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## **EFFECT OF VISUAL AND HAPTIC PERCEPTION WITH MULTI SENSORY TRAINING TO IMPROVE HANDWRITING SKILLS FOR CHILDREN WITH DYSGRAPHIA**

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### **ABSTRACT**

This study aimed to investigate the impact of visual and haptic perception through multi-sensory training on improving handwriting skills in children with dysgraphia. A total of 30 children aged between 6 and 12 years with learning disabilities participated in the study. They were divided into two groups: an experimental group (15 children) and a control group (15 children). The

experimental group received multi-sensory training that incorporated visual and haptic perception techniques, while the control group followed a conventional handwriting improvement program. The intervention lasted for three months, consisting of 36 sessions held three times per week. Handwriting legibility was assessed using the Evaluation Tool of Children's Handwriting (ETCH). Statistical analysis revealed significant improvements in the handwriting legibility of the experimental group following the intervention. These findings suggest that incorporating visual and haptic perception-based multi-sensory training can be an effective strategy for occupational therapists to enhance handwriting instruction and therapy for children with learning disabilities.

**Keywords: Visual Perception, Haptic Perception, Multi-Sensory Training, Handwriting**

## INTRODUCTION

Occupational therapy interventions for children are designed to enhance their engagement and participation in everyday roles. These roles include developing personal independence, becoming productive, and participating in play and leisure activities. When children are unable to engage in these roles due to illness, disability, or skill deficits, they may experience marginalization, social isolation, and reduced self-esteem. Occupational therapists choose interventions based on an analysis of the child's performance in daily life roles, the impact of their disability on this performance, and the ways in which their environment either supports or hinders their abilities [1]. In India, the prevalence of Dysgraphia among school children was found to be 14%, while dyscalculia was present in 5.5% [2]. Learning disabilities in mathematics are quite common in school-aged children and are more

frequently observed in boys. Additionally, many children with mathematical learning disabilities do not exhibit a comorbid reading disorder [3].

The term "learning disability" (LD) refers to a range of difficulties that impact a child's ability to master academic tasks, process information, and communicate effectively. Despite being provided with appropriate learning opportunities similar to their peers, children with LDs often face challenges that hinder their academic potential and educational performance [4]. Handwriting is a multifaceted perceptual-motor skill that relies on the development and integration of various cognitive, perceptual, and motor abilities. It involves managing written language through aspects such as pencil grip, letter formation, and body posture. Beyond being a crucial academic skill, handwriting plays a significant role in daily

activities, including filling out forms, taking notes, making lists, and setting reminders. Difficulties with handwriting can negatively impact school performance, limit learning opportunities, and affect self-esteem. Such issues are reported more often in boys than in girls, though most can improve with appropriate intervention [5]. Handwriting is a vital fine motor skill for school-aged children. The ability to produce fluent and legible writing is crucial for expressing and communicating ideas, recording information, and is essential for educational development, academic achievement, and self-esteem [6].

#### **Visual And Haptic Perceptiuon:**

Visual and haptic perception involve the accuracy and precision with which humans perceive the local aspects of three-dimensional object shapes. This ability encompasses comparing shapes and objects through both vision and touch, where individuals haptically explore an object and then identify whether visible objects have the same shape or different ones [7]. Haptic perception is the sense of touch, mediated by cutaneous and kinesthetic receptors. It allows individuals to perceive and interpret tactile properties of objects, including texture, temperature, and shape. Through active exploration, humans employ different strategies to discern specific properties,

enabling a nuanced understanding of their environment [8]. The sense of touch, known as haptic perception, is facilitated by receptors in the skin and muscles, allowing people to experience and understand the tactile characteristics of objects. By actively exploring their surroundings, individuals can gather detailed information about the world around them [9]. The term "haptic" encompasses both cutaneous and kinesthetic senses, integrating information from dynamic touch experiences [10]. Unlike vision, haptic perception is primarily used to identify, explore, and manipulate objects. This sense is frequently engaged in everyday activities, often unconsciously, such as reaching into a bag, closing a zipper, or pressing keys on an instrument [11]. Haptic impressions are formed through active movement, incorporating information about body position, joint orientation, and physical contact with objects, including aspects like weight, compliance, and thermal conductivity [12].

