**Development of Strategic and Interactive Writing Instruction (SIWI) for deaf and hard of hearing students: Year 3 Pilot Study**

## Purpose

This study, funded by US Institute of Education Sciences under Grant R324A120085, is an examination of the impact of Strategic and Interaction Writing Instruction (SIWI) implemented with deaf and hard of hearing (d/hh) 3-5th graders.

## Method

This study was a randomized controlled trial. Teachers (N=15) and their respective d/hh students (N=78) were randomly assigned to groups. Comparison group teachers proceeded with their regular instruction, while experimental group teachers implemented SIWI approximately two-hours/ week. SIWI teachers attended a week-long summer workshop, and periodic online meetings during the academic year. Diverse educational settings (i.e., public school self-contained or pull-out, and schools for the deaf) were represented in each group, as well as varying communication philosophies (i.e., ASL-English bilingual, Listening and Spoken Language, Total Communication).

Research questions included:

*Writing*

1. To what extent does SIWI lead to improved student outcomes in recount writing, information report, and persuasive writing skills over a 9-week period?
2. To what extent do writing skills (recount and information report) maintain 9 weeks after the removal of SIWI instruction for the genre of writing?

*Language*

3. To what extent does SIWI lead to improved student outcomes in clarity of language in recount writing, information report writing, and persuasive writing over a 9-week period?
4. To what extent does SIWI lead to improved student outcomes in complexity of language in recount writing, informational report writing, and persuasive writing over a 9-week period?

*Length*

5. To what extent does SIWI lead to improved student outcomes in length of recount writing, information report writing, and persuasive writing over a 9-week period?

Data collection included: writing samples for personal narrative, informational report and persuasive writing, and Woodcock Johnson III broad written language. Samples were scored for writing traits using modified NAEP rubrics, and scored for language accuracy and complexity using the *Structural Analysis of Written Language* (SAWL). Writing variables (e.g., Recount, Information Report and Persuasive Genre Composite) and language variables (e.g., WER I, II & III, TWC, WPT, and Complete Sentences) are further described in Table 1.

Table 1

| **Variable** | **Description** |
|---|---|
| Recount Genre Composite | Composite of scores for three writing traits associated with Recount writing: orientation, events, and organization. |
| Recount Complete | Percentage of complete sentences in Recount writing. |

| | |
|---|---|
| Sentences | |
| Recount WERI | Word Efficiency Ratio I for Recount writing as scored using the SAWL. Indicates ratio of perfect T-units. |
| Recount WERII | Word Efficiency Ratio II for Recount writing as scored using the SAWL. Indicates perfect and flawed T-units. |
| Recount WERIII | Word Efficiency Ratio III for Recount writing as scored using the SAWL. Indicates word strings, and perfect and flawed T-units. |
| Recount TWC | Total word count in Recount writing. |
| Recount WPT Flawed | Words per flawed and perfect T-unit in Recount writing. |
| Info Genre Composite | Composite of scores for three writing traits associated with Information Report writing: topic, facts, and organization. |
| Info Complete Sentences | Percentage of complete sentences in Information Report writing. |
| Info WERI | Word Efficiency Ratio I for Information Report writing as scored using the *Structured Analysis of Written Language* (SAWL). Indicates ratio of perfect T-units. |
| Info WERII | Word Efficiency Ratio II for Information Report writing as scored using the SAWL. Indicates perfect and flawed T-units. |
| Info WERIII | Word Efficiency Ratio III for Information Report writing as scored using the SAWL. Indicates word strings, and perfect and flawed T-units. |
| Info TWC | Total word count in Information Report writing. |
| Info WPT Flawed | Words per flawed and perfect T-unit in Information Report writing. |
| Persuasive Genre Composite | Composite of scores for three writing traits associated with Persuasive writing: reasons, examples, and organization. |
| Persuasive Complete Sentences | Percentage of complete sentences in Persuasive writing. |
| Persuasive WERI | Word Efficiency Ratio I for Persuasive writing as scored using the *Structured Analysis of Written Language* (SAWL). Indicates ratio of perfect T-units. |
| Persuasive WERII | Word Efficiency Ratio II for Persuasive writing as scored using the SAWL. Indicates perfect and flawed T-units. |
| Persuasive WERIII | Word Efficiency Ratio III for Persuasive writing as scored using the SAWL. Indicates word strings, and perfect and flawed T-units. |
| Persuasive TWC | Total word count in Persuasive writing. |
| Persuasive WPT Flawed | Words per flawed and perfect T-unit in Persuasive writing. |
| Spelling SS | Standard score on the Spelling Subtest of the Woodcock Johnson III Tests of Achievement. |
| Fluency SS | Standard score on the Writing Fluency Subtest of the Woodcock Johnson III Tests of Achievement. |
| Sample SS | Standard score on the Writing Sample Subtest of the Woodcock Johnson III Tests of Achievement. |
| Broad Written Language SS | Standard score for Broad Written Language as measured by the Woodcock Johnson III Tests of Achievement. |

