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MEJORANDO LA EDUCACIÓN MATEMÁTICA: ENFOQUES EFECTIVOS PARA ENSEÑAR ECUACIONES LINEALES A ESTUDIANTES CON Y SIN DIFICULTADES DE APRENDIZAJE

Enhancing mathematics education: effective approaches for teaching linear equations to students with and without learning difficulties

Melhorando a educação matemática: abordagens eficazes para ensinar equações lineares a estudantes com e sem dificuldades de aprendizagem.

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Abstract

This study examined the teaching complexities of linear equations to students with Specific Learning Difficulties (SpLDs), such as dyslexia and dyscalculia, compared to students without SpLDs but with difficulties in mathematics. It intended to identify significant differences in mathematicians' teaching experiences, the impact of these challenges on students' lives, and the effectiveness of specialized teaching strategies. Conducted with 380 mathematics teachers in secondary schools across Attica and Thessaloniki, Greece, this quantitative study employed Two-Tailed Wilcoxon Signed Rank Test and Spearman's rho correlation. Findings highlighted the heightened difficulties faced by students with SpLDs in learning linear equations, necessitating more varied and intensive interventions. A positive correlation was noted between the interventions and factors contributing to SpLDs, implying the need for personalized teaching approaches. The study highlights early identification of student difficulties, individualized support, and the need for a more inclusive and supportive learning environment, suggesting policy revisions for inclusive education and further research on effective, innovative educational tools.

Resumen

Este estudio examinó las complejidades de la enseñanza de ecuaciones lineales a estudiantes con Dificultades Específicas de Aprendizaje (DEA), como dislexia y discalculia, en comparación con estudiantes sin DEA pero con dificultades en matemáticas. Su objetivo era identificar diferencias significativas en las experiencias de enseñanza de los matemáticos, el impacto de estos desafíos en la vida de los estudiantes y la efectividad de estrategias de enseñanza especializadas. Realizado con 380 profesores de matemáticas en escuelas secundarias a través de Ática y Tesalónica, Grecia, este estudio cuantitativo empleó la Prueba de Rangos con Signos de Wilcoxon de Dos Colas y la correlación rho de Spearman. Los hallazgos destacaron las mayores dificultades enfrentadas por estudiantes con DEA en el aprendizaje de ecuaciones lineales, lo que requiere intervenciones más variadas e intensivas.

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Se notó una correlación positiva entre las intervenciones y los factores que contribuyen a las DEA, implicando la necesidad de enfoques de enseñanza personalizados. El estudio destaca la identificación temprana de las dificultades de los estudiantes, el apoyo individualizado y la necesidad de un entorno de aprendizaje más inclusivo y de apoyo, sugiriendo revisiones de políticas para la educación inclusiva y más investigación sobre herramientas educativas efectivas e innovadoras.

Resumo

Este estudo examinou as complexidades do ensino de equações lineares a estudantes com Dificuldades Específicas de Aprendizagem (DEA), como dislexia e discalculia, em comparação com estudantes sem DEA mas com dificuldades em matemática. Pretendia identificar diferenças significativas nas experiências de ensino dos matemáticos, o impacto desses desafios na vida dos estudantes e a eficácia de estratégias de ensino especializadas. Realizado com 380 professores de matemática em escolas secundárias através de Ática e Tessalônica, Grécia, este estudo quantitativo empregou o Teste de Postos com Sinal de Wilcoxon de Duas Caudas e a correlação rho de Spearman. Os resultados destacaram as dificuldades aumentadas enfrentadas por estudantes com DEA no aprendizado de equações lineares, necessitando intervenções mais variadas e intensivas. Uma correlação positiva foi notada entre as intervenções e os fatores que contribuem para as DEA, implicando a necessidade de abordagens de ensino personalizadas. O estudo destaca a identificação precoce das dificuldades dos estudantes, suporte individualizado e a necessidade de um ambiente de aprendizagem mais inclusivo e de apoio, sugerindo revisões de políticas para a educação inclusiva e mais pesquisa sobre ferramentas educacionais eficazes e inovadoras.

Keywords: Specific Learning Difficulties (SpLDs), Linear Equations, Educational Strategies, Math Anxiety, Cognitive Differences.

Palabras Clave: Dificultades Específicas de Aprendizaje (DEA), Ecuaciones Lineales, Estrategias Educativas, Ansiedad Matemática, Diferencias Cognitivas.

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Palavras-chave: Dificuldades de Aprendizagem Específicas (DAEs), Equações Lineares, Estratégias Educacionais, Ansiedade em Matemática, Diferenças Cognitivas.

