Specialized Writing Instruction for Deaf Students: A Randomized Controlled Trial

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Kimberly Wolbers[1], Hannah Dostal [2], Steve Graham[3], Lee Branum-Martin[4], and Leala Holcomb[1]

[1] University of Tennessee

[2] University of Connecticut

[3] Arizona State University

[4] Georgia State University

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Specialized Writing Instruction for Deaf Students: A Randomized Controlled Trial

Writing is a complex activity for all ages that requires the integration of multiple skills and cognitive processes. Elementary writers are working to develop a range of production skills from idea generation and revision to the use of appropriate and relevant sentence structures, vocabulary, and spelling. These skills are cognitively demanding and build on early language and literacy experiences. Because deaf students have varied histories with regard to accessing and developing language, their characteristics as writers are highly heterogeneous. For example, deaf children differ as to when they receive initial exposure to American Sign Language (ASL; e.g., birth to 3 years, upon entering school at 4-6 years of age, or later) as well as the quality and quantity of input (e.g., high number of fluent language models in their lives to few or none) (Hall & De Anda, 2021). Therefore, they demonstrate varying levels of proficiency in ASL and English--from significant delays in one or both languages to age appropriate bilingual development (Hall, 2020). Similarly, deaf children not exposed to ASL demonstrate varying levels of English competency due to the ease or difficulty they experience accessing spoken language (Lederberg et al., 2013). Last, some children have such impoverished experiences in both languages, they experience language deprivation, which presents complex challenges in cognition, language, and literacy development (Hall, 2017; Mayberry & Kluender, 2018).

Teachers of deaf students often find it difficult to apply existing approaches without first adapting resources to fit the specific language and cultural needs of their students (Vostal & Ward, 2015). Thus far, studies that focus on writing instruction for deaf children have been applications of approaches used with hearing students to examine selected aspects of writing such as vocabulary, spelling, grammar, writing process, and journaling (Strassman et al., 2019; Strassman & Schirmer, 2013). We propose a theoretical framework for writing instruction that

guides the development of word-, sentence-, and discourse-level skills through strategic and supported writing practice, and provides responsive language instruction to deaf learners (Easterbrooks, 2020). The randomized controlled trial (RCT) described in this manuscript is an evaluation of such a framework in teaching practice.

Theory to Practice in Writing Instruction with Deaf Students

Recently articulated models of writing merge sociocultural and cognitive theories to reflect writers within communities (Author). This combined model details the interaction between individual cognition and the broader writing community, whereby members share and shape the cognitive resources brought to the social act of writing. Strategic and goal-driven instruction occurring within an environment of collaboration and apprenticeship provide the mechanisms to propel writing and motivation (De Smedt & Van Keer, 2014). Strategic and Interactive Writing Instruction (SIWI) is built upon a cognitive and sociocultural framework and is directed by the language needs of deaf students (Author).

There are three foundational principles to SIWI--strategic, interactive, and linguistic/metalinguistic. First, strategic instruction--drawn from cognitive theories of composing (Flower & Hayes, 1981)--involves explicitly teaching students what skilled writers do when they write. For example, recursive writing processes such as planning, organizing, and revising are explicitly taught and practiced, often with visual scaffolds or procedural facilitators (Scardamalia & Bereiter, 1983). Meta-analyses have revealed that teaching strategies for writing processes (e.g., planning, revising) or genre-specific writing skills results in enhanced quality and knowledge of writing (Author). These effects are known to benefit children learning English as a second language and those with disabilities (Author).

Second, interactive writing is defined here as a collaborative, dialogic experience. It is inspired by the application of sociocultural theories in writing instruction, whereby novice writers are actively involved and supported in writing communities (Englert, Mariage, et al., 2006). Interactive writing allows for apprenticeship of writers during the co-construction of text, which may be written with an authentic purpose and audience in mind (Blanch et al., 2017). The collaborative writing experience, while initially teacher-guided for the purpose of introducing new skills, becomes increasingly student-led as learners appropriate the discourse and practices of the community (Englert, Berry, et al., 2001). During interactive writing, participants engage in supportive problem solving, share thought processes, and negotiate writing actions--all which contribute to a transfer of control over the writing. In particular, students learning a second language are empowered to lead discussions on grammar-related features along with the content, structure, and organization of text (Villarreal & Gil-Sarratea, 2020). Interactive writing implemented with deaf writers has resulted in students identifying as writers and gaining independence with various writing skills (Author; Williams, 2011).

A third SIWI driving principle is intentionality with developing greater metalinguistic knowledge and linguistic competence; this is derived from the theory that both explicit and implicit language knowledge is important to second language facility (Ellis, 1994). Comparing and contrasting English and ASL on word, sentence, and paragraph levels, as well as highlighting language features in mentor texts, are among the approaches used to elevate meta-awareness of the structures in both languages. When ideas are generated in ASL, the teacher uses the language zone--a physical space where language work occurs--to guide and actively engage students in finding equivalent English translations, phrase-by-phrase, for the co-constructed text (Author). While deaf writers show improved organization and a higher number of subordinate

clauses when translating from sign language, they do not show significant improvements in grammar absent of metalinguistic instruction (Koutsoubou et al., 2007). Heightening students' awareness of ASL, English, and ASL-English equivalencies leads to significant gains in both languages (Author) and a motivation toward English literacy (Gough, 2014).

Additionally, teachers implicitly promote ASL and English linguistic competence through the interactive, collaborative environment--by engaging students in dialogue through questioning, providing language models that are contingently responsive to student contributions, and expanding students' expressive language before writing. The teacher will also frequently prompt students to reread their revised ideas in English text, which promotes familiarity with new language forms (Skerrit, 2017). In these ways, SIWI has been effectively implemented in Listening and Spoken Language (LSL) environments or with children who do not use ASL to promote further acquisition and development of English (Author). For children with significant language delays, the teacher enacts approaches in the language zone designed to repair communication breakdowns, increase clarity and complexity of expressive language, and connect expressions to written English. This focus on metalinguistic knowledge and linguistic competence is what makes SIWI specialized for the deaf population. [For more information, see Enactment of SIWI Principles in the online supplemental materials.]

