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The Effect of Pre-Writing Training on Teachers of Children with Special Needs on the Developmental Test of Visual Motor Integration

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Abstract:

- ***Background:***
Visual-motor integration (VMI) provides an important foundation for the academic development of children with special needs. Delays in VMI development can affect handwriting performance and hinder classroom learning and learning outcomes. Although many occupational therapy studies have shown the effectiveness of improving VMI, most inclusive school teachers have not received specific training to support teaching practices related to VMI and pre-writing skills specifically for children with special needs.

- ***Objective:***
This study aims to assess the effect of structured pre-writing developmental prerequisite training for inclusive school teachers in improving the VMI skills of students with special needs.

- ***Methods:***
This quantitative study used a one-group pretest-posttest design involving 10 children with special needs from an inclusive school. The intervention consisted of a teacher training program on pre-writing and handwriting strategies. The Beery–Buktenica Developmental Test of Visual-Motor Integration (DTVMI) was used to assess VMI scores before and after the intervention. Data were analyzed using paired sample t-tests when the data distribution was normal or with Wilcoxon if it was not.

- ***Results:***
The results showed a statistically significant increase in VMI scores after teacher training (mean pretest = 19.6; mean posttest = 21.8; $p = 0.0005$). Improvement in Visual Perception (VP) and Motor Coordination (MC) increased, although not statistically significant ($p > 0.05$).

- ***Conclusion:***
Handwriting training for inclusive school teachers can significantly improve visual-motor integration scores of children with special needs. Teacher empowerment through practical training can be utilized in inclusive education practices to improve the academic performance of CSN.

Keywords: *Handwriting Training, Visual-Motor Integration, Inclusive Education, Children with Special Needs, Occupational Therapy, Teacher Empowerment.*

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I. INTRODUCTION

Inclusive education is an approach that aims to ensure that all children, including children with special needs (CSNs), receive equitable learning opportunities within regular school environments [1]. One of the primary challenges faced by CSNs is difficulty with visual-motor integration (VMI), which involves coordinating visual perception and hand movement. These challenges significantly affect essential academic tasks such as handwriting, drawing, and other fine motor-based classroom activities [2]. VMI is critical to both functional and academic development, especially for children with disabilities such as dysgraphia, autism spectrum disorder (ASD), or cerebral palsy [3].

Teachers in inclusive classrooms play a vital role in supporting the development of CSNs, including enhancing their visual-motor skills. However, many teachers lack specialized training to meet these unique needs [4]. Handwriting training programs for teachers are designed to equip them with knowledge and strategies tailored to the developmental needs of their students, especially those who struggle with fine motor and writing skills [5].

One promising intervention is handwriting training using structured and multisensory approaches, which can enhance teaching effectiveness and support the improvement of visual-motor integration in children [6]; [7]. Such training enables teachers to develop classroom strategies that promote academic engagement and skill development among students with special needs.

Previous studies have demonstrated that teacher-led interventions can significantly influence the motor and cognitive development of CSNs [8]. However, there is still limited research specifically evaluating the impact of handwriting training for teachers in inclusive schools and its effect on children's visual-motor integration abilities. Moreover, the gap between research and classroom practices remains a challenge, especially in contexts where inclusive education is still developing.

Understanding visual-motor integration as a foundational skill is essential. It allows children to perform everyday classroom activities, such as writing, tracing, cutting, and using classroom tools efficiently [9]. Difficulties in this area may lead to decreased academic performance, low self-esteem, and limited independence in both school and home settings [10].

Given the importance of teacher competence in inclusive classrooms, structured training programs should not only focus on content delivery but also on equipping educators with hands-on strategies to foster children's fine motor and perceptual development [11]. Teachers, as primary agents of change, need to be empowered to provide accommodations and targeted support to meet the unique needs of each learner.

This study aims to quantitatively examine the effects of handwriting training provided to inclusive education teachers on the visual-motor integration abilities of children with special needs. By bridging the gap between theory and practice, this research seeks to offer evidence-based recommendations to improve teacher preparedness and student developmental outcomes in inclusive learning environments.