Introducción

Teaching linear equations in Mathematics education presents challenges to students with SpLD and without difficulties but having difficulties in mathematics in general. These not only affect the academic performance of students, but also have great implications in their life scenarios. That demands customized interventions and deep comprehension of the contributing factors in order to be considered appropriate aids in the process of their learning.

Thus, for students with SpLDs, among the most common being dyslexia and dyscalculia, the study of linear equations presents special challenges. These challenges include underlying cognitive differences relate to speed processing and memory, alongside the perception and understanding of visual-spatial information, and language processing. For example, students with dyscalculia have difficulties in abstract mathematical concepts and symbols, thus it is a challenge to understand and solve the linear equations of linear (Oginni & Olugbuyi, 2014; Peters et al., 2018). Apparently, students who find mathematics to be quite difficult yet do not have SpLDs have been found to suffer from math anxiety and negative attitude towards it, coupled with a lack of basic knowledge rather than from some kind of cognitive dysfunctions (Ashcraft & Moore, 2009; Dowker et al., 2016).

The impact of SpLDs on students' lives is way more than the academic challenges. It can deeply affect the self-esteem, motivation, and social interaction of the student, thus causing long-term consequences in personal and professional opportunities. SpLDs require the holistic support that goes beyond mere academic interventions to cover psychological support and general class teaching (Alfonso & Flanagan, 2018; Mantzáris, 2019). In the same way, poor math performance among children without SpLDs leads to low confidence, high anxiety, and low performance, generally impacting the quality

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of their life and their attitudes toward learning. However, these impacts are more directly tied to the actual experiences of the children and the attitudes created within society more so than to inherent cognitive differences.

Interventions for students with SpLDs require specialized teaching methods that address their specific learning needs. These can run the gamut from multisensory teaching approaches, to explicit instruction in mathematical vocabulary, to use of visual aids and any accommodations such as extra time for processing (Pollack & Waller, 1994; L. Fuchs & D. Fuchs, 2002). The intervention for those without SpLDs, but struggling with mathematics, would possibly involve strategies around increasing confidence, changing negative attitudes towards mathematics, as well as the solidification of foundational skills through the use of creative pedagogies and supportive classroom environments (Van de Walle et al., 2010; Swan, 2000).

Factors contributing to SpLDs and learning difficulties in mathematics are multi-factorial. Often, SpLDs are associated with biological, genetic, and environmental factors, such as differences in brain structure and function, genetic predispositions, and unfavorable environmental conditions (Swanson et al., 2014; Selikowitz, 2012). On the other hand, problems in mathematics without SpLDs are affected by a lack of practice because of disinterest or creating a negative impression because of social norms. Due to the lack of suitable opportunities for practicing along with the non-supporting classroom environment, such challenges become aggravated (Boaler, 2016). This creates a vicious cycle of anxiety-avoidance that prevents students further from learning and deriving pleasure from mathematics (Dowker et al., 2016).

Teachers are supposed to be in very many other roles to enhance students' successes in dealing with difficulties in mathematics. This includes them not only having a deep understanding of the mathematical concepts but also committed to creating a supportive and engaging environment for learning. For example, building a classroom culture that supports questions and considers mistakes to be a part of learning math may profoundly add to the reduction of math anxiety and enhance perseverance and acceptance among students (Kunwar, 2020). In addition, effective teaching and learning of mathematics can only take place through comprehensive implementation based on cooperative

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efforts among the teachers, the institutions, and the policymakers to enable all students to reach their full potential in the subject (Peters et al., 2018).

Therefore, teaching the linear equations or, in general, teaching of mathematics requires understanding the distinct challenges that students with and without SpLDs face. Interventions and teaching strategies would have to be custom-designed for the each group of students that take into account the cognitive, emotional, and environmental factors contributing to their learning difficulties. Creating a supportive and inclusive learning environment where every child can overcome these barriers in mathematics and achieve to their maximum ability, equipping them to meet the wider challenges in the world outside the classroom walls.

Methodology

The general objective of this study is to investigate and understand the complexities and distinctions in teaching linear equations to students with Specific Learning Difficulties (SpLDs) and those without SpLDs but who face difficulties in mathematics. This involves examining the challenges, impacts, interventions, methods, and strategies relevant to both groups, with the aim of enhancing the educational experience and outcomes for these students.

The specific objectives of this research are as follows:

Q1 – To determine if there are significant differences in difficulties found when teaching linear equations to students with SpLDs compared to those without SpLDs but with difficulties in mathematics.
Q2 – To assess the differential impacts of SpLDs and general mathematics difficulties on students' lives.
Q3 – To evaluate the differences between interventions, comprehensive methods, and strategies used in teaching mathematics to students with SpLDs and those without SpLDs but with difficulties in mathematics.
Q4 – To investigate and understand the relationship between interventions, teaching methods, and strategies tailored to students with Specific Learning Difficulties (SpLDs) and those without SpLDs but who

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experience difficulties in mathematics, focusing on how these educational approaches relate to the challenges encountered in learning linear equations, the contributing factors to both SpLDs and general learning difficulties in mathematics, and their impact on students' lives.