Prior research indicates SIWI has potential to positively impact the writing of deaf students. A quasi-experimental study conducted with 33 middle school students (16 in treatment, 17 in comparison, matched) lasting 8 weeks with a focus on information report writing led to statistically significant differences in writing traits of the taught (information report) and untaught genres (narrative), contextual language variables from the TOWL-3, and length of text (Author). Student participants included emerging writers exhibiting significant language delays

to proficient bilinguals, who were separated into three classes for instruction based on literacy levels. Students in each class demonstrated gains, and effect sizes were high (1.27-2.65). Instruction was provided by an experienced teacher with high fidelity in providing responsive language instruction during guided writing. A second quasi-experiment study (Author) was conducted with 3rd-5th grade deaf students (41 in treatment, 22 in comparison); a total of 36 hours (18 weeks) of SIWI were provided for two genres (personal narrative and persuasive). Teachers were not as experienced with SIWI as in the previous study, with instructional fidelity averaging 75%. Even so, there were significant differences on primary traits across both genres, and on clarity and complexity language variables (e.g., length of t-units, complete sentences, grammar accuracy) in personal narrative writing (effect sizes 0.46-2.01). Language variables for persuasive writing were not statistically significant but did show treatment effect (0.38-1.06).

Two single-case design studies further understanding of the impact of SIWI on elementary students' writing and language outcomes. Participants varied by hearing level (mild to profound) and language use. Instructional fidelity in both studies ranged from 54-76%. The first included five multiple-probe case studies across genre traits (Author). Visual analysis showed an immediate effect of SIWI on information report and persuasive writing outcomes; lengthier exposure to personal narratives was needed to positively impact outcomes, likely due to it being the first genre taught. A second study using a multiple-baseline probe design across language skills investigated the impact of SIWI on elementary students' (n=6) use of written grammar and conventions (Author). In this study, there were gains in mean level of performance across word- and sentence-level language skills (e.g., sentence length and completeness, verb tense and variance, capitalization and punctuation); however, language objective areas were

selected by the teachers, who indicated not having proper tools to identify syntactic and grammar needs, nor monitor improvement.

The Current Study

This study is part of a larger project funded by the Institute of Education Sciences. The first two years of the project involved developing SIWI approaches and materials--previously implemented with deaf middle school students (Author)--to match the needs of deaf elementary students in grades 3-5. The study presented here is the third year of the project--an experimental study with deaf students in grades 3-5. Students in SIWI and Business As Usual (BAU) groups were compared across three 9-week periods of genre-specific instruction in recount (i.e., the retelling of an experience), information report, and persuasive writing e SIWI has on writing traits, language clarity, language complexity, and motivation.

This study represents the first RCT of SIWI. It extends previous work in three important ways. First, unique to this study is the inclusion of maintenance samples collected 9 weeks after genre-specific instruction was discontinued. We hypothesize that writing skills will be maintained over time due to mechanisms that support wide application of writing skills across genres such as writing process strategies, and because of explicit conversations teachers have with students about genre similarities and differences. Secondly, prior studies have not examined students' performance on standardized measures of writing. The Woodcock Johnson III (WJ III) measure of broad written language was collected from student participants at the beginning and end of the year to assess the impact of SIWI compared to BAU. Our prediction is that students receiving SIWI instruction make significantly greater gains in genre-specific writing and language, and that these gains extend to the WJ III broad written language standardized assessment. Lastly, there have not been any previous attempts at quantifying and analyzing

motivation. In a prior qualitative study (Author), 20 middle school deaf students receiving SIWI showed greater interest in engaging in writing over one year. To examine motivation, we collect survey data at the beginning and end of the academic year. We do not make a prediction, as little is known in this area. We ask the extent to which SIWI leads to:

1. Improved outcomes in genre-specific **writing,** and **clarity and complexity of language**?
2. **Maintenance** of writing 9 weeks after the removal of SIWI instruction in the genre?
3. Improved outcomes on **WJ III Broad Written Language** (a norm-referenced measure)?
4. Increased **writing motivation** in each genre?

Method

This RCT took place during one school year. Fifteen teachers and their 79 students were recruited through a nationwide call for participants. The inclusion criteria for teachers required them to: (1) agree to the randomization process, (2) sign a contamination agreement to not share SIWI information or materials with others, (3) provide a minimum of two hours of writing instruction a week to deaf students in grades 3-5. Upon approval of the study by the Institutional Review Board, teacher consent forms were collected, and then teachers were randomly assigned to comparison and experimental groups through computer generated randomization.

Comparison group (or BAU) teachers proceeded with their regular instruction, while experimental group teachers implemented SIWI. Both groups taught writing for approximately two-hours a week. Standardized writing assessments and writing motivation scales were collected at the beginning and the end of the academic year, and pre, post, and maintenance writing samples were collected across three, nine-week periods of genre instruction. Samples were analyzed for writing traits, language clarity, and language complexity. The effects of treatment were analyzed using the statistical design of two-wave and three-wave models.

School and Teacher Participants

Teachers from schools and programs using various communication approaches to educating DHH children in the United States (U.S.) were recruited to participate in the study. Teacher participants were from eleven educational settings across the U.S.--four public schools with self-contained classes or pull-out, and seven schools for the deaf. The experimental group consisted of ASL/English Bilingual classrooms (4 teachers, 29 students), Total Communication (TC) classrooms (3 teachers, 12 students) and one Listening and Spoken Language classroom (1 teacher, 2 students). The BAU group consisted of ASL/English Bilingual classrooms (4 teachers, 18 students), classrooms transitioning from TC to ASL/English Bilingual (2 teachers, 14 students) and one TC classroom (1 teacher, 4 students). Teachers reported the communication approach used by their school or program; this information was verified by either an administrator or the school's website.

