

Visual perception and writing readiness : Crucial determinants of quality handwriting

■ RUPINDER KAUR GREWAL, DEEPIKA VIG AND SARITA SAINI

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See end of the paper for authors' affiliations

RUPINDER KAUR GREWAL
Department of Human
Development, Punjab Agricultural
University, LUDHIANA (PUNJAB)
INDIA
Email: grewalroop2@
rocketmail.com

■ **ABSTRACT :** The present study aimed to ascertain the contribution of visual perception and writing readiness in determining the quality of handwriting. The total sample for the study comprised of 160 public school children studying in grade 3 and 4. Raven's Coloured Progressive Matrices was administered to ascertain intellectual abilities of the children. They were further evenly distributed across the categories of good and poor writers (English language) viz., children with good handwriting (n=80) and poor handwriting (n=80) by administering set - a (handwriting test) and set - b (visual perception test) of occupational therapy screening test by Lilley (2006). Later, on the same sample, self-structured writing readiness assessment tool was administered. The results of the present study have highlighted the positive role of sub – skills of visual perception and writing readiness in determining quality of handwriting in children. Therefore, activities to enhance visual perceptual skills should be part of young child's daily schedule as it helps to enhance the writing readiness and formal writing skills among children.

■ **KEY WORDS:** Visual perception, Writing readiness, Good handwriting, Poor handwriting, Quality handwriting

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Handwriting is an essential skill for both children and adults (Feder and Majnemer, 2007). Handwriting is an important functional skill that young children must acquire, since it is used frequently in pre-school through elementary grades (Lust and Donica, 2011; Marr *et al.*, 2001). The ability to write at an age - appropriate level is required for all academic purposes. For some children, the acquisition of written expression skills is a difficult and enduring problem. Writing is a complex task requiring the mastery and integration of a number of sub skills. It is form of communication that consists of three areas- spelling, handwriting and written expression or composition. Longstaff and Heath (1999) reported that typically, once handwriting is learned, the skill becomes rapid, accurate and mechanical, with little need for active conscious control. This allows the handwriting process to become almost automatic, keeping the generation of text from interfering with the creative thinking process and serving to increase efficiency and reduce redundancy (Scardamailia *et al.*, 1982;

Latash, 1998). Handwriting acquisition consists in learning the visual representation of letters, which is used to guide their production, as well as the motor representation specific to each one. At the beginning of learning, movements are slow and guided by visual and kinaesthetic feedbacks (Chartrel and Vinter, 2006; Sovik, 1974).

In fact, the World Health Organization (2002) has included handwriting difficulties as one of the problems thought to cause a barrier to school participation, a significant element in the normal developmental process of the child.

Visual perception involves 'a number of related abilities that tend to be interdependent upon one another'. Consequently it is difficult to explicitly distinguish one perceptual ability from another during development (Kurtz, 2006). These abilities of visual perception can be categorized theoretically into six types:

- Spatial relationships that enable perception of the relative position of objects.
- Visual discrimination that enables the discrimination

between the features of different objects, such as position, colour and shape.

- Figure ground that distinguishes an object from surrounding or background objects.
- Visual closure that identifies a whole figure when only fragments of the figure are presented.
- Visual memory that recognizes a stimulus item following a brief interval.
- Form constancy that constitutes the ability to recognize the dominant features of objects when they appear in different sizes, shadings and/or textures (Frostig *et al.*, 1961; Colarusso and Hammill, 1996; Reynolds *et al.*, 2002).

Accurately perceiving letter shapes is a critical factor for the development of handwriting legibility, because the quality of letter handwriting depends on memory references for the motor system. The role of perceptual skills in handwriting acquisition was highlighted by studies which compared the effects of different kinds of teaching interventions. Karlsdottir (1996) proposed two programmes for children in grade four, one involving copying exercises and one consisting in visually and verbally explaining the letter shape. The writing quality of the group of children who participated in the letter copying programme did not improve, compared to an equivalent group that did not participate in the programme. However, the group of children who received an instructional programme consisting in the verbal/visual demonstration of the letter shape improved their handwriting quality. Hays (1982) and Sovik (1976) also showed that visual and verbal prompting of letter shapes improved handwriting accuracy. Wright and Wright (1980) reported that copying letters improved when a dynamic model, a model that depicted motion, was presented. Berninger *et al.* (1997) selected first grade children who were experiencing difficulties in learning to write and assigned them to five handwriting treatment groups and a phonological awareness control condition. The four ways of teaching handwriting were as follows:

- The child wrote the letter after seeing the instructor writing it,
- The child wrote the letter after seeing a copy of it with arrows indicating the order and direction of each stroke,
- The child wrote the letter from memory after examining a copy of it,
- The child wrote the letter from memory after examining a copy of it with arrows indicating the order and direction of each stroke.