Based on the specific objectives mentioned and considering the literature review, the following research questions are formulated:

1) Are there any significant differences between difficulties found when teaching linear equations to students with SpLDs and students without SpLDs but with difficulties in mathematics?
2) Are there any significant differences between the Impact of SpLDs on students' lives and the Impact of difficulties in mathematics on students without SpLDs' lives?
3) Are there any significant differences between Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs and students without SpLDs but with difficulties in mathematics?
4) What relationship exists between Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs and Difficulties in mathematics in the context of linear equations for students with SpLD, Factors contributing to SpLDs as well as the Impact of SpLDs on students' lives?
5) What relationship exists between Interventions, comprehensive methods and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics, and the Difficulties in mathematics in the context of linear equations for students without SpLDs, Factors contributing to learning difficulties in mathematics, and the Impact of difficulties in mathematics on students without SpLDs' lives?

This study focused on the educational sector, applying quantitative research methods to enhance understanding and improvement in teaching and learning as per Lodico et al. (2006). It adopted a quantitative approach, characterized by hypothesis testing and numerical data analysis. According to Bloomfield and Fisher (2019), quantitative research is divided into descriptive, correlational,

quasi-experimental, and experimental categories. Specifically, this research utilized a correlational design to explore the relationships between variables in their natural settings, aiming to identify significant associations without manipulating the variables.

This research design followed a structured approach as detailed by Graziano and Raulin (2019), encompassing seven distinct phases:

Phase 1: Idea-generation, where the research topic is identified.
Phase 2: Problem-definition, refining the initial concept into a more precise question.
Phase 3: Procedures-design, establishing the methods for data collection and analysis.
Phase 4: Observation, collecting data from participants.
Phase 5: Data-analysis, applying statistical techniques to the gathered information.
Phase 6: Interpretation, comparing results with theoretical predictions.
Phase 7: Communication, drafting a report to share findings with peers or for publication, which includes a detailed account of all preceding steps.

The study population targeted mathematics teachers in secondary schools across Attica and Thessaloniki in Greece, focusing on a 1,243 public schools, including both general and special education schools. Employing simple random sampling for equitable selection, a comprehensive list enabled the use of a random number generator to pick participants. Out of 700 targeted mathematics teachers, 380 (54% response rate) completed the questionnaires, comprising the study's final sample. This sample notably included a gender distribution of 58.2% males and 41.8% females. The educational qualifications of mathematicians in the study showed that 63.4% had a bachelor's degree, 29.5% had a master's degree, and 7.1% held a Ph.D. Regarding teaching experience, 12.4% had less than 10 years, 39.7% had between 10 and 20 years, and the largest group, 47.9%, had over 20 years of experience in education.

The study applied a quantitative research method. Specifically, a descriptive method was employed through a structured questionnaire which designed

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around the theoretical framework and the research questions as primary tool for data collection. This questionnaire was divided into four sections, including both closed-ended (simple and Likert scale) and open-ended formats. Each section focused on specific areas of interest:

Sociodemographic Information - This section included questions about the participants' sex, level of studies, and teaching experience.

Experience, knowledge of characteristics and difficulties in mathematics among students with SpLDs - This section explores the level of knowledge and experience of mathematicians concerning the characteristics and difficulties of students with SpLDs. It is further divided into six sub-dimensions, covering education, training, understanding of SpLDs, knowledge about the causes of SpLDs, difficulties experienced by students with SpLDs, factors contributing to learning challenges, and the impact of SpLDs on students' lives.

Characteristics and difficulties in mathematics among students without SpLDs - This section explores the experiences of mathematicians with the characteristics and difficulties in mathematics among students without SpLDs, divided into four sub-dimensions. It assesses the extent of difficulties encountered, specific challenges in linear equations, contributing factors to learning difficulties, and the impact of these difficulties on students' lives.

Comparative Evaluation of challenges and distinctions - The comparison of the challenges and differences of the students with and without SpLDs falling actually in the difficulty of the subject of Mathematics. This part gets aligned with five sub-dimensions, which are the way of collecting data, diagnosis of the difficulties in Mathematics, intervention, and strategies in teaching Mathematics, and the factors, which affect the support of the children facing difficulty. It has also evaluated the support, which is needful in its proper juncture for the students with or without SpLDs.

