

Effect of Visual Motor Integration Training on Legibility of Urdu Handwriting

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Abstract

Visual Motor integration is considered an important skill for the development of manual ability of the children. Handwriting is essential for the school going children. The study in hand examined the effect of Visual Motor Integration (VMI) Training on legibility of Urdu handwriting in 4th and 5th grade students. There were 134 participants taken who have poor handwriting and VMI from general education schools. The research was conducted as an experimental study. Pretest-Posttest Two Group Designed was used in the study. The students were divided into experimental and controlled groups. The selected students in experimental group were imparted six weeks training in order to improve VMI whereas the second was a control group without any intervention. It was observed that the students in experimental group showed significant improvement in legibility of handwriting as compared to control group. The male did not outperform as compared to the female respondents and vice versa. Concisely speaking, the readability in handwriting, similarities in manuscript, roundness and recognition of words were improved as a result of training by the same individual. The VMI training showed the improvement in Urdu handwriting of the students of 4th and 5th classes of primary school.

Keywords: Handwriting, learning, legibility, visual motor integration (VMI).

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Introduction

Handwriting is an essential task in academic life of a child. School work of students involves them in reading and writing assignments. Handwriting considers the shadow of intelligence (Rosenblum, Aloni, & Josman, 2010). Students who have good handwriting are considered the brilliant by teachers and examiners as well. This indicates their response about legible handwriting (Poon, Li-Tsang, Weiss, & Rosenblum, 2010). Moreover, good handwriting influences positively over self-image, behavior, attitude and academic achievements of children (Feder & Majnemer, 2007). Failure in production of impressive handwriting leads to low self-esteem and efficacy among students (Engel-Yeger, Nagauker-Yanuv, & Rosenblum, 2009). Certain measures may be adopted to improve the handwriting capabilities in typically developing children.

Handwriting is a combination of many sensory, motor and cognitive factors. Deficiency in these skills decreases the ability of manual work by the children which may affect the handwriting. Certain visual, perceptual and motor variables are important for the development of handwriting skills (Howe, Roston, Sheu, & Hinojosa, 2013). Visual Motor Integration (VMI) is one of important component of complex handwriting activity (Brossard-Racine, Majnemer, Shevell, Snider, & Bélanger, 2011; Bumin & Kavak, 2008; Weintraub & Graham, 2000) and its development is considered essential for handwriting development (Cornhill & Case-Smith, 1996; Kaiser, Albaret, & Doudin, 2009). It coordinates visual information with motor response, allowing a child to reproduce letters and numbers for written school assignments (Benbow, 1995). Coloring, copying shapes and writing tasks are guided by the eyes. There is strong correlation between handwriting legibility and VMI (Poon et al., 2010; Rosenblum et al., 2010).

Most of the studies were performed on native English speakers and atypical children. Typically developing and bilingual children were less studied under this heading although they come across many problems in developing this skill (Overvelde & Hulstijn, 2011). Some researchers studied handwriting in other languages also i.e. Chinese & Hebrew (Poon et al., 2010; Rosenblum et al., 2010). So far, no study reflects any research work affect the Urdu handwriting of school going children in Pakistan. Each language has its own unique written characteristics of letter formation and smoothness (Rosenblum, Parush, & Weiss, 2003). There was need of such a study in which VMI might be improved and their effects might be observed on Urdu handwriting. In recent study, typical students with poor handwriting were involved in the development

of VMI to see its effects on legibility of Urdu handwriting and its components. This may be a positive addition in the regular and special handwriting classes. Class teachers may find new avenues in the form of exercises to enhance the handwriting abilities of the students. This study may explore the strategies to upgrade VMI and Urdu legibility especially for typical children.

Objectives of the Study

1. To identify the effect of training on the VMI capacity of typical children studying at Primary level.
2. To highlight the effects of VMI training on Urdu handwriting and its components of Primary school students.

Material and Method

This study was planned as an experimental study with two group pretest, posttest design. This study design is represented by using these symbols (Campbell, Stanley, & Gage, 1963)

Experimental Group	RO _{E1}	X	O _{E2}
Control Group	RO _{C1}		O _{C2}

Here

- R Shows random assignments to separate treatment groups
 O_{E1} Pre-Treatment Evaluation of Experimental Group
 O_{E2} Post-Treatment Evaluation of Experimental Group
 X Treatment/Exercises performed with Experimental Group
 O_{C1} Pre-Treatment Evaluation of Control Group
 O_{C2} Post-Treatment Evaluation of Control Group