**Data Analysis**

For developing basic estimates of treatment effects, there are two designs: three-wave and two-wave. For the three wave design, 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:

$$Y_{wst} = Intercept_{st} + Time_{w} + SIWI2_{t} + SIWI3_{t} + hearing_{st} + Time*hearing_{st} + e_{st}$$

where $Intercept_{st}$ represents initial performance for the student on the outcome test (with random variation for student and teacher), $Time_{w}$ 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, $SIWI3_{t}$ represents remaining effect for students in a treatment classroom at time three after treatment was withdrawn (maintenance effect), and the hearing variables represent group difference effects for intercept and slope (Time) for the hearing comparison students. $e_{st}$ 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.

The second kind of model is for the outcomes which were only measured twice. The model is a pre-post regression, nested within teachers. For the present analysis, only deaf children were modeled (hearing children were excluded).

$$Y_{st} = Intercept_{t} + Pretest_{s} + SIWI_{t} + SIWI_{t} * Pretest_{s} + e_{st}$$

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 an effect for students in a treatment classroom, $SIWI_{t} * Pretest_{s}$ represents an interaction of treatment with pretest, and $e_{st}$ represents random error.

**Results**

Results show the treatment to be effective for recount, information report and persuasive writing composite scores with statistically significant results at post-intervention for all three genres and at the maintenance probe for recount writing. Treatment effects were also substantial for language outcomes associated with all three genres, with recount WER III and information report WER II being statistically significant. Effect sizes range from 0.53 to 0.71. Results also show SIWI to be effective for length of recount writing (1.31) and all writing variables measured by the WJ III: spelling, fluency, samples (1.01-1.82). Broad Written Language, as measured by the WJ III, was statistically significant with an effect size of 1.88.