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The questionnaire's validity and reliability are crucial for the effectiveness of the study, as highlighted by Cohen, Manion, & Morrison (2007) and Creswell (2012). Validity ensures the questionnaire's questions are aligned with the study's objectives, enhancing its value. Reliability, on the other hand, measures the consistency of responses, with Flynn et al. (1990) suggesting repeated completions by the same entity as a test for absolute reliability. A pilot study, recommended by Hazzi & Maldaon (2015) as a key part of research design, was conducted to assess the questionnaire's reliability and validity. This involved data collection from the selected regions of Attica and Thessaloniki, were firstly participants approached through their school units' telephone numbers, with the purpose to refine the questionnaire for accuracy, clarity, and to prevent misunderstandings.

The pilot study for the questionnaire involved seventy mathematics teachers, selected and then contacted by telephone to ensure they understood the prerequisites, process, and purpose of the research. The sample demographics showed 57.1% men and 42.9% women. Educational qualifications within the group were predominantly bachelor's degrees (67.1%), followed by master's degrees (28.6%), and a small fraction (4.3%) with Ph.D.s. Regarding teaching experience, 10.0% had less than 10 years, 38.6% had between 10 and 20 years, and the majority (51.4%) boasted over 20 years of experience.

Internal consistency analysis using Cronbach's Alpha and item discrimination analysis through Student's t-test was performed to confirm the validity and reliability of the questionnaire. These analyses were applied to the Likert scale questions in sections two, three and four, evaluating the homogeneity across the 71 questions.

The scale's reliability analysis obtained a Cronbach's Alpha value of 0.954, showing a high reliability criterion, as indicated by Flynn et al. (1990). On applying the test across different dimensions, values exceeding 0.885 were achieved, as shown in Table 1.

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Table 1

Cronbach's Alpha coefficient of the questionnaire according to dimensions and subdimensions

Subdimensions	Cronbach's alpha
Knowledge about the causes of SpLDs	.948
Difficulties in mathematics in the context of linear equations for students with SpLDs	.952
Factors that may contribute to SpLDs	.927
Impact of SpLDs on students' lives	.885
Difficulties in mathematics in the context of linear equations for students without SpLDs	.935
Factors that may contribute to learning difficulties in mathematics among students without SpLDs	.951
Impact of difficulties in mathematics on students without SpLDs' lives	.916
Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs	.975
Interventions, comprehensive methods and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics	.977
Factors influence the appropriate support for students, both with and without SpLDs, who are facing difficulties in mathematics	.956
Appropriate level of support for students with and without SpLDs	.902

Data analysis strategies

The research made use of IBM SPSS Statistics V.25 for quantitative data analysis, starting with a pilot survey to test the questionnaire's reliability and validity. Cronbach's Alpha assessed the internal consistency of the Likert scale questions, and the Student's t-test for independent samples evaluated the discrimination coefficient between low and high score groups. Following data correction and coding, the final data's normality was examined using skewness, kurtosis, and the Kolmogorov-Smirnov test, leading to the adoption of non-parametric tests due to non-normal distribution.

Descriptive analysis provided central tendency and dispersion measures (median and interquartile range) for study's items. Variables representing means of sub-dimensions were analyzed for their relationships. Specifically, the study explored the connections between difficulties in teaching linear equations to students with and without SpLDs, the impact of these difficulties and SpLDs on students' lives, contributing factors to SpLDs and learning difficulties, and the

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interventions used by mathematicians. A comparative analysis using the Two-Tailed Wilcoxon Signed Rank Test was conducted to address the first three specific objectives. Additionally, correlation tests through Spearman's rho index were performed, targeting the dimensions mentioned above to address the fourth and fifth specific objectives.

Results

Table 2 presents the measures of central tendency (median) along with dispersion and variability (interquartile range) for each sub-dimension. These sub-dimensions incorporates the mathematicians' knowledge of difficulties found while teaching linear equations for both students with and without SpLDs, the impact of these difficulties on the lives of students with and without SpLDs, the interventions, comprehensive methods, and strategies for teaching mathematics and linear equations to students with and without SpLDs, and the factors contributing to learning difficulties in mathematics for students with and without SpLDs.

Table 2

Mathematicians' knowledge of the complexities involved in teaching linear equations and supporting students with and without SpLDs.

	N	Mdn	IQR
Difficulties in mathematics in the context of linear equations for students with SpLDs	380	4.89	.33
Difficulties in mathematics in the context of linear equations for students without SpLDs	380	4.89	.44
Impact of SpLDs on students' lives	380	3.67	1.00
Impact of difficulties in mathematics on students without SpLDs' lives	380	3.33	1.00
Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs	380	2.11	1.89
Interventions, comprehensive methods and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics	380	2.00	1.56
Factors that may contribute to learning difficulties in mathematics among students without SpLDs	380	2.50	1.69
Factors influence the appropriate support for students, both with and without SpLDs, who are facing difficulties in mathematics	380	3.29	.57

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A comparative study explored the connection between mathematicians' understanding of the difficulties in teaching linear equations to students with and without SpLDs. Through a two-tailed Wilcoxon signed-rank test, the study aimed to identify significant differences in the difficulties encountered while teaching linear equations, the impact of these difficulties on students' lives, and the interventions and strategies used.

