Pencil Size and their Impact on Penmanship Legibility

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Abstract
Legible penmanship is important. However, young students have difficulty producing legible handwriting (Marr, Windsor, & Cermak, 2001). As legible handwriting is a benefit for both the students and the teachers in the classroom setting, this study examined if pencil size had an impact on preschool and kindergarten students' handwriting. The students used four different pencil sizes over a two-week period. The data showed pencil size did not impact handwriting legibility but there was a pencil size preference difference between preschool and kindergarten students, which may impact the yearly student supply lists.

This action research study began after several second-year teachers attended a mandated professional development workshop on the importance of teaching handwriting. During the workshop they learned that writing promotes thinking, builds communication skills, enhances learning and reading, and builds fine motor skills. In addition, they examined the writing Texas Essential Knowledge and Skills (TEKS) and found that kindergarten students should be able to form upper and lower-case letters using the basic conventions of print (left to right and top-to-bottom). The teachers were curious to know if pencil size had an impacted preschoolers and kindergarten students' handwriting legibility. However, they were not interested in writing an article, so they gave us the data to do so.

Theoretical Framework

There are several theories that can be connected to penmanship: 1) connection theory; and 2) motor learning theory. First, the connection theory looks at the idea that handwriting legibility is related to fluency of writing and reading skills (Rose, 2004). This supports the idea that penmanship legibility impacts academic achievement and self-esteem (Kushki et al., 2011). Second, motor learning is defined as "a set of processes associated with practice or experience leading to permanent changes in the capability for movement" (Schmidt & Lee, 2005, p. 302). The motor learning theory states that for students to improve their handwriting, fine motor skills need to be developed and this can only occur through practice (Hoy, Egan & Feder, 2011).

Handwriting Importance

Handwriting is an essential part of the school experience as the majority of classroom assignments require handwriting (Graham & Santangelo, 2012). In addition, "handwriting involves cognitive, kinesthetic and perceptual-motor components" (Hanover Report, 2012, p. 2)

and thus, "handwriting instruction benefits students' cognitive development as well as their motor functioning" (Zubrzycki, 2012, p. 13). Furthermore, handwriting is the foundational skill necessary for literacy success, as writing helps students to become fluent in recognizing letter formations (Berninger, 2012). Moreover, it has been shown that the act of writing newly learned words results in a significant strengthening of word recognition (Adams, 1990).

The nice thing is good penmanship is a learned skill and does improve with handwriting instruction (Graham, 2009-2010). It has been found that school work written with good penmanship receives higher scores than work with poor penmanship (Chase, 1986). But more importantly, writing instruction improves "not just the legibility of writing, but its quantity and quality" (Graham, 2009-2010, p. 20). However, it is estimated that 25%-33% of elementary students don't gain the necessary handwriting skills needed to write legibly and fluently putting them at a disadvantage (Handwriting Summit, 2012). Therefore, it is important that teachers plan numerous writing tasks, as that is the "most effective method for facilitating handwriting fluency" (Graham, 2009-2010, p 26).

Handwriting, Fine Motor Skills and Pencil Size

Even though research has found that 30-60% of the class time is spent with fine motor/writing activities students still have difficulty producing legible handwriting (Pape & Ryba, 2004). There are a variety of reasons why some people have handwriting problems. One of these reasons is the internal factor found within the child, which consists of such ideas as fine motor skill development and attitude toward writing (Marr, Windsor, & Cermak, 2001). The second reason concerns external factors which consist of such ideas as pencil size, time to write and teacher instructional approach toward writing (Marr, Windsor, & Cermak, 2001). Lack of motor skills is one reason for poor handwriting. This is important to note, as "research has shown that fine motor skills are the strongest predictor of special education referrals and the second strongest predictor of kindergarten retention" (Cameron, Brock, Murrah, Bell, Worzalla, Grissmer, & Morrison, 2012, p. 485).

Another reason for handwriting problems is the pencil size. However, recommendations regarding the best pencil size are conflicting (Marr, Windsor, & Cermak, 2001). Some research has shown pencil size does not make a difference (Ochler et al, 2000) while other research shows large diameter pencils should be used as they encourage correct finger positioning and may prevent hand cramps (Carlson & Cunningham, 1990).