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| *Outcome* | *Type* | *Effect* | *Estimate* | *Standard Error* | *DF* | *t Value* | *Pr > \|t\|* | *ES* |
|---|---|---|---|---|---|---|---|---|
| Recount Genre Composite | Fixed | Intercept | 4.59 | 0.59 | 16 | 7.81 | <.01 | . |
| | | time | 0.07 | 0.22 | 107 | 0.34 | 0.74 | . |
| | | SIWI2 | 3.31 | 0.38 | 213 | 8.61 | <.01 | 2.64 |
| | | SIWI3 | 3.13 | 0.60 | 111 | 5.19 | <.01 | 2.50 |
| | | hearing | 2.44 | 1.31 | 13 | 1.87 | 0.09 | . |
| | | time*hearing | 0.58 | 0.32 | 106 | 1.83 | 0.07 | . |
| | Random | Teacher | 3.68 | 1.65 | . | . | . | . |
| | | Int(stu) | 3.37 | 0.72 | . | . | . | . |
| | | cov(Int,Slope) | -0.54 | 0.38 | . | . | . | . |
| | | Slope(stu) | 0.93 | 0.27 | . | . | . | . |
| | | Residual | 1.58 | 0.22 | . | . | . | . |
| Recount Complete Sentences | Fixed | Intercept | 0.55 | 0.08 | 11 | 7.16 | <.01 | . |
| | | Pretest | 0.34 | 0.16 | 64 | 2.13 | 0.04 | . |
| | | SIWI | 0.17 | 0.10 | 12 | 1.65 | 0.13 | 0.70 |
| | | Pretest*SIWI | 0.35 | 0.22 | 60 | 1.60 | 0.11 | . |
| | Random | Teacher | 0.02 | 0.01 | . | . | . | . |
| | | Residual | 0.06 | 0.01 | . | . | . | . |
| Recount WERI | Fixed | Intercept | 0.22 | 0.07 | 7 | 2.99 | 0.02 | . |
| | | Pretest | 0.27 | 0.16 | 60 | 1.69 | 0.10 | . |
| | | SIWI | 0.07 | 0.10 | 7 | 0.70 | 0.51 | 0.36 |
| | | Pretest*SIWI | 0.32 | 0.25 | 56 | 1.29 | 0.20 | . |
| | Random | Teacher | 0.02 | 0.02 | . | . | . | . |
| | | Residual | 0.04 | 0.01 | . | . | . | . |
| Recount WERII | Fixed | Intercept | 0.51 | 0.07 | 9 | 6.80 | <.01 | . |
| | | Pretest | 0.28 | 0.17 | 57 | 1.64 | 0.11 | . |
| | | SIWI | 0.14 | 0.10 | 10 | 1.44 | 0.18 | 0.59 |
| | | Pretest*SIWI | 0.41 | 0.25 | 53 | 1.67 | 0.10 | . |
| | Random | Teacher | 0.02 | 0.01 | . | . | . | . |
| | | Residual | 0.06 | 0.01 | . | . | . | . |
| Recount WERIII | Fixed | Intercept | 0.61 | 0.06 | 11 | 10.28 | <.01 | . |
| | | Pretest | 0.62 | 0.17 | 45 | 3.57 | <.01 | . |
| | | SIWI | 0.16 | 0.08 | 12 | 1.97 | 0.07 | 0.71 |
| | | Pretest*SIWI | 0.21 | 0.22 | 44 | 0.94 | 0.35 | . |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Random | Teacher | 0.01 | 0.01 | . | . | . | . |
| | | Residual | 0.05 | 0.01 | . | . | . | . |
| Recount TWC | Fixed | Intercept | 50.30 | 10.80 | 11 | 4.66 | <.01 | . |
| | | Pretest | 0.12 | 0.11 | 67 | 1.06 | 0.29 | . |
| | | SIWI | 32.30 | 14.35 | 11 | 2.25 | 0.04 | 1.31 |
| | | Pretest*SIWI | 0.61 | 0.15 | 68 | 3.95 | <.01 | . |
| | Random | Teacher | 536.3 | 285.1 | . | . | . | . |
| | | Residual | 608.1 | 113.4 | . | . | . | . |
| Recount WPT Flawed | Fixed | Intercept | 4.61 | 0.53 | 9 | 8.77 | <.01 | . |
| | | Pretest | 0.56 | 0.17 | 55 | 3.26 | <.01 | . |
| | | SIWI | 0.83 | 0.70 | 9 | 1.19 | 0.26 | 0.48 |
| | | Pretest*SIWI | 0.29 | 0.23 | 54 | 1.24 | 0.22 | . |
| | Random | Teacher | 0.95 | 0.72 | . | . | . | . |
| | | Residual | 2.94 | 0.55 | . | . | . | . |
| Info Genre Composite | Fixed | Intercept | 4.68 | 0.67 | 15 | 6.98 | <.01 | . |
| | | time | 0.64 | 0.18 | 99 | 3.54 | <.01 | . |
| | | SIWI2 | 1.25 | 0.35 | 202 | 3.62 | <.01 | 1.01 |
| | | SIWI3 | 0.66 | 0.50 | 99 | 1.32 | 0.19 | 0.53 |
| | | hearing | 5.69 | 1.55 | 13 | 3.68 | <.01 | . |
| | | time*hearing | -0.15 | 0.26 | 99 | -0.59 | 0.56 | . |
| | Random | Teacher | 5.59 | 2.29 | . | . | . | . |
| | | Int(stu) | 1.18 | 0.41 | . | . | . | . |
| | | cov(Int,Slope) | 0.41 | 0.22 | . | . | . | . |
| | | Slope(stu) | 0.29 | 0.19 | . | . | . | . |
| | | Residual | 1.52 | 0.22 | . | . | . | . |
| Info Complete Sentences | Fixed | Intercept | 0.54 | 0.05 | 68 | 11.21 | <.01 | . |
| | | Pretest | 0.59 | 0.12 | 68 | 4.73 | <.01 | . |
| | | SIWI | 0.12 | 0.07 | 68 | 1.83 | 0.07 | 0.44 |
| | | Pretest*SIWI | 0.08 | 0.17 | 68 | 0.45 | 0.65 | . |
| | Random | Teacher | 0.00 | . | . | . | . | . |
| | | Residual | 0.08 | 0.01 | . | . | . | . |
| Info WERI | Fixed | Intercept | 0.13 | 0.08 | 9 | 1.73 | 0.12 | . |
| | | Pretest | 0.19 | 0.12 | 66 | 1.53 | 0.13 | . |
| | | SIWI | 0.20 | 0.10 | 9 | 1.97 | 0.08 | 1.27 |
| | | Pretest*SIWI | 0.89 | 0.25 | 66 | 3.50 | <.01 | . |
| | Random | Teacher | 0.03 | 0.02 | . | . | . | . |

