

# THE TEXAS JOURNAL OF LITERACY EDUCATION

A large, light-colored wooden star is positioned on the left side of the cover, resting on a dark blue wooden plank. The background consists of horizontal wooden planks in blue, white, and red, reminiscent of the Texas state flag.

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# HIGH-FREQUENCY WORDS: SOME WAYS TO TEACH AND HELP STUDENTS PRACTICE AND LEARN THEM

JERRY L. JOHNS AND KRISTINE H. WILKE

## ABSTRACT

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*This is a practical article for teachers in the primary grades and for other teachers and reading specialists whose students experience difficulty responding automatically to high-frequency words. In this article, we will begin by providing some helpful information about vocabulary and high-frequency words in particular. You will learn why high-frequency words are critical if students are to become efficient and effective readers. Then we will turn our attention to the heart of the article: providing numerous ways to teach and help students practice and learn high-frequency words. Finally, we will provide you with two word lists, some phrases, and sentences that you can use to help teach, practice, and reinforce the words.*

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Words are important. They stimulate the student's experience and background so meaning can be constructed from print. There are a large number of words in the English language. Estimates range from 600,000 to over a million words. It is doubtful that anyone knows all these words. Various word count studies suggest that proficient readers like you are able to recognize 50,000 or so words at sight. You know most of these words automatically; you rarely have to sound them out or use affixes like prefixes and suffixes to identify them. You also know that some words occur more frequently than other words.

Beginning readers and struggling readers know a very small percentage of the 50,000 words that are known by proficient readers like you. But here's the good news: because some words occur more frequently than others, we can make some choices of words to teach. For example, there are a mere thirteen words that account for approximately 25% of all the words in school texts and the materials adults read (Johns & Lenski, 2019). In the sentence you just read, ten of the 25 words are among these 13 words (40%). Before you think we created this sentence to buttress our argument (we didn't), check out some other reading materials in your classroom. Sometimes the 13 words will account for less than 25% of the words, and sometimes the 13 words will account for more than 25% of the words. On average, however, these 13 words will account for approximately 25% of the words in all sorts of reading material. We know you want to know what the words are, but we first want to share another valuable piece of information.

A list of 100-200 high-frequency words will make up over 50% of the words in school texts. Those 13 words are among these words. It therefore makes great sense to ensure that beginning readers learn these 13 words at sight. That gives them automaticity with about 25% of the words they meet in their reading. Another 100-200 high-frequency words, if known automatically by students, will enable them to know more than half the words they encounter in their reading.

Here are the magic 13: a, and, for, he, in, is, it, of, that, the, to, was, you. At the end of this article, we have included two other important word lists: Revised Dolch List (226 words) and List of High-Frequency Nouns (46 words). You may have other lists you prefer to use like the Fry list and the original Dolch List. The Revised Dolch List (RDL) is statistically better than the original Dolch list, but you should feel confident with any high-frequency word list you use in your teaching and practice activities.

## THE IMPORTANCE OF HIGH-FREQUENCY WORDS

If you want students to become efficient and effective readers, you need to ensure that students master these words by the end of third grade. By mastery, we mean that they recognize these words automatically (by sight). We recommend teaching the 13 words to mastery along with another dozen of the most-frequently occurring words (i.e., on, as, are, they, with, be, his, at, or, from, had, I) to kindergarten students. Continue teaching more of the words from the Revised Dolch List in first and second grade and ensure mastery by third grade. For readers who struggle in the upper grades, assess their knowledge of the high-frequency words and help students learn the words by sight (automatically). You want all students to know the words by sight. Now, here's the payoff: If students are able to recognize these words by sight, they will know half or more of the words they encounter in their reading. The words are a necessary, but insufficient condition, for efficient reading. Students will also need to learn many words beyond these couple hundred so they can recognize most of the words in their reading. Learning several thousand more words will require plenty of reading in high-success texts along with systematic instruction. But students who know a core of 200 or so high-frequency words by sight will possess a solid foundation for reading.

Now let's focus on some of the things you can do to help your students learn high-frequency words so they become known at sight. We'll begin with several teaching strategies.

## DIRECT TEACHING STRATEGIES

### EXPLICIT INSTRUCTION

1. Select a high-frequency word, or several words, that students should learn to read by sight.
2. Write the word(s) on the board.
3. Model for the students: touch the word, say the word, and spell the word as each letter is touched.
4. Have students write the word on a 4"x 6" card using assorted colored markers, pencils or crayons.
5. Have students demonstrate the procedure you modeled. Students touch the word, say the word, and spell the word touching each letter as it is said. This activity may be done independently or in pairs.
6. Students may pass cards. Each time cards are passed, students touch, say, and spell each word while continuing to touch each letter. Repeat.

7. Use these cards during a read aloud. Every time their word is read, have students put up the word.
8. Give students a story, poem, or created passage that uses the sight word many times. Have the students highlight or circle the word. This text may be read to the students while they are following along, or they may read independently.
9. Students may cut the word into letters, placing them in an envelope that has the word written on the envelope by the student. Ask the student to build the word to practice arranging the letters throughout the day.
10. Write many sentences with a blank space for the sight word on chart paper located around the room. Have students write the word in the sentence, read the sentence silently, and then read the sentence aloud.

### LEARNING THROUGH REPETITION

1. Select words from the Revised Dolch List (RDL) - perhaps the first three words from each column of the RDL (18 words). This list is at the end of the article. Ask the student to read the words and note the words missed. If the student does not recognize the word automatically, ask them to “skip” that word and move to the next. The intent is to determine which words the student does not recognize by sight.
2. Create flash cards from the words that the student did not recognize by sight. You may also include the words that the student displayed hesitancy with (words may be printed on cardstock and cut out or you may write the words on index cards). As a guide, if a student recognizes a word within one second or less, the student is given credit for the word. For the first session, choose three to five words to teach.
3. Present each card to the student, saying the word as it is presented and then placed in front of the student. Once the student recognizes the words, move them around until automaticity is achieved.
4. Begin the next session by reviewing the words learned in the previous session. When the student demonstrates automaticity, continue with the next three to five words missed on the RDL using the same procedure as in step three. To keep words separated, put the words that have been learned and reviewed in the envelope with newly learned words and words missed clipped outside the envelope.
5. In each session, begin by reviewing the newly learned three to five words first, then add them to the known words and have the student review all the words for strengthened automaticity. Unknown words are taken out each time and kept clipped on the outside of the envelope with the newly learned words. Continue these steps until all the words are recognized automatically.
6. After the student has learned the whole set, continue to review and practice the words until the student can automatically recognize each word three times in a row. This may be done with flash cards that the student or you can turn over once the prior word is said. Cards may be sent home for continued practice and review.