More specifically, as presented in table 3, the statistical analysis revealed significant findings across the three dimensions concerning teaching linear equations to students with and without SpLDs. First, mathematicians face significantly fewer difficulties teaching students without SpLDs (Z=-2.575, p=.010). Second, the perceived impact of mathematical difficulties on students' lives is significantly lower for those without SpLDs (Z=-5.922, p<.001). Lastly, there are significantly fewer interventions and strategies used for teaching students without SpLDs compared to those with SpLDs (Z=-8.355, p<.001).

Results indicated that mathematicians face fewer difficulties while teaching linear equations and perceive a lower impact on students without SpLDs, also applying fewer interventions and strategies for them compared to students with SpLDs.

The findings, are significant across all dimensions (difficulty in teaching, impact on lives, interventions/strategies), highlight the distinct challenges and needs of students with SpLDs in learning linear equations.

Table 3

Comparison of means about the attitudes and perceptions of directors of special education school unit according to the variable Levels of knowledge

	Negative ranks		Positive ranks		Test statistics		
	N	Mean rank	N	Mean rank	Ties	Z	p
Difficulties in mathematics in the context of linear equations for students without SpLDs – Difficulties in mathematics in the context of linear equations for students with SpLDs	141	135.02	112	116.91	127	-2.575[a]	.010

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Impact of difficulties in mathematics on students' lives – Impact of difficulties in mathematics on students without SpLDs' lives	223	171.28	110	158.33	47	-5.922[a]	<.001
Interventions, comprehensive methods and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics – Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs	141	102.77	43	58.83	196	-8.355[a]	<.001

Note. [a] Based on positive ranks
[b] Based on negative ranks

A correlational study employing Spearman's rho index investigated the relationship between the teaching interventions for students with SpLDs, the difficulties these students encounter in mathematics specifically within linear equations, the factors contributing to SpLDs, and the impact of SpLDs on students' lives. The analysis revealed as presented in table 4:

A weak positive correlation between the teaching interventions for students with SpLDs and their difficulties in mathematics within linear equations (r=.172, p=.001), suggesting a slight increase in teaching interventions is associated with an increase in observed difficulties.

A very strong positive correlation was found between the teaching interventions for students with SpLDs and the factors contributing to SpLDs (r=.804, p<.001), indicating that as the complexity of contributing factors to SpLDs increases, so does the extent of teaching interventions.

A weak positive correlation exists between the teaching interventions for students with SpLDs and the impact of SpLDs on students' lives (r=.326, p<.001), showing a mild association where increased teaching interventions correspond with an increased perceived impact of SpLDs on students' lives.

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Table 4

Correlation between Interventions, comprehensive methods, and strategies for teaching mathematics to students with SpLDs, and the Difficulties in mathematics in the context of linear equations for students with SpLDs, Factors contributing to SpLDs as well as the Impact of SpLDs on students' lives

		Difficulties in mathematics in the context of linear equations for students with SpLDs	Factors contributing to SpLDs	Impact of SpLDs on students' lives
Interventions, comprehensive methods and strategies for teaching mathematics to students with SpLDs	r	.172**	.804**	.326**
	p	.001	<.001	<.001

*Note.*** The correlation is significant at the 0.01 level (2-tailed).

Also, a correlational study using Spearman's rho index explored the relationship between teaching interventions for students without SpLDs facing difficulties in mathematics, specifically within the context of linear equations, and various related variables. The findings indicated as indicated in table 5:

No significant relationship between the interventions and strategies for teaching mathematics to students without SpLDs and their difficulties in linear equations (r=.040, p=.441), suggesting that the applied teaching methods do not directly correlate with difficulties encountered in this area.

A moderate positive association was found between the interventions and strategies for teaching and the factors contributing to learning difficulties in mathematics among students without SpLDs (r=.556, p<.001), indicating that as the complexity of contributing factors increases, so does the extent of teaching interventions.

A weak positive association was observed between the interventions and strategies for teaching and the impact of these difficulties on the lives of students without SpLDs (r=.212, p<.001), showing a slight association where increased teaching interventions correspond with an increased perceived impact of difficulties on students' lives.