**Multisensory Training:** Multisensory learning engages multiple senses to create optimal learning conditions. This approach stimulates sensory pathways, including hearing, sight, and touch. By integrating senses, students connect new information with existing knowledge.

Multisensory learning transforms simple sensory inputs into complex cognitive forms. Sensory receptors transmit information to brain regions involved in cognition. Interactions among brain cortices underpin cognitive processes like perception and memory. Sensory integration occurs in the brain, coordinating functions like attention and emotions. Educational strategies emphasizing sensory integration enhance working memory. Working memory is a temporary network that maintains current processing tasks. Multistory educational practices improve learning outcomes and career development [13].

## **MATERIALS AND METHODS:**

### **STUDY DESIGN:**

A Quasi-experimental study design was used in the study to find out the effects of Visual and haptic perception with multi-sensory training to improve handwriting skills for children with Dysgraphia. A convenient sampling technique was used. Sample were collected in Mont Fort Her. Sec. School in butt road chennai.

### **PARTICIPANTS:**

The participants were selected according to the inclusion and exclusion criteria. The person diagnosed the school aged children in handwriting difficulties. The age group was 6 to 12 years. The study conducted

in Montfort Her. Sec. School in chennai. There were 30 subjects was selected according to inclusion criteria and exclusion criteria.

**INSTRUMENTS:** The Evaluation Tool of Children's Handwriting (ETCH) is a standardized assessment that evaluates children's handwriting skills. It assesses the legibility of words, letters, and numbers, providing a comprehensive picture of a child's handwriting abilities. Suitable for children aged 5-12, the ETCH scale is a reliable and valid tool used by occupational therapists to identify handwriting difficulties and monitor progress. It helps evaluate the effectiveness of handwriting interventions.

**PROCEDURE OF THE STUDY:** The study was carried out at Mont Fort Higher Secondary School, situated on Butt Road in St. Thomas Mount, Chennai. The head of the institution was briefed about the study, and their consent was secured. Thirty participants were selected based on specific criteria for the study. Prior to starting the intervention, written consent was obtained from the participants' caregivers. Using a convenience sampling method, participants were assigned to two groups: 15 individuals in the experimental group and 15 in the control group. The ETCH scale was utilized as a measurement tool during the pre-test in the

initial session. Each participant underwent a total of 36 intervention sessions, each lasting 45 minutes, with three sessions per week over a span of 3 months.

The experimental group engaged in activities like tracing, writing, and visual perception tests to enhance handwriting skills and sensory integration. They practiced writing letters, numbers, and simple sentences, and developed fine motor skills through threading and lacing. In contrast, the control group focused on fine motor skills and hand-eye coordination through balloon and cloth clip exercises, writing, and puzzles. The study compared the effectiveness of these two approaches in improving handwriting skills in children with dysgraphia. The experimental group's activities were more comprehensive, targeting multiple aspects of handwriting. This allowed for a thorough comparison of the two approaches.

The control group participated in activities aimed at supporting handwriting skills, including balloon exercises to enhance hand strength and coordination. They also engaged in cloth clip activities, writing exercises, and puzzle games to develop fine motor skills. The children practiced copying shapes, circling numbers and letters, and playing letter games to build foundational skills. These activities were designed to

improve handwriting through traditional methods.