7. Retest the student on the RDL to check for mastery. Do this by displaying the words in another print form. Any words missed may be added to the new set of sight words.
8. You can also create and place the words in short phrases or sentences (see phrases and sentences at the end of this article) to help promote transfer to context.

### SEE/HEAR/WRITE/CHANT

1. Choose three to five words. Write one word on the board. Say the word as you point to the word. Have the students write the word on an index card. Then have students chant the word.
2. After students chant the word, they can spell the word again as an individual or group chant. Have fun and let the students clap or tap their foot to the spelling chant. Repeat the chanting of the word followed by the spelling of the word several times.
3. Repeat steps one and two for the targeted three to five words. After all words have been practiced, write a word on the board and see if students can continue the chant of saying and spelling without hesitation. Repeat this process so students can begin to get a rhythm to the practice. This activity can be done as students stand for a movement break multiple times during the day to practice after the initial teaching of the words (steps 1 & 2).

## PRACTICE

Research has found that sight word intervention games are highly effective when used for sight word achievement (Gibbon, Duffield, Hoffman, & Wageman, 2017). Below are some ideas that are easy and fun to include for practice activities.

1. Word Walls. Create word walls so students have the words always accessible. As you use the words daily during instruction, take the time to ask them to find the word within the word wall lists.

Cunningham (2017) offers the following word activity suggestions:

- Easy Rhyming. Have students create lists of the word wall words that rhyme. Students can make word wall booklets of these words.
- Easy Endings. Students can add endings such as *s*, *ed*, *ing*, and *er* to words to create more words.
- Read My Mind. You or a student may choose a word on the word wall. That word can be written on a piece of paper without anyone seeing it. Give the students five clues to see if they can “read” your or the student’s mind.

Example:

It’s one of our Word Wall words.

It has three letters.

It begins with o.

It is the opposite of young.

It is missing from this sentence. Today I am seven years \_\_\_\_\_.

2. Word Families. Have students create word families on chart paper. Students should say the words after they have created the list(s) for additional practice. Some examples of word families can be found below.

at: cat, sat, chat, mat, flat, pat, vat, bat, rat, that  
 ad: had, sad, glad, tad, pad,  
 an: man, can, tan, ran, fan  
 and: hand, band, sand, land,  
 ee: three, bee, knee, tree, see, flee, tee

3. Read pattern books. Encourage students to read books to increase automaticity and build confidence.

4. Create phrases or sentence strips that contain high-frequency words for students to practice. See example phrases and sentences at the end of this article.

5. Word Search. Create your own word search using a list of high-frequency words. Depending on the age and capability of the student, have him or her create the word search for the group. Be sure your word searches go from left to right only. One free resource for creating word searches can be found at this site:

<https://worksheets.theteacherscorner.net/make-your-own/word-search/>



6. Sign It (Sherman, 2011). Use the following website to see what the word looks like in sign language: <https://www.handspeak.com/word/>

This is a great way for students to teach others as they become familiar with the written word as well as the word in sign language.

7. Write sight words everywhere using items like those that follow.
  - Sidewalk chalk – Take students outside and let them write around the playground.
  - Magnets – Use magnetic letters to form words on baking sheets. If you have the opportunity to have magnetic painted walls, these are a great way to allow students to manipulate letters and form words.
  - Sand – Pour sand in a tray and let students write the words with their finger.
  - Play dough – Form sight words with play dough.
8. Treasure Hunt. Hide high-frequency words around room. Write words on index cards, fun post-its or cut outs for more fun. Have students go on a treasure hunt. The student cannot collect the word unless he or she can say the word.
9. Pick a Stick. Write words on popsicle sticks or craft sticks. The words may be used in a variety of different ways. One is to call students up to pick a stick throughout the day. If they get the word correct, they may win a point toward something you decide. At the end of the day or week, they may earn extra free time or reading time!
10. Memory Game. You may use the same stack of word pairs as used for Go Fish (see #12). The cards are laid face-down on the floor. The students take turns flipping two cards over and say them as they try to remember where previously flipped words are. The student who has the most matches at the end wins the game.
11. Sight Word Bingo, Create Bingo cards with a few sight words or sight word phrases (i.e., on the tree, in the tree). Randomly read aloud sight words, marking (or placing a small item) on each square with the matching sight word.
12. Go Fish. Write high-frequency words twice on index cards or cardstock and shuffle them like a deck of cards. Have a pair of students takes turns to see if another player has a sight word that matches one in his or her hand. If there is not a match, the student draws a card from the deck. Any pair of matching words gets stacked in a pile. After the first student has no cards, players count up their matches. The player with the most matches wins the game.

