARING STUDENTS WITH AND WITHOUT SLD AND THE POTENTIAL ROLE OF ACTIVE BREAKS

MATEMATICA E ANSIA SCOLASTICA: CONFRONTO TRA STUDENTI CON E SENZA DSA E IL POTENZIALE RUOLO DELLE PAUSE ATTIVE

Valeria Di Martino
University of Palermo
valeria.dimartino@unipa.it

Clarissa Sorrentino
University of Salento
clarissa.sorrentino@unisalento.it

Rosa Bellacicco
University of Turin
rosa.bellacicco@unito.it

Angela Diverti
University of Palermo
angela.diverti@gmail.com

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ABSTRACT
School and math anxiety can hinder learning, especially in students with SLD, who often struggle with Executive Functions and emotion regulation. This paper, based on data from the PRIN PNRR 2022 "Inclusive didactic for enhancing math learning and reducing math anxiety: efficacy of active breaks in the classroom" project, analyzes anxiety traits in a sub-sample of 4150 students from Sicily, Puglia, and Piedmont, comparing SLD and non-SLD students. It also explores Active Breaks as an inclusive strategy to reduce anxiety and support math learning.

L'ansia scolastica e l'ansia da matematica può ostacolare l'apprendimento, soprattutto negli studenti con DSA, che faticano nell'ambito delle funzioni esecutive e regolazione emotiva. L'articolo, basato sul progetto PRIN PNRR 2022 "Didattica inclusiva per migliorare l'apprendimento della matematica e ridurre l'ansia da matematica: efficacia delle pause attive in classe", analizza dati di 4150 studenti in Sicilia, Puglia e Piemonte, confrontando ansia scolastica e da matematica tra studenti con e senza DSA. Si esplorano le pause attive come strategia inclusiva per ridurre l'ansia e supportare l'apprendimento della matematica.

KEYWORDS
Math anxiety, school anxiety, specific learning disorders, inclusive teaching
Ansia da matematica, ansia scolastica, disturbi specifici dell'apprendimento, didattica inclusiva

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Introduction

Anxiety about school and, in particular, anxiety about mathematics refer to emotional factors that can significantly impair both the learning processes and the well-being of students. These types of anxiety take the form of dysfunctional reactions to demands perceived as threatening and are usually associated with a fear of failure, low self-esteem and negative expectations (Ashcraft & Moore, 2009; Ramirez et al., 2018). In the school context, these experiences are even more impactful in individuals with Specific Learning Disorders (SLDs), who not only face specific difficulties in reading, writing or calculation, but also tend to experience greater emotional vulnerability and difficulties in emotion regulation (Mammarella et al., 2016; Passolunghi et al., 2020). Research has shown that students with Specific Learning Disorders (SLDs), for example dyslexia, dysorthography or dyscalculia, tend to bring with them ineffective early management of Executive Functions (FEs), like attention, working memory, inhibition, flexibility, regulation (Caprara et al., 2010). These crucial conditions for tackling complex tasks such as solving mathematical problems are often weakened by conditions of stress and anxiety, generating a vicious circle that still compromises learning effectiveness (Caretti et al., 2015). Anxiety about mathematics, in particular, has been associated with a reduction in available cognitive resources, with negative effects on performance and perceived self-efficacy, especially in contexts where performance is assessed or exposed to judgement (Ashcraft & Moore, 2009).

In this challenging environment, the need for teaching strategies that are inclusive and multifaceted emerges. Among these, Active Breaks take the form of short, motor-based interventions to be included in everyday school life. Numerous researches highlight how these structure-free activities can facilitate self-regulation, optimisation of executive performance, and stress and anxiety in developmental age (Donnelly et al, 2016; Mahar et al, 2006). Active Breaks, as forms of mindful movement, allow children to recharge their attention, reprocess emotions, and free their minds from cognitive blocks.

This contribution is part of the PRIN PNRR 2022 project “Inclusive Didactic for Enhancing Maths Learning and Reducing Maths Anxiety: Efficacy of Active Breaks in the Classroom”, funded by the European Union – Next Generation EU (CUP: F53D23010970001), whose objective is to analyze the prevalence of school and

math anxiety in a specific sub-sample of approximately 4150 students from three Italian regions (Sicily, Apulia and Piedmont). The project is designed to assess the impact of Active Breaks as an accessible didactic tool, capable of combining emotional and cognitive support, promoting truly inclusive teaching.

This paper examines the relationship between Specific Learning Disorders and both mathematical and school anxiety in Italian primary school students, comparing anxiety levels across different types of SLD (dyslexia, dyscalculia, dysorthography, and dysgraphia), and discusses the potential role of Active Breaks as an inclusive teaching strategy to address these challenges.

1. Anxiety in the Context of Specific Learning Disorders: Theoretical Framework and Diagnostic Classifications

As mentioned earlier, in the school context, anxiety can take specific forms, such as performance anxiety or anxiety related to specific disciplines, including mathematics (Ashcraft & Ridley, 2005). This picture is further complicated in the presence of Specific Learning Disorders (SLD). These are included in the main diagnostic manuals (DSM-5-TR, ICD-11) within the macro-category of Neurodevelopmental Disorders. This placement emphasises their nature as conditions with onset in developmental age, linked to a neurobiologically based alteration that compromises the normal process of acquiring specific academic skills. The fundamental characteristic of SLDs is the "specificity" of the deficit: difficulties manifest themselves in one or more circumscribed domains of learning (reading, written expression, calculation), against a global intellectual functioning in the normal range.

