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Examination of Spelling Skills of Elementary Students who are Deaf and Hard of Hearing

Lacey Simpson

Undergraduate Honors Thesis Proposal

Communication Sciences and Disorders

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Abstract

Spelling is a crucial skill that children must learn to read, write, and communicate effectively, but this comes with challenges for students with hearing loss. Linguistic processes, such as phonological awareness, morphological awareness, orthographic awareness, semantic awareness, and mental graphemic representations are building blocks to understanding how to spell words accurately but are more difficult to grasp and apply with hearing loss. The purpose of this study was to evaluate the spelling skills of deaf and hard of hearing (d/hh) students to identify which linguistic processes need to be corrected and strengthened. By identifying which linguistic processes need remediation, educators may be able to better understand what specific skills to focus on when teaching spelling skills to deaf and hard of hearing students. This may help build spelling skills and strengthen spelling accuracy overall. For this study, the spelling skills of twenty-five students in the third, fourth, and fifth grades, all who are deaf or hard of hearing (d/hh), were evaluated over one academic year. The students all participated in Strategic and Interactive Writing Instruction (SIWI), an approach designed to improve the writing skills of d/hh students. The methods included the administration of the spelling subtest of the Woodcock Johnson Tests of Achievement (3rd Edition; WJTA-3) to d/hh students. A Multi-Linguistic Coding (MLC) System was used to identify what type of error was made for each incorrect spelling attempt. The six categories included in the MLC system are: phonological awareness errors (PA), orthographic pattern awareness errors (OPA), mental graphemic representation errors (MGR), morphological awareness errors (MA), semantic awareness errors (SA), and visual image errors (VI). The scores from the MLC were analyzed using a one-way analysis of variance (ANOVA) with one repeated measure, Error Type (PA vs. OPA vs. MGR vs. SA vs. MA vs. VI). Results indicated that there was a significant main effect for Error Type, $F(1,9.069)$,

$p=0.004$. An examination of the means by each spelling error type revealed that the participants made more PA errors ($M= 3.37$, $SD= 2.81$, range 0–12) than any other type of error.

Additionally, participants made more MGR errors ($M=2.46$, $SD=3.13$, range 0–11) and VI errors ($M=2.38$, $SD=2.99$, range 0-13) more often than OPA errors ($M=1.58$, $SD=2.19$, range 0–11), SA errors ($M=0.94$, $SD=1.63$, range 0–7), or MA errors ($M=0.46$, $SD=0.70$, range 0–3) on the spelling assessment. In conclusion, as predicted, d/hh students made more phonological errors than any other type on the spelling test, which is in direct contrast to the type of errors that were present in the spelling errors of students in grades 3-5 with typical hearing. Visual image errors were the next largest category. Also, the study found that the students' age equivalent scores as well as the number of words spelled correctly both increased over the course of eight months while the teachers implemented the SIWI. Future research is warranted to explore the MLC system, which can be used to inform intervention approaches used to improve the spelling skills of d/hh students.

Examination of Spelling Skills of Elementary Students Who Are Deaf and Hard of Hearing

Language is one of the most important parts of life and the way individuals communicate. There are many ways language is used, including spelling, which is a significant skill that is necessary to successfully communicate with others. The domains of language play an important role in learning to spell, and phonology is especially important as it encompasses the sounds of the language (MacGlaughlin, 2018). Spelling becomes challenging when communication is impaired. Many children are born with hearing loss or acquire hearing loss during childhood before establishing a first language. According to the National Institute on Deafness and Other Communication Disorders (NIDCD), “about 2 to 3 children out of every 1,000 children in the United States are born with a detectable level of hearing loss in one or both ears.” There is not an abundance of research on the spelling skills of children who are deaf or hard of hearing. The purpose of this study is to evaluate the spelling skills of children who are deaf or hard of hearing in the third, fourth, and fifth grades to remediate linguistic processes that are lacking in the child’s spelling and assess how the students’ spelling changes over the course of eight months to strengthen spelling skills overall.