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### ***Word Lists, Phrases, and Sentences***

*The four resource pages that follow can be used for both teaching and practice activities.*

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## Revised Dolch List

a	could	he	might	same	told
about	cut	heard	more	saw	too
across	did	help	most	say	took
after	didn't	her	much	see	toward
again	do	here	must	she	try
all	does	high	my	short	turn
always	done	him	near	should	two
am	don't	his	need	show	under
an	down	hold	never	six	up
and	draw	hot	next	small	upon
another	eat	how	new	so	us
any	enough	I	no	some	use
are	even	I'm	not	soon	very
around	every	if	now	start	walk
as	far	in	of	still	want
ask	fast	into	off	stop	warm
at	find	is	oh	take	was
away	first	it	old	tell	we
be	five	its	on	ten	well
because	for	just	once	than	went
been	found	keep	one	that	were
before	four	kind	only	the	what
began	from	know	open	their	when
best	full	last	or	them	where
better	gave	leave	other	then	which
big	get	left	our	there	while
black	give	let	out	these	white
blue	go	light	over	they	who
both	going	like	own	think	why
bring	gone	little	play	this	will
but	good	long	put	those	with
by	got	look	ran	thought	work
call	green	made	read	three	would
came	grow	make	red	through	yes
can	had	many	right	to	yet
close	hard	may	round	today	you
cold	has	me	run	together	your
come	have	mean	said		

The rationale and research for this list are described in Johns, J.L. (1981). The development of the revised Dolch list. *Illinois School Research and Development*, 17(3), 15–24.

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## High-Frequency Nouns

air	group	people
back	hand	place
book	head	road
boy	home	room
car	house	school
children	man	side
city	men	table
day	money	thing
dog	morning	time
door	mother	top
eye	Mr.	town
face	Mrs.	tree
father	name	water
feet	night	way
friend	nothing	year
girl		

The development of this list is described in Johns, J.L. (1975). Dolch list of common nouns—A comparison. *The Reading Teacher*, 28(6), 538–540.

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### Phrases with High-Frequency Nouns

through the air	give some money
back again	in the morning
saw the book	with my mother
boy can play	Mr. Green
car went fast	Mrs. White
small children	your name
the big city	every night
a long day	nothing better
their old dog	many good people
open the door	the only place
close one eye	a long road
see your face	my own room
with my father	his new school
two feet	by my side
one good friend	under the table
a small girl	which small thing
four in a group	how much time
in your hand	over the top
on her head	through some town
going home	up in the tree
around the house	in the warm water
an old man	one way to go
two mean men	every year

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### Sentences with High-Frequency Nouns

The air is cold.

Can you bring it back?

Mr. Green read a book.

The boy ran away.

A car is going fast.

The children read.

The city is big.

Another day went by.

The dog can play.

Close the door.

Keep one eye open.

I see your face.

Ask your father.

Put those on your feet.

Who is your friend?

This girl can draw.

The group went to town.

He can hold her hand.

Put that on your head.

Let us go home.

I like our little house.

That man is Mr. Black.

Some men left town.

Do you have any money?

I get up in the morning.

My mother is short.

Mr. Black is going home.

Mrs. Green read this book.

What is your name?

I read at night.

Nothing can stop you.

The people sit at the table.

Which place will you go?

The car is in the road.

I have my own room.

She is going to school.

Come over by my side.

The dog is under the table.

Which thing do you have?

How much time is left?

Look at the top of the tree.

I'm going to town.

Can he go up the tree?

Turn off the water.

Which way did he go?

Every year I grow.

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# STORIES MATTER: SHARING OUR VOICES WITH DIGITAL STORYTELLING

LINDSAY YEARTA, SHAWNNA HELF, AND LISA HARRIS

## ABSTRACT

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*Our students' voices matter; their stories are important. Digital tools can help students craft and publish their stories for wide, varied, authentic audiences. As little as a decade ago, it was difficult and expensive to publish digital stories. Given the myriad of apps and tools now available, teachers in elementary, middle, and high school settings can select the tools that will work best for their students. Digital storytelling can empower students and teachers to share their voices, participate in the ongoing, collective conversation, and learn from one another as they listen to and engage with others.*

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Our students matter. Stories matter. Our students' stories matter. Yet, when we introduce the unit on digital storytelling at our university, students typically react with a flurry of questions that do not focus on the stories themselves. Instead, they ask questions such as, "How long does this need to be?" and "When is this due?" However, as students become entrenched in the digital storytelling process, the focus turns to the story. While our original intent with digital storytelling was to teach students the process, how to use the necessary digital tools, and how to integrate content, we were delighted to discover that when students shared their stories, our classroom community was strengthened, students often discovered they had something important to say and the process of learning from others was better understood.

The project is presented in a way so students understand they may construct a personal, funny, or informative story. Given a plethora of choices, many students choose to share something personal about themselves. We have had students share stories about battling anxiety and depression, living with eating disorders, taking transformative trips, and dealing with death. Through listening to and sharing stories, students are better able to understand one another and the world (Cunningham, 2015; Lambert, 2013; Rief, 2016) and empathy is developed. Digital tools can better enable students and teachers to share stories with authentic audiences.

In this article, we discuss the benefits of digital storytelling and examine digital storytelling as a medium for sharing voices from the classroom. We share two examples from university students enrolled in a technology integration course in an education program. Then we describe the digital storytelling procedures and resources that can be used by any grade level.

## WHY DIGITAL STORYTELLING?

The way we read, interact with, and compose texts in the 21<sup>st</sup> century is changing. Many teachers and students embrace new technologies as tools for writing, thinking, and learning. In fact, the use of technology has been found to improve student learning outcomes (Andes & Claffett, 2011; Boling,



Castek, Zawlinski, Barton & Nierlich, 2008; Larson, 2009; Mills & Levido, 2011; Yearta, Stover-Kelly & Sease, 2015) as well as student motivation and engagement with academic tasks (Couse & Chen, 2010; Mills & Levido, 2011). Technology can enhance storytelling with an increased awareness of audience (Crawley, 2015; Sylvester & Greenidge, 2009), more time and effort spent in planning and revision (Sylvester & Greenidge, 2009), and opportunities for development of and engagement across a broad range of literacy skills (Morgan, 2014).

Creating digital stories provides English Learners (ELs) a context for using language that is authentic, personal, and meaningful (Rance-Roney, 2008). The oral aspect of digital storytelling allows for English Learners to activate background knowledge and develop ideas (Tompkins, 2015) without having to rely solely on spoken or written language (McGeoch, 2012). Additionally, digital storytelling by ELs has been shown to increase motivation (Yang, & Wu, 2012; Gimeno-Sanz, 2015; Nishioka, 2016; Yoon, 2013; Razmi, Pourali, & Nozad, 2014); improve listening, reading, and writing skills (Yang, & Wu, 2012); and develop speaking skills related to proficiency, pronunciation, and grammar (Nishioka, 2016).