The results showed that all the handwriting treatment groups made greater handwriting gains than the control group, with the highest training performance for the group that wrote the letters from memory after seeing a copy containing numbered arrows. Jongmans *et al.* (2003) investigated the effect of task-specific self-instruction on

handwriting speed and quality in children with poor handwriting. The child had to write the letter several times and to indicate which of them was best. The results showed that children who received the self-instruction method improved the overall legibility of their handwriting, but not their handwriting speed, compared with children who did not receive this kind of instruction. These results suggest that the ability of children to accurately perceive letter shape determines handwriting quality. They are consistent with information-processing models of learning (Sternberg, 1969), in which the learning process starts with the perception and storage of letter shapes in memory. It is possible that perceptual learning leads to greater difficulties than does the acquisition of motor skills for beginning writers.

The emphasis on fine motor manipulative skill as a precursor to writing is based on the assumption that uncoordinated finger movements would translate into slow, awkward and ultimately illegible handwriting (Erhardt and Meade, 2005). Writing demands many prerequisites and a distinction must be made between the child's ability to simply copy forms - as letters - and his ability to express his ideas in writing. Both abilities require perceptual - motor coordination for producing the letters, but certainly the latter is a more involved and more advanced accomplishment. Written expression utilizes combinations of sensory input and output. The child must learn to express himself through symbols. Therefore, he must remember previous sensory input so that it can be correlated, sequenced and then expressed by an exacting eye- hand skill (Ebersole *et al.*, 1968). The motor activity of writing is a specific kind of voluntary movement. Development of paper and pencil activities starts with the first scribbles shortly after the child is able to hold a crayon. Often this happens by coincidence and because the child enjoys it, he will repeat the activity more and more. Colouring often precedes drawing and is an important preparation for handwriting. It demands refined movements children need in handwriting and in colouring fine motor control is required. Furthermore, the child needs to control timing and pencil pressure (Litière, 2002). When the child ages and his motor skills mature, drawing is more controlled. Recognizable figures such as lines and circles arise. A child regularly using writing implements and paper discovers his drawings look like familiar objects. Children or adults who have difficulty in fine and gross motor coordination would also have difficulty in writing.

Young children do have the habit to make all letters of the same height which makes uppercase letters very suitable for them to use. Parents usually present capitals at home and within daily life capitals are most common; they are used in headlines, advertisements and in shops (Amundson, 2005). Tan-Lin (1981) examined the sequential stages of letter acquisition of children between the ages of three and five years old. Children were observed copying numbers, letters,

a few words and a sentence three times over a period of four months. Her findings revealed the following sequential stages of pre-writing and handwriting: (1) controlled scribbles (2) discrete lines, dots or symbols (3) straight-line or circular uppercase letters (4) uppercase letters and (5) lowercase letters, numerals and words.

Cermak (1991) has stressed the fact that children must master writing- readiness skills before handwriting instruction is initiated. The authors have also found that children who are taught writing before they are ready may become discouraged and develop poor writing habits, which may be difficult to correct later. Ziviani (1995) stated that letter formation in manuscript requires a spatial analysis that is similar to that needed when copying geometric forms. He also stated that copying forms at some early level precedes writing. Gesell (1940) explained that children gradually develop their ability to copy forms in a very predictable order. Starting with the vertical line, children progress in their copying abilities to the horizontal line, circle, cross, square and triangle.

It is important to ensure that children continually maintain good handwriting skills throughout the school years. Therefore, handwriting instruction including pre-writing skills, fine motor skills and development of visual perceptual skills may be deemed even more necessary in the pre-kindergarten and kindergarten years to develop a solid foundation of handwriting skills and prevent handwriting difficulties from occurring in the future. Hence, keeping all the above factors in the mind, the present study was planned with the following objectives:

- To assess the visual perceptual skills and writing readiness of young children.
- To explore the relationship between different sub-skills of visual perception and writing readiness.
- To ascertain the contribution of visual perception and writing readiness in determining the quality of handwriting.