The ICD-11 employs the term "developmental learning disorder" as an umbrella classification, subsequently specifying the predominant area of impairment (reading, written expression, or mathematics). In contrast, Italian legislation (Law 170/2010) formally recognizes four distinct categories of Specific Learning Disorders (SLDs): dyslexia, dysorthography, dysgraphia, and dyscalculia. The conceptualization of SLDs as "specific" disorders—characterized as intrinsic to the individual and not primarily attributable to external environmental factors or generalized cognitive deficits—presents a theoretical paradox when considered

alongside the well-documented pattern of comorbidity with internalizing disorders, particularly anxiety-related conditions.

1.1 Anxiety in students with Dyslexia

Developmental dyslexia, defined as a specific learning disorder that impairs accuracy and/or speed in reading and decoding written language, has not only cognitive but also emotional implications (American Psychiatric Association, 2013; Snowling & Hulme, 2012). Numerous research studies have highlighted how children and young people with dyslexia are significantly more likely to develop anxiety symptoms than peers without learning difficulties (Mugnaini et al., 2009; Francis et al., 2019). Anxiety can manifest in a generalised form or as school performance anxiety, negatively affecting motivation, self-esteem and school adjustment (Humphrey & Mullins, 2002). Specifically, repeated experiences of reading failure, adverse social comparisons, and heightened awareness of one's difficulties can establish a detrimental cycle whereby anticipatory anxiety further compromises cognitive performance, thereby exacerbating dyslexic symptoms (Hellendoorn & Ruijssenaars, 2000). This bidirectional interaction between cognitive and emotional factors necessitates that inclusive pedagogical approaches address not only the technical dimensions of compensatory instruction, but also elements pertaining to psychological wellbeing and the development of supportive educational environments (Cottini, 2020).

1.2 Anxiety in students with Dyscalculia

Dyscalculia represents a specific learning disorder characterized by persistent difficulties in processing numerical information, acquiring arithmetic facts, and performing accurate or fluent calculations (DSM-5-TR). Rather than constituting a discrete diagnostic category, mathematics difficulties exist along a continuum with multiple underlying etiological factors. Episodes of severe anxiety or clinical anxiety disorders, often accompanied by somatic complaints or panic attacks, frequently co-occur with both circumscribed and broader manifestations of learning difficulties across the lifespan (Butterworth, 2005; DSM-5-TR).

Beyond its impact on mathematical skill acquisition, dyscalculia significantly affects emotional functioning, frequently precipitating the development of mathematics

anxiety. This condition encompasses negative emotional responses, including tension, apprehension, and fear, that emerge during mathematics-related activities (Ashcraft & Ridley, 2005; Maloney & Beilock, 2012). In individuals with dyscalculia, mathematics anxiety typically emerges early and remains stable over time, perpetuated by repeated academic failures, negative feedback, and the development of a self-concept as mathematically incompetent (Dowker et al., 2016). This anxiety creates a cyclical pattern whereby cognitive overload further impairs mathematical performance while simultaneously undermining learning motivation and classroom engagement, resulting in long-term adverse effects on self-esteem and academic progress (Carey et al., 2017).

Understanding the reciprocal relationship between dyscalculia and anxiety, particularly the role of emotional factors in mathematical learning, is essential for developing inclusive pedagogical approaches that integrate emotional support with cognitive intervention strategies.

1.3 Anxiety in students with Dysgraphia

Dysgraphia constitutes a specific learning disorder affecting written expression through impairments in spelling accuracy, writing fluency, and motor execution (DSM-5-TR). Beyond its motor and linguistic manifestations, this condition exerts significant emotional consequences for affected individuals. Recent research has demonstrated a substantial correlation between dysgraphia and elevated anxiety symptoms among children and adolescents, who frequently experience frustration, feelings of inadequacy, and performance-related anxiety in academic settings (Döhla & Heim, 2016; Capodieci et al., 2020).

Graphomotor difficulties, which often attract negative evaluations from teachers and peers, can progressively erode self-esteem and intrinsic motivation. This creates a detrimental cycle wherein anticipatory anxiety further compromises the quality of written output (Sumner, Connelly & Barnett, 2016). Additionally, anxiety can disrupt attentional processes and fine motor coordination, thereby exacerbating dysgraphic symptoms and potentially limiting the efficacy of remedial interventions.

Given these interconnected factors, educational and pedagogical interventions must adopt an integrated approach that addresses both emotional and relational dimensions alongside graphomotor skill development. This necessitates the

cultivation of empathetic school environments and the implementation of inclusive instructional strategies (Capodieci et al., 2020).

1.4 Anxiety in students with Dysorthographia

Dysorthographia is classified in the DSM-5-TR as a manifestation of specific learning disorder that primarily affects spelling accuracy and phonographic encoding in written expression (American Psychiatric Association, 2022). However, this condition extends beyond purely linguistic difficulties to encompass significant emotional consequences for affected students. Students with dysorthographia frequently encounter academic experiences characterized by corrective feedback, explicit evaluative judgments, and recurring frustration, which collectively contribute to the emergence of anxiety symptoms, particularly those related to written performance (Woltering, Bazinet & Liu, 2020).