When students understand their work will be shared with an authentic audience, they are more likely to spend time planning (Graham & Harris, 2013) and become more active and invested in the writing process. Digital tools can help teachers open the classroom (Stover-Kelly & Yearta, 2017), serve as writing mentors, and provide students with increased decision making ability and choice. As students plan their digital stories, they gather information, pictures, and music. They make decisions about what best helps them tell the story and then decide on the format. As they work on their storyboards and scripts, they repeatedly read their drafts. This continual process of planning, writing, and creating includes constant revision as students evaluate whether the story works and is appropriate for the intended audience.

Although digital storytelling can help develop and nurture students' writing skills, the highlight of this process is being able to share stories with audiences within and beyond the classroom. It is about discovering that being a part of a collective conversation means sharing, listening, and learning about ourselves and one another.

## SHARING THEIR VOICES

When we ask our students to share personal stories with one another and the world, it helps if we do the same. Teachers serve as models and mentors for their students in many ways. Specifically, teachers can show students the importance of telling and listening to stories by creating and sharing their own digital stories. This has become increasingly important in today's political climate, where many feel as if their voices are not being heard. Jennie, an undergraduate middle level education major, eloquently describes how digital storytelling can make a difference. She posits that digital storytelling can be an "excellent platform for both teachers and students to have a voice and share their stories with a wide, authentic audience" and states how important it is for students to have their voices "not only heard, but valued."

Do students feel their voices are valued? Sandez, an undergraduate special education major, discussed how we must not "shy away from the stories that make us uncomfortable." We must use our stories as catalysts for discussions. It is through this process of crafting and understanding our own stories, as well as listening to and reflecting upon the stories of others, that we can truly begin to engage in powerful discussions.

In one of their college courses, Jennie and Sandez were given an assignment to create a digital story on a topic of their choosing. They were required to include images and narration and to post their final product on a course discussion board. Students were also encouraged to share their stories on social media in order to reach a wider audience. Jennie chose to create a story based on her experience as a peer mentor (See Figure 1) and Sandez created a digital story on the Black Lives Matter movement (See Figure 2).



*Figure 1: Digital Story on Peer Mentor Experience by Jennie*  
<https://www.youtube.com/watch?v=vs8XUFaklHw>



*Figure 2: Digital Story on Black Lives Matter by Sandez*  
<https://www.youtube.com/watch?v=TPGMb9BY3n4>

Working through the process of digital storytelling was beneficial to these future teachers, as we imagine it would be for practicing teachers, in several ways. First, Jennie and Sandez recognized the importance of choice. Being able to choose a topic of interest leads to increased motivation and engagement (Graham & Harris, 2013). Although the digital storytelling project accounts for a very small percentage of the course grade, students spend more time on this assignment than any others in the course. They traversed the writing process as they carefully crafted the script, chose only the most relevant photographs and images to support the writing, and recorded and rerecorded until they were satisfied with the narration and flow of the story.

Students posted the final product to the class discussion board and several posted to YouTube. As students shared their work and viewed the work of others, a collective conversation began. By selecting their own topics and sharing the products within and beyond the classroom walls, a sense of classroom community was developed (Cunningham, 2015). This sense of community, often begun with teachers sharing their own work, is an integral component of an effective learning environment.

Teachers who teach writing should be writers themselves (Angelillo, 2005; Fletcher & Portalupi, 2001). Similarly, teachers who encourage the crafting and sharing of digital stories need to add their voices to the collective conversation. Jennie and Sandez worked through the digital storytelling process and, therefore, have experienced the difficulties and joys of creating a finished product. Sandez noted that it “took a lot to gain the strength to write and speak the words in my story.” When teachers have gone through the process, they are better able to empathize with and encourage students as they negotiate the process themselves. They are better able to support students as they struggle to determine a meaningful topic, help troubleshoot when students run into difficulties with the writing process or the technology, and contribute to the class writing community.

Both Jennie and Sandez created stories on topics that were important to them, and with the help of digital tools, added their voices to the larger conversation. Being a part of the collective conversation requires the right tools. In the following section, we examine a few of these tools.

## DIGITAL STORYTELLING PROCEDURES AND RESOURCES

A decade ago, digital storytelling tools had an associated cost and learning curve (Robin, 2016). Now, everything that students need to create a digital story can be found on a computer, tablet, or smartphone. Before beginning a digital storytelling project with the students, teachers should decide which tools will work best in their classroom. Computer programs such as iMovie and MovieMaker are readily available. Additionally, tablets and smartphones provide access to a myriad of useful apps. Puppet Pals, ShowMe, Photostory, Splice, Book Creator, and Educreations are free apps that allow the user to upload or draw images and record audio. Once a tool is selected, the teacher should create a digital story first. This can serve as an example and allows the teacher to practice with the tool and experience any technical difficulties that might arise for the students. In addition to teachers sharing the digital story they created, students should also view and discuss a variety of examples. These could include previous students’ work or examples the teacher has found online. Students can then engage in a conversation about possible feedback they would provide the author, such as the alignment of image and narration, the volume of narration, or the story itself. Evaluating sample stories allows students to determine effective methods for portraying their own stories. Once students are familiar with the genre of digital storytelling, students should brainstorm ideas for their own stories, and then begin drafting the script. This can be done in writer’s notebooks or with digital tools such as Google Docs or Notability.

Once a story is drafted, students can determine where natural breaks in the story occur, what images fit the story, and where those images should be placed. Storyboards are useful here and can be compared to a digital storytelling blueprint (Robin, 2016) as they help students construct and see the order of the story (Sylvester & Greenidge, 2009). See Appendix A for a sample storyboard created with Microsoft Word.