■ RESEARCH METHODS

Sample selection:

The study was conducted in public schools of Ludhiana city. Out of four zones of Ludhiana district, one zone was purposively selected for this study. The total sample for the present study comprised of 160 public school children studying in grade 3 and 4, with atleast average intelligence. They were further evenly distributed into two categories of handwriting (English language) *i.e.* children with good handwriting (n=80) and poor handwriting (n=80) by administering (set – A, handwriting test) and to assess visual perceptual skills of the students (set –B) of occupational therapy screening test by Lilley (2006) was administered . Later, on the same sample self structured writing readiness assessment tool was administered.

Research instruments used:

Set -A:

Occupational therapy screening test by Lilley (2006) was used to assess handwriting of the selected students. The handwriting was assessed on 12 dimensions as described below:

- Correct formation of lower case letters.
- Correct formation of upper case letters.
- Formation of numbers.
- Alignment of letters and numbers on line.
- Consistency in size of letters and numbers.
- Spaces between letters.
- Spaces between words.
- Use of capital letters.
- Use of margins.
- Readability of writing.
- Time taken to finish written work.

Set - B:

It was used to assess the visual perceptual skills of the selected students. Various sub- skills of visual perception *viz.*, visual discrimination, visual closure, visual motor integration, position in space and visual analysis were assessed:

‘Visual discrimination’ is related to the ability to visually differentiate small differences between similar looking forms such as b/d, shapes such as 5/s, symbols such as ‘x’ and ‘+’ or objects. It also includes the ability to relate these key features to memory and categorize these forms, shapes, symbols or objects in order to make sense of the written word or numbers.

‘Visual closure’ which is the ability to recognize clues presented visually that allow a child to determine the appearance of the final product without all the details being present.

‘Visual motor integration (VMI)’ consists of coordinating visual perceptual skills together with gross-motor movement and fine-motor movement. It is the ability to integrate the visual input with motor output.

‘Position in space’ which is the ability to recall the spatial location of an object or stimuli. It is the ability to be able to recall, identify or reproduce a design or dominant feature of an object.

‘Visual analysis’ is the ability to recall the spatial location of an object or stimuli. It is the ability to be able to recall, identify, or reproduce a design or dominant feature of an object.

Self - structured writing readiness assessment tool :

It was used for assessing writing readiness in children. Following are the dimensions of writing readiness:

‘Moving from freedom to confinement’ measured arm-hand coordination, eye- hand coordination and muscular

control.

'Drawing and tracing of circle' measured tracing and drawing of variations of the circle.

'Drawing of curves' measured different variations of curves with right/left orientation.

'Drawing and tracing of horizontal lines' measured tracing and drawing of horizontal lines with concept of directionality as straight and horizontal line is important, both for constructing letters and for use as a guideline in space on which letters are to be written.

'Drawing and tracing of vertical lines' measured tracing and drawing of vertical lines with concept of directionality with production of shapes by combining different forms of circle and vertical lines. Mastery in vertical lines is important to produce the stick letters *i.e.* l, I, t, j and combination is important for clockwise letters *i.e.* m, n, h, b, p.

'Drawing and tracing of oblique lines' measured tracing and drawing of oblique lines keeping directionality in mind. Mastery in the oblique lines help a child to write letters such as A, K, N, R, V, W, X, Y, Z.

'Continuity of motions involving curves and straight lines' measured tracing and drawing of zig-zag, curling lines, coordination of paper and lines. While creating letters a child needs to use its pencil fluently in all directions. If children, in producing zig-zag lines or arcades and garlands, have to turn their paper it can reveal a problem with preference of direction. A fluent intersecting of lines is required for cursive writing in the following letters: e, g, h, k, l, b and f. It also measures the crossing the midline and the intersection in the form of racetrack.

'Use of transposing markings' measured whether the child can copy from paper to paper.

'Clarity of the concept of below, above and on the line' measured whether the child has understanding about the concepts such as on the line, above the line, below the line. This helps to judge whether child knows where to write or not.

'Ability to differentiate the size' measured whether the child can differentiate between tall and short, big and small, large and small letters and has knowledge of alphabet size

while writing.

Statistical analysis:

The collected data were classified and tabulated in accordance with the objectives to arrive at the meaningful and relevant inferences by using z- test, multiple linear regression analysis and coefficient of correlation.