Participants

The population of this study consisted of the students of 4th and 5th grade of general education system who have illegible handwriting at Faisalabad District, irrespective of gender discrimination. The students ages ranged from years 9 to 12. The criterion for the sample was advertised through print and electronic media (local newspapers, television and radio) in Faisalabad. There were 424 students who have

poor handwriting contacted by the researcher as a result of campaign. Children were asked to copy an Urdu paragraph having 160-170 words. Among the students, 262 students were excluded on the ground that they have legible handwriting. Research plan was discussed with remaining 162 students as well as with their parents out of whom 11 students were not convinced. 151 students were final participants for this study. Afterwards, a session was arranged with the selected participants to develop their rapport with the research team. There were 76 students assigned the experimental group and 75 to control group, randomly through draw system. Nine students from experimental group did not complete their study due to their domestic issues, leaving 67 students in experimental group. Therefore, the final evaluation of control group was also reduced to 67 to maintain equivalence between groups.

Instruments

Handwriting and VMI were assessed as under

Evaluation of Visual Motor Integration

Beery defined the VMI as coordination between the visual perception and movements of the hand. It involves in most of the handwriting tasks. For this study, VMI was measured by Beery Baktinaca's Developmental Test of VMI (Beery, 2004). Beery VMI (2004) is a standardized norm reference and non-cultural test to measure VMI. The students copied 24 geometric shapes arranged from simple to complex. This test may be used for 2-18 years old children. Inter-rater reliability ($r = 0.93$) and test-retest reliability ($r = 0.75$ to 0.92) of this test has been established (Beery, 2004).

Evaluation of Handwriting

Legibility is an ability to read an individual character on the basis of its appearance. Measurement of global legibility means assessment of overall readability of handwriting. Evaluation of global legibility is an easy and appropriate to assess the functional handwriting of children in a classroom setting (Sudsawad, Trombly, Henderson, & Tickle-Degnen, 2001). Global legibility was measured for this research work. A questionnaire was prepared to evaluate the handwriting capability on the basis of indicators of good and bad handwriting. In expressions of

legibility components of handwriting utmost frequently measured with every handwriting referral, more than 80% of the therapists evaluated formation of letters, alignment of words, spacing and size and letter slant was 'always' assessed by 57% of therapists of handwriting evaluators (van der Merwe, Smit, & Vlok, 2011). Urdu language teachers, therapist, raters and researchers were involved during preparation of questionnaire. It assessed handwriting on the basis of 11 indicators of good handwriting including overall readability (Readability), use of margin (Margin), similarities among writing (Similarity), use of line (Line), presence of appropriate spaces (Space), overall size of letters (Size), shapes of words (Shape), slants of words (Slant), roundness of words (Roundness), alignment of words (Align), and recognition of words (Recognition). It assessed the Urdu handwriting on 5-point Likert scale. One to five scores was given to poor and excellent legible handwriting, respectively. The format for the assessment of handwriting is given in Table 1.

Table 1

Questionnaire to evaluate handwriting

Description	Item	5	4	3	2	1
Paragraph is easily readable	Readability					
Usage of the page margins	Margin					
Overall writing is similar	Similar					
Usage the lines properly	Line					
Spaces of the paragraph are good	Space					
Sizes of the words are appropriate	Size					
Shapes of the words are good	Shape					
Roundness of words are appropriate	Roundness					
Slants of the words are good	Slant					
Alignment of the words is present	Alignment					
Words are easily recognizable	Recognition					

Note: 5 = Excellent, 4 = Good, 3 = Average, 2 = Fair, 1 = Poor,

Test-retest reliability ($\alpha = 0.884$ to $\alpha = 0.890$) was ensured by Cronbach alpha statistics. A training session was arranged to develop the consensus on the scoring criteria. In case of any ambiguity in the scoring, re-evaluation was made until the scoring process become uniform.

Interventions

Experimental group was treated for 45 minutes for 3 days a week for 6 weeks. Eighteen sessions were given to improve VMI of experimental group for 45 minutes per day for 3 days a week for 6 weeks. However, eight sessions (one session per week) were administered to improve the VMI in a previous research (Poon et al., 2010). While, eighteen sessions were given in this research for the improvement in VMI capacities of the students. The activities and exercises were conducted in individual and in group forms. Exercises and activities were selected from well-recognized and authentic resources (Case-Smith & O'Brien, 2013; Dankert, Davies, & Gavin, 2003; Razi, 2011; Schneck, Amundson, Case-Smith, & O'Brien, 2010). For the development of VMI, the individual and groups sessions were conducted. Treatment was provided by first author, two physiotherapists and their team. Each student was monitored by the teachers and therapist for the accuracy of performing activity. The uniformity in treatment and evaluation was ensured by observation of the experts. Interventions were provided in 3 phases. The first phase was designed for the development of visual perception capacity. The second phase was designed for the betterment of motor coordination. And, third phase was designed for the awareness of left and right in the students. The detailed of the exercises are given in