Teachers were randomly assigned to conditions--eight to the SIWI group (all white female), and seven to the BAU group (six white females and one white male). All teachers continued participation to the end of the study, and there were none who joined late. Two teachers in each group identified as deaf or hard of hearing, with one using a cochlear implant in the experimental group and one using a hearing aid in the comparison group. Teachers in the experimental group had a higher level of educational attainment--four with Master's degrees compared to two in the BAU group. An independent T-Test was applied to years of teaching (SIWI M=14.75, SD=12.84; BAU M=8.07, SD 5.84), which was not statistically significantly different by group, $t(13) = 1.26$, $p = 0.23$. When asked to rate their preparation to teach writing coming into the current project, two teachers in each group said they had *exceptional* preparation. Four SIWI teachers and five BAU teachers rated their preparation as adequate, and

two SIWI teachers said they received minimal preparation. The majority of teachers said they liked to write themselves (7 SIWI, 5 BAU), one BAU teacher said they didn't like nor dislike writing, and one teacher in each group said they didn't like writing. Teachers provided ratings of their comfort levels communicating in ASL and written English, on a scale of 1 to 5, where 1 is *not comfortable at all* and 5 is *fully comfortable*. Two-tailed independent T-Tests were conducted to compare the groups' ASL comfort (SIWI M=4.25, SD=0.89; BAU M=4.57, SD=0.79) and written English comfort (SIWI M=5, SD=0; BAU M=4.86, SD=0.38), and it was determined they are comparable, ASL $t(13) = -0.74$, $p = 0.47$ and English $t(13) = 1.08$, $p = 0.3$.

Student Participants

There were 43, 3rd-5th grade students in the experimental group, and 36 students in the comparison group. Baseline demographic data on gender, race, hearing levels, language use, and amplification are provided in Table 1. In addition to indicating students' expressive/receptive language (sign or spoken language), teachers were asked to rate their students' fluency in that language for their age, from 1 to 5 (1=can fluently express most anything; 5=difficulty expressing most things fluently). Teachers reported 22 students in the experimental group and 10 students in the BAU group could express most anything in the expressive/receptive language, while the majority of students presented mild to significant language delays. An independent T-Test was run to compare language fluency by group (SIWI M=1.71, SD=1.03; BAU M=2.11, SD=0.99), which was not statistically significantly different, $t(74) = -1.75$, $p = 0.085$.

Procedures

SIWI Instruction

During the school year, SIWI teachers spent approximately nine weeks at two hours per week on instruction in each genre of writing--recount, informative, and persuasive. Teachers

implemented the following aspects: (a) guided, interactive writing with students, (b) writing with authentic purposes and audiences, (c) strategic instruction of writing process, skills, and genre-specific features, and (d) language zone techniques. Every guided co-construction was accompanied with time for shared or independent writing, either as breakouts from guided writing, or as separate constructions. Instruction for transcription skills was not a component of the program. Writing instruction was video recorded and uploaded to a database for review.

SIWI Professional Development (PD). The SIWI PD program is intensive and sustained (Darling-Hammond & Richardson, 2009). It is designed to deepen teachers' content and pedagogical knowledge through applied practice and contextualized feedback. Teachers in this study began implementing after a week-long summer workshop that introduced SIWI principles and provided opportunities for small-group simulated practice. During the academic year, teachers received eight online consultations, two site visits, and attended a two-day fall workshop focused on analyzing their students' writing samples to set appropriate objectives, and transitioning instruction from recount to information report writing.

SIWI teachers typically average 75% implementation fidelity in their first year, and achieve high fidelity after three years of PD and implementation (Author). For this study whereby teachers were randomly assigned, we compare the impact of first year SIWI teachers to BAU teachers. Even though typically lower the first year, prior studies have demonstrated teachers' implementation at this level significantly impacts student outcomes (Author).

Instructional Fidelity. Integrating SIWI in the classroom requires teachers to learn and implement new tools and approaches to literacy instruction. SIWI can be applied in diverse contexts guided by students' language and writing objectives, yet its driving principles create a uniform approach for instructional planning and delivery. The SIWI instructional fidelity

instrument has 53 items grouped by three main principles: strategic instruction, interactive instruction, and metalinguistic/linguistic (see the full instrument in Author); items are rated 0 (not implemented), 0.5 (partially implemented), and 1 (fully implemented). Fidelity items reflect teacher behaviors during instruction such as *explicitly discussing text structure associated with the genre of writing* (strategic), *inviting students to take active roles in constructing text* (interactive), correspondence between written text and expressive language is made explicit during rereading (metalinguistic), and *getting to a point of shared understanding using drawing, pictures, role play, etc. in the language zone* (linguistic).

The amount of fidelity items implemented and scored in the metalinguistic/linguistic section are dependent on the language used in the classroom and by the student. All teachers apply five items that guide them to include text that is a close approximation of English and reflect the students' language, encourage students to reread their writing, and make connections between text and the students' expressive language (i.e., ASL or spoken English) while also providing explicit English language instruction. If students use ASL, three additional items are included that support connections within and between ASL and English, such as comparing and contrasting grammatical features. Finally, five additional items specifically address students with significant language delays who are learning to convey and understand ideas.

Two research team members rated the teachers' instructional fidelity on three videotaped writing units throughout the year (recount, information report, and persuasive). The raters' scores and the unit scores were averaged. Each unit began with establishing an audience and purpose, took students through the writing process, and concluded with a final publication. Instructional fidelity for the eight SIWI teachers ranged from 53%-88%, with an average of 72%, and similar

levels of performance across the three main principles. The level of fidelity attained in this study compares with prior research involving first year SIWI teachers (Author).