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Table *5*

Correlation between Interventions, comprehensive methods, and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics, and the Difficulties in mathematics in the context of linear equations for students without SpLDs, Factors contributing to learning difficulties in mathematics, and the Impact of difficulties in mathematics on students without SpLDs' lives

		Difficulties in mathematics in the context of linear equations for students without SpLDs	Factors contributing to learning difficulties in mathematics among students without SpLDs	Impact of difficulties in mathematics on students without SpLDs' lives
Interventions, comprehensive methods and strategies for teaching mathematics to students without SpLDs but with difficulties in mathematics	r	.040	.556**	.212**
	p	.441	<.001	<.001

*Note.*** The correlation is significant at the 0.01 level (2-tailed).

Conclusions and Discussion

This article explores the peculiarities of teaching linear equations to students with Specific Learning Difficulties (SpLDs), in comparison to students without them, in an attempt to report how such teaching challenges affect student well-being and whether these concerns influence the effectiveness of any specific educational strategies. The research identified that students diagnosed with SpLDs encounter serious issues in understanding abstract mathematical concepts, and this is an area where Peters et al. (2018) along with Taylor & Vestergaard (2022) proposed new methods of instruction for creative learning of children or individuals having dyslexia and dyscalculia. In relation to this, Almahrag (2021) and Duff et al. (2023) identified a necessity for additional instruction and reported lower academic achievements in this demographic, suggesting that traditional teaching methods might not suffice.

Significantly, the study also revealed that SpLDs profoundly affect a learner's life beyond academics, touching self-esteem, motivation, and social interaction. This is supported by Hulme & Snowling (2016) and Sofwan et al. (2020), who discussed, apart from the academic risks, the broader academic and emotional development risks associated with unaddressed dyscalculia and dyslexia. Abd

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Rauf et al. (2020) and Schulte-Körne (2016) went further and elaborated that these learning difficulties were also related to difficulties in social skill development and fear of failure, which called for an integrated support system, as also reported by Alfonso and Flanagan (2018).

The significance of specialized educational practices is an emerging theme, the presented results indicate that multisensory techniques combined with technology have been able to create successful personalized learning environments. This aligns with the observations of Taylor & Vestergaard (2022) and Mahmud et al. (2020),who put great emphasis on early intervention and collaborative approaches to managing SpLDs. Additionally, the study highlighted the importance of teacher preparedness in creating an inclusive educational setting, as stressed by Johnson (2017).

Our analysis found a weak positive association of interventions on academic support for students with SpLDs and improvement in the skills of mathematics. Shin and Bryant (2017) and Witzel & Mize (2018) further argued that both computer-assisted instructions and validated assessments increased learning. However, for students without SpLDs, there was no significant correlation and contrasting with SSumirattana et al. (2017) and Yu & Singh (2016) who underscored the importance of adapting problems to students' backgrounds and the indirect benefits of teacher support on self-efficacy and interest in mathematics.

The study also identified a strong positive correlation between interventions for students with SpLDs and contributing factors to SpLDs, evidently hearing the same appeals for early detection and purposeful intervention that are made by Sunil et al. (2023) and Rajesh & Sunney (2021). Another finding in the research was the addressing math anxiety through strategic teaching methods, as proposed by Luttenberger et al. (2018). Key findings of Choi et al. (2017) were that both attitude change and inclusive education brought about an improved rise in the academic performance of all students.

Furthermore, our study claims a weak positive impact of interventions on the lives of students with SpLDs, corroborating previous research. Alamro (2019) noted the important role played by educators in overcoming dyslexia and

dyscalculia. Tam and Leung (2019) emphasizing the necessity of self-regulation and motivation to the program of training. The absence of such specific support puts students with dyscalculia at substantial risk regarding their academic performance; it is one of the major factors, if not the primary one, underlying the imperative need for policy and educational intervention, as noted by Schulte-Körne (2016) and Haberstroh & Schulte-Kör.

Similarly, for students without SpLDs, a weak positive correlation was found between teaching strategies and life outcomes. This confirms earlier research by Dowker et al. (2016) on the profound negative impacts of math anxiety. Revision of traditional instructional methods, as suggested by Luttenberger et al. (2018), can alleviate math anxiety, thereby improving academic and career choices. Choi et al. (2017) add that inclusive education has also been reported to yield success in an entire range of academic accomplishments across the ability spectrum—suggesting potentially huge benefits from adaptive teaching techniques.

In summary, this research further cements the need for more inclusive and effective teaching practices for students with SpLDs, further emphasizing the constant innovation, investigation, and collaborations between teachers and policymakers. Additional studies should try to expand their scope in studies to include longitudinal data and dig deeper into the efficaciousness of specific interventions so that a full picture of today's educational landscape can be painted for students with or without SpLDs.