Table 2

Activities for training for visual motor integration

Level	Activities
Phase I	Color vertical lines of a picket excluding fence Draw train track color wheels of a printed car Insert lines between words Making of shapes with sticks or tooth picks
Phase II	Draw half shape; remaining half shape was drawn by child Lace around shapes Beanbag Toss Game Wrap the gift and decorate Ball is thrown on the hole from a specific distance
Phase III	Left-right March Play table tennis Ask children to wear red ribbon in right wrist and blue to left wrist Play with flash light

Data Analysis

Data analysis was carried out by SPSS 16 (Statistical Analysis of Social Sciences). Independent and paired sample t-test (Table 1) were applied to see (i) equality in the pre-test scores of for variables including VMI, legibility of handwriting (ii) effects of training on pre-test and post-test scores of control and experimental group (iii) effects of training on male and female participants of experimental group. To see any difference in the correlation scores of control and experimental group, a combined correlation matrix of and Chi-square for association (Table 3) was used to any association with types of intervention on 11 components of Urdu legibility were made separately and (iv) effects of training in pre-post experimental scores of experimental groups. R 3.2.0 was used for Principal Component Analysis (PCA) with Varimax rotation (Table 3) with 3 conceptual factors of 11 legibility components of Urdu handwriting. A path diagram was made to see causation of individual legibility components from control to experimental groups.

Results

Data of 134 students were analyzed (67 from treatment and 67 from control group). No significance difference ($p > .05$) between two groups in terms of pre scores age, Visual Perception, VMI and legibility of handwriting of the students were seen. It showed that children had similar characteristics before application of any kind of intervention.

Table 3

Comparison of experimental and control group with mean, standard deviation, degree of freedom, t-test, p-value and effect size

Statistics	Groups	Measurements	VMI	Legibility
Independent Sample t-test on Pre Experimental Scores of VMI and Control Group	Experimental	Mean	18.92	32.03
		(SD) ¹	(1.84)	(2.50)
	Control	Mean	18.58	32.10
		(SD) ²	(1.84)	(2.12)
		df	131	131
t-Test		1.08***	0.17***	
Independent Sample t-test on Pre-Post Experimental Scores of VMI and control group	Experimental	Mean	19.94	41.21
		(SD) ¹	(1.60)	(4.90)
	Control	Mean	18.64	35.58
		(SD) ²	(1.81)	(4.18)
		df	132	132
		t-Test	-4.40*	-7.15*
R		0.36	0.53	
Independent Sample t-test on Gender of VMI Group	Male	Mean	19.97	40.64
		(SD) ³	(1.50)	(5.01)
	Female	Mean	19.86	42.36
		(SD) ⁴	(1.78)	(4.28)
		df	65	43.92
t-Test		0.29**	-1.47**	

Note: Mean (SD)¹ = Mean and Standard for Experimental Group, ² = Control Group, ³ = Males of Experimental Group, ⁴ = Females of Experimental Group, df = Degree of Freedom, r = Effect Size, * = p value < 0.001, ** = p value < 0.05, *** = p value > 0.05.

Factor Analysis of Urdu Data

For control and experimental groups, principal component analysis was conducted on 11 items of legibility of handwriting with orthogonal rotation using Varimax method and 3 components were extracted on conceptual basis of study as explained in Figure 1.

Table 3
Effects of training on components of legibility

Measurement	Association		Experimental Group			Control Group		
	χ^2	df	1	2	3	1	2	3
Readability	27.45*	3	0.69	0.09	0.17	0.11	0.07	0.71
Margin	14.55**	3	0.05	-0.05	0.52	-0.04	0.16	0.62
Similar	21.54*	4	0.73	0.18	0.13	0.56	-0.41	0.47
Line	15.37**	3	0.71	-0.17	0.08	0.71	-0.12	0.26
Space	24.85*	3	0.14	-0.72	0.30	0.74	0.26	-0.02
Size	16.91**	3	0.30	-0.05	0.74	0.70	0.13	0.10
Shape	17.98*	3	0.55	-0.13	-0.52	0.05	0.07	0.56
Round	24.39*	4	0.59	0.00	0.15	0.04	0.80	0.19
Slant	12.66**	3	0.44	0.49	0.00	0.05	0.62	0.30
Align	18.41*	4	0.00	0.76	0.39	0.31	0.51	-0.08
Recognize	43.91*	3	0.56	-0.05	-0.05	0.44	0.19	-0.22
SS Loading			2.77	1.42	1.46	2.17	1.63	1.70
Proportion Variance			0.25	0.25	0.26	0.20	0.15	0.15