BAU Instruction

Teachers in the BAU group continued with their typical writing instruction at a minimum of two hours a week. All reported providing instruction in the evaluated genres--recount, informative, and persuasive writing. To describe instructional similarities and differences between groups, BAU teachers were asked to respond to a survey indicating their instructional practices. The survey contained a combination of SIWI practices (e.g., I teach grammar as needed while students are engaged in writing) and non-SIWI practices (e.g., I teach grammar using a curriculum). When teachers indicated practices aligning with SIWI, a member of the research team conducted a follow up interview using open questions (e.g., You indicated that your students write one draft, revising as they go. Could you tell us more about that?). Teachers' responses allowed us to document areas of overlap as well as distinct differences in instruction.

The biggest difference between groups was not what teachers taught, but how. SIWI teachers utilized an apprenticeship approach where new skills were practiced and applied to authentic writing through units of guided, interactive writing. The teacher continually assessed students' needs and current levels of performance during purposeful writing acts. They provided sufficient support with objective areas and gradually released control to the students as they evidenced greater independence. While there were some similarities in what BAU and SIWI teachers taught such as pre-writing activities, grammar, and ASL-English language contrasting, BAU teachers largely approached these as mini lessons or decontextualized practice, rather than applying skills during guided and authentic writing. Three other major differences were identified. The BAU group (a) did not write for authentic purposes and audiences, (b) did not

apply approaches that promote greater ASL and English linguistic competence, and (c) were more likely to edit their students' writing and then require a next draft, rather than apprenticing students in recursive writing practices such as rereading and revising as you go. After their year of participation concluded, BAU teachers attended the summer SIWI PD and received materials.

Measures

Pre and Post Academic Year Measures

Students in experimental and BAU groups received the Spelling, Writing Fluency, and Writing Sample subtests of the Woodcock Johnson III Tests of Achievement (WJ III), which were used to derive the Broad Written Language standard score at the beginning and the end of the school year. The Broad Written Language reports a test/retest reliability of 0.94 (Schrank et al., 2001). Persons local to each school such as administrators or retired teachers were trained and monitored by the research team to collect assessments. Research team members, blinded from test date and name, tallied spelling subtest results, and scored the fluency and writing sample subtests following the WJ III scoring guidelines.

Students also took the Situated Writing Activity and Motivation Scale (SWAMS; Author) for each genre at the beginning and the end of the year to measure writing motivation. The aggregate internal consistency reliability of the SWAMS is reported at 0.88. Each of the three surveys (i.e., recount, information report and persuasive writing) contained 15 questions related to self-efficacy and task interest sub-constructs. To contextualize the questions within writing activity, each of the surveys began with a scenario that involved writing in the genre. Questions were measured along a likert scale from 0-totally disagree to 6-totally agree. Examples of questions include: *I would be able to come up with great ideas and include lots of details for this article* (self-efficacy) and *I think this writing assignment is boring* (task interest). The survey

questions were presented to students in written English. Students were also given access to questions in ASL (via video) and/or spoken English (via voice recording). Test administrators noted students who did not understand the motivation survey or appeared to be circling responses without reading or watching the question, and these surveys were excluded. Approximately 52-56 surveys were retained for the analyses.

Pre, Post, and Maintenance Writing Samples

Writing samples were collected from all students prior to and following 9 weeks or 18 hours of genre instruction (pre and post), and once again 9 weeks after instruction in the genre concluded (maintenance). See Table 2. The recount prompt asked students to share a personal experience. There were three counterbalanced information report prompts, which asked students to describe an animal or insect, a game or activity, or a familiar teacher. There were also three persuasive prompts (counterbalanced) in which students argued for or against a pool or trampoline, an ipad or a laptop, or owning a pet. The teachers did not assist students in writing or revising. Students completed the writing in 15-20 minutes, and were given more time as needed.

Scoring. All writing samples were typed and de-identified before scoring was completed by research team members and trained graduate assistants. The samples were scored for writing traits at pre, post, and maintenance timepoints using elements of the NAEP 2011 rubrics that address organization and genre-specific traits (National Assessment Governing Board, 2010). The writing score reflects three primary traits--organization and two genre-specific features. In recount writing, for example, writing was scored for (a) organization, and the level at which students (b) oriented the reader to their experience and (c) provided a series of events and sensory details. Writing traits were given a score of 1 to 6, where 1 demonstrates little to no skill and 6 evidences effective skill, and then totaled (0-18). Twenty percent were scored by two

raters. Intraclass correlations (ICC), measuring interrater reliability, were 0.97 for recount, 0.93 for information report, and 0.96 for persuasive writing.

Writing samples were also scored for language features at pre and post timepoints using the Structural Analysis of Written Language (SAWL; White, 2007). Since the SAWL was designed to track and quantify deaf writers' use of written language and can measure emergent expressions to fluent writing, it was used instead of elements on the NAEP rubric that address sentence structure and conventions. When evaluating text using the SAWL, the writing is first divided into t-units--independent clauses and related dependent clauses. Each t-unit is then evaluated as perfect (i.e., containing no language errors) or flawed (i.e., minor language errors; critical structures such as subjects, predicates, and prepositions were present). If a t-unit is not perfect or flawed, the scorer may evaluate three or more words together in a word string that are without error. Any remaining words that are not evaluated are discarded. The word efficiency ratio III (WER III), presented as a language clarity variable, is calculated by adding the number of words in perfect t-units, flawed t-units, and perfect word strings, and dividing the sum by the total words in the sample. Twenty percent of the samples were scored by two research members; the ICC for interrater reliability for WER III was 0.96. A second variable derived from the SAWL was the average number of words in perfect and flawed t-units (ICC=0.99), which was utilized as a language complexity variable.

Data Analysis

For developing basic estimates of treatment effects, there are two designs: two-wave and three-wave. The two-wave model is a pre-post regression, with students nested within teachers.

$$Y_{st} = Intercept_t + Pretest_s + SIWI_t + SIWI_t * Pretest_s + e_{st} \quad [1]$$

where $Intercept_{st}$ represents the predicted score for the student on the outcome test (with random variation for teacher), $Pretest_s$ represents the effect of student pretest score (centered at the grand mean), $SIWI_t$ represents a dummy variable for treatment effect (1) versus control (zero), $SIWI_t$ * $Pretest_s$ represents an interaction of treatment with pretest, and e_{st} represents random error. A random intercept for teachers was also estimated (not shown).