Purpose of the Study

At the beginning of every school year teachers make a supply list. However, before you stock up on school supplies, it is important to pick a pencil that really works. However, there is no clear evidence of what type of writing tools are best for young children. Thus, the purpose of this study was to answer the following question:

1. What impact will pencil size (diameter and length) have on the legibility of handwriting among preschool students and kindergarten students?
2. What impact will pencil grip have on the legibility of handwriting among preschool students and kindergarten students?

Methods

Participants

All the participants were preschool and kindergarten students who attended an urban school. One group consisted of 33 preschool students whose ages ranged from three years three months to four years eleven months. There were 20 boys and 13 girls all African American. They were placed in either the three-year-old classroom or the four-year-old classroom.

The second group consisted of 16 kindergarten students whose ages ranged from five years one month to five years eleven months. There were eight boys and eight girls, seven Caucasian, and nine African American. They were placed in the five-year-old classroom.

Pencil Types

There were four different pencils used during the intervention. The first pencil was a short skinny pencil, 3 ½ inches in length and ¾ centimeters in diameter. An example of this is a golf pencil. The second pencil was a short oversized pencil. It was 4 inches long by 1 centimeter in diameter. This was created by buying a jumbo pencil and sharpening it down to 4 inches. The third pencil was a long skinny pencil, 7 ¼ inches long with a ¾ centimeter diameter. This is a standard pencil. The fourth pencil was a long oversized pencil, 7 ½ inches long and 1 centimeter in diameter. This is a regular jumbo pencil.

Handwriting Rubric

In order to be consistent with assessment, the teachers created a rubric that all three teachers used while analyzing their student's handwriting data. It consisted of 4 categories: pencil grip, pressure, letter formation, and relationship to the line. In addition, handedness and height of grip were noted (Figure 1).

Pencil Grip. The pencil grip category consisted of four different grips (Table 2). First, the tripod grip has the pencil positioned so that there is equal pressure between the thumb, the side of the middle finger, and the tip of the index finger with all fingers being bent slightly. Second, the quadrapod grip has the pencil positioned by the four fingers and the thumb opposing. Third, the thumb wrap grip had the pencil held against the index finger with the thumb crossed over the pencil. Fourth, the palmar pencil grip had the pencil being held fisted in the palm with the thumb up or down.

Pressure. The pressure category was defined as firm, shaky firm, wispy, and shaky wispy. Firm pressure was characterized as a straight, steady line, while the shaky firm pressure was characterized as a wavy, dark colored line. Wispy pressure was characterized as a very light colored line and shaky wispy pressure was characterized as a wavy, light colored line.

Letter Formation & Line Relationship. The letter formation category was defined as how many letters of the word "CAT" were written legibly. The relationship to the line category pertained to how many letters or symbols of the word "CAT" were written correctly on the line provided.

Student Writing Sample Paper

The student writing sample paper was a 8½x11 sheet of paper that was folded in half. The top section of the paper contained a dark black line that was centered at the bottom, which was the baseline to write "CAT." This allowed the children to have plenty of room for a picture, if they chose to add a picture to their sample.

Procedure

The study took two weeks to complete and the intervention activity took approximately 20-30 minutes per day. Observational field notes (Figure 1) and interviews on Friday to ask students about their choices were used to collect the data. As the same procedure was used for both weeks, ten writing samples per participant were collected and analyzed.

On Monday, the classroom teacher handed out the student writing sample paper, an index card with the word "CAT" (1 inch letters), and the long oversized pencil was placed in front of the child. The teacher then asked the child to look at the index card and copy the word cat. The teacher also told the child if they would like to draw a picture of the cat, they could. While the child was writing and drawing, the teacher observed which pencil grip and hand (left or right) was used by the student. On Tuesday, the same procedure was followed but the participants used a short oversized pencil. On Wednesday, the short skinny pencil was used by the students to write the word cat. And on Thursday, the long skinny pencil was used for the hand writing sample. On Friday, all four pencils were given to the child. The teachers asked the child to copy the word cat with their favorite pencil. After the student completed the task, the teachers informally interview each student to find out which pencil was chosen and why it was chosen. The same procedure was used for the second week.