To add images to the script, students can use personal photographs or find appropriate images online. There are several helpful tools for finding free and appropriate images online including the

Google suite of tools, or websites such as Photos for Class, Pexels, and Pics4Learning. Additionally, historic images are available through the Library of Congress.

The variety of tools available allows teachers to tailor digital storytelling to fit students' needs. Regardless of the tools selected, digital storytelling tends to follow a recursive process inclusive of writing the story, creating storyboards, creating or selecting images, recording narration, and putting everything together. Students may revise and edit or revisit past stages throughout the process.

Once the digital stories are complete, there are several ways to save and share the work. Digital stories made with MovieMaker or iMovie can be saved as mp4 files and uploaded to Canvas, Edmodo, class websites, YouTube, or Vimeo. Puppet Pals, ShowMe, Photostory, Splice, Book Creator, and Educreations all provide links that can be shared on any platform. See Appendix B for an easy-to-reference listing of potential tools. The ability to share work with a wide audience is one of the best features of digital storytelling and can widen the community of writers and impact motivation and engagement.

## FINAL THOUGHTS

The need for stories is everlasting. Stories can be used to support ideas and underscore main points (Ohler, 2013). Katie Egan Cunningham (2015) discusses how stories, such as those shared by the people of New York, <http://www.humansofnewyork.com>, can illustrate the universality of many aspects of our lives. Specifically, sharing and listening to stories can help people better understand themselves and others.

Digital tools can allow stories to be shared within a classroom or with a wide and varied audience. By engaging in this authentic experience, our university students Jennie and Sandez now better understand how digital storytelling allows for choice in the writing process, leads to increased engagement, contributes to classroom community, strengthens student voice, and aids in the development of empathy. While it was difficult for some of our students to find the strength to speak their truth, in the end they recognized the value of engaging in discussions that might have made them slightly uncomfortable. Empowering students and teachers to add their voices to the collective conversation means that we continuously discover ourselves, learn from one another, and strengthen our ability to empathize and advocate.

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Appendix A: Digital Storytelling Storyboard

Title: \_\_\_\_\_

Author: \_\_\_\_\_

Scene: Main Idea:	Scene: Main Idea:	Scene: Main Idea:
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Script

<div></div>	<div></div>	<div></div>
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Image and Transition

<div></div>	<div></div>	<div></div>
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transition	transition
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Music/ Sound  
Effects

<div></div>	<div></div>	<div></div>
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Appendix B: Easy-to-Reference List of Digital Storytelling Tools

Component	Description	Digital Tools
<b>Drafting</b>	In this initial stage, students begin to write their stories. Traditional writer's notebooks or daybooks can be used for this part of the process.	<a href="#">Notability</a> (app) <a href="#">Google Docs</a> (app/web-based)
<b>Creating Storyboards</b>	After students have a draft of their stories, they will want to begin thinking about what image will best represent each portion of the story. Students can chunk text and match each chunk with an idea for an image in this stage.	<a href="#">Storyboard That</a> (web-based) Microsoft Word (see Appendix A)
<b>Selecting Images</b>	Once students have an idea of what images will work for each chunk of text, they can begin exploring appropriate photographs online. Photos for class comes with automatic citations and images that have been filtered. Pexels has a wider variety of images, but no filter is in use. Both Photos for Class and Pexels use Creative Commons licensing. Pics4Learning features images that are safe and free for education. The photos are copyright friendly. The Library of Congress features historical images.	<a href="#">PhotosforClass</a> <a href="#">Pexels</a> <a href="#">Pics4Learning</a> <a href="#">Library of Congress</a>
<b>Combining Stories, Images, and Narration</b>	When students have their drafted stories aligned with the images that they have chosen, they can upload everything to an app or software editing tool. Students can narrate their stories in this stage as well. Keep in mind, there is variability in this process. Book Creator works well for realistic videos. If students prefer to have animated stories, Puppet Pals is a good choice. If you have older students, Splice is a favorite.	<a href="#">Book Creator</a> (app) <a href="#">Puppet Pals</a> (app) <a href="#">Show Me</a> (app) <a href="#">Splice</a> (app) MovieMaker or Photos (software) iMovie (software/app)
<b>Sharing Widely</b>	Many of the apps allow for students to upload their work to a repository. They also have the choice to share to video websites. This will allow for easy sharing across wide audiences.	<a href="#">YouTube</a> (app/web-based) <a href="#">Vimeo</a> (app/web-based)

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# LEARNING FROM STUDENTS: WHAT, WHY, AND HOW ADOLESCENT ENGLISH LEARNERS WANT TO READ AND WRITE

MARY AMANDA STEWART, KATIE WALKER, AND CAROL REVELLE

## ABSTRACT

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*In various conversations regarding how to teach language and literacy to adolescent English Learners (ELs), students' voices are often lost. This article privileges those voices by surveying ELs in Texas high schools regarding what, why, and how they want to read and write in and out of school. The authors surveyed the students before and after an instructional intervention designed to increase students' literacy engagement by introducing culturally relevant reading and writing in their classrooms. The findings indicate that the participants want to read and write about relevant topics in order to affirm their identities, express themselves, or to learn about others. The authors encourage educators to maintain high literacy expectations for ELs while providing opportunities to select relevant literature and respond in authentic ways. Most importantly, this research suggests we should privilege student voices as we consider how to provide effective language and literacy instruction.*

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Despite growing standardization, secondary educators still have numerous curricular and instructional options available to them, especially when working with bilingual adolescents in the dynamic process of second language acquisition (Stewart, 2017a). Consequently, educators frequently debate the various ways that language and literacy acquisition should be approached when working with adolescent English learners (ELs) (Crawford & Reyes, 2015). Questions such as the following are frequently debated among professional educators in the fields of English as a Second Language (ESL) and English Language Arts (ELA) instruction: What types of texts should be provided to ELs: novels within the canon, beginner level basal readers, picture books, young adult novels, or literature in their first languages (L1s)? Should texts be simple and predictable or should students engage in a variety of poetry, fiction, and non-fiction? Should students read to learn English, prepare for required tests, or explore their identities? Do they prefer to read independently or with teacher support? Do students prefer to write about topics that are personal or academic in nature? How much scaffolding and structure do students want or need when writing? Do students prefer to write for an authentic audience or only the teacher?