Referencias Bibliográficas

Abd Rauf, A. A., Akmar Ismail, M., Balakrishnan, V., Cheong, L. S., Admodisastro, N. I., & Haruna, K. (2020). Analysis of Support for Parents in Raising Children with Dyslexia. *Journal of Family Issues*, 42(2), 276-292. https://doi.org/10.1177/0192513X20948925

Alamro, R. (2019). Strategies for Teaching Primary School Students with Learning Difficulties; Dyslexia and Dyscalculia. *Journal of Special Education and Rehabilitation (JSER)*, 9(32), 1-41. https://doi.org/10.12816/0054853

Alfonso, V. C., & Flanagan, D. (2018). *Essentials of specific learning disability identification.* Hoboken: John Wiley & Sons.

Almahrag, K. M. (2021). Effect dyslexia on early learning of mathematics to the children. *Arts and Design Studies*, 95, 34-39. https://doi.org/10.7176/ADS/95-05

Ashcraft, M., & Moore, A. (2009). Mathematics anxiety and the affective drop in performance. *Journal of Psychoeducational Assessment*, 27, 197-205. https://doi.org/10.1177/0734282908330580

Bloomfield, J., & Fisher, M. J. (2019). Quantitative research design. *Journal of the Australasian Rehabilitation Nurses' Association (JARNA)*, *22*(2), 27–30. https://doi.org/10.33235/jarna.22.2.27-30

Boaler, J. (2016). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass/Wiley.

Choi, J. H., Meisenheimer, J. M., McCart, A. B., & Sailor, W. (2017). Improving Learning for All Students Through Equity-Based Inclusive Reform Practices: Effectiveness of a Fully Integrated Schoolwide Model on Student Reading and Math Achievement. *Remedial and Special Education*, 38(1), 28-41. https://doi.org/10.1177/0741932516644054

Cohen, L., Manion, L. & Morrison, K. (2007). *Research Methods in Education* (6th ed.). London: Routledge.

Creswell, J. W. (2012). *Educational research: planning, conducting, and evaluating quantitative and qualitative research (4th ed.)*. Boston, MA: Pearson.

Dowker, A., Sarkar, A., & Looi, C. Y. (2016). Mathematics anxiety: What have we learned in 60 years? *Frontiers in Psychology*, 7, 508. https://doi.org/10.3389/fpsyg.2016.00508

Duff, D. M., Hendricks, A. E., Fitton, L., & Adlof, S. M. (2023). Reading and Math Achievement in Children With Dyslexia, Developmental Language Disorder, or Typical Development: Achievement Gaps Persist From Second Through Fourth Grades. *Journal of Learning Disabilities*, 56(5), 371-391. https://doi.org/10.1177/00222194221105515

Flynn, B., Sakakibara, S., Schroeder, R., Bates, K., Flynn, J. (1990): Empirical research methods in operations management. *Journal of operations management*, 9(2), 250-284. https://doi.org/10.1016/0272-6963(90)90098-X

Fuchs, L. S., & Fuchs, D. (2002). Mathematical Problem-Solving Profiles of Students with Mathematics Disabilities With and Without Comorbid Reading Disabilities. *Journal of Learning Disabilities*, 35(6), 564-574. https://doi.org/10.1177/00222194020350060701

Graziano, A., & Raulin, M. (2019). *Research Methods: A Process of Inquiry (9th ed.)*. Harlow: Pearson.

Haberstroh, S., & Schulte-Körne, G. (2019). The Diagnosis and Treatment of Dyscalculia. *Deutsches Arzteblatt international*, 116(7), 107–114. https://doi.org/10.3238/arztebl.2019.0107

Hazzi, O. & Maldaon, I. (2015). A pilot study: vital Methodological issues. *Verslas:Teorija ir praktika/business:Theory and Practice*, 16(1), 53-62. https://doi.org/10.3846/btp.2015.437

Hulme C, Snowling MJ. (2016). Reading disorders and dyslexia. Curr *Opin Pediatr*, 28(6), 731-735. https://doi.org/10.1097/MOP.0000000000000411

Johnson, B. (2017). Learning Disabilities in Children: Epidemiology, Risk Factors and Importance of Early Intervention. *BMH Medical Journal - ISSN 2348–392X*, 4(1), 31-37. https://www.babymhospital.org/BMH_MJ/index.php/BMHMJ/article/view/120

Kunwar, R. (2020). Mathematics Phobia: Causes, Symptoms and ways to overcome. *International Journal of Creative Research Thoughts*, 8(8), 2320-2882. http://www.ijcrt.org/papers/IJCRT2008103.pdf

Lodico, M. G., Spaulding, D. T., & Voegtle, K. H. (2006). *Methods in Educational Research: From Theory to Practice.* San Francisco: Jossey - Bass.