This anxiety typically manifests as fear of evaluation, avoidance behaviors toward writing tasks, and anticipatory tension preceding assessments, thereby further undermining academic self-efficacy and intrinsic motivation (Caviola et al., 2017). A detrimental cycle emerges wherein anxiety depletes the attentional and mnemonic resources essential for accurate spelling, consequently exacerbating dysorthographic symptoms and impeding learning processes, especially within evaluative contexts perceived as threatening.

Given these dynamics, pedagogical practices must be grounded in an inclusive framework that integrates academic support with interventions targeting emotional wellbeing. This approach requires reducing sources of academic stress while fostering educational environments where errors are conceptualized as integral components of the learning process rather than indicators of failure.

2. Methodology

2.1 Research aims and hypotheses

The relationship between Specific Learning Disorders (SLD) and anxiety has been increasingly recognized in recent literature, with studies demonstrating elevated anxiety levels among students with various learning difficulties. However, existing research has predominantly focused on individual SLD types in isolation or has

examined general anxiety rather than domain-specific anxieties. Notably, there is a conspicuous gap in the literature regarding comparative studies that simultaneously examine multiple types of SLD (dyslexia, dyscalculia, dysorthography, and dysgraphia) in relation to anxiety manifestations. Furthermore, most studies have not comprehensively addressed both general school anxiety and specific domain anxiety, such as mathematical anxiety, within the same investigation.

This study aims to address these significant gaps by examining the relationship between different types of SLD and both mathematical and school anxiety in a large sample of Italian primary school students. The research seeks to provide a comprehensive understanding of how various learning difficulties may differentially impact students' emotional well-being across both general and specific academic contexts. The primary objectives of this research are:

1. To assess whether significant differences exist in the levels of mathematical and school anxiety between students with and without SLD.
2. To specifically analyze how different types of SLD (dyslexia, dyscalculia, dysorthography, and dysgraphia) are associated with different levels of mathematical and school anxiety.
3. To investigate whether the two components of performance anxiety – cognitive (worry) and emotional – manifest differently in students with various types of SLD.

Based on existing literature and theoretical frameworks, the following hypotheses were formulated:

- H1: Students with SLD will demonstrate significantly higher levels of both mathematical anxiety and school anxiety compared to peers without reported SLD.
- H2: Among the different types of SLD, students with dyscalculia will exhibit the highest levels of mathematical anxiety, while students with other SLDs (dyslexia, dysorthography, dysgraphia) will present distinct anxiety profiles, with varying manifestations of school anxiety depending on their specific learning impairment.
- H3: The cognitive (worry) and emotional components of performance anxiety will manifest differently across students with various types of SLD.

2.2 Sample

The current study drew from a large-scale sample collected through the ABMOVE! Project, which involved 4150 students from 37 schools across three Italian regions: Apulia, Sicily, and Piedmont. After accounting for missing data and incomplete questionnaires, our final analytical sample comprised 3317 students with a mean age of 8.3 years (SD = 1.16). This sample represents a diverse cross-section of Italian primary school children spanning from second to fifth grade.

The regional distribution of participants showed a predominance from Apulia (48.2%, n = 1,600), followed by Sicily (37.4%, n = 1241), with a smaller representation from Piedmont (14.4%, n = 476). In terms of gender composition, the sample was relatively balanced, with 51.1% male students (n = 1605) and 48.9% female students (n = 1537). The grade distribution provided good coverage across all four targeted primary school years, with third grade students representing the largest group (28.0%, n = 930), followed by fourth grade (26.9%, n = 891), second grade (22.9%, n = 759), and fifth grade students (22.2%, n = 737).

Within this sample, we identified 101 students (3.1%) who had been diagnosed with at least one Specific Learning Disorder (SLD). Breaking this down further by specific diagnosis, 44 students (1.4%) had dyslexia, 31 students (1.0%) had dyscalculia, 38 students (1.2%) had dysorthography, and 30 students (0.9%) had dysgraphia. Additionally, our sample included 178 students (5.5%) identified as having disabilities and 92 students (2.9%) with Special Educational Needs (SEN) who had personalized didactic plans but did not meet the criteria for SLD diagnosis.

2.3 Measures

The study employed two validated self-report measures to assess anxiety. Both instruments were administered in their validated Italian versions. These complementary measures allowed us to differentiate between general academic performance anxiety and mathematics-specific anxiety.

For mathematics-specific anxiety, we utilized the Abbreviated Math Anxiety Scale (AMAS; Hopko, 2003; Italian validation by Caviola et al., 2017), a 9-item instrument measuring anxiety during mathematics learning and evaluation situations. Participants rated their level of apprehension on a 5-point Likert scale from "Very little" (1) to "A lot" (5), with higher scores indicating greater math anxiety. The AMAS demonstrated satisfactory reliability in our sample, Cronbach's $\alpha = 0.750$, McDonald's $\omega = 0.752$ (Taber, 2018).

For general school-related anxiety, we administered the Worry Emotionality-Junior Questionnaire (WE-J; Di Vita & Di Martino, 2024), an adaptation of the Worry Emotionality test (Di Nuovo, 2013) designed specifically for primary school children aged 8-10 years. The WE-J consists of 16 items assessing two fundamental dimensions of performance anxiety: worry (cognitive component) and emotionality (affective-physiological component). Children rated the frequency of various anxiety symptoms during evaluative school situations on a 5-point Likert scale from "Never" to "Always". The instrument produces separate scores for both subscales while maintaining strong overall reliability, Cronbach's $\alpha = 0.893$, McDonald's $\omega = 0.893$ (Taber, 2018).