Name: _____ Age: _____ Gender: _____

Date: _____ Type of Pencil: _____

1. Pencil Grip:
   - Used Right Hand
   - Used Left Hand

2. Pencil Grip:
   - Tripod Grip (4 pts)
   - Quadrapod Grip (3 pts)
   - Thumb Wrap Grip (2pts)
   - Palmar or Pronated Grip (1 pt)

3. Pencil Grip:
   - High on Pencil
   - Low on Pencil

4. Pressure:
   - Firm (4 pts)
   - Shaky Firm (3 pts)
   - Wispy (2 pts)
   - Wispy Shaky (1 pt) 1

5. Letter Formation:
   - Wrote all 3 letters legibly (4 pts)
   - Wrote 2 letters legibly (3 pts)

- Wrote 1 letter legibly (2 pts)
- Wrote No letters legibly (1 pt)

6. Relationship to Line:
    - All 3 letters were written on line (4 pts)
    - Three letters were written on line (3 pts)
    - Two letters were written on line (2 pts)
    - NO letters were written on the line (1pt)

Observations and Comments:

Figure 1. Hand-writing Rubric

Data Analysis

Each day the teachers filled out the field note part of the writing sample paper using their observational information and the writing rubric. Next, these scores were totaled for each sample. Finally, each pencil sample was totaled and an average determined.

Results

Using the Handwriting Rubric

The ten rubrics for each child were totaled and averaged. The results showed that the three-year olds, four-year olds and five-year olds average rubric scores with each pencil size was basically the same. The three-year-old participants had a two-tenths difference between the short oversized pencil and the short skinny pencil. The four-year-old participants had a two-tenths difference between the long oversized pencil and the long skinny pencil. The five-year-old participants had a two-tenths difference between the short oversized pencil and the long oversized pencil. This little bit of difference could have been because of the child's mood that day, the child's pace in writing, or the other activities taking place in the classroom.

Pencil Grip. All the children were able to hold the pencil in a tripod or quadrapod grip, which is typical of adults. However, a few children used the thumb wrap in conjunction with the tripod or quadrapod grip.

Pressure. When analyzing the amount of pressure applied by the children, the teachers found that it did not vary from pencil to pencil. Instead, the children maintained the same grip height on each pencil, which made the pressure a static variable. Children who held the pencil at

a higher level, typically the younger children, had a shaky lighter script, whereas those children with a low grip had a firm darker writing sample.

Letter Formation & Line Relationship. The younger the age of the child, the less accurate the letter formation was of the word "cat." The younger the child the less they focused their writing on the baseline. However, as the participants' age moved towards four, there was a clearer attempt to write on or near the line. Many of the five years old participants had a clear understanding of the baseline and often wrote a majority of the letters on the line.

Using Friday's Observation and Interview Data by Age Level

On each Friday, the students were given choice in the pencil they chose to write with and then they were interviewed to see why the pencil was chosen. As seen in Table 1, the most popular by the whole group was the short skinny pencil. This was because both the three-year-old children and the four-year-old children chose the short skinny pencil as their favorite. However, it was the least popular by the five-year-old children who indicated they liked the long oversized pencil the most. The kindergarteners had more reflective comments for their preferences such as "it is bigger and easier to control," "I can write better with it," and "it is sharp." Finally, as week one concluded, most of the four and five year old children were able to complete the writing sample without the assistance of the "CAT" index card and were comfortable using whichever tool was mandated.