For the three wave design (applied to recount and information report writing analyses with maintenance probes), we fit an individual growth curve model of wave nested within student within teacher (3 levels: w, s, t, respectively). The general form of the model is:

$$Y_{wst} = Intercept_{st} + Time_{wst} + SIWI2_t + SIWI3_t + e_{st} \quad [2]$$

where $Intercept_{st}$ represents initial performance for the student on the outcome test (with random variation for student and teacher), $Time_{wst}$ represents linear change between waves for students in the control group (with random variation in slope for students, but not for teachers), $SIWI2_t$ represents an effect for students in a treatment classroom at time two, and $SIWI3_t$ represents remaining effect for students in a treatment classroom at time three after treatment was withdrawn (maintenance effect). e_{st} represents random error. The model therefore is one of linear change over three time points, with a treatment "bump" at times two and three, to measure the displacement from the overall linear trend due to treatment. Models were estimated in SAS 9.4 PROC MIXED (Littell et al., 2006) using FIML, assuming data were missing at random.

Results

Table 3 and 4 present descriptive statistics for outcomes administered at two time points and three time points. Table 5 presents the results of the individual growth models for recount and information report writing. The two outcomes, arranged in columns and rows, represent three types of estimates. First, there are fixed effects estimates following Equation 2, with

intercept representing where students started the year and Linear representing the baseline amount of change expected per wave. Second, there are two random effects: the variance for nesting within teachers and error for students. Third, there is an effect size for the SIWI treatment effect, which represents the average number of model-based SDs that students in the treatment received over BAU (Hedges, 2007). In recount writing, linear change was not statistically different from zero (0.06 per wave), but it was significantly positive for information report (0.63 per wave). The effect sizes for SIWI at wave 2 were substantial for both outcomes (3.32 and 1.12 for Recount and Information, respectively). The effect sizes for SIWI at the maintenance wave was 3.12 for Recount and 0.62 for Information. These results suggest not only substantial treatment effects (wave 2) but also maintenance of those gains. The random effects suggest substantial differences in students' starting levels as well as in their rates of change.

Table 6 presents the genre results from the two-time point language and writing trait outcomes. Three language clarity outcomes (WER III by genre), three language complexity outcomes (words/T-unit by genre), and one writing outcome (persuasive) are presented. The results follow the same format as Table 5, with fixed effects representing the regression coefficients in Equation 1. Table 6 shows that pretest was in all cases a significant predictor of posttest. Only one treatment effect (WER III information report) was statistically significant, and no pretest by treatment effects were statistically significant. Pretest interactions were quite mixed with no clear pattern (-0.20 to 0.34). The variance components for teachers ranged from being not estimable to fairly large, reflecting the instability of a small sample. The effect sizes for all variables were substantial, ranging from 0.44 to 0.71.

Table 7 presents the pre-post academic year results, following the format of Table 6. The pretest was a significant predictor of posttest in all cases except persuasive motivation. The

treatment for WJ III Broad writing was statistically significant, with a substantial effect size of 1.88. The pretest by treatment effect was statistically significant for persuasive motivation (0.55); other interactions were not statistically significant (-0.16 to -0.45). Again, the variance components for teachers ranged from being not estimable to fairly large, reflecting the instability of a small sample. Motivation by genre was not statistically significant; although, these variables showed moderate effect sizes (0.33 to 0.54).

All models were fit with default handling, assuming data were missing at random. Pre to post attrition was negligible (averaged 1.2-3%), with the exception of the motivation survey for which there are significant limitations.

Discussion

This study is the first randomized controlled trial of Strategic and Interactive Writing Instruction (SIWI). Results indicate the treatment for three 9-week periods of genre-based instruction had a positive impact on upper elementary deaf students' genre-specific writing traits and written language. Students in the SIWI group made statistically significant gains in recount and information report writing compared to students in the BAU group. The treatment effect for information report writing (1.26) indicates twice the normal expected growth (0.63). Students' recount writing showed no growth on average without the intervention (0.06), and presented as 3 units higher at treatment (3.32). Effect sizes for both genres indicated substantial effects with treatment (1.12, 3.32) and also maintenance of those effects (0.62, 3.12). The persuasive genre, taught in the last nine weeks, was not statistically significant yet showed a moderately strong experimental effect (0.58). Written language clarity, as measured by the SAWL word efficiency ratio (WER III), showed statistically significant gains in information report writing, and moderate to large effect sizes in all three genres (0.45-0.71). Language complexity, measured as

words per T-unit, was not statistically significant; however, mean gains were observed in the SIWI group that were not evident in the BAU group. Whereas students in both groups were averaging 4 words per T-unit, the mean for SIWI students increased to 5 words per T-unit on post writing samples. Furthermore, writing and language gains observed on genre-based writing samples were also evident on the WJ III Broad Written Language collected at the beginning and end of the school year. Students in the SIWI group demonstrated statistically significant gains compared to BAU, with a large effect size of 1.88. Lastly, there were not statistically significant differences in genre-based motivation; however, effect sizes indicate the treatment had a small to moderate impact (0.33-0.54) on students' motivation.

Cognitive and sociocultural theories come together to guide strategic instruction that is practiced within supportive writing communities (De Smedt & Van Keer, 2014; Author). Grammar instruction as an example has moved from traditional decontextualized drills to dialogic communication about how language features can relay meaning with readers in mind (Myhill & Newman, 2016). This occurs while apprenticing students in the writing process, inviting them to take active roles in the construction, monitoring, and revision of text. Teachers of deaf students must additionally consider the diversity of their students' language experiences (Knoors, 2016; Lederberg et al., 2013). With the SIWI framework, teachers have a variety of pedagogical tools to advance language skills, such as the linking concepts through drawing, gesturing, fingerspelling, signing, and writing, and comparing and contrasting languages (Author). While previous research suggested SIWI had a positive impact on deaf students' discourse- (Author), word-, and sentence-level skills (Author), this RCT brings SIWI closer to an evidence-based approach, for which there are few for deaf students (Crowe & Guiberson, 2019).