2.4 Procedure

Data were collected and recorded during the baseline assessment phase of the ABMOVE! Project between December 2024 and January 2025. The administration of questionnaires was conducted in a paper-and-pencil format under standardized conditions across all participating schools. The assessment was carried out during regular school hours, and children were also provided with age-appropriate information about the study. For younger participants (second-grade students), additional support in reading the items was provided when necessary, while ensuring they did not influence children's responses. Participation was voluntary and anonymous, with all procedures receiving approval from the ethics committees of the participating universities.

For data analysis, a comprehensive statistical approach was employed. Given that the sample, although extensive, was not randomly selected but rather represented a convenience sample from specific Italian regions, and considering the potential non-normal distribution of anxiety measures, both parametric and non-parametric statistical tests were conducted. Additionally, the substantial imbalance between subsamples (students with SLD constituting a much smaller group compared to their typically developing peers) further justified the use of non-parametric tests, which are more robust when analyzing unequal group sizes. This dual statistical approach was implemented to ensure reliable findings regardless of potential violations of parametric assumptions. For group comparisons between students with and without SLD, as well as between students with specific types of learning disorders (dyslexia, dyscalculia, dysorthography, and dysgraphia), Mann-Whitney U tests were performed.

Descriptive statistics, including means, standard deviations, medians, and ranges, were calculated to characterize the distributions of both math anxiety (AMAS) and school anxiety (WE-J) scores across different subgroups. Additionally, 95% confidence intervals were computed to provide estimates of population parameters.

All statistical analyses were conducted using the open-source software JAMOVI (version 2.3) (The jamovi project, 2022). For all inferential statistics, a significance level of $\alpha = .05$ was applied, with exact p-values reported to allow for nuanced interpretation of statistical significance.

3. Results

3.1 Math and school anxiety in students with SLD

Analysis of math and school anxiety levels revealed significant differences between students with Specific Learning Disorders (SLD) and students without reported SLD. As shown in Tab. 1, students with SLD reported higher levels of math anxiety on the AMAS compared to students without SLD. This difference was statistically significant according to Mann-Whitney U test ($U = 77425$, $p < .001$).

Similarly, total anxiety scores on the WEJ were significantly higher for students with SLD compared to typically developing students, as confirmed by Mann-Whitney U test ($U = 56230$, $p < .001$).

				95% Confidence Interval					
	SLD	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
AMAS_Tot	No	2414	19.0	18.7	19.2	18.0	6.46	9.00	45.0
	Yes	85	21.6	20.3	22.9	22.0	6.25	9.00	37.0
WEJ_tot	No	2160	38.3	37.7	38.8	38.0	12.85	16.00	80.0
	Yes	69	43.2	40.3	46.0	45.0	11.71	16.00	69.0

Table 1. Descriptive statistics for mathematics anxiety (AMAS) and school anxiety (WEJ) total scores in students with and without SLD

When examining the subscales of the WEJ (Tab. 2), students with SLD showed significantly higher scores on both the Emotionality subscale ($t(2459) = -2.14$, $p < .05$; $U = 75155$, $p < .05$) and the Worry subscale ($U = 68514$, $p < .001$). These results

suggest that students with SLD experience greater anxiety related to both the emotional and cognitive components of test anxiety.

				95% Confidence Interval					
	SLD	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
WEJ_E	No	2385	18.3	18.0	18.5	18.0	6.59	8.00	40.0
	Yes	76	19.9	18.5	21.3	20.5	6.03	8.00	34.0
WEJ_W	No	2384	20.1	19.8	20.4	20.0	7.20	8.00	40.0
	Yes	76	23.0	21.5	24.6	22.0	6.83	8.00	38.0

Table 2. Descriptive statistics for Emotionality (WEJ_E) and Worry (WEJ_W) subscales in students with and without SLD

3.2 Math and school anxiety in students with Dyslexia

When focusing specifically on students with dyslexia, we found a marginally significant difference in math anxiety as measured by the AMAS (Tab. 3). Students with dyslexia showed higher AMAS scores compared to students without dyslexia, though this difference approached but did not reach statistical significance according to Mann-Whitney U test (U = 42551, p = .087).

For school anxiety as measured by the WEJ, students with dyslexia exhibited higher total scores compared to peers without dyslexia, though again this difference was not statistically significant (U = 31500, p = .118).

				95% Confidence Interval					
	Dyslexia	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
AMAS_Tot	No	2458	19.0	18.8	19.3	18.0	6.46	9.00	45.0
	Yes	41	20.9	18.7	23.1	21.0	6.92	9.00	37.0
WEJ_tot	No	2195	38.4	37.8	38.9	38.0	12.86	16.00	80.0
	Yes	34	41.2	37.1	45.2	41.5	11.59	16.00	62.0

Table 3. Descriptive statistics for mathematics anxiety (AMAS) and school anxiety (WEJ) total scores in students with and without dyslexia

Analysis of the WEJ subscales showed that while students with dyslexia scored higher on both the Emotionality subscale and the Worry subscale (Tab. 4), neither difference reached statistical significance (U = 39688, p = .507) for Emotionality; U

= 35685, p = .060 for Worry). These results suggest that while students with dyslexia tend to experience somewhat elevated levels of math and school anxiety, these differences are more subtle than those observed in the broader SLD population.