## DATA ANALYSIS

**Table 1 and Figure 1:** The statistical comparison between the pre-test and post-test scores of the control group, measured using the ETCH scale, reveals a notable finding. The post-test mean scores were lower than the pre-test mean scores across all components (Word, Letter, and Number), with a p-value less than 0.05 in each category. As a result, the alternative hypothesis is supported, indicating a statistically significant difference between the pre-test and post-test scores in the control group. This suggests that the intervention received by the control group led to a meaningful improvement. **Table 2 and Figure 2:** Shows the statistical comparison between the pre-test and post-test scores in the control group, measured using the ETCH scale, revealed that the post-test mean was lower than the pre-test mean in the Experimental Group. For all components (Word, Letter, and Number), the p-value was found to be less than 0.05, supporting the acceptance of the alternative hypothesis. Therefore, a highly significant difference was observed in the Experimental Group between the pre-test and post-test scores on the ETCH scale. This indicates that the intervention provided to the experimental group led to

significant improvements. **Table 3 and Figure 1**, Show the statistical comparison between the pre-test and post-test results for the control group, measured using the ETCH scale, shows that the mean post-test score is lower than the mean pre-test score for the experimental group. With a p-value of less than 0. 05 across all components (Word,

Letter, and Number), the alternate hypothesis is supported. This indicates a statistically significant difference in the post-test scores between the experimental and control groups. Consequently, it suggests that the intervention provided to the experimental group led to greater improvements compared to the control

**Table 1: Comparison between ETCH pre-test and post-test scores of the control group**

| Group         |             | Mean    | SD       | N  | Z value | p value |
|---------------|-------------|---------|----------|----|---------|---------|
| Control group | Pre Word    | 70.6    | 7.7164   | 15 | -3.5710 | 0.00*   |
|               | Post Word   | 72      | 7.82852  | 15 |         |         |
|               | Pre Letter  | 68.9333 | 6.91238  | 15 | -3.5730 | 0.00*   |
|               | Post Letter | 70.2667 | 6.90204  | 15 |         |         |
|               | Pre Num     | 68.0667 | 13.81752 | 15 | -2.9590 | 0.003*  |
|               | Post Num    | 69.4    | 13.19524 | 15 |         |         |

\*Significant at 5% alpha level

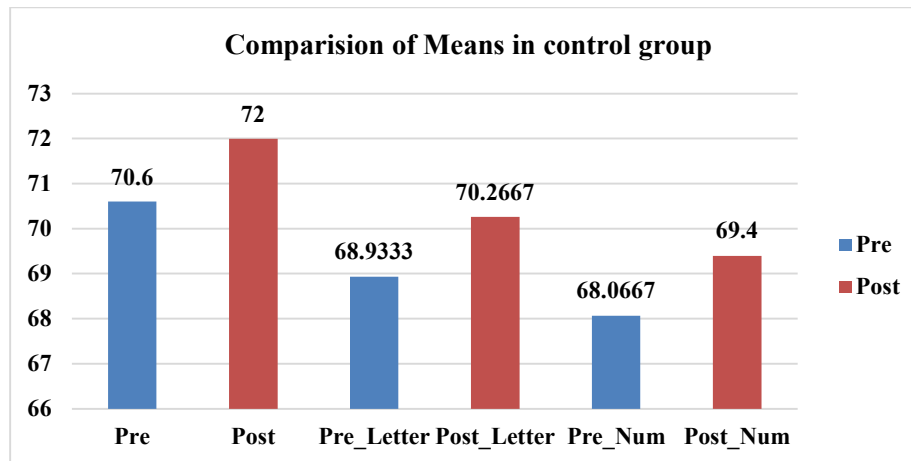


**Figure 1: Comparison between ETCH pre-test and post-test scores of the control group**

**Table 2: Comparison between ETCH pre-test and post-test scores of the Experimental group**

|                    |             | Mean    | SD       | N  | Z value | p value |
|--------------------|-------------|---------|----------|----|---------|---------|
| Experimental group | Pre Word    | 72.3333 | 7.74289  | 15 | -3.441  | 0.001*  |
|                    | Post Word   | 77.7333 | 7.58256  | 15 |         |         |
|                    | Pre Letter  | 70.4    | 6.85357  | 15 | -3.429  | 0.001*  |
|                    | Post Letter | 76.1333 | 5.97455  | 15 |         |         |
|                    | Pre Num     | 69.7333 | 13.15005 | 15 | -3.432  | 0.001*  |
|                    | Post Num    | 77.9333 | 12.98057 | 15 |         |         |