In this study, students did not improve as much in persuasive writing traits compared to recount and information report writing. Persuasion or argumentation is considered the most challenging type of writing for hearing students, even at the secondary and post-secondary levels, due to its demands for higher levels of thinking (Nippold et al., 2005). To effectively persuade someone, critical thinking is needed to make a claim and support it with relevant reasons and examples. Research shows that as students become older, their sentence complexity along with their ability to consider opposing perspectives increases, impacting the use of persuasive elements used in writing (Nippold, 2014). Moreover, there is a relationship between students' persuasive skills in spoken language and their persuasive writing (Brimo & Hall-Mills, 2019). Deaf students' relative weakness in persuasive writing may be attributed to multiple factors raised in the literature on hearing student writers, while their experience with language access and deprivation also presents additional and different barriers.

Language deprivation occurs when a student did not have sufficient access to language during the early language acquisition period to achieve age-appropriate language milestones (Hall, 2017). A student who received late exposure to sign language, for example, may exhibit delays in expressive language, as well as considerable delays in written English. Since language deprivation may lead to lifelong effects on cognitive, linguistic, and executive functions (Hall et al., 2017), it poses neurological complications in developing higher levels of thinking required for persuasion. Research indicates deaf students learning sign language beyond the critical period struggle with analogical reasoning tasks (Henner et al., 2016) and Theory of Mind abilities (Schick et al., 2007). The majority of students in this study exhibited mild to severe language delays. This factor combined with the general difficulty of persuasive writing for all may explain why the outcome was not statistically significant.

Another potential explanation is the possibility of our writing prompt asking students to argue for pools, pets, trampolines, or laptops. Depending on the students' background, this task and the connected thinking and behaviors may be outside the realm of the students' experience. It may be that in some students' cultures or socio-economic backgrounds, making such arguments is inappropriate and insensitive. If this is the case, those students may find it very difficult to write about these ideas (Kroll & Reid, 1994).

It was an aim of the current study to document treatment gains in writing, as well as maintenance of those gains. While there are challenges in maintaining newly developed skills, the application of cognitive strategies through shared, dialogic writing activities appears to contribute to maintenance of skill, potentially leading to greater internalization (Stoddard & MacArthur, 1993). In this study, writing gains for recount and information report genres sustained in the treatment group nine weeks after the class instruction shifted to a different genre of writing. These outcomes may be similarly attributed to the use of cognitive strategies in supported, interactive writing environments. Another possible explanation for the sustained outcomes is teachers' pedagogical content knowledge--knowledge of how and why they should teach content (Ball, 2008; Myhill et al., 2013; Park & Oliver, 2008; Shulman, 1987).

SIWI PD is designed to be intensive and sustained, and to deepen teachers' pedagogical content knowledge (Darling-Hammond & Richardson, 2009). Relevant to writing skill maintenance is the coaching teachers receive as they are transitioning instruction from one genre to the next. During the two-day fall workshop, teachers review and compare SIWI's genre-specific materials, and discuss how to extend the writing process (e.g., planning, organizing, writing for an audience) to different types of writing (c.f., Harris et al., 2008). They practice making explicit connections in structure across genres (e.g., opening and supporting details).

Thus, teachers' instruction may have led to the maintenance of writing skills, for students were engaged in extending and comparing genre knowledge for recount and information report writing, even while persuasive writing was the focus of the instruction.

Motivation is a critical component of development in language and writing. Many traditional writing assignments lack authenticity, and students, especially those with disabilities, are disinterested (Author). Motivation is a prominent feature particularly in increasing stamina, applications of strategies, and quality of writing (Schrodt et al., 2019). Motivated students have the tendency to seek feedback, which in turn, helps them internalize and maintain new writing knowledge and skills (Waller & Papi, 2017). Since motivation influences writing performance, it is important that instruction boosts, rather than diminish, students' interest in writing. In this study, writing motivation was positively impacted by treatment, although not statistically significant at the 0.05 level. Increased motivation may be attributed to strategic and collaborative writing with ongoing feedback (Camacho et al., 2020; Author; Martín et al., 2020) and having authentic purpose and audience (Magnifico, 2010). However, additional research should be conducted due to the high number of students who had difficulty accessing the language of the survey and were therefore excluded. Results of this study do not reflect the full sample of students. Additional methods such as observations and open-question interviews may allow for a more inclusive investigation of motivation.

Limitations and Future Research

The scientific community has shown strong preference for RCTs as a methodology in educational research. Yet, group experimental studies produce many challenges with low incidence populations (Wendel et al., 2015) such as generating sample groups that are large enough and comparable. In this study, teachers and their students were randomly assigned to

groups, and efforts were made to document comparability of groups. Even still, group numbers were small, and there are a range of external variables associated with the diverse language experiences of deaf students and the environments in which they are taught that could potentially impact a small study. Nevertheless, the findings of this study demonstrate important treatment effects in writing traits and language. Replicating the study with a larger sample of deaf students will further increase power of the tests to reject the null hypotheses when they are indeed false.

Low instructional fidelity of teacher participants is a potential weakness of this study and should be considered when interpreting the results. Levels of instructional fidelity in this study can be explained by the challenges of unlearning previous ways of teaching, and fully incorporating all 53 items on the SIWI fidelity instrument. While past studies have shown teacher fidelity to improve over three years of SIWI PD and classroom experience (Author), this study, with the purpose of conducting a RCT, enrolled teachers new to SIWI who were randomized into groups. Future studies should examine the effects of higher instructional fidelity on student outcomes. We hypothesize that SIWI teachers in their second and third years of the PD program will produce a stronger impact on students' language and writing outcomes.