Linguistic Processes

There are five different areas that work together to develop spelling skills for students have typical hearing, including “phonological awareness, orthographic awareness, mental graphemic representations, morphological awareness, and semantic knowledge,” (Bowers et al., 2015, p. 2). Phonological awareness embodies the understanding and production of speech sounds. (Ehri, 2000; Ehri & Wilce, 1980). This presents challenges to students who are deaf or hard of hearing as phonological awareness is typically acquired and learned through oral language (Aaron et al., 1998; Alamargot et al., 2007; Sterne & Goswami, 2000). As children are acquiring phonological awareness, they are recognizing sound units (e.g., sound identification and rhyming) and learning to manipulate the sounds in words (e.g., phoneme deletion, elision; Bowers et al., 2014). Phonological knowledge can develop through other methods besides

hearing including lip reading or speech reading. However, not all speech sounds can be understood through speech reading and lip reading (Hayes, 2009). Thus, sound plays a large role in learning how to spell. Orthographic awareness, is the ability to use proper spelling patterns, including sound-letter combinations, and conventions of a written language (Apel, 2011; Treiman & Bourassa, 2000). Mental graphemic representations are the knowledge that has been stored regarding the spelling of words, including the words where the spelling may not match the sounds (Apel, 2011; Apel & Masterson, 2001). Morphological awareness is the capability of discerning morphemes that are in words and how the morphemes relate to the spelling and the meaning of words (Apel, 2011; Carlisle, 1995). This is important, as morphemes are the smallest parts of a word that carry meaning (Singleton & Shulman, 2020), and larger words contain multiple morphemes. Semantic awareness is the understanding of what different words mean and the way that spelling may affect the particular definition of a word. (Bowers et al., 2014). It is necessary to have an understanding of these linguistic processes as they contribute to obtaining spelling skills.

Spelling Skills of Students Who Are Deaf or Hard of Hearing

Spelling skills are more difficult to achieve for kids who are deaf or hard of hearing (d/hh). Bowers et al. (2014) conducted a study evaluating the spelling errors for middle school students who are deaf or hard of hearing, and it was found that they displayed various spelling errors specifically in phonology, morphology, and semantics. Additionally, another study found that children who are deaf may not have access to auditory phonology, but they do have access to visual phonology through sign language (McQuarrie & Parilla, 2014). In kindergarten, spelling skills do not differ greatly between children with typical hearing and children who are deaf or hard of hearing, but the spelling skills do not grow as rapidly throughout the later years of elementary school for children who are deaf or hard of hearing (Aho & Werfel, 2021). A study was conducted evaluating the spelling skills of children who have cochlear implants. The results showed that the spelling skills were strong when the students wrote their own stories, suggesting

that context plays a huge role in spelling (Hendricks et al., 2016). Overall, research demonstrated that spelling skills may develop slower for students who are deaf or hard of hearing in later elementary school years. Also, students who are deaf or hard of hearing but have access to some sounds through a cochlear implant were found to have stronger spelling skills, implying that sound does play a role but that spelling has other important factors as well, such as the context of spelling words.

Methods for Evaluating Spelling Skills

There are various ways to gather information and analyze the spelling of children who are deaf or hard of hearing. The Multilinguistic Coding System (MLC) is a form of analyzing the spelling of students who are deaf or hard of hearing. Through the MLC, spelling words produced by the students can be analyzed thoroughly and connected to a linguistic processes that students are or are not utilizing accurately (Bowers et al., 2014). Thus, the MLC analyzes spelling qualitatively through the different linguistic processes. It was found that the MLC is more descriptive and relevant to analyzing the spelling skills of children who are deaf or hard of hearing (Bowers et al., 2015).

In summary, research conducted with d/hh children in kindergarten demonstrated no significant difference in their spelling abilities as compared to their hearing peers (Aho & Werfel, 2020). Studies conducted with middle school-age children show significant differences in spelling errors for d/hh students compared to their peers, including the types of linguistic errors that they make. To date, there is no published research on the spelling patterns of d/hh students in the elementary grades, specifically grades 3-5. The purpose of this research study is to examine the spelling skills of d/hh students participating in a year-long writing instruction intervention.

The research questions are as follows:

1. Does the percentage of spelling errors change over the course of one year?

It is predicted that spelling accuracy will increase over the course of one year.

2. What spelling error patterns do d/hh children in grades 3-5 in a spelling test?

It is predicted that students demonstrate weak phonological awareness skills, with a high percentage of spelling errors consisting of errors of sound.

Method

Participants

Fifty-two students who are deaf or hard of hearing were participants in a yearlong study to assess growth over time in different areas within writing, including spelling. Students were recruited from a wide range of classrooms using different types of communication modalities, including listening and spoken language, total communication (TC) and bilingual-bicultural classrooms using both English and American Sign Language for instructional purposes. Parental consent was obtained by the IRB.