	Dyslexia	N	Mean	Median	SD	Minimum	Maximum
WEJ_E	No	2426	18.3	18.0	6.59	8.00	40.0
	Yes	35	18.7	19.0	5.79	8.00	28.0
WEJ_W	No	2424	20.1	20.0	7.21	8.00	40.0
	Yes	36	22.2	21.5	6.72	8.00	34.0

Table 4. Descriptive statistics for Emotionality (WEJ_E) and Worry (WEJ_W) subscales in students with and without dyslexia

3.3 Math and school anxiety in students with Dyscalculia

Students with dyscalculia showed significantly higher levels of math anxiety compared to their peers without dyscalculia (Tab. 5). The AMAS total scores for students with dyscalculia were significantly higher than for students without dyscalculia, as confirmed by Mann-Whitney U test (U = 20824, p = .005).

Regarding school anxiety, students with dyscalculia reported higher total WEJ scores compared to students without dyscalculia, though this difference did not reach statistical significance (U = 18856, p = .140).

				95% Confidence Interval					
	Dyscalculia	N	Mean	Lower	Upper	Median	SD	Minimum	Maximum
AMAS_Tot	No	2474	19.0	18.8	19.3	18.0	6.47	9.00	45.0
	Yes	25	22.4	20.1	24.7	22.0	5.48	12.00	32.0
WEJ_tot	No	2208	38.4	37.8	38.9	38.0	12.85	16.00	80.0
	Yes	21	42.0	36.9	47.0	40.0	11.00	20.00	60.0

Table 5. Descriptive statistics for mathematics anxiety (AMAS) and school anxiety (WEJ) total scores in students with and without dyscalculia

Analysis of the WEJ subscales (Tab. 6) revealed no significant differences for either the Emotionality subscale (U = 24550, p = .492) or the Worry subscale (U = 22881, p = .066). These findings suggest that while dyscalculia is associated with

significantly higher math anxiety, its relationship with broader school anxiety is less pronounced.

	Dyscalculia	N	Mean	Median	SD	Minimum	Maximum
WEJ_E	No	2439	18.3	18.0	6.58	8.00	40.0
	Yes	22	19.1	19.0	6.55	10.00	28.0
WEJ_W	No	2436	20.1	20.0	7.21	8.00	40.0
	Yes	24	22.4	23.5	5.71	10.00	33.0

Table 6. Descriptive statistics for Emotionality (WEJ_E) and Worry (WEJ_W) subscales in students with and without dyscalculia

3.4 Math and school anxiety in students with dysorthography

Our analysis revealed that students with dysorthography (Tab. 7) experienced significantly higher math anxiety than their peers without this condition. AMAS total scores for students with dysorthography were significantly higher than for students without dysorthography, as confirmed Mann-Whitney U test (U = 28834, p = .018).

For school anxiety, students with dysorthography showed elevated total WEJ scores compared to students without dysorthography, though this difference did not reach statistical significance (U = 24829, p = .077).

				95% Confidence Interval					
	Dysorthographia	N	Mean	Lower	Upper	Median	SD	Minimum	Maximum
AMAS_Tot	No	2468	19.0	18.8	19.3	18.0	6.47	9.00	45.0
	Yes	31	21.5	19.4	23.7	23.0	5.89	12.00	30.0
WEJ_tot	No	2201	38.4	37.8	38.9	38.0	12.86	16.00	80.0
	Yes	28	41.8	37.8	45.8	41.5	10.39	20.00	60.0

Table 7. Descriptive statistics for mathematics anxiety (AMAS) and school anxiety (WEJ) total scores in students with and without dysorthography

When examining the WEJ subscales (Tab. 8), no significant difference was found for the Emotionality subscale (U = 34955, p = .490). However, the Mann-Whitney U test

revealed a significant difference in the Worry subscale (U = 29462, p = .037). These results suggest that students with dysorthography may experience particular difficulties with the cognitive worry component of test anxiety.

				95% Confidence Interval					
	Dysorthographia	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
WEJ_E	No	2430	18.3	18.1	18.6	18.0	6.59	8.00	40.0
	Yes	31	18.8	16.7	20.9	19.0	5.75	10.00	28.0
WEJ_W	No	2429	20.1	19.9	20.4	20.0	7.21	8.00	40.0
	Yes	31	22.4	20.2	24.5	22.0	5.85	9.00	33.0

Table 8. Descriptive statistics for Emotionality (WEJ_E) and Worry (WEJ_W) subscales in students with and without dysorthography

3.5 Math and school anxiety in students with dysgraphia

Students with dysgraphia showed slightly elevated levels of math anxiety on the AMAS compared to students without dysgraphia (Tab. 9), though this difference was not statistically significant (U = 26013, p = .294).

For school anxiety, students with dysgraphia exhibited higher total WEJ scores compared to students without dysgraphia, with this difference approaching but not reaching statistical significance (U = 18402, p = .050).

