

Big Words Science: Decoding intervention for adolescent struggling readers



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Disclosures

- Presenters are affiliated with The Center for Literacy and Disability Studies at the University of North Carolina at Chapel Hill.
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Learning Outcomes

1. Describe major elements of the study design.
2. Discuss the authors' conclusions.
3. Identify possible implications for practice.



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Agenda

- Background
- Methods
- Results
- Q & A



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Big Words Science

- Project funded by a Steppingstones Technology Innovation in Education grant from the Department of Education
- Phase I investigation
 - most common morphemes in written English
 - showed positive results for students in primary grades (3-5)
- Phase II investigated
 - common morphemes in science
 - evaluated intervention for older struggling readers



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Does use of the Big Words software lead to significantly greater scores in:

- Text comprehension?
 - Silent reading comprehension
- Word reading?
 - Word reading of morphologically complex, multisyllabic words
- Language?
 - Vocabulary
 - Morphological Awareness
 - Orthographic Knowledge
 - Phonological Awareness



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Background



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A majority of fourth and eighth grade students have not mastered the skills required to be considered proficient readers at grade level (Aud et al., 2013)



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Struggling Readers

- Many are successful reading 1 and 2 syllable words silently with comprehension.
- Many demonstrate good phonological skills for decoding unfamiliar words.
 - letter-sound associations
 - Common phonograms and syllable types
- Many demonstrate understanding of less complex morphemes
 - Inflectional morphemes, e.g., talk-s, talk-ed, talk-ing
- Many struggle with more complex morphemes
 - Derivational morphemes
 - Polysyllabic words

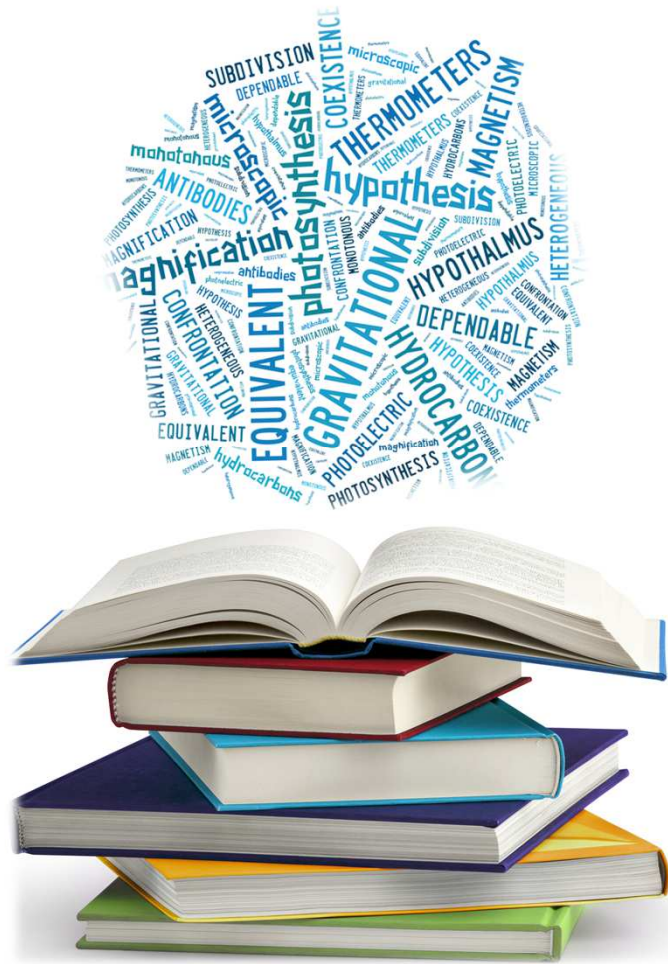


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Text Complexity



- More than 50% of English words are considered to be morphologically complex
- Academic texts are brimming with complex morphemes.
- Without strategies for attacking these unfamiliar and difficult to decode polysyllabic words, reading comprehension suffers

(Katz & Carlisle, 2009; Nagy, Beringer, and Abbot, 2006)



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Predictors of Success

- Growing body of research supporting the importance of orthographic and morphological awareness (Apel, Diehm and Apel, 2013; Berninger, Abbot, Nagy & Carlisle, 2010; Goodman & Ahn, 2010).



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Instruction

- Target ability to process orthographic units at the morpheme level to improve decoding and comprehension of polysyllabic words (Goodman & Ahn, 2010).
- Morphemes as meaningful units help build vocabularies, with estimates that for every known word an additional six or seven that share morphemes can be efficiently taught (Cunningham & Cunningham, 2002).
- Target identification of orthographic patterns to support the processing of smaller chunks and assist in making connections to familiar words with shared patterns.