Though these debates are common among educators in professional settings, the voices of other educational stakeholders such as the community, families, and students are habitually lost.

Researchers and policy makers regularly speak for multilingual adolescents rather than allow adolescents a voice in the conversation. We believe that by excluding the voices of these young adults from the conversation of how to best teach them, we are missing out on our richest resource. This study was based on the understanding that adolescent ELs' voices are often missing from the conversation around effective literacy and language instruction. Therefore, we sought to include the voices of adolescent ELs by surveying students before and after an instructional intervention regarding their attitudes toward reading and writing. The intervention's purpose was to engage adolescent ELs in culturally relevant literacy activities in the classroom as guided by literature, as well as the pre-surveys (see appendix). In this particular article, we analyze the qualitative responses of student surveys collected post-intervention. The research questions guiding the study are:

After the inclusion of student input in pre-surveys and an intervention of culturally relevant reading and writing:

- a. What do students prefer to read and write?
- b. What are students' motivations for reading and writing?
- c. How do students prefer to engage in reading and writing within their ESL or ELA classrooms?

## DIVERSITY IN SECONDARY ELA CLASSROOMS

It is important to consider literacy and language instruction for ELs due to the "new mainstream" of the secondary English language arts (ELA) classroom which abounds in cultural and linguistic diversity (Enright, 2011). The diversity in middle and high school ELA classrooms is astounding—diversity in students' personal biographies, family backgrounds, socio-economic status, previous schooling, ethnic and national loyalties, and literacy skills in their first, second, and additional languages are all visible in the modern classroom. We are remiss if we ignore these differences within the EL population.

At one end of the spectrum, newcomers have arrived in the country fairly recently and are often new to the English language acquisition process. These students may be dealing with recent trauma and frequently arrive with varying educational backgrounds. Some newcomers may have a strong educational background in their first language, while others may have experienced a limited or interrupted formal education. In the same classroom, a teacher may also be serving long-term ELs who may have stunted progress in language and literacy development due to subtractive bilingualism (Menken & Kleyn, 2009) or an educational experience that devalued their culture through subtractive schooling (Valenzuela, 1999). Some of these youth have checked out from their educational experience by the time they reach the secondary level due to years of feeling that their language, cultural traditions, and histories are not valued in the academic classroom (Stewart, 2014). In addition to newcomers and long-term ELs, other students might have been learning English for a few years. They could be progressing at a consistent pace or may be struggling with various aspects of literacy in their second language (L2). Secondary educators are tasked with meeting the needs of these unique students.

High stakes testing impacts the instruction for ELs as educators feel pressured to focus on basic skills or items that will be tested (Giouroukakis & Honigsfeld, 2010). As researchers have noted, standards-based educational reform in a test-and-punish model hurts all students (Au, 2011), particularly ELs (Luke, 2012; Menken, 2008). Thus, it is crucial for ELA educators to provide the necessary support to meet the needs of diverse student populations in an increasingly standardized academic world.

Because of the many strengths and unique abilities adolescent ELs possess (Stewart, 2017b), there is reason to direct attention to the limitless potential these students could have in our societies. Yet, in order for these multilingual and multicultural students to fully reap the benefits of their skills, we must ensure that their language and literacy instruction completely leverages their strengths to maximize learning in and out of the classroom.

### RETHINKING SECONDARY READING AND WRITING INSTRUCTION

This study is grounded in the belief that the best learning occurs when educators leverage students' cultures, languages, and lived experiences by valuing the knowledge that students bring into the classroom and empowering them to voice their unique perspectives. One of the most critical components of adolescent literacy and culturally responsive pedagogy is that students consistently report the importance of being heard and seen in the classroom (Francois, 2013; Smith & Wilhelm, 2006). It is particularly important that educators empower students from marginalized groups to take charge of their own educations and to voice their learning needs (Chang, 2013).

Listening to ELs' ideas, interests, and strengths, may lead educators to rethink some aspects of their curricular and instructional practices. Curriculum standardization is increasingly rampant (Enright et al., 2012; Gilbert, 2014) and often leaves little room for professional decision-making (Athanasese & de Oliveira, 2014). Behizadeh (2014a, 2014b) strongly critiqued narrow writing assessments currently employed in the U.S., which perpetuate a monolithic form of daily classroom instruction. She advocates for using students' lived experiences when administering writing assessments, because "writing instruction that fails to connect to students' funds of knowledge is not only conceptually unsound but pedagogically impotent" (p. 133).

Furthermore, Rubin (2014) explained that we should question the canon that grounds traditional ELA curriculum and instruction, ensuring that the sanctioned literature is diverse and represents all students' cultural and linguistic backgrounds. Yet, young adult and multicultural literature is often marginalized within the secondary language arts classroom, where traditional canonical texts, most often written by White British and American authors, still dominate (Coats, 2011; Lewis & Dockter, 2011). The widespread reliance on this narrow selection of texts continues, even as the population continues to diversify, resulting in a curriculum that feels outdated, as it no longer mirrors the modern student population. Rethinking ELA curriculum and instruction requires that educators engage in purposefully working toward expanding the literature canon to include literature that privileges wide-ranging perspectives of family histories, lived experiences, and transcultural identities (Campano & Ghiso, 2011).

Some research has demonstrated great promise for ELs when educators purposefully select instructional activities and curriculum that connects to their lives. Athanases & de Oliveira (2014) noted ELs' increased levels of engagement and academic gains when presented with reading and writing tasks that leveraged their cultural knowledge. Studies also illustrate that adolescent ELs' reading engagement increases with the number of connections they make to a text (Araujo, 2013; Giouroukakis & Honigsfeld, 2010).