				95% Confidence Interval					
	dysgraphia	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
AMAS_Tot	No	2475	19.1	18.8	19.3	18.0	6.47	9.00	45.0
	Yes	24	20.3	17.6	22.9	20.5	6.39	9.00	36.0
WEJ_tot	No	2207	38.4	37.8	38.9	38.0	12.84	16.00	80.0
	Yes	22	42.9	37.5	48.4	46.0	12.30	16.00	65.0

Table 9. Descriptive statistics for mathematics anxiety (AMAS) and school anxiety (WEJ) total scores in students with and without dysgraphia

Analysis of the WEJ subscales (Tab. 10) revealed no significant differences for either the Emotionality subscale (U = 24471, p = .016) or the Worry subscale (U = 24902,

p = .061). These findings suggest that while students with dysgraphia tend to experience somewhat elevated levels of both math and school anxiety, these differences are less pronounced than for other specific learning disorders.

				95% Confidence Interval					
	dysgraphia	**N**	**Mean**	**Lower**	**Upper**	**Median**	**SD**	**Minimum**	**Maximum**
WEJ_E	No	2437	18.3	18.1	18.6	18.0	6.58	8.00	40.0
	Yes	24	19.8	17.2	22.4	21.0	6.23	8.00	32.0
WEJ_W	No	2434	20.1	19.9	20.4	20.0	7.20	8.00	40.0
	Yes	26	22.7	19.7	25.6	21.5	7.30	8.00	33.0

Table 10. Descriptive statistics for Emotionality (WEJ_E) and Worry (WEJ_W) subscales in students with and without dysgraphia

3.6 Comparison across specific learning disorder types

To visualize the differences in anxiety profiles across different learning disorder types, we created comparative analyses of AMAS and WEJ scores. Fig. 1 and Fig. 2 present the mean scores on math anxiety (AMAS) and school anxiety (WEJ) for students with different types of SLD compared to and students without reported SLD.

The analysis revealed that dyscalculia was associated with the highest levels of math anxiety (AMAS M = 22.4), followed by dysorthography (M = 21.5), dyslexia (M = 20.9), and dysgraphia (M = 20.3).

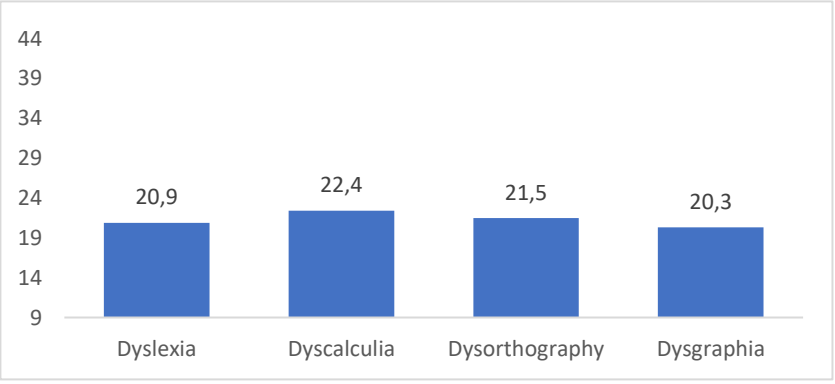

Figure 1. Mean mathematics anxiety scores (AMAS) across different types of SLD compared to typically developing students

For school anxiety as measured by the WEJ total score, students with dysgraphia showed the highest levels (M = 42.9), followed by dyscalculia (M = 42.0), dysorthography (M = 41.8), and dyslexia (M = 41.2).

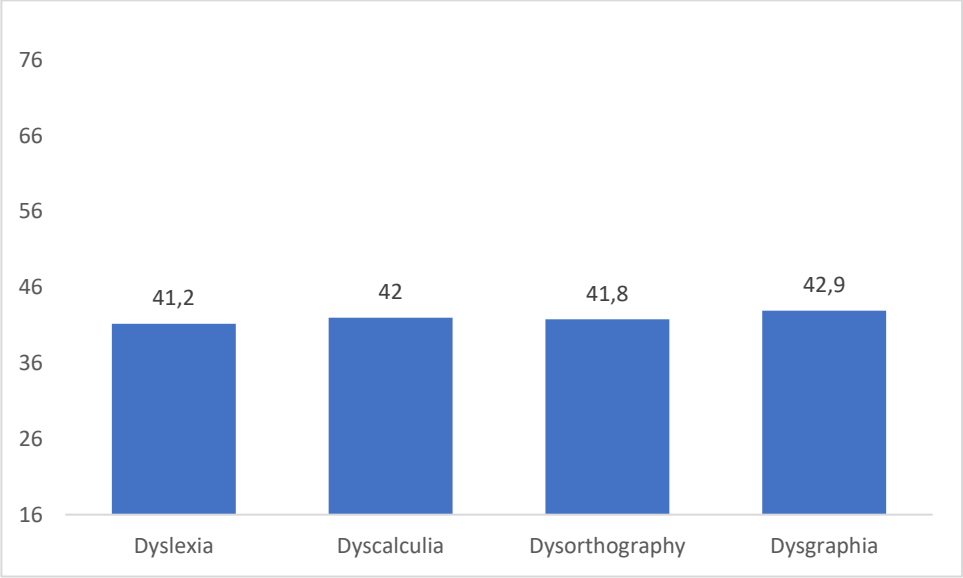

Figure 2. Mean school anxiety scores (WEJ total) across different types of SLD compared to typically developing students

Figure 3 illustrates the differential patterns observed in the cognitive (Worry) and emotional (Emotionality) components of school anxiety across different SLD types. The data reveal that students with dysorthography exhibited the most pronounced elevation in the Worry subscale (M = 22.4) compared to students without SLD (M = 20.1), while students with dysgraphia showed relatively higher scores on the Emotionality component (M = 19.8) compared to students without SLD (M = 18.3).