Methods:

Data collection was conducted by classroom teachers. All students were administered a spelling subtest titled the *Woodcock Johnson Tests of Achievement (3rd edition: WJTA-3)*, which included 59 test items and was given once at the beginning of the year, and a second time at the end of the year. (Woodcock, McGrew & Mather, 2001). Figure 1 provides the spelling words from the WJTA-3. The time in between the administration of the pre-test and post-test was approximately eight months.

Strategic and Interactive Writing Instruction (SIWI) was provided to students to improve writing skills. SIWI was provided to the elementary students by trained professionals for two

hours per week for the academic year. SIWI uses guiding principles to provide authentic and meaningful writing experiences for students who are deaf and hard of hearing (d/hh).

Spelling data was entered into a Microsoft Excel spreadsheet listing each student’s response for the pretest and posttest. Two primary investigators coded 20% of the spelling tests, with 97% inter rater reliability. For each student’s pretest and posttest, each response from the student that was spelled correctly received one point. Then, the student’s points for each test were counted, and the total number of points resulted in a raw score which was used to record each student’s age equivalence. The raw score was used to determine a student’s age-equivalent score for the pre-test and post-test to determine if the score changed over the course of the year.

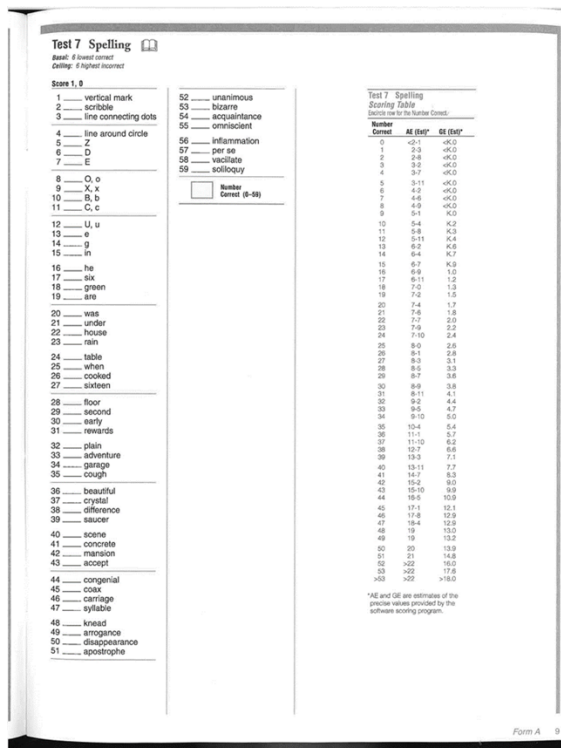


Figure 1. The WJTA-3 Spelling Subtest

Data Analysis

The spelling words were first compared to the target word for accuracy. Percentage accuracy was calculated by dividing the number of accurate answers to the number of attempted spelling words. Results were compared to normative data for age equivalence. Spelling errors were then coded using the MLC system. Six error categories were defined for coding: phonological awareness errors, orthographic pattern awareness errors, mental graphemic representation errors, morphological awareness errors, and semantic awareness errors. A pair-samples t-test was used to determine if there were any differences in pre-test to post-test spelling errors. It is predicted that over one year of writing instruction, students will demonstrate statistically significant gains in spelling accuracy. A one-way ANOVA was used to determine if there were any statistically significant differences between the spelling error categories. Consistent with the literature, it was predicted that students will demonstrate more phonological errors.

Table 1. *Multi-Linguistic Coding System for Spelling.*

Linguistic Category	Definitions, Defining Characteristics and Examples
Phonological errors (PA)	<ul style="list-style-type: none"> •Errors of SOUND •omission or addition of phonemes not in the word •maximally different incorrect representations of vowels (“o” for “a”; “u” for “e”) •all letter reversals
Orthographic Pattern Awareness Errors (OPA)	<ul style="list-style-type: none"> •Errors of regular PATTERNS •rules for combining letters (“kry” for “cry”; “jrum” for “drum”) •patterns that govern spelling (“ran” for “rain” ; “lader” for “ladder”) •positional constraints on spelling patterns (“ckow” for “cow”)
Mental Graphemic Representation Errors (MGR)	<ul style="list-style-type: none"> •Errors of IRREGULARITY (you just have to memorize the word) •correct “phonetic” spelling of non-phonetic words (“cidy” for “city”)