In order to give students' own lived experiences a place in the classroom, mentor texts can be used as a bridge to culturally relevant writing for adolescent ELs (Newman, 2012). Through using a culturally responsive reading and writing workshop model in one after-school writing program, literature became a resource that served as mentor texts for Latina adolescent writers (García & Gaddes, 2012). The goal of this project was to help students see their lives in writing and realize that experiences similar to their own were evident in classroom texts. Jacobs (2008) explained that long-term ELs benefited from writing short stories and poetry about their own lives because the project honored students' everyday experiences and brought a new level of authenticity to the writing curriculum.

Culturally mediated writing instruction is a framework which can help secondary ELs, among other populations of students, engage in personal and academic writing (Patterson, Wickstrom, Roberts, Araujo, & Hoki, 2010). Studies using this framework (e.g. Wickstrom, Patterson, & Isgit, 2012) advocate for secondary ELs having authentic writing experiences that build on their cultural and linguistic knowledge. Some of these writing experiences might also leverage students' full linguistic repertoires through translating or writing in the L1, as well as in English (e.g. Park, 2015).

The body of work discussed in this section demonstrates the promise of drawing from adolescent ELs' cultures and lived experiences through reading and writing. Subsequently, the present study used research presented in this section to explore students' perceptions of self-selected, culturally relevant reading and writing activities about students' own lived experiences.

## METHODOLOGY

This article draws from a larger study that took place over a period of two years in English Language Arts classrooms at five different high schools in Texas. A total of 80 students participated in the study who were classified as Beginning, Intermediate, or Advanced English learners, according to the State's classification system. Most were born in other countries, but approximately 5% were U.S. born long-term ELs. Each classroom had a variety of ethnicities and languages represented as illustrated in Table 1.



**Table 1.**  
*Schools and Students in the Study*

<b>School</b>	<b>District</b>	<b>Mandy's Role (Author 1)</b>	<b>Number of Students in the ESL classes Place of Origin**</b>	<b>Time of Year</b>	<b>Type of School</b>	<b>Number of New Texts Introduced in the Class</b>
1	A	Co-taught with teacher	1 Asia 23 Latin America	April-June 2013	Suburban	80
2	B	Teacher *	8 Asia 9 Africa 10 Latin America	July-August 2013	Urban	139***
3	C	Co-taught with teacher	2 Middle East 2 Asia 9 Latin America	February-May 2016	Rural/Suburban	65
4	C	Conducted PD with teacher-not in classroom	2 Asia 2 Africa 18 Latin America	February-May 2016	Rural/Suburban	50
5	C	Conducted PD with teacher-not in classroom	1 Middle East 2 Africa 9 Latin America	February-May 2016	Rural/Suburban	55

*\*Mandy acted as the sole teacher in this classroom.*

*\*\*In a few cases, students were born in the U.S. but had parents born in the region mentioned.*

*\*\*\*The other classrooms already had some texts available that were at various levels and about diverse topics. The 139 texts in Classroom 2 are the only texts available to the students.*

After each student took the pre-survey (see appendix) which was used to guide the intervention, we provided multiple titles of culturally relevant literature for shared and independent reading (see examples in Table 2), aimed at connecting to the cultures, lived experiences, or interests of each student in the classroom. The literature was selected to be accessible for ELs at beginning through

advanced stages of English proficiency and included a variety of texts including picture books, graphic novels, short stories, poetry, and novels. Books were also included in all of the students' L1s: Spanish, Vietnamese, Chinese, Arabic, Japanese, Swahili, French, Luganda, and Burmese. We paid special attention in selecting texts that were appealing to adolescent readers, as all of the students fell within this developmental range. This included the picture books, which were selected based upon topics that were appropriate for more mature readers, such as discrimination, the immigrant experience, or the ramifications of war. During the intervention, Mandy and the cooperating teachers leveraged the non-linguistic text available in picture books such as artwork, photography, and the universality of the topics (e.g. discrimination) to promote high level interactions with texts for students who were in the early stages of English acquisition.

**Table 2.**  
*Examples of Texts Added to the Classroom during the Intervention*

<b>Picture Books</b>	<b>Poetry</b>	<b>Novels</b>	<b>Bilingual Books**</b>	<b>Books of Short Stories</b>
<i>Baseball Saved Us*</i> (Mochizuki & Lee, 1993)	<i>Red Hot Salsa: Bilingual Poems on Being Young and Latino in the United States.</i> (Carlson, 2005)	<i>Dying to Cross: The Worst Immigrant Tragedy in American History*</i> (Ramos & Cordero, 2005)	<i>I See the Sun in China*</i> (King, 2014)	<i>Santa Claus in Baghdad and Other Stories of Teens in the Arab World</i> (Marston, 2008)
<i>Peppe the Lamplighter</i> (Bartone & Lewin, 1993)	<i>Sonia Sotomayor: Supreme Court Justice*</i> (Bernier-Grand & Gonzalez, 2010)	<i>Fresh off the Boat</i> (De la Cruz, 2005)	<i>I See the Sun in Mexico*</i> (King, 2012)	<i>First Crossings: Stories about Teen Immigrants</i> (Gallo, 2004)
<i>Dia's Storycloth</i> (Cha, Cha, Cha, & Minnesota Humanities Commission, 2002)	<i>African Acrostics: A Word in Edgeways</i> (Harley, 2012)	<i>The Fault in our Stars*</i> (Green, 2012)	<i>Sonia Sotomayor: A Judge Grow in the Brox</i> (Winter, Rodriguez, & Palacios, 2009)	<i>Papers: Stories of Undocumented Youth</i> (Manuel, Pineda, Galisky, & Shine, 2012)
<i>Roberto Clemente: Pride of the Pittsburgh Pirates</i> (Winter & Colón, 2005)	<i>To Swim in Our Own Pond: A Book of Vietnamese Proverbs*</i> (Tran & Dang, 1998)	<i>Habibi</i> (Nye, 1997)	<i>M is for Myanmar*</i> (Rush, 2011)	<i>Fitting in</i> (Bernardo, 1996)

\*Book was available to students in English and another language such as Spanish, Vietnamese, Chinese, Swahili, or Burmese.