Despite the relatively low fidelity scores (averaging 75%) of this study, statistically significant differences were found for the WJ III Broad Written Language, as well as treatment effects for genre-specific traits and written language clarity and complexity. This is consistent with prior research that shows first year SIWI teachers (while learning themselves) have a positive impact on their students' writing and language outcomes (Author). In the current study, SIWI and BAU teachers reported some similarities in the writing and language skills they taught; however, there were notable differences between how writing instruction was enacted. SIWI teachers provided students with opportunities to practice writing and language skills during

authentic, interactive writing--gradually transferring control of the writing practices. BAU teachers reported teaching skills in a less integrated way. Future studies, however, should include observation of BAU writing instruction to have greater confidence in the differences reported.

Lastly, samples in this study were analyzed for gains in writing (genre-specific traits) and language (clarity and complexity) for 9-week periods of genre-based instruction. This design allowed an examination of whether writing gains in one genre were maintained one quarter after instruction in that genre halted. However, it did not permit an examination of whether students transferred writing skills and knowledge to subsequent genres, even though teachers applied pedagogical practices that facilitate transfer such as discussing similarities and differences of genre purpose and text structure (Hill, 2016). Means of the pre-writing samples for the SIWI group show a slight increase from the first introduced genre to the second and third, potentially indicating this phenomenon. SAWL variables were also compared by genre of writing, but this design did not allow an assessment of written language gains for the year. While analysis of language contextualized within purpose is important, as language features are more or less prominent depending on the type of writing (Derewianka, 1990; Schleppegrell, 2010), global features of written language growth may also be seen across genres. In this study, the WJ broad written language variable (examined pre/post year) demonstrated a significant and large effect. For these reasons, we recommend in future research that writing samples are additionally collected at the beginning and end of the full instructional period.

Conclusion

Strategic and Interactive Writing Instruction is designed specifically for the population of deaf students with their linguistic experiences and needs in mind. SIWI creates a community of writers engaging collaboratively in writing activities with authentic purposes and audiences.

Teachers establish individual and group language and writing objectives, and scaffold skills through explicit and contextualized instruction across genres. Teachers are not only cognizant of the principles informed by evidence-based practices but also learn to address the diverse language needs in deaf students. This experimental study is a part of a three-year grant project to develop and assess the promise of the SIWI approach for grades 3-5. After a year-long RCT, the findings from this study show that students receiving SIWI demonstrate statistically significant growth on the WJ III standardized writing measure, and on recount and information report writing samples compared to students receiving their usual writing instruction. Gains in persuasive writing traits were not significant, possibly because of the high cognitive demands of forming effective arguments, which is challenging for children at this age, especially if they experienced deprivation during the critical period of language acquisition. Positive effects of SIWI were also observed for maintenance of writing traits, language clarity and complexity, and motivation, although not all statistically significant at the 0.05 level. With the evidence provided in this study, SIWI holds considerable promise to positively impact the writing, language, and motivation of deaf elementary students compared to current approaches, and provides a foundation of literacy skills needed for academic success.

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Table 1

Student Baseline Demographic Data

Baseline Demographics		SIWI (n=43)	BAU (n=36)
Gender	Female/ Male/ Undisclosed	23/ 19/ 1	12/ 24/ 0
Grade	3rd/ 4th/ 5th	13/ 10/ 20	16/ 11/ 9
Race	White	19	20
	Black/African Americans	10	6
	Latinx	7	3
	Asians	1	3
	Native Americans	2	1
	Multiracial	4	3
Hearing Technology	Hearing Aids/ Cochlear Implants	23/ 14	18/ 9
	None/ Not Reported	4/ 2	8/ 1
Hearing Level, Without and With Technology	Slight (0-25dB)/ Slight with tech	1/ 14	2/ 7
	Mild (26-40dB)/ Mild with tech	3/ 8	2/ 4
	Moderate (41-55dB)/ Mod with tech	3/ 2	6/ 3
	Mod-Severe (56-70dB)/ Mod-Severe with tech	8/ 1	4/ 1
	Severe (71-90dB)/ Sever with tech	8/ 0	5/ 2
	Profound (91dB+)	18	16
	Info Not Available/ Info with tech not available	2/ 12	1/ 7
	Infrequent Use	6	12
Disability	Yes/ No	2*/ 41	0/ 36
Preferred Language	ASL	24	23
	Speech or Sign-Supported Speech	16	11
	None or Limited Language	1	1
	Not Reported	2	1

Note. * = ADHD (1) and Hydrocephalus with deteriorated cerebral cortex (1)

Table 2

Writing Sample Collection

	Recount	Information Report	Persuasive
Sample Collection Period 1	Pre	--	--
9 weeks or 18 hours of recount writing instruction			
Sample Collection Period 2	Post	Pre	--
9 weeks or 18 hours of information report writing instruction			
Sample Collection Period 3	Maintenance	Post	Pre
9 weeks or 18 hours of persuasive writing instruction			
Sample Collection Period 4	--	Maintenance	Post