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Instruction (cont.)

- SLPs are particularly well-suited to apply the guidance of this research to reading instruction (Apel, Diehm and Apel, 2013).
- Morphemes can be processed as orthographic patterns without linking to the semantic or syntactic characteristics (Carlisle & Stone, 2005).



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Reading of Easy Texts

- Time spent reading independently is one of the strongest predictors of reading achievement in the upper grades (Anderson, Wilson & Fielding, 1988; Cunningham & Stanovich, 1991, 1998; Gambrell et al., 2011)
- In this study students were randomly assigned to groups that varied in terms of time spent engaged with the Big Words software and reading self-selected books of interest.



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Computer-assisted Instruction (CAI)



- Can foster engagement and motivation (Potocki, Ecalle, & Magnan, 2013)
- Provide immediate and explicit feedback (Hall, Hughes, & Filbert, 2000)
- Deliver instruction during any available time in a student's school day or home study.



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Methods



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Affix Identification

1. Identified spelling patterns common in science (110 initially).
2. Refined list of spelling patterns (dropped to 86) based on number of words determined to be practical to use for instruction (based on frequency values).
3. Defined groupings of spelling patterns that could hang together in lessons

Nellenbach, K., Zoski, J., Diamond, J., & Erickson K. (2014). A graphomorphemic approach to identifying and selecting a set of high utility, stable affixes common to technical vocabulary of science. *Applied Psycholinguistics*. Advance online publication. doi: <http://dx.doi.org/10.1017/S0142716414000344>



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Example Words and Patterns Used in Lessons

bio + **logy** **biology**
sphere **biosphere**
tic **biotic**
chemical **biochemical**



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Example Words and Patterns Used in Lessons

bio

biology

astro

+ logy

astrology

eco

ecology

geo

geology



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Example Words and Patterns Used in Lessons

recognize +able

recognizable

gene +tic

genetic

relate +ive

relative

comprehend +sion comprehension



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Big Words Content Development

- Multiple activity types
- Science-related words (where possible)
- 60 lessons total (~3600 activities)
- 12 weeks of daily instruction
- Each lesson consisted of ~60 activities
- Designed to engage students for 25-30 minutes
- Piloted lessons in Spring 2014
- Revised based on pilot observations
- Implemented in Fall 2014



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Big Words Activity Types

- Building new words from individual morphemes/orthographic units
- Completing sentences with derived or decomposed word forms
- Sorting words based on shared spelling patterns



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Activities used in Big Words (cont.)

Word Builder

The nurse gave her a hot

Beginning	Ending
<input type="text" value="com"/>	<input type="text" value="pose"/>
<input type="text" value="dis"/>	<input type="text" value="cover"/>
	<input type="text" value="honest"/>
	<input type="text" value="press"/>
	<input type="text" value="fort"/>
	<input type="text" value="pound"/>
	<input type="text" value="pare"/>
	<input type="text" value="appear"/>
	<input type="text" value="appoint"/>
	<input type="text" value="place"/>

Spellbinder

biotic → antbiotic phone → microphone alti → altimeter

An (body) is part of our immune system.

Sorting

Sort these	biotic → <u>ant</u> biotic	phone → <u>micro</u> phone
<input type="text" value="microscope"/>	<input type="text" value="antibody"/>	<input type="text" value="microscope"/>
	<input type="text" value="antiseptic"/>	
		<input type="text" value="microscope"/>

Alphabet Soup

Combine 2 or more parts

<input type="text" value="ad"/>	<input type="text" value="her"/>	<input type="text" value="ence"/>
<input type="text" value="inter"/>	<input type="text" value="fer"/>	<input type="text" value="ion"/>
	<input type="text" value="act"/>	
	<input type="text" value="apt"/>	
	<input type="text" value="here"/>	
	<input type="text" value="miss"/>	
	<input type="text" value="opt"/>	

Slice and Dice

homogeneous hydrocarbon

is a gas that has no color or smell.



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Word Builder

The nurse gave her a hot compress .

Beginning	Ending
com	pose
dis	cover
	honest
	press
	fort
	pound
	pare
	appear
	appoint
	place

Submit

Spell Binder

biotic → antibiotic phone → microphone alti → altimeter

An (body) is part of our immune system.