Luttenberger, S., Wimmer, S., & Paechter, M. (2018). Spotlight on math anxiety. *Psychology research and behavior management*, 11, 311–322. https://doi.org/10.2147/PRBM.S141421

Mahmud, M.S., Zainal, M.S., Rosli, R., & Maat, S.M. (2020). Dyscalculia: What We Must Know about Students' Learning Disability in Mathematics? *Universal Journal of Educational Research*. https://doi.org/10.13189/ujer.2020.082625

Mantzáris, K. (2019). *Mathisiakés dyskolíes kai filikés schéseis: i optikí ton efívon me mathisiakés dyskolíes kai ton stenón tous fílon* [Learning disabilities and friendships: the perspective of teenagers with learning disabilities and their close friends]. Athína: Thesis.

Oginni, O. I. & Olugbuyi, O. (2014). An appraisal of sciences and mathematics dyslexia and dyscalculia syndrome among secondary schools students. *American Journal of Educational Research*, 2 (4), 219-224. https://doi.org/10.12691/education-2-4-7

Peters, L., Bulthe, J., Danies, N., & de Beeck, H. O. (2018). Dyscalculia and dyslexia: Different behavioral, yet similar brain activity profiles during arithmetic. *Neurolmage: Clinical*, 18, 1-35. https://doi.org/10.1016/j.nicl.2018.03.003

Pollack, J., & Waller, E. (1994). *Day-To-Day Dyslexia in the Classroom*. London: Routledge.

Rajesh, R., Sunney, H. (2021).Assessment on prevalence and risk factors of dyslexia among primary school students. *Indian Journal of Psychiatric Nursing*, 18(2), 85-9. https://doi.org/10.4103/iopn.iopn_18_21

Schulte-Körne, G. (2016). Mental health problems in a school setting in children and adolescents. *Deutsches Ärzteblatt International*, 113(11), 183–190. https://doi.org/10.3238/arztebl.2016.0183

Selikowitz, M. (2012). *Dyslexia and other learning difficulties.* Oxford, New York: Oxford University Press.

Shin, M., & Bryant, D. P. (2017). Improving the Fraction Word Problem Solving of Students With Mathematics Learning Disabilities: Interactive Computer Application. *Remedial and Special Education*, 38(2), 76-86. https://doi.org/10.1177/0741932516669052

Sofwan, M. M. & Roslinda, R. & Siti, M. & Mohd, Z. (2020). Dyscalculia: What We Must Know about Students' Learning Disability in Mathematics?. *Universal Journal of Educational Research*, 8, 8214-8222. https://doi.org/10.13189/ujer.2020.082625

Sumirattana, S., Makanong, A., & Thipkong, S. (2017). Using realistic mathematics education and the DAPIC problem-solving process to enhance secondary school students' mathematical literacy. *The Kasetsart Journal Social Sciences*, 38, 307-315. https://doi.org/10.1016/j.kjss.2016.06.001

Sunil, A. B., Banerjee, A., Divya, M., Rathod, H. K., Patel, J., & Gupta, M. (2023). Dyslexia: An invisible disability or different ability. *Industrial psychiatry journal*, 32(1), S72–S75. https://doi.org/10.4103/ipj.ipj_196_23

Swan, M. (2000). Making sense of algebra. *Mathematics Teaching*, 171, 16-19. https://eric.ed.gov/?id=EJ610402

Swanson, L., Harris, K., & Graham, S. (2014). *Handbook of learning disabilities.* New York, London: The Guilford Press.

Tam I.O.L., & Leung C., (2019). Evaluation of the effectiveness of a literacy intervention programme on enhancing learning outcomes for secondary students with dyslexia in Hong Kong. *Dyslexia*. 25, 296–317. https://doi.org/10.1002/dys.1626

Taylor, H., & Vestergaard, M. D. (2022). Developmental Dyslexia: Disorder or Specialization in Exploration?. *Frontiers in psychology*, 13, 889245. https://doi.org/10.3389/fpsyg.2022.889245

Van de Walle, J. A., Karp, K. S., & Bay-Williams, J. M. (2010*). Elementary and middle school mathematics: Teaching developmentally*. New York: Pearson Education.

Witzel, B., & Mize, M. (2018). Meeting the needs of students with dyslexia and dyscalculia. *SRATE Journal*, 27(1), 31-39. https://files.eric.ed.gov/fulltext/EJ1166703.pdf

Yu, R., & Singh, K. (2016). Teacher support, instructional practices, student motivation, and mathematics achievement in high school. *The Journal of Educational Research*, 111(1), 81–94. https://doi.org/10.1080/00220671.2016.1204260