Table 3

Outcomes at Two Time Points

		Pretest			Posttest		
Outcome	Group	n	Mean	SD	n	Mean	SD
WERIII							
Recount	BAU	36	0.69	0.28	35	0.59	0.34
	SIWI	41	0.58[n]	0.33	40	0.68	0.33
Info Report	BAU	35	0.61	0.32	34	0.58	0.34
	SIWI	39	0.54[a]	0.38	39	0.67	0.32
Persuasive	BAU	35	0.56	0.35	31	0.61	0.31
	SIWI	38	0.61[a]	0.32	38	0.70	0.33
Word/T-unit							
Recount	BAU	36	4.47	2.15	35	4.18	2.91
	SIWI	41	4.46	2.41	40	5.15	2.36
Info Report	BAU	35	3.74	2.62	34	3.81	2.18
	SIWI	39	4.18[a]	3.23	39	4.88	2.24
Persuasive	BAU	35	4.35	3.49	31	4.38	2.06
	SIWI	38	5.03[a]	3.41	38	5.50	3.35
Writing, Persuasive	BAU	35	5.49	2.91	31	6.50	2.82
	SIWI	38	5.53	2.46	38	7.03	3.49
WJ III Broad Writing	BAU	36	64.11	22.68	33	61.85	22.05
	SIWI	43	50.40[n]	31.24	37	71.59	22.49
Motivation							
Recount	BAU	29	4.09	1.01	29	4.32	0.98
	SIWI	27	3.90[a]	0.96	27	4.50	0.82
Info Report	BAU	29	4.33	0.74	29	4.25	0.92
	SIWI	26	3.99[n]	0.85	26	4.57	0.84
Persuasive	BAU	26	4.20	1.06	26	4.14	0.95
	SIWI	26	4.01[a]	0.86	26	4.48	0.75

Note. WER = word efficiency ratio; [a] = adjustable baseline difference; [n] = non-adjustable baseline difference, based on What Works Clearinghouse standards 4.1 (WWC, 2020).

Table 4

Outcomes at Three Time Points

		Pretest			Posttest			Maintenance		
Outcome	Group	n	Mean	SD	n	Mean	SD	n	Mean	SD
Writing, Recount	BAU	36	4.38	2.16	35	4.24	2.36	34	4.60	2.58
	SIWI	42	3.93	2.53	40	7.18	3.70	38	7.16	4.14
Writing, Info	BAU	35	3.91	1.75	34	4.79	2.15	31	5.48	2.58
	SIWI	39	4.36	2.84	39	6.17	3.47	37	5.92	3.78

Note. For both outcomes, baseline differences were adjustable based on WWC standards (2020).

Table 5

Individual Growth Models for Pre, Post, and Maintenance Genre Measures

Effect	Writing, Recount			Writing, Info		
Fixed	Est.	SE		Est.	SE	
Intercept	4.45	2.11	*	4.67	2.16	*
Linear	0.06	0.24		0.63	0.79	*
SIWI2	3.32	1.82	*	1.26	1.12	*
SIWI3	3.12	1.77	*	0.70	0.84	
Random	Est.	SD		Est.	SD	
Teacher	3.23	1.80		4.70	2.17	
Student intercept	2.70	1.64		1.14	1.07	
covariance	-0.15	(-0.08)		0.48	(0.64)	
Student linear	1.24	1.11		0.49	0.70	
Residual	0.90	0.95		1.28	1.13	
SIWI2 Effect Size	3.32			1.12		
SIWI3 Effect Size	3.12			0.62		

Note. Est. = estimate. Var = variance. SE = standard error. Linear = slope for 9 week instructional period. * = $p < .05$. Covariance = covariance between student intercept and slope (correlation shown in parentheses). Effect sizes are the treatment effect divided by the residual SD (Hedges, 2007).

Table 6

Models for Pre-Post Genre Measures

Effect	WER III, Recount			Word/T-unit, Recount			WER III, Information			Word/T-unit, Information			Writing, Persuasive			WER III, Persuasive			Word/T-unit, Persuasive		
Fixed	Est.	SE		Est.	SE		Est.	SE		Est.	SE		Est.	SE		Est.	SE		Est.	SE	
Intercept	0.61	0.06	*	4.61	0.53	*	0.55	0.04	*	4.08	0.45	*	6.23	0.51	*	0.59	0.04	*	4.36	0.53	*
Pretest	0.62	0.17	*	0.56	0.17	*	0.80	0.12	*	0.44	0.13	*	0.73	0.13	*	0.77	0.12	*	0.30	0.13	*
SIWI	0.16	0.08		0.83	0.70		0.14	0.05	*	0.76	0.60		0.99	0.68		0.10	0.05		1.07	0.72	
Pretest*SIWI	0.21	0.22		0.29	0.23		-0.20	0.16		-0.08	0.16		0.29	0.20		0.02	0.16		0.34	0.17	
Random	Var.	SD		Var.	SD		Var.	SD		Var.	SD		Var.	SD		Var.	SD		Var.	SD	
Teacher	0.01	0.10		0.95	0.97		0	—		0.49	0.70		0.81	0.90		0	—		0.65	0.81	
Residual	0.05	0.22		2.94	1.71		0.05	0.22		3.04	1.74		2.95	1.72		0.05	0.22		4.46	2.11	
Effect Size	0.71			0.48			0.63			0.44			0.58			0.45			0.51		

Note. WER = word efficiency ratio; Est. = estimate. Var = variance. SE = standard error. * = $p < .05$. Dashes indicate a parameter which estimated at zero. Effect sizes are the treatment effect divided by the residual SD (Hedges, 2007).

Table 7

Model Results for Pre-Post Academic Year Data

Effect	WJ III Broad Writing SS			Motivation, Recount			Motivation, Info Report			Motivation, Persuasive		
Fixed	Est.	SE		Est.	SE		Est.	SE		Est.	SE	
Intercept	56.75	3.29	*	4.25	0.17	*	4.15	0.16	*	4.18	0.25	*
Pretest	0.84	0.10	*	0.59	0.16	*	0.61	0.21	*	0.08	0.17	
SIWI	18.15	4.30	*	0.26	0.24		0.45	0.23		0.31	0.35	
Pretest*SIWI	-0.16	0.13		-0.32	0.24		-0.45	0.29		0.55	0.25	*
Random	Var.	SD		Var.	SD		Var.	SD		Var.	SD	
Teacher	35.86	5.99		0.03	0.17		0	—		0.24	0.49	
Residual	93.01	9.64		0.62	0.79		0.69	0.83		0.47	0.69	
Effect Size	1.88			0.33			0.54			0.46		

Note. Est. = estimate. Var = variance. SE = standard error. * = $p < .05$. Dashes indicate a parameter which estimated at zero. Effect sizes are the treatment effect divided by the residual SD (Hedges, 2007).