Sorting

Sort these	biotic-- > <u>antibiotic</u>	phone > <u>microphone</u>
microscope	antibody	microscope
	antiseptic	
		microscope

microscope

Submit

The diagram illustrates a sorting task. It features a table with three columns: 'Sort these', 'biotic-- >antibiotic', and 'phone >microphone'. The 'Sort these' column contains the word 'microscope'. The 'biotic-- >antibiotic' column contains 'antibody' and 'antiseptic'. The 'phone >microphone' column contains 'microscope' and 'microscope'. A dashed arrow points from the 'microscope' in the first column to the 'microscope' in the second column. Another dashed arrow points from the 'microscope' in the second column to the 'microscope' in the third column. A 'Submit' button is located at the bottom left of the interface.

Alphabet Soup

Combine 2 or more parts		
	her	ence
ad	fer	ion
inter	act	
	apt	
	here	
	miss	
	opt	

Slice and Dice

homogeneous hydrocarbon


is a gas that has no color or smell.

Independent Reading Time

- Don Johnston Start-to-Finish Online



Start-to-Finish
Online Accessible Library



“So it is! Now I wish they really *was* devils. What do you suppose they’re up to, Tom?”

The whispering stopped now because the three men had reached the grave of Hoss Williams and stood only a few feet from the boys’ hiding place.

“Here it is,” said the third voice. Both boys recognized the man as young Dr. Robinson. He was holding the lantern. Muff Potter and Injun Joe began digging up the grave with their shovels. For some time there was no noise but the sound of the shovels digging up the fresh dirt. Finally one shovel hit the coffin with a dull *thud*. In a minute, Potter and Injun Joe had the coffin out of the ground and opened. They lifted Hoss’s body out of the coffin and dumped it into a wheelbarrow. Potter covered it with a blanket, cut off a length of rope with his knife, and tied the blanket around the body.

“There it is, Doctor, and you’ll hand over another five dollars, or it will stay right here,” said Muff Potter.

Chapter 03

Contents 6
..... 28

Sentence Word

32 33

Quit



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Participants

- 58 middle school students (6-8th grade) in a rural school district in North Carolina