	<ul style="list-style-type: none"> •incorrect spelling of unstressed syllables (“buckit” for “bucket”) •incorrect vowels preceding –ng, r, l (“reng” for “rang” ; “whil” for “wheel”) •incorrect spelling for repeated attempts (stopd, stopt, stoppd)
Morphological Awareness Errors	<ul style="list-style-type: none"> •Errors of MODIFICATION (i.e. prefix, suffix, tense change) •incorrect use of morphemes •wrong tense is represented (“walk” for “walked”)
Semantic Awareness Errors (SA)	<ul style="list-style-type: none"> •Errors of MEANING •suffix modification errors represent another word (“fry” for “fried”; “drive” for drivers”) •wrong word used (“cried” for “cries”) <ul style="list-style-type: none"> • Correct spelling of a word, wrong word represented
Visual Image (VI) Error	<ul style="list-style-type: none"> • Use of VISUAL information or ASL influence • Mental image of word based on ASL sign • Word reversals (e.g., cake cup for cup cake) • Incorrect use of visually similar, different sounding letters (diat for bike) • Abbreviations (one letter to represent a word)

Results

The students’ pre- and post-tests were analyzed using a one-way ANOVA for differences in the age equivalency and in the number of correct words on the spelling subtest. Students made statistically significant gains in their age equivalencies in months ($t(51) = -3.649, p = .001$), and number of correct words ($t(51) = -2.743, p = .008$). Mean scores for age equivalency increased from 90.75 months (SD=20.44) to 102.65 months (SD=32.94), a gain of 12 months over an 8-month time period (see Figure 2). The number of correctly spelled words increased from a mean

of 23 words (SD=8.9) to 26 words (SD=10.9) (see Figure 3). The analysis showed a general increase in students' spelling accuracy percentage and indicated that positive gains in age equivalencies were made over the course of the academic year.

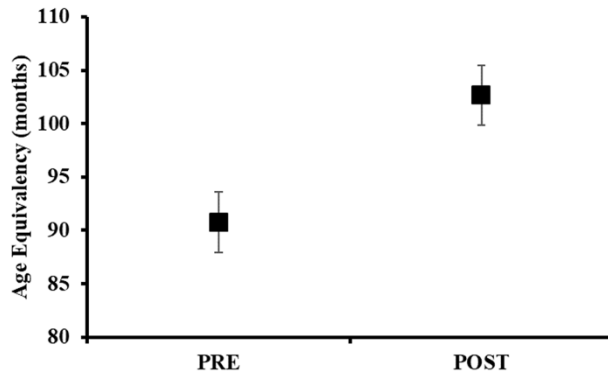


Figure 2. Age Equivalencies

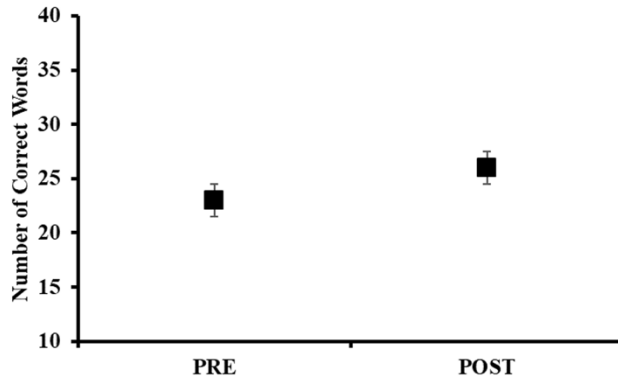
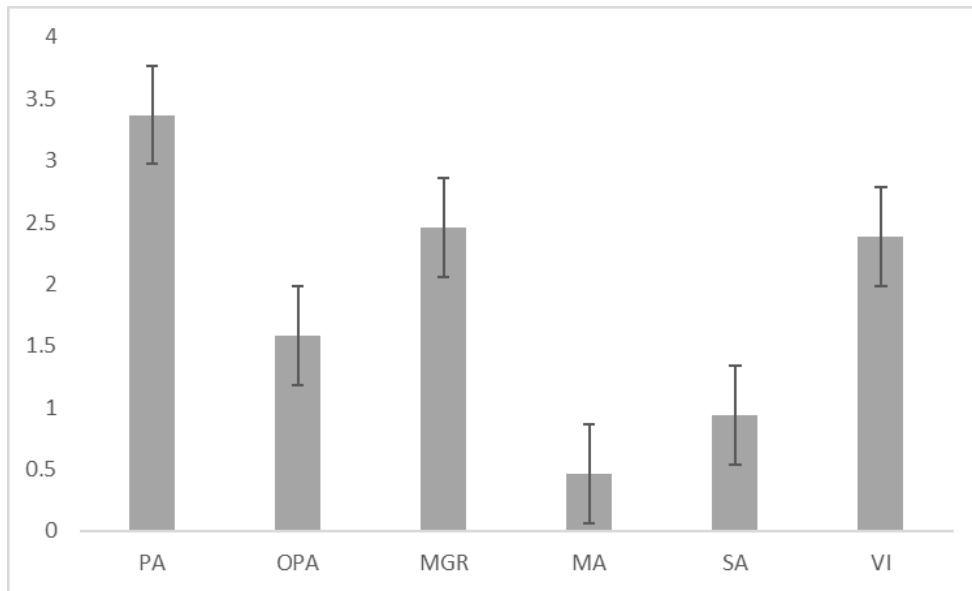