Notably, the cognitive worry component appears to be more consistently elevated across all SLD types compared to the emotional component, suggesting that anticipatory concerns about academic performance may represent a common feature of the SLD experience. The prominence of worry-related symptoms is particularly evident in students with dysorthography and dysgraphia, which may reflect the highly visible and frequently evaluated nature of written expression difficulties in classroom settings.

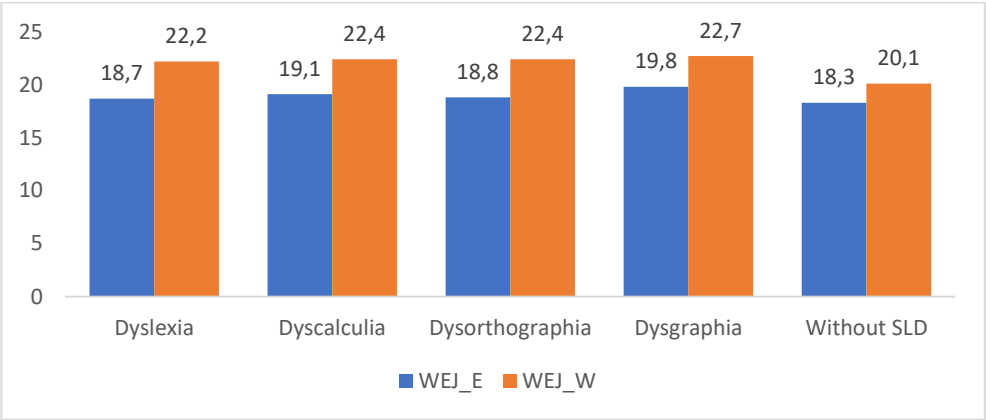

Figure 3. Comparison of Worry and Emotionality subscale scores across different types of SLD and students without SLD

These findings highlight that different types of learning disorders are associated with distinct anxiety profiles. While dyscalculia is most strongly linked to math-specific anxiety, dysgraphia appears to be associated with higher general school anxiety. Furthermore, the analysis of anxiety components reveals that students with dysorthography show particular vulnerability to cognitive worry, while students with dysgraphia exhibit elevated emotional responses compared to students without SLD. This differentiated pattern suggests that targeted interventions for anxiety reduction might need to be tailored not only to the specific learning disorder profile of each student, but also to the predominant anxiety component (cognitive versus emotional) that characterizes their experience.

4. Discussion

The present study aimed to examine the relationship between Specific Learning Disorders (SLD) and both mathematical and school anxiety in a large sample of Italian primary school students. Our findings provide substantive evidence supporting our hypotheses and reveal important patterns regarding anxiety manifestations across different types of learning disorders.

4.1 Elevated Anxiety Levels in Students with SLD

Our first hypothesis predicted that students with SLD would demonstrate significantly higher levels of both mathematical anxiety and school anxiety compared to peers without reported SLD. This hypothesis was fully confirmed.

Students with SLD showed significantly higher AMAS scores and WEJ total scores compared to students without SLD. These findings align with previous research documenting increased vulnerability to anxiety in this population (Dowker et al., 2016; Mammarella et al., 2016; Carey et al., 2019).

The significantly elevated anxiety levels confirm earlier findings by Passolunghi et al. (2020) and Mammarella et al. (2016), who emphasize that emotional dysregulation and impaired executive functioning often co-occur in children with SLDs, potentially exacerbating anxiety symptoms during academic tasks. The magnitude of these differences suggests that anxiety represents a clinically meaningful concern for students with SLD rather than merely a statistical artifact.

4.2 Differentiated Anxiety Profiles Across SLD Types

Our second hypothesis proposed that among different types of SLD, students with dyscalculia would exhibit the highest levels of mathematical anxiety, while students with other SLDs would present distinct anxiety profiles with varying manifestations of school anxiety. This hypothesis was strongly supported.

As predicted, dyscalculia was associated with the highest levels of math anxiety ($M = 22.4$), representing a statistically significant difference ($p = .005$) that aligns with domain-specificity theory of math anxiety (Ashcraft & Ridley, 2005). This finding supports the perspective that mathematical anxiety in students with dyscalculia "tends to manifest itself early and stable over time, fueled by unsuccessful school experiences, negative feedback and a perception of oneself as 'incapable' in numeracy" (Dowker et al., 2016, p. 248).

Interestingly, students with dysorthography also demonstrated significantly elevated math anxiety, second only to dyscalculia. This unexpected finding may reflect what Woltering et al. (2020) described as the generalization of anxiety from one academic domain to another, particularly when both involve symbolic representation systems.

Students with dysgraphia exhibited the highest levels of general school anxiety, consistent with Capodieci et al.'s (2020) observation that the visible nature of handwriting difficulties can lead to pronounced performance anxiety across academic contexts.