RESEARCH FINDINGS AND DISCUSSION

The experimental findings obtained from the present study have been discussed in following heads:

Frequency distribution of children with good and poor handwriting on two performance levels of visual perception:

Table 1 describes the performance of children with good and poor handwriting across two levels of visual perception. The table reflects that no significant differences were observed in frequency distribution of children with good and poor handwriting skills across two levels of performance as majority of children with good (88.75%) and poor handwriting (80.00%) showed good visual perceptual skills. However, the percentage of children with poor handwriting (20%) was found more in children who had poor visual perceptual skills. From the above data, it can be concluded that proportion of children with good and poor visual perception did not differ significantly as far as handwriting were concerned.

Pereformance of children with good and poor handwriting across various levels of writing readiness:

Table 2 depicts the performance of children with good and poor handwriting across various levels of writing readiness. The table states that majority of students with good handwriting had good writing readiness ($z=2.88$; $p<0.05$). It was observed that percentage of children with good handwriting was found to be 83.75 whereas it was found 63.75 per cent in case of children with poor handwriting. On the other hand, only 16.25 per cent of children with good

| Table 1: Frequency distribution of children with good and poor handwriting on two performance levels of visual perception (n=160) | | | | |
|---|-------------------|-----------------------------------|-----------------------------------|----------|
| Sr. No. | Visual perception | Handwriting | | z- value |
| | | Good handwriting Frequency (%) | Poor handwriting Frequency (%) | |
| 1. | Good | 71 (88.75) | 64 (80.00) | 1.52 |
| 2. | Poor | 9 (11.25) | 16 (20.00) | |

| Table 2 : Performance of children with good and poor handwriting across various levels of writing | | | | |
|---|-------------------|-----------------------------------|-----------------------------------|----------|
| Sr. No. | Writing readiness | Handwriting | | z- value |
| | | Good handwriting Frequency (%) | Poor handwriting Frequency (%) | |
| 1. | Good | 67 (83.75) | 51 (63.75) | 2.88* |
| 2. | Poor | 13 (16.25) | 29 (36.25) | |

* indicate significance of value at P=0.05

handwriting were found to have poor writing readiness as compared to significantly higher proportion of children who had poor handwriting (36.25 %). From the above data, it could be concluded that writing readiness is important to be acquired for formal handwriting as most of the students with good handwriting had mastered writing readiness for classroom assignments and tasks. Karlsdottir and Stefansson (2002), in their study found that the quality of children's handwriting develops quickly in grade 1 and it reaches its permanent level during grade 2. They found that slower development indicates handwriting dysfunction. It is, therefore, very important for learners to be ready to attain this goal.

Table 3 describes the relationship between different sub-skills of visual perception and writing readiness. It depicts significant positive relationship of visual discrimination with drawing and tracing of circle ($r=0.229$; $p<0.05$), horizontal lines ($r=0.229$; $p<0.05$) and vertical lines ($r=0.273$; $p<0.01$). This indicates that with increase in visual discrimination skill, children were better able to draw as well as trace the circle, horizontal, vertical and oblique lines. Further, visual closure which plays a significant role in visualizing the end product and completing the presentation of what a child is going to copy was found significantly correlated with continuity of motions involving curves and straight lines ($r=0.266$; $p<0.05$) and use of transposing markings ($r=0.227$; $p<0.05$). Similarly, visual motor integration

was found positively related with moving from freedom to confinement ($r=0.236$; $p<0.05$), drawing and tracing of curves ($r=0.229$; $p<0.05$), vertical lines ($r=0.270$; $p<0.01$) and ability to use transposing markings ($r=0.288$; $p<0.01$). Visual motor integration consists of coordinating visual perceptual skills together with gross-motor movement and fine-motor movement. It is the ability to integrate visual input with motor output. The child uses visual motor integration skill in tasks like copying from blackboard, from paper to paper and while writing also. The data findings revealed highly significant and positive relationship between visual analysis and various sub – skills of writing readiness *viz.*, moving from freedom to confinement ($r=0.277$; $p<0.01$), drawing and tracing of circle ($r=0.369$; $p<0.01$), curves ($r=0.450$; $p<0.01$), horizontal lines ($r=0.334$; $p<0.01$), vertical lines ($r=0.454$; $p<0.01$), drawing and tracing of oblique lines ($r=0.386$; $p<0.01$), continuity of motions involving curves and straight lines ($r=0.386$; $p<0.01$) and clarity of the concept of below, above and on the line ($r=0.319$; $p<0.01$). Visual analysis is the integration of visual perceptual skills and position in space, which underlies the ability to competently complete scholastic tasks.