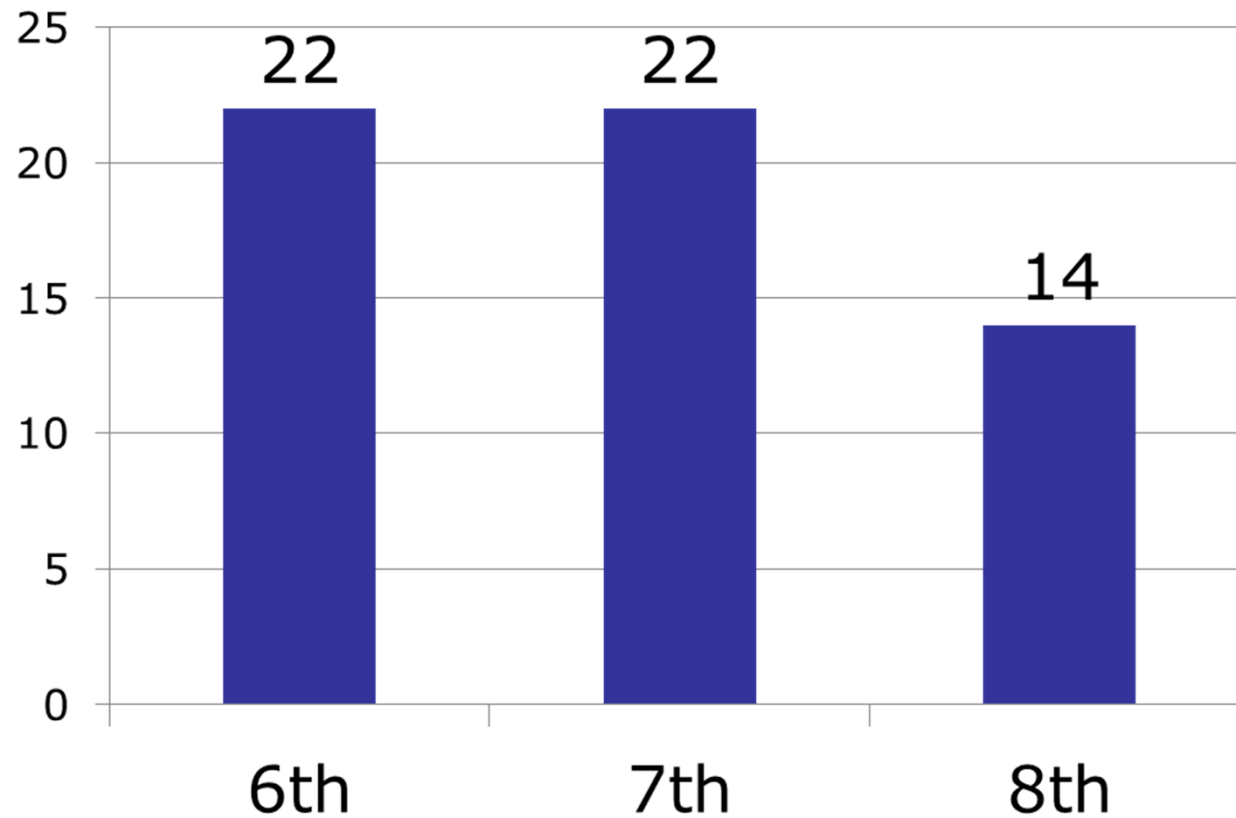


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Participants by Grade

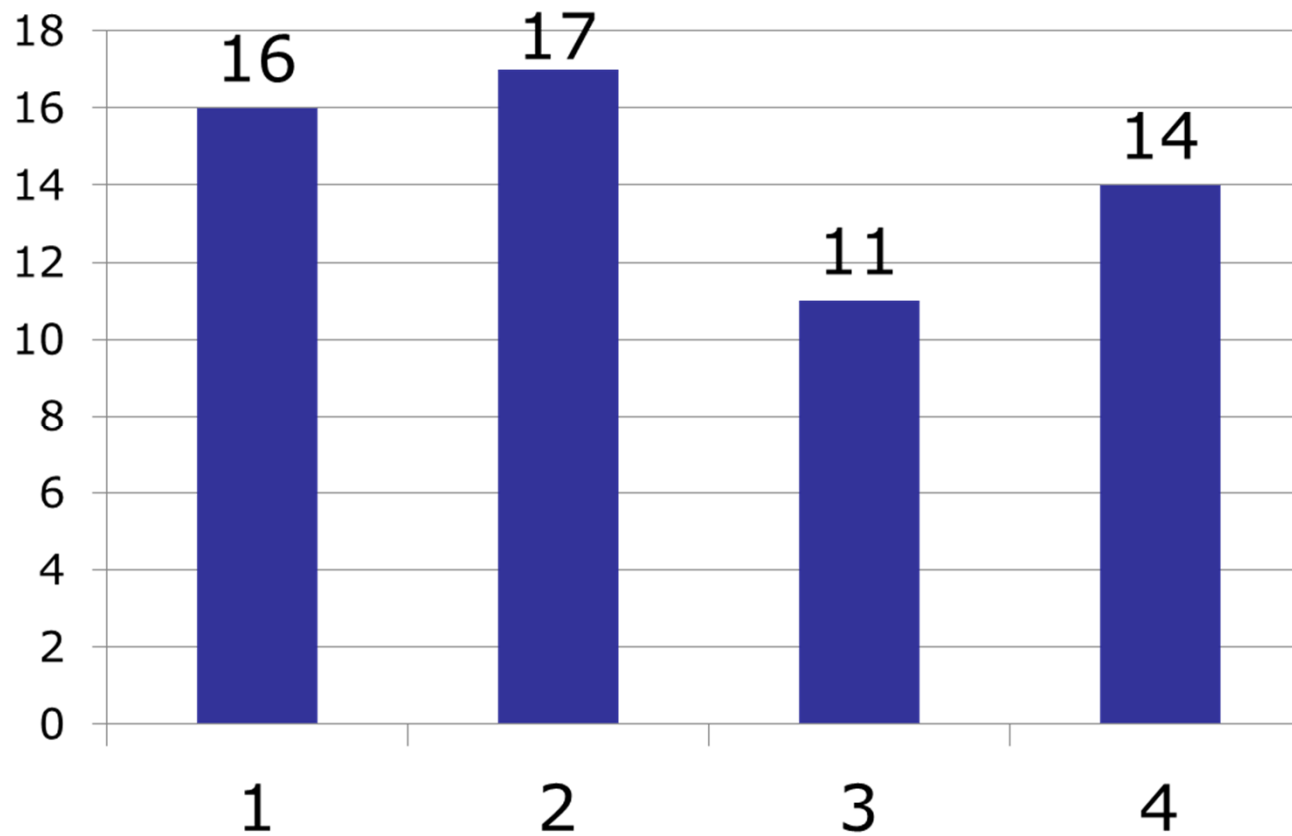


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Participants by Group

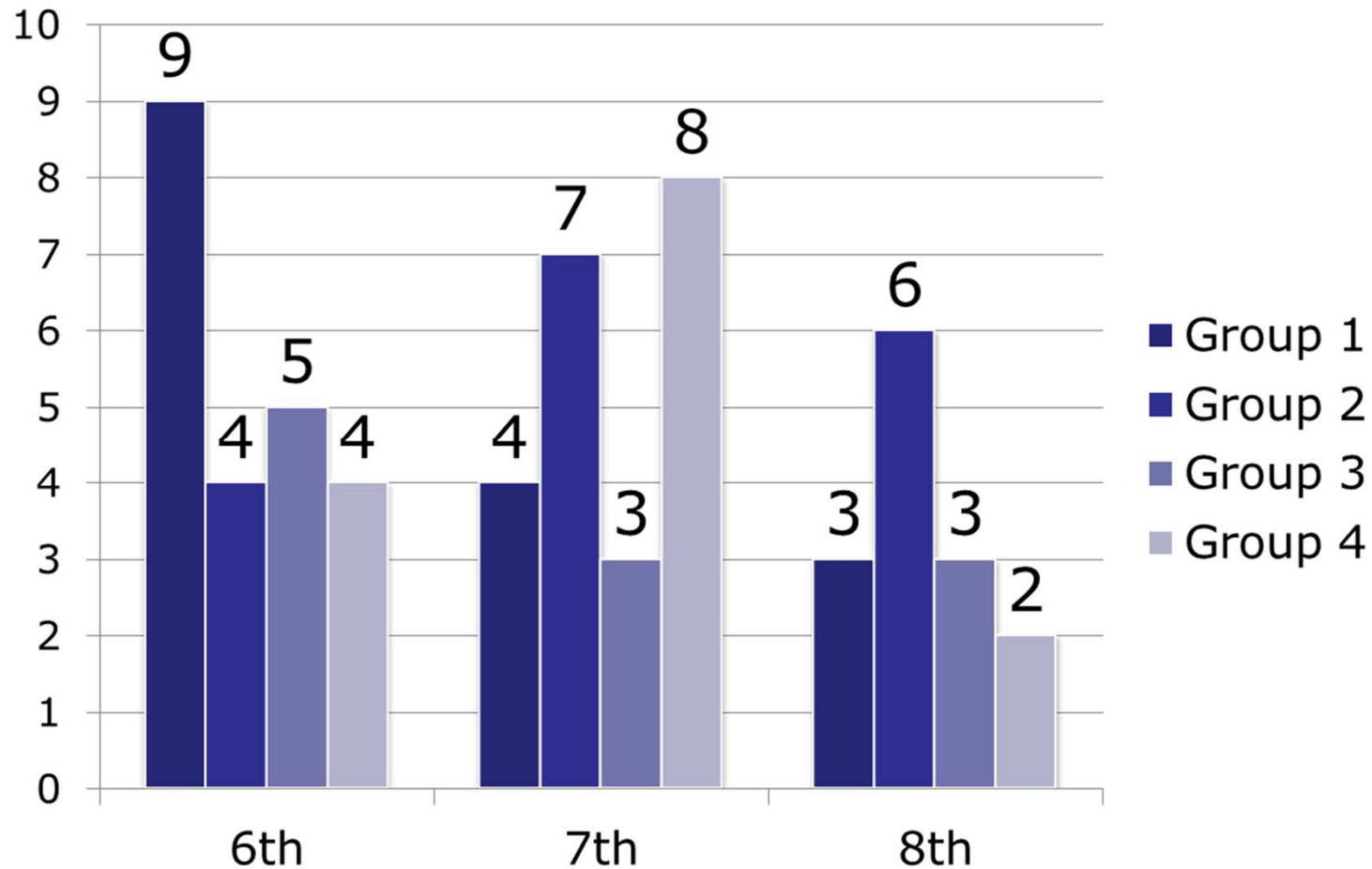


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Groups by Grade



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Groups

- **Group 1**
 - 1 week reading Start-to-Finish books
 - 12 weeks of Big Words activities
- **Group 2**
 - 3 weeks reading Start-to-Finish books
 - 10 weeks of Big Words activities
- **Group 3**
 - 5 weeks reading Start-to-Finish books
 - 8 weeks of Big Words activities
- **Group 4**
 - 7 weeks reading Start-to-Finish books
 - 6 weeks of Big Words activities



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Preliminary Results



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Compared Pre & Post Test Means: Paired Samples t test