For students with dyslexia, while both math and school anxiety were elevated, the differences approached but did not reach statistical significance. This may reflect greater variability in individual compensatory strategies or increased societal and educational awareness around dyslexia (Snowling & Hulme, 2012), which may act as a protective buffer.

4.3 Cognitive and Emotional Components of Performance Anxiety

Our third hypothesis predicted that the cognitive (worry) and emotional components of performance anxiety would manifest differently across students with various types of SLD. This hypothesis was partially supported.

Analysis of the WEJ subscales revealed that students with SLD scored higher on both Emotionality and Worry components, with a more pronounced difference observed in the Worry component. This pattern suggests that while students with SLD experience physiological manifestations of anxiety, they are particularly vulnerable to cognitive rumination about potential academic failure.

The prominence of the Worry component was particularly notable in students with dysorthography. This pattern supports the cognitive interference model of anxiety (Eysenck et al., 2007), which posits that worry consumes working memory resources that would otherwise be available for task performance.

Students with dysgraphia showed elevated scores on both components, with a marginally significant difference on the Emotionality subscale, suggesting a more diffuse anxiety experience encompassing both cognitive and somatic elements, consistent with Sumner et al.'s (2016) descriptions.

4.4 Implications for Inclusive Educational Practices and Active Breaks

The differentiated anxiety profiles observed across different types of SLD highlight the need for targeted interventions that address both the cognitive and emotional needs of students. Our findings have particular relevance for the ABMOVE! Project's focus on Active Breaks as a potential intervention strategy, as physical activity interventions have demonstrated efficacy in reducing anxiety through multiple pathways (Lubans et al., 2016; Rodriguez-Ayllon et al., 2019).

Active Breaks may be especially beneficial for students with SLD given their documented difficulties with executive functions and emotional regulation (Diamond & Ling, 2019). The integration of movement into the classroom routine offers an opportunity to reset attentional resources and reduce physiological

markers of stress that can interfere with learning (Watson et al., 2017). Furthermore, Active Breaks may help disrupt the vicious cycle between anxiety and performance documented by Ashcraft and Krause (2007) by providing students with opportunities to experience success and positive affect in the classroom context.

Conclusions

The evidence emerging from this study confirms what has already been outlined in the previous paragraphs: specific learning disorders (SLDs) are not limited to a purely cognitive dimension, but are deeply intertwined with emotional and relational aspects, particularly with the manifestation of various forms of anxiety. The data collected have highlighted how each SLD profile — from dyslexia to dyscalculia, dysgraphia and dysorthography — presents specific patterns of anxiety, which can further compromise students' academic performance and quality of life. This interaction between learning difficulties and emotional distress confirms the urgent need to adopt inclusive and systemic pedagogical approaches that consider the student as a whole.

However, some methodological limitations — including the exclusive use of self-report questionnaires, the small size of the diagnostic subgroups and the absence of contextual variables such as school climate or socioeconomic status — require caution in interpreting the results, especially in terms of generalisability and causal inferences. Nevertheless, the value of the study lies in its ability to provide an initial differentiated picture of the relationships between anxiety and specific types of SLDs, paving the way for future research.

In particular, it will be essential to investigate the psychological mechanisms underlying this relationship, such as executive functions and emotional regulation, as well as to experimentally evaluate the effectiveness of interventions such as Active Breaks, which have already emerged as promising tools for supporting school well-being. Given the complex interplay between cognitive and emotional factors in SLD, addressing the cognitive worry component becomes paramount and requires explicit instruction in worry management strategies including thought stopping, positive self-talk, and grounding techniques. Creating "mistake-friendly" classroom cultures where errors become learning opportunities represents a fundamental shift in educational practice, alongside providing advance organizers and clear expectations to reduce anticipatory anxiety, and implementing pre-

assessment confidence building activities that collectively contribute to anxiety reduction in students with SLD.

Furthermore, investigating the role of teacher awareness and educational accommodation strategies may contribute to making educational interventions more effective, reducing the risk of emotional distress becoming chronic. This necessitates enhancing teacher preparation and ongoing training through comprehensive programs that provide training on recognizing anxiety manifestations specific to different SLD types, teaching evidence-based anxiety reduction techniques suitable for classroom implementation, developing skills in adapting instruction to support both learning and emotional needs, and fostering understanding of the neurobiological connections between learning difficulties and anxiety. Such professional development initiatives are essential for creating educators who can effectively navigate the complex relationship between academic challenges and emotional well-being in their students.

In summary, this study represents a significant contribution to the existing literature, as it specifically analyzes the different anxiety profiles in relation to various types of SLD and offers insights for the development of targeted interventions, such as active breaks and comprehensive teacher training programs, which can effectively support the emotional well-being and learning of students with SLD in the Italian school context.

Author contributions

This article is the result of a collaborative effort, with all authors contributing substantially to its conception, development, and finalization. Specific responsibilities were as follows: Valeria Di Martino was responsible for paragraphs 2.1, 2.4, 3.1, 3.2, 3.3, 3.4, 3.5, 4.2, 4.3 and 4.4; Clarissa Sorrentino was responsible for paragraphs 2.2, 4 and 4.1; Rosa Bellacicco was responsible for paragraphs 2.3, 3.6 and 4.4; Angela Diverti was responsible for: Introduction, paragraphs 1, 1.1, 1.2, 1.3, 1.4 and Conclusion.

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