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|---|---|---|---|---|---|---|---|---|
| | | Residual | 0.02 | 0.00 | . | . | . | . |
| Info WERII | Fixed | Intercept | 0.44 | 0.04 | 68 | 10.19 | <.01 | . |
| | | Pretest | 0.64 | 0.12 | 68 | 5.25 | <.01 | . |
| | | SIWI | 0.13 | 0.06 | 68 | 2.21 | 0.03 | 0.53 |
| | | Pretest*SIWI | 0.01 | 0.18 | 68 | 0.04 | 0.97 | . |
| | Random | Teacher | 0.00 | . | . | . | . | . |
| | | Residual | 0.06 | 0.01 | . | . | . | . |
| Info WERIII | Fixed | Intercept | 0.55 | 0.04 | 68 | 13.82 | <.01 | . |
| | | Pretest | 0.80 | 0.12 | 68 | 6.45 | <.01 | . |
| | | SIWI | 0.14 | 0.05 | 68 | 2.63 | 0.01 | 0.63 |
| | | Pretest*SIWI | -0.20 | 0.16 | 68 | -1.26 | 0.21 | . |
| | Random | Teacher | 0.00 | . | . | . | . | . |
| | | Residual | 0.05 | 0.01 | . | . | . | . |
| Info TWC | Fixed | Intercept | 60.77 | 6.81 | 5 | 8.93 | <.01 | . |
| | | Pretest | 0.69 | 0.21 | 46 | 3.24 | <.01 | . |
| | | SIWI | 5.69 | 9.27 | 5 | 0.61 | 0.57 | 0.21 |
| | | Pretest*SIWI | -0.11 | 0.24 | 45 | -0.44 | 0.66 | . |
| | Random | Teacher | 104.7 | 153.6 | . | . | . | . |
| | | Residual | 737.2 | 145.1 | . | . | . | . |
| Info WPT Flawed | Fixed | Intercept | 4.08 | 0.45 | 7 | 9.15 | <.01 | . |
| | | Pretest | 0.44 | 0.13 | 61 | 3.35 | <.01 | . |
| | | SIWI | 0.76 | 0.60 | 8 | 1.27 | 0.24 | 0.44 |
| | | Pretest*SIWI | -0.08 | 0.16 | 63 | -0.51 | 0.61 | . |
| | Random | Teacher | 0.49 | 0.55 | . | . | . | . |
| | | Residual | 3.04 | 0.58 | . | . | . | . |
| Persuasive Genre Composite | Fixed | Intercept | 6.23 | 0.51 | 8 | 12.29 | <.01 | . |
| | | Pretest | 0.73 | 0.13 | 62 | 5.62 | <.01 | . |
| | | SIWI | 0.99 | 0.68 | 8 | 1.46 | 0.18 | 0.58 |
| | | Pretest*SIWI | 0.29 | 0.20 | 50 | 1.46 | 0.15 | . |
| | Random | Teacher | 0.81 | 0.71 | . | . | . | . |
| | | Residual | 2.95 | 0.58 | . | . | . | . |
| Persuasive Composite | Fixed | Intercept | 0.57 | 0.07 | 6 | 8.65 | <.01 | . |
| | | Pretest | 0.79 | 0.14 | 60 | 5.50 | <.01 | . |
| | | SIWI | 0.04 | 0.09 | 7 | 0.47 | 0.65 | 0.17 |
| | | Pretest*SIWI | -0.22 | 0.19 | 61 | -1.17 | 0.25 | . |
| | Random | Teacher | 0.01 | 0.01 | . | . | . | . |