At the end, it could be elated that visual perception and its various sub skills including visual discrimination, visual closure, visual motor integration, visual analysis were found to have strong correlation with writing readiness in children. With increase in visual perceptual skills, a child's ability to acquire different writing readiness skills also improved and

Table 3: Correlation between different sub-skills of visual perception and writing readiness

| Sr. No. | Dimensions of writing readiness | Dimensions of visual perception | | | | |
|---------|---|---------------------------------|----------------|--------------------------|-------------------|-----------------|
| | | Visual discrimination | Visual closure | Visual motor integration | Position in space | Visual analysis |
| 1. | Freedom to confinement | 0.012 | 0.157 | 0.236* | 0.105 | 0.277** |
| 2. | Drawing and tracing of | | | | | |
| | Circle | 0.229* | 0.151 | 0.074 | -0.069 | 0.369** |
| | Curves | 0.092 | 0.145 | 0.229* | 0.213 | 0.450** |
| | Horizontal lines | 0.229* | 0.207 | 0.039 | 0.052 | 0.334** |
| | Vertical lines | 0.273** | 0.189 | 0.270** | 0.174 | 0.454** |
| | Oblique lines | 0.203 | 0.102 | 0.151 | -0.006 | 0.386** |
| 3. | Continuity of motion | 0.202 | 0.266* | 0.206 | 0.074 | 0.386** |
| 4. | Use of transposing markings | -0.141 | 0.227* | 0.288** | 0.094 | 0.026 |
| 5. | Concept of below, above and on the line | 0.178 | 0.129 | 0.017 | -0.043 | 0.319** |
| 6. | Ability to differentiate the size | -0.061 | 0.039 | -0.058 | 0.017 | 0.148 |

* and ** indicate significance of values at $P=0.05$ and 0.01 , respectively

Table 4 : Contribution of visual perception and writing readiness in determining quality of handwriting

| Variables | Regression | | | | |
|-------------------|------------|--------|---------|----------|---------|
| | Constant | | t-value | R-square | F-ratio |
| Visual perception | -3.8613 | 0.1153 | 4.50** | 0.1665 | 15.68** |
| Writing readiness | -1.1610 | 0.1751 | 3.16** | 0.1134 | 20.20** |
| Combined | | 0.1722 | 4.76** | 0.1253 | 22.63** |

** indicate significance of value at $P=0.01$

hence, the writing was found more legible.

It is inferred from Table 4 that visual perception and writing readiness had a significant effect on handwriting of children. The table indicated that in case of visual perception 16.6 per cent variation in the handwriting scores can be attributed to visual perceptual skills. Co-efficient of visual perception was found significant ($p < 0.01$) and positive suggesting that it plays important role in determining the handwriting skills of children and enhances the legibility and clarity of their handwriting. The table further explains that writing readiness was also found significantly contributing in determining the quality of handwriting. The variation in handwriting scores was found to be 11.3 per cent due to writing readiness in children. Co-efficient of writing readiness was found significant and positive which highlights the supporting role of writing readiness in determining the quality of writing skills among children.

It was further found from data that visual perception had better role to play in improving the quality of writing skills among children. The negative constant value found in case of visual perception clearly indicated that if the visual perceptual skills of children aren't enhanced the chances of further deterioration of handwriting are high. However, if writing readiness is kept constant, the writing scores of children could lead to deterioration but to lesser extent. Therefore, the table indicates that improving visual perceptual skills of children are imperative for improving the handwriting quality of children.

Conclusion:

The results of the present study have highlighted the role of sub – skills of visual perception and writing readiness in determining quality of handwriting in children. Therefore, activities to enhance visual perceptual skills should be part of young child's daily schedule as it helps to enhance the writing readiness and formal writing skills among children. Regression analysis revealed that visual perception and writing readiness had made a positive and significant contribution in improving quality of handwriting of children. Both variables were found to enhance the legibility and clarity of the handwriting.

Authors' affiliations:

DEEPIKA VIG AND SARITA SAINI, Department of Human Development, Punjab Agricultural University, LUDHIANA (PUNJAB) INDIA
Email: vigdeepika@pau.edu

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