II. MATERIAL AND METHOD

This study used a single-group pre-experimental quantitative design, namely pre-test-post-test, to evaluate the impact of handwriting training for teachers on students' visual-motor integration (VMI) scores. This study was conducted for two months. Participants included ten children aged 6–7 years with various developmental conditions—such as expressive language disorders, dyslexia, ADHD, and giftedness—enrolled in an inclusive elementary school. Each child was taught by a teacher who had completed a structured handwriting training program based on occupational therapy principles, incorporating multisensory strategies, visual-motor stimulation, and fine motor skill development. The Developmental Test of Visual-Motor Integration (DTVMI) was administered before and after the intervention. Statistical analysis involved a paired sample t-test and Wilcoxon Signed-Rank Test, depending on the normality of the data, using SPSS with a significance level of $p < 0.05$.

III. RESULTS

➢ *Demographics of Participants*

The demographic profile of the participants consisted of ten children who were identified and intervened with during the pre-writing skills training. Their characteristics are summarized in Table 1.

Table 1 Demographic Characteristics of Participants

Variables	Category	Frequency (n)	Percentage (%)
Gender	Man	4	40%
	Woman	6	60%
Age Group	6 years	4	40%
	7 years	6	60%
Diagnosis Category	Expressive Language Disorder	1	10%
	Dyslexia (Confirmed)	1	10%
	Suspected Dyslexia	3	30%
	Allegedly Talented	3	30%
	Suspected ADHD	1	10%

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	Behavioral Concerns	1	10%
	Typical/Normal	1	10%
Types of Interventions	Interventions Accepted	2	20%
	Filtering Only	8	80%

Among the 10 samples, 60% were female and 40% were male. The age range was 6 to 7 years, with the majority of children (60%) being 7 years old. Diagnostically, 20% of the children had confirmed developmental conditions (expressive language disorder and dyslexia), while 70% were identified with suspected developmental indicators such as dyslexia, giftedness, ADHD, and behavioral problems. Only one child was considered to be developing typically. Two children received full intervention through structured OT-based pre-writing training, and the other eight children were only involved in identification.

➢ *Descriptive Statistics*

Pre-test and post-test comparisons were conducted on three variables: Visual Motor Integration (VMI), Visual Perception (VP), and Motor Coordination (MC) using the Beery VMI assessment tool. The following Table 2 summarizes the mean scores:

Table 2 Summarizes the Mean Scores

Instrument	Pre-Test Average	Post Test Average	Average Difference	N
VMI	19.6	21.8	+2.2	10
VP	18.0	21.0	+3.0	
MC	16.4	17.6	+1.2	

➢ *Normality Test (Shapiro-Wilk)*

Since the normality test showed that VMI and MC data were normal, we used parametric tests for them, but we had to use non-parametric tests for VP data because its pre-test scores were not normal. Data normality was tested using the Shapiro-Wilk test shown in Table 3, the inferential analysis of the VMI and MC views in Table 4, and the inferential analysis of VP in Table 5.

Table 3 Data normality was tested using the Shapiro-Wilk test:

Variables	Statistics	p value	Normality Conclusion
VMI pre-test	0.869	0.097 years	Normal (p>0.05)
VMI post test	0.95	0.665 years	Normal (p>0.05)
VP Pre-test	0.811	0.019	Abnormal (p < 0.05)
VP post-test	0.926	0.406	Normal (p>0.05)
MC pre-test	0.948 years	0.642	Normal (p>0.05)
MC post-test	0.945 years	0.614	Normal (p>0.05)

➢ *Inferential Analysis*

- *Paired Sample T Test (VMI and MC)*

Table 4 Inferential Analysis of VMI and MC

Instrument	t value	p value	Interpretation
VMI	-5.284	0.0005	Significant improvement
MC	-1,050	0.321	Not significant