\* Significant at 5% alpha level

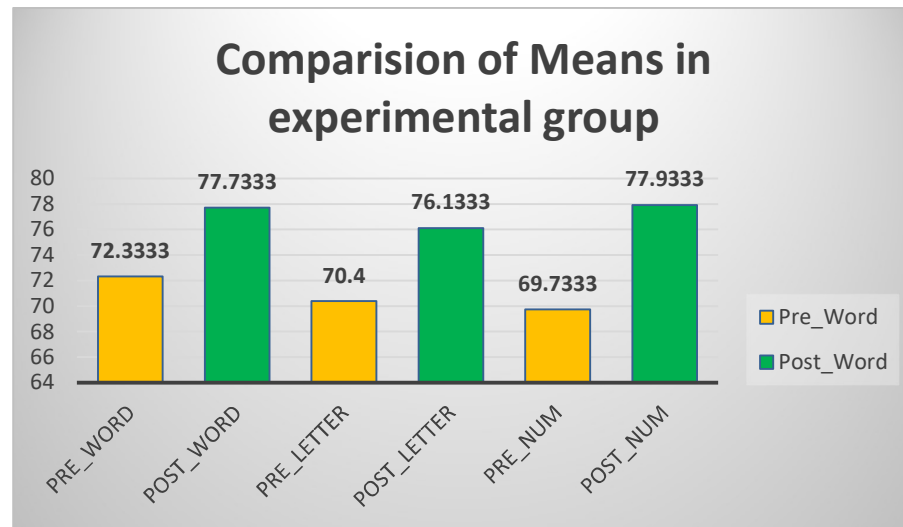


Figure 2: Comparison between ETCH pre-test and post-test scores of the Experimental group

Table 3: Comparison between the post- test scores of the control and experimental group

|           |             |         |          |    |        |        |
|-----------|-------------|---------|----------|----|--------|--------|
| Post test | Cntr_Word   | 72      | 7.82852  | 15 | -2.156 | 0.03*  |
|           | Expt_Word   | 77.7333 | 7.58256  | 15 |        |        |
|           | Cntr_Letter | 70.2667 | 6.90204  | 15 | -2.156 | 0.03*  |
|           | Expt_Letter | 76.1333 | 5.97455  | 15 |        |        |
|           | Cntr_Num    | 69.4    | 13.19524 | 15 | -2.011 | 0.044* |
|           | Expt_Num    | 77.9333 | 12.98057 | 15 |        |        |

\*Significant at 5% alpha level

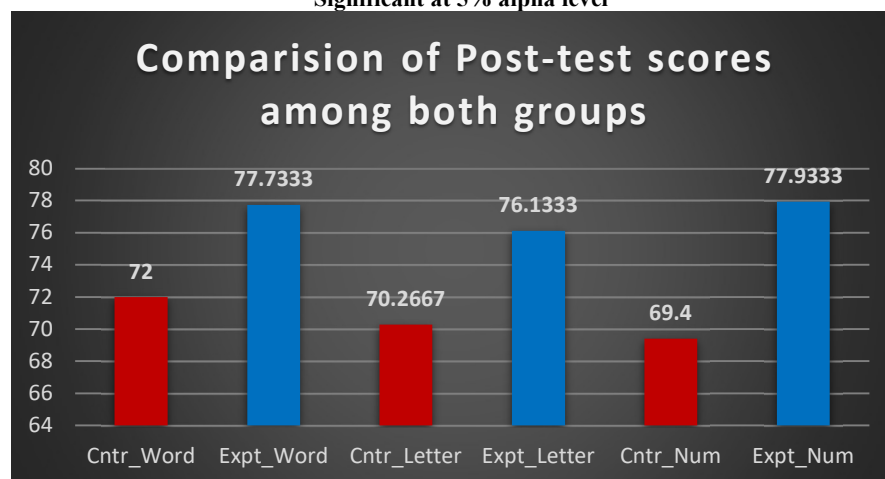


Figure 3: Comparison between the post- test scores of the control and experimental group