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|---|---|---|---|---|---|---|---|---|
| | | Residual | 0.06 | 0.01 | . | . | . | . |
| Persuasive WERI | Fixed | Intercept | 0.14 | 0.04 | 5 | 3.57 | 0.02 | . |
| | | Pretest | 0.45 | 0.13 | 51 | 3.40 | <.01 | . |
| | | SIWI | 0.09 | 0.05 | 5 | 1.77 | 0.13 | 0.58 |
| | | Pretest*SIWI | 0.53 | 0.18 | 42 | 2.90 | <.01 | . |
| | Random | Teacher | 0.00 | 0.01 | . | . | . | . |
| | | Residual | 0.03 | 0.01 | . | . | . | . |
| Persuasive WERII | Fixed | Intercept | 0.44 | 0.04 | 64 | 11.53 | <.01 | . |
| | | Pretest | 0.65 | 0.11 | 64 | 5.77 | <.01 | . |
| | | SIWI | 0.09 | 0.05 | 64 | 1.79 | 0.08 | 0.44 |
| | | Pretest*SIWI | 0.15 | 0.16 | 64 | 0.97 | 0.34 | . |
| | Random | Teacher | 0.00 | . | . | . | . | . |
| | | Residual | 0.04 | 0.01 | . | . | . | . |
| Persuasive WERIII | Fixed | Intercept | 0.59 | 0.04 | 64 | 15.27 | <.01 | . |
| | | Pretest | 0.77 | 0.12 | 64 | 6.33 | <.01 | . |
| | | SIWI | 0.10 | 0.05 | 64 | 1.86 | 0.07 | 0.45 |
| | | Pretest*SIWI | -0.02 | 0.16 | 64 | -0.15 | 0.88 | . |
| | Random | Teacher | 0.00 | . | . | . | . | . |
| | | Residual | 0.05 | 0.01 | . | . | . | . |
| Persuasive TWC | Fixed | Intercept | 53.58 | 9.12 | 12 | 5.87 | <.01 | . |
| | | Pretest | 0.26 | 0.11 | 63 | 2.37 | 0.02 | . |
| | | SIWI | 6.55 | 12.04 | 12 | 0.54 | 0.60 | 0.29 |
| | | Pretest*SIWI | 0.31 | 0.21 | 64 | 1.48 | 0.14 | . |
| | Random | Teacher | 350.5 | 199.3 | . | . | . | . |
| | | Residual | 512.7 | 99.74 | . | . | . | . |
| Persuasive WPT Flawed | Fixed | Intercept | 4.36 | 0.53 | 10 | 8.25 | <.01 | . |
| | | Pretest | 0.30 | 0.13 | 45 | 2.26 | 0.03 | . |
| | | SIWI | 1.07 | 0.72 | 10 | 1.49 | 0.17 | 0.51 |
| | | Pretest*SIWI | 0.34 | 0.17 | 54 | 1.93 | 0.06 | . |
| | Random | Teacher | 0.65 | 0.68 | . | . | . | . |
| | | Residual | 4.46 | 0.85 | . | . | . | . |
| Spelling SS | Fixed | Intercept | 67.02 | 2.90 | 11 | 23.13 | <.01 | . |
| | | Pretest | 0.87 | 0.11 | 43 | 8.19 | <.01 | . |
| | | SIWI | 16.85 | 3.69 | 11 | 4.57 | <.01 | 1.82 |
| | | Pretest*SIWI | -0.42 | 0.12 | 39 | -3.48 | <.01 | . |
| | Random | Teacher | 18.95 | 16.38 | . | . | . | . |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Residual | 86.20 | 16.22 | . | . | . | . |
| Fluency SS | Fixed | Intercept | 63.92 | 2.63 | 8 | 24.33 | <.01 | . |
| | | Pretest | 0.72 | 0.12 | 33 | 6.14 | <.01 | . |
| | | SIWI | 9.23 | 3.51 | 9 | 2.63 | 0.03 | 1.01 |
| | | Pretest*SIWI | 0.30 | 0.17 | 38 | 1.84 | 0.07 | . |
| | Random | Teacher | 20.47 | 18.17 | . | . | . | . |
| | | Residual | 83.13 | 15.89 | . | . | . | . |
| Sample SS | Fixed | Intercept | 64.06 | 3.22 | 9 | 19.89 | <.01 | . |
| | | Pretest | 0.62 | 0.11 | 48 | 5.75 | <.01 | . |
| | | SIWI | 14.12 | 4.30 | 10 | 3.28 | <.01 | 1.27 |
| | | Pretest*SIWI | 0.32 | 0.16 | 56 | 1.95 | 0.06 | . |
| | Random | Teacher | 31.79 | 25.93 | . | . | . | . |
| | | Residual | 124.2 | 23.58 | . | . | . | . |
| Broad Written Language SS | Fixed | Intercept | 56.75 | 3.29 | 11 | 17.24 | <.01 | . |
| | | Pretest | 0.84 | 0.10 | 44 | 8.19 | <.01 | . |
| | | SIWI | 18.15 | 4.30 | 11 | 4.22 | <.01 | 1.88 |
| | | Pretest*SIWI | -0.16 | 0.13 | 43 | -1.23 | 0.23 | . |
| | Random | Teacher | 35.86 | 24.76 | . | . | . | . |
| | | Residual | 93.01 | 17.62 | . | . | . | . |