- MSWR: Multisyllabic Word Reading (Experimenter Designed Measure)
- TOAL-4: Test of Adolescent and Adult Language–Fourth Edition
 - *Word Derivations Subtest*
- TOC: Test of Orthographic Competence
- TOWRE-2: Test of Word Reading Efficiency, Second Edition
 - *Sight Word (SW) Subtest*
 - *Phonemic Decoding (PDE) Subtest*
- PPVT™-4: Peabody Picture Vocabulary Test, Fourth Edition
- GMRT®: Gates-MacGinitie Reading Tests®, Fourth Edition



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Significant Gains

- MSWR: Multisyllabic Word Reading
- TOAL-4: Test of Adolescent and Adult Language–Fourth Edition
 - *Word Derivations Subtest*
- TOC: Test of Orthographic Competence
- TOWRE-2: Test of Word Reading Efficiency, Second Edition
 - *Sight Word (SW) Subtest*



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All Students

$n=58$

Average # Independent Reading Sessions = 7 ($SD = 5.38$)

Average # Big Words Science Sessions = 39 ($SD = 15.19$)

MSWR $t(57) = -7.254, p < .001, d = .787$

TOAL $t(57) = -5.997, p < .001, d = .953$

TOWRE-SW $t(57) = -2.392, p < .007, d = .370$

TOC $t(57) = -2.392, p < .02, d = .314$



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6th Grade

$n=22$

Average # Independent Reading Sessions = 7 ($SD = 6.02$)

Average # Big Words Science Sessions = 30 ($SD = 16.41$)

MSWR $t(21) = -5.899, p < .001, d = 1.258$

TOAL $t(21) = -3.412, p < .003, d = .727$



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7th Grade

$n=22$

Average # Independent Reading Sessions = 8 ($SD = 5.34$)

Average # Big Words Science Sessions = 44 ($SD = 12.08$)

MSWR $t(21) = -3.885, p < .001, d = .828$

TOAL $t(21) = -3.310, p < .003, d = .706$

TOWRE-SW $t(21) = -2.149, p < .043, d = .458$



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8th Grade

$n=14$

Average # Independent Reading Sessions= 5 ($SD = 4.20$)

Average # Big Words Science Sessions= 44 ($SD = 12.00$)

MSWR $t(13) = -2.870, p < .003, d = .978$

TOAL $t(13) = -3.659, p < .013, d = .767$

TOC $t(13) = -2.600, p < .022, d = .695$



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Group 1

n=16

1 week Independent Reading ($M=3$ sessions, $SD = 1.61$)
12 weeks Big Words Science ($M=49$ sessions, $SD= 10.98$)

MSWR $t(15) = -3.689, p < .002, d = .922$

TOAL $t(15) = -3.127, p < .007, d = .782$



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Group 2

n=17

3 weeks Independent Reading ($M = 5$ sessions, $SD = 3.04$)
10 weeks Big Words Science ($M = 46$ sessions, $SD = 9.74$)

MSWR $t(16) = -3.474, p < .003, d = .843$

TOAL $t(16) = -3.255, p < .005, d = .789$

TOC $t(16) = -2.382, p < .030, d = .578$



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Group 3

n=11

5 weeks Independent Reading ($M = 11$ sessions, $SD = 4.98$)
8 weeks Big Words Science ($M = 30$ sessions, $SD = 14.38$)

MSWR $t(11) = -5.070, p < .001, d = 1.529$



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Group 4

n=14

7 weeks Independent Reading ($M = 12$ sessions, $SD = 4.91$)

6 weeks Big Words Science ($M = 25$ sessions, $SD = 10.81$)

MSWR $t(14) = -2.746, p < .001, d = 1.193$

TOAL $t(14) = -4.463, p < .017, d = .734$

TOWRE SW $t(14) = -2.379, p < .033, d = .636$



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Limitations

- Unequal groups of students
- Compliance
- Additional unrelated literacy intervention
- Messy data



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Additional Analysis

- Multilevel modeling to account for clusters of students in grades 6, 7, and 8
- Does the number of days students participated in Big Words activities predict gains in multisyllabic word reading?



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Implications

- Big Words Science instruction used in combination with reading of easy texts may lead to improvements in morphological awareness and multisyllabic word reading for struggling adolescent readers.



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Future Development

- Big Words software in 3 formats:
 - Most common English morphemes
 - Most common science morphemes
 - Dynamic content generation
- Multi-platform
- Flexible application across grades and content areas



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Thanks

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