Table 1
Pencil Type Preference over the 2-week Study

	Short oversized	Long oversized	Short skinny	Long skinny
3 year olds	6	5	20	4
4 year olds	4	5	18	4
5 year olds	4	18	2	8
Total	14	28	40	16

Note: Total N for preschoolers = 66 and Total N for kindergarten = 32

Using Friday's Observation and Interview Data by Gender

On Friday, the students were given choice in pencils and interviewed to determine why participants chose the pencil. As seen in Table 2 below, there is a slight difference in gender preference. Both preschool boys and girls preferred the short skinny pencil while both kindergarten boys and girls preferred the long oversized pencils. Even though gender did not show significant difference, the comments made by each group were gender specific. The girls seemed to focus on the aesthetics of the pencil, such as the color, and the design while the boys were aware of which pencils were "bigger and biggest," as well as which were "easier to write with or harder to control."

Table 2

Pencil Preference by Gender

	Short oversized		Long oversized		Short skinny		Long skinny	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Preschooler	6	5	6	2	19	16	6	1
Kindergartener	1	3	7	10	2	0	6	2

Note: Total N for preschoolers = 66 and Total N for kindergarten = 32

Discussion and Conclusion

Even though the findings of this study are a contribution to the small body of information regarding the relationship between pencil diameter, pencil length, and handwriting skills for young children several limitations are present which may limit the generalizability. The first limitation of the present study relates to the participants. The participants were from one elementary school. Even through three teachers were involved there were only 49 students. In addition, the classroom teachers reported that the students found the assessment of their handwriting tedious and monotonous which may have impacted their approach to this handwriting activity.

The purposes of this present study were to determine if pencil size had an impact on student's pencil grip and handwriting legibility. The results showed that the pencil grip, pressure and letter formation was due to the hand position on the pencil. The higher the hand gripped the pencil, the more wispy and illegible the writing. However, the majority of the students used the tripod or quadropod grip. These results are similar with past research that shows by the age of four most children should have a normal adult grip. In addition, the teachers felt that the pressure, letter formation and relationship to the line followed a developmental pattern and the students worked to the best of their ability and were neither exhausted nor labored by this writing task. It was also noted that by the end of week one, most of the four and five year old children were able to complete the writing sample without the assistance of the "CAT" index card and were comfortable using whichever tool was mandated.

However, there was a preference difference in pencil size between preschoolers and kindergartners. It was found that both the boys and girls in the preschool classroom picked the short skinny pencil while both the boys and girls in kindergarten classroom picked the long oversized pencil. According to the teachers' field notes, the kindergarteners had more reflective comments which make sense as they are older and can communicate their thoughts better. In addition, the girls seemed to focus on the aesthetics of the pencil while the boys focused on the pencil itself.

Implication

Educators are concerned about young students' handwriting legibility and if there are certain writing tools that should be included on the school supply list. This study shows there is a big difference in preference of both size and aesthetic of the pencil. Thus, when teachers put yellow #2 pencils on the supply list and they teach young children, they may want to rethink what they write, as preschoolers like the short skinny golf pencil while the kindergarten students like the long oversized pencil, which contradicts some past research (Cole & Goodman, 1980). In addition, as girls and boys alike did comment about the color of the pencil having just yellow

pencils may not be best practice. From this research there is evidence that there is no particular advantage to having only one size of writing tool in the classroom.

In addition, the literature review shows that teachers need to be teaching hand writing skills and providing a variety of writing tasks to provide students with practice. So, even though we are in the 21st century where technology abounds and keyboarding skills are necessary, legible handwriting as well as handwriting automaticity is also important (Berninger, 2012; Kiss, 2007), as it is the foundation for language acquisition and literacy development (Cahill, 2009; Berninger, 2012, James, 2012). In addition, handwriting is a readiness skill which has been shown to increase academic achievement & brain development, which leads to better grades in school (Dinehart, 2014; Dinehart & Manfra, 2013). Furthermore, students who have good handwriting skills are more creative writers (Graham & Harris, 2005), are more confidence and have better memory skills (Berninger, 2012). Finally, writing will lead to better keyboard skills, as "the pen is mightier than the keyboard" (NAEYC, 2009, title). Thus, it is important to include hand-writing instruction not only in preschool and kindergarten (Graham, Harris, & Fink, 2000) but in general education and special education classrooms to aid struggling readers and writers (Cahill, 2009; Graham & Harris, 2005).

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