## DISCUSSION:

This study explored the impact of integrating visual and haptic perception with multi-sensory training to enhance handwriting skills in children with Dysgraphia. Handwriting difficulties are frequently

observed in children with learning disabilities and can negatively affect academic performance [14]. The study included 30 participants with learning disabilities, who were divided into two groups: a control group of fifteen children receiving conventional

occupational therapy, and an experimental group of fifteen children who underwent visual and haptic perception training combined with multi-sensory techniques. The intervention protocol for the experimental group was informed by methods used in previous research [15 and 9].

**Table 1 and Figure 1** show that the p-values for all components (word, letter, and numeral) were below 0.05, indicating that the null hypothesis was rejected. There was a statistically significant difference between pre-test and post-test scores on the ETCH scale for words, letters, and numerals. Specifically, the mean scores improved from 70.6 to 72 for words, from 68.93 to 70.27 for letters, and from 68.07 to 69.4 for numerals. These results suggest significant improvement in handwriting within the control group, demonstrating that conventional occupational therapy interventions were effective in enhancing handwriting skills. These findings align with previous research by [16], which supports the effectiveness of traditional occupational therapy approaches in addressing dysgraphia and improving handwriting in children with learning disabilities.

**Table 2 and Figure 2** indicate that the p-values for all components (word, letter, and numeral) in the experimental group were

below 0.05, demonstrating a highly statistically significant difference between pre-test and post-test scores. Specifically, the mean scores improved from 72.33 to 77.73 for words, from 70.4 to 76.13 for letters, and from 69.73 to 77.93 for numerals on the ETCH scale. These results suggest significant improvement within the experimental group, leading to the acceptance of the alternative hypothesis. This indicates that the visual and haptic perception training combined with multi-sensory techniques led to noticeable enhancements in handwriting skills. These findings are consistent with the study by [9], which supports the effectiveness of visual and haptic perception training for improving handwriting in children with dysgraphia.

**Table 3 and Figure 3** show that the p-values for all components (word, letter, and numeral) were below 0.05, indicating a statistically significant difference between the post-test scores of the control and experimental groups. Specifically, the mean scores were 72 for words, 70.27 for letters, and 69.4 for numerals in the control group, compared to 77.73 for words, 76.13 for letters, and 77.93 for numerals in the experimental group. These results demonstrate a highly significant improvement in handwriting skills in the experimental group, validating the alternative hypothesis. This indicates that the

experimental intervention led to greater enhancements in handwriting compared to conventional therapy. The findings are consistent with the study by [17], which supports the effectiveness of combining visual, haptic, and multi-sensory training in improving handwriting skills. Additionally, the results suggest that this combined approach is more effective than conventional therapy alone.

### CONCLUSION:

This study examined the effectiveness of combining visual and haptic perception with multi-sensory training to improve handwriting skills in children with Dysgraphia. The study involved 30 children with learning disabilities, divided into two groups: one group of 15 children received conventional occupational therapy, while the other group of 15 children underwent training incorporating visual and haptic perception with multi-sensory activities. The results revealed a highly significant improvement in handwriting between the pre-test and post-test for the experimental group. This finding indicates that integrating visual and haptic perception with multi-sensory training was more effective in enhancing handwriting legibility for children with Dysgraphia compared to conventional occupational therapy.

### LIMITATION & RECOMMENDATIONS:

This study had a limited sample size of 30 children with learning disabilities. The number of sessions was also relatively small. To improve validity and generalizability, replication with a larger sample size is recommended. Increasing the number of sessions could provide more therapeutic benefits. This would allow for a more comprehensive understanding of the intervention's effects.

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