Note: χ^2 = Chi Square, df = Degree of Freedom, * = p value < 0.001, ** = p value < 0.05

Proportion of control group was 50 % and 76 % for experimental group. Exploratory Factor Analysis for Urdu handwriting indicated improvement of causation of similarities from .6 to .7, recognition from 0.4 to 0.5, and alignment from 0.5 to 0.8.

Discussion

This study was designed to see the effect of VMI training for VMI on Urdu handwriting performance with comparison of control group. Initial assessment indicated that there was no significant difference between both groups before the start of experiment. Control and experimental groups were statically equal in VMI and handwriting legibility of Urdu.

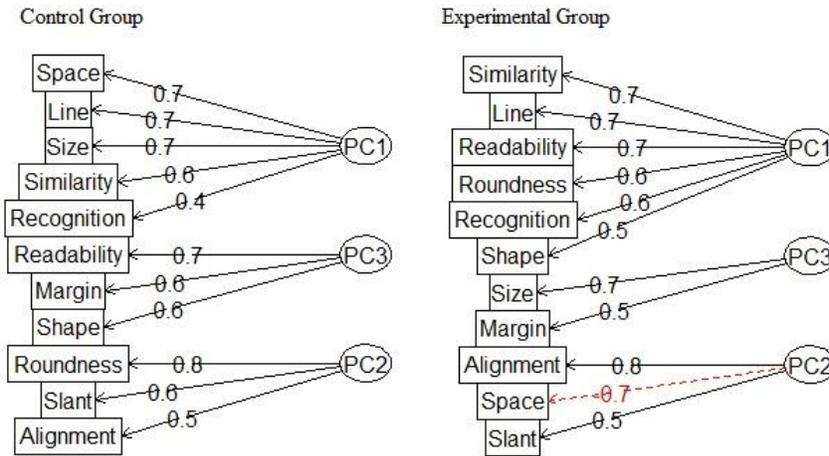


Figure 1: Principal component Analysis with Varimax Rotation represented by Path Diagram

Effects of Intervention on VMI Ability of Children

Post experiment results showed significant improvement in VMI abilities of students in the experimental group. Several previous studies reported similar improvement in VMI of children facing difficulties in motor coordination and/or handwriting difficulties (Volman, van Schendel, & Jongmans, 2006; Weintraub & Graham, 2000). A previous study on typically developing children indicated that students' sustained or improved the performance scores of visual-motor and visual-perceptual as a result of training provided by the occupational therapist in the school (Case-Smith, 2002). The researchers were expecting the similar results, after intensive training of 18 sessions for the improvement of VMI. This improvement revealed the efficacy of the treatment given to students for improvement of the VMI. There was no significant effect of training on the gender in improvement of VMI and legibility of handwriting.

Effects Intervention on legibility of Handwriting

Result of post experimental assessment indicated that students of experimental group showed significant improvement in overall legibility of Urdu handwriting. This supported the results of many researches which showed an improvement in English handwriting legibility after VMI training. One may conclude from our finding that VMI training is

an effective strategy for improvement of Urdu handwriting legibility in typically developing children as claimed in previous studies. A very strong relationship is reported between VMI and legibility of handwriting (Daly, Kelley, & Krauss, 2003). Similar results are reported in a previous study, in which student's functional handwriting were significantly improved as a reflection of training provided for improvement of Visual Perception and VMI (Case-Smith, 2002; Jameel & Nabeel, 2016). It revealed the improvement of similarities, recognition and alignment in Urdu handwriting of children as a result of VMI training provided to students.

Conclusion

In this study, students in the experimental group showed improvement in the VMI and legibility and its components. Readability, roundness, and recognition of the words are improved in Urdu handwriting as a result of training provided to the students in experimental group. This study is important to practice for improvement of Urdu handwriting of the typically developing children in the general education system. Students in the experimental group enjoyed the interactive activities for six weeks as reported by the parents.

Limitation and Direction for Further Research

Unavailability of standardized tool for assessment Urdu handwriting was a basic limitation for this study. Eleven combined components were selected by the researchers for their assessment of Urdu. Other components may be there for the assessment of English and Urdu handwriting simultaneously. The researchers believe that more factors may be explored for the coming researchers.

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