Figure 3. Number of Correct Words

Scores from the MLC were analyzed using a one-way analysis of variance (ANOVA) with one repeated measure, Error Type (PA vs. OPA vs. MGR vs. SA vs. MA vs. VI). Results indicated that there was a significant main effect for Error Type, $F(1,9.069)$, $p=0.004$. An examination of the means by each spelling error type revealed that the participants made more PA errors ($M= 3.37$, $SD= 2.81$, range 0–12) than any other type of error. Additionally,

participants made more MGR errors ($M=2.46$, $SD=3.13$, range 0–11) and VI errors ($M=2.38$, $SD=2.99$, range 0–13) more often than OPA errors ($M=1.58$, $SD=2.19$, range 0–11), SA errors ($M=0.94$, $SD=1.63$, range 0–7), or MA errors ($M=0.46$, $SD=0.70$, range 0–3) on the spelling assessment.



Discussion

As predicted, d/hh students made more phonological errors than any other type on the spelling test, which is in direct contrast to the type of errors that were present in the spelling errors of students in grades 3–5 with typical hearing. This means that d/hh students were leaving out various phonemes (sounds) in their spelling, indicating that the students are not aware of specific sounds in words, whereas students with typical hearing rely on phonological awareness skills the most for spelling words accurately. Phonological awareness “serves as the foundation for spelling development,” and students who are deaf or hard of hearing do not grasp this skill easily (Aaron et al., 1998, Alamargot et al., 2007; Sterne and Goswami, 2000). It is important to understand phonemes for accurate spelling, and d/hh students do not have access to sounds for

spelling, thus making spelling more difficult. Visual image errors were the next largest category. These errors are specific to students who are deaf or hard of hearing because it has been seen that American Sign Language and images of words influence the spelling of words, thus causing a student to use an incorrect letter that looks similar to another letter, an incorrect word influenced by a certain sign in ASL, or a drawing of a picture representing the target word (Bowers et al., 2015). These findings showed that the phonological awareness, a linguistic processes that we expect 3-5 graders to use accurately when spelling words, was not used consistently by students who are d/hh included in the study. However, visual imaging, a linguistic processes not typically utilized by students when spelling, was consistently used by d/hh students. Thus, qualitatively analyzing the linguistic processes used during spelling tasks could be a useful diagnostic tool when working with d/hh students.

Another important finding was that the students who were enrolled in the Strategic and Interactive Writing Instruction (SIWI) increased in their age equivalent scores from the pre-test to the post-test. This means that on average, the students demonstrated more accurate spelling skills that were closer to the spelling skill level of their peers with typical hearing. In addition to higher age equivalency scores, the students also on average had an increase in the number of words that were spelled correctly. It appears that participation in SIWI may have contributed to an increase in the spelling accuracy of d/hh students over the course of eight months. SIWI focuses on increasing the writing outcomes of students, which in turn may positively impact spelling. This gives insight into a potentially different way spelling can be taught or strengthened in children who are deaf or hard of hearing, which is focusing on writing as a whole and context. The use of SIWI and the understanding of linguistic processes that are lacking in students who

are deaf or hard of hearing gives educators insight to potentially more efficient methods of strengthening spelling skills.

Conclusion

There is not an abundance of research on the spelling skills of children who are deaf or hard of hearing, specifically in the middle school age range. Further research into the spelling skills of students who are deaf or hard of hearing as well as differing interventions or methods of teaching spelling could give more insight into the most effective ways possible to teach spelling. With more information on this subject, positive changes may be made in communication. Some limitations in this study include that there was no control group, and that the MLC was not used to analyze the post spelling tests. Training and scoring using the MLC can be time intensive. Future research is warranted to explore the MLC system, which can be used to inform intervention approaches used to improve the spelling skills of d/hh students.

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