- *Wilcoxon Signed Rank Test (VP)*

Table 5 Inferential Analysis of VP

Instrument	Z Value	p value	Interpretation
VP	-1,779	0.109	Not significant

The results of this study indicate that handwriting training provided to teachers in inclusive schools significantly improved Visual-Motor Integration (VMI) skills in children with special needs (p = 0.0005). This finding illustrates the effectiveness of teacher-based interventions in supporting visual and fine motor coordination—a prerequisite skill for readiness for writing and other academic activities. Although there was an average increase in the Visual Perception (VP) and Motor Coordination (MC) aspects, by +3.0 and +1.2 points, respectively, the changes did not reach statistical significance. The lack of significance in VP was probably due to the wide range of scores and the uneven distribution of pre-test data (p = 0.019). Meanwhile, the limited increase in MC may indicate the need for more specific and intensive motor training. Overall, these results reinforce the research objective of examining the impact of teacher training on children's visual-motor domains, with VMI being the domain that showed the strongest response. These findings also suggest potential additional benefits for

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VP and MC development if the intervention were conducted over a longer duration or with a more focused approach. Interdisciplinary collaboration between therapists and teachers is key to maximizing these benefits.

IV. DISCUSSION

This study found a significant improvement in Visual Motor Integration (VMI) following handwriting training in an inclusive early childhood classroom. The intervention, which focuses on structured, teacher-led handwriting activities, effectively enhances children's ability to coordinate visual input with motor output. This result aligns with current findings that emphasize the importance of multisensory instruction in developing visual-motor skills required for handwriting readiness [6]; [7]. The significant gain in VMI scores suggests that young children, including those with developmental and learning difficulties, benefit from systematic and repetitive handwriting practice. Such training strengthens neural pathways associated with motor planning and visual feedback integration—essential components of legible writing [12]. The two-month program appears sufficient to produce measurable changes in VMI, supporting its feasibility for implementation in classroom settings with limited time. In contrast, although Visual Perception (VP) scores increased on average, the improvement was not statistically significant. This may be attributed to the non-normal distribution of pretest scores, indicating a wide range of baseline visual processing abilities among participants. Recent studies highlight that visual perceptual skills often require more targeted intervention approaches, such as computerized audio-visual remediation programs, especially in children with attention or processing difficulties [13]; [14]. The lack of significant improvement in motor coordination (MC) may be explained by the general nature of the handwriting training used. While writing practice does involve fine motor activity, improvements in MC—particularly in bilateral integration, speed, and dexterity—typically require focused motor exercises. Literature suggests that combining handwriting tasks with fine motor play (e.g., pegboard, threading, scissors) may produce stronger effects on motor coordination outcomes [15]. Another factor to consider is the intervention duration. Although VMI improved significantly in just eight weeks, VP and MC may demand more sustained or intensive intervention to produce measurable outcomes. Long-term studies of handwriting programs that focus on sensorimotor skills over 12–16 weeks have shown greater improvements in various motor skills. Future research may extend the intervention period or use booster sessions to support long-term gains. The findings also reinforce the value of teacher involvement in motor skill development. Equipping educators with strategies to support pre-writing and writing skills can strengthen early identification and intervention for at-risk learners. Additionally, programs in the classroom help students use their skills in different situations and lessen the need for separate therapy sessions, which fits well with effective inclusive education practices. From an occupational therapy perspective, these results validate the role of school-based interventions in supporting academic readiness through functional skill development. The improvements in VMI demonstrate the value of handwriting as a therapeutic medium not only for fine motor development but also for building attention, task persistence, and coordination [17].

V. CONCLUSION

This study shows that handwriting training conducted by teachers can significantly improve Visual-Motor Integration (VMI) skills in early childhood in inclusion classes. These results support the use of simple but planned methods in strengthening basic academic skills through multisensory stimulation and fine motor skills training. Although Visual Perception (VP) and Motor Coordination (MC) showed positive progress, the improvement of both was still not statistically measurable and may require more specific and more intensive interventions. This study suggests developing longer and more comprehensive handwriting programs, as well as increasing collaboration between educators and occupational therapists to support children's holistic development in inclusive educational environments.

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