\*\* For this study, bilingual books refer to books with text in both English and another language presented parallel to one another. We also include books available in two languages such as a separate English and Spanish version.

All authors are current or former secondary ESL/Reading teachers who have devoted their careers to supporting students from minority language populations. Author 1, Mandy, played active, yet diverse roles in each of the schools in the study. In two schools, she co-taught and planned instruction with the existing ESL/ELA teacher. In these classes, she joined the class one to two times per week for the duration of the study to support literature circles, writer's workshop, or to lead shared reading. In two other classrooms, Mandy conducted professional development sessions with teachers focused on using culturally relevant reading and writing in the classroom, then continued her support of these teachers through on-going correspondence after the professional development sessions had ended. In School B, Mandy was the teacher of a small group of students in a summer literacy program, acting as both the teacher and researcher. Throughout the study, co-authors Katie and Carol provided input on literature while assisting in iterative data analysis to inform subsequent curricular and instructional decisions.

The goal of this study was to measure students' attitudes and engagement with literacy activities before and after introducing culturally relevant reading and writing, mainly through the inclusion of different genres of culturally relevant literature in each classroom. The students had increased access to culturally relevant texts during the study, as well as increased opportunities to engage in literacy activities designed by the authors and the cooperating teachers to utilize these texts (Table 2) to develop reading, writing, and oral language skills.

## DATA COLLECTION

The data set utilized for this study was the post-intervention survey data set. We analyzed this data set according to the research questions. Each of the students completed a survey with open-ended questions after the intervention (see the appendix for the portion of the survey analyzed for this study). The questions measured what students liked to read and write about, their purposes for reading and writing, and how they preferred to engage in literacy activities within the classroom. This data allowed the researchers to look for patterns in students' preferences for what, why, and how to read and write when presented with culturally relevant texts.

The pre-intervention survey data set was used to guide the intervention by driving text selection and writing activities, but was not analyzed to answer the research questions. Efforts were made during each intervention to provide students with literature, language, and literacy opportunities that differed from their traditional curriculum, therefore allowing them the opportunity to provide feedback on the two different approaches to ESL/ELA instruction pre- and post-intervention. Guided by the studies cited in the literature review, we wanted the students to experience culturally relevant reading and writing in an ELA classroom that centered on their interests, backgrounds, cultures, and languages.

## DATA ANALYSIS

The qualitative data were analyzed using the constant-comparative method (Glaser & Strauss, 1968) to identify themes for the post-surveys. The pre-surveys were used to guide the intervention, but the analysis draws from the post-surveys after students had the opportunity to experience multiple forms of culturally relevant reading and writing.

Examples from the open coding of the data regarding what students stated they wanted to read post-intervention are: Real People, True Events, and Love Stories. Codes were then collapsed into larger categories. For example, during the process of axial coding, the themes of Real People, True Events, and Love Stories were collapsed into the larger category, What Students Want to Read. The data yielded from the before- and after-surveys provided the researchers with a deeper understanding of student interactions and reactions to two different types of ELA curriculum, as well as their overall preferences for what, why, and how to read and write.

Although we analyzed the data for each question in the post-surveys, we present an overall view of the students' responses in the section below. This serves to provide a general view of their attitudes toward reading and writing. Because we did not note a distinction of students' attitudes based on the school, analysis from all of the participants are presented together.

## RESULTS

In this section, we present findings from the post-surveys to generally describe: 1) *What* students want to read and write; 2) *why* they read and write; and 3) *how* they want to accomplish reading and writing.

### WHAT STUDENTS WANT TO READ AND WRITE

The goal of this research study was to better understand what students wanted to read and write in a general and specific sense. Far too often, the decisions of what to read and write are made for adolescent ELs by their teachers. The researchers encouraged students to be honest and share their preferences through the surveys.

*WHAT STUDENTS WANT TO READ.* Students wanted to read to discover more about themselves and others. One student wrote: *"I want [to read] maybe stories about love, about my life, the problems, reflections and things like that."* Students were particularly interested in reading about themselves and exploring the way in which their experiences fit into the broader human experience. Students stated that they wanted to read about *"my culture and the history of the Mexican culture."* On the surveys, students mentioned enjoying books about people like them, young people with whom they could identify in some way. They stated: *"I did like it [the book] because it talks about immigrants"* and *"I like this book, because it is about the Mexico and the immigrants and it is interesting."* When discussing why they liked reading a specific book, Than<sup>1</sup> wrote: *"The person of the book get to united states without english<sup>2</sup>."* As a student who immigrated to the U.S. as an adolescent, this was an experience that resonated with Than.

Although students reported wanting to read about adolescents like themselves, they also reported a desire to read about others. Isela stated: *"In the future I want to read about other cultures."* Many students explained that they wanted to read about *"life"*, referring to the importance of authentic

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<sup>1</sup> All names are pseudonyms.

<sup>2</sup> Student writing appears exactly how the students, who were all acquiring English, wrote it on the surveys.

reading, such as *“teenage suicide, drama, problems”* as one student explained. Students also stated that they were interested in the biographies of famous people and informational texts.

Students had varying opinions on whether they preferred the format of novels or picture books. Some responded that they preferred to *“read the big book”* referring to novels while others felt that the picture books supported their comprehension. Similarly, two students preferred reading manga, because, as Yoko explained, *“I can understand the pictures.”*

*WHAT STUDENTS WANT TO WRITE.* The students primarily wanted to write about themselves and their cultural knowledge. Juan wrote: *“I would like to write about my country how it is and how they are.”* Aye Cho wanted to write about everyday occurrences: *“I would love to write about my weekend.”* Nala stated that she enjoyed writing during the intervention, because *“I got to describe my culture.”* She was the only student from the Congo in her entire class, and writing enabled her to develop relationships with the other students in her class as she shared her cultural knowledge. Many other students stated that they were proud of their essays and poems about their own lives, memories, dreams for the future, and family.

## WHY STUDENTS READ AND WRITE

During the intervention, students were encouraged to self-select the form that reading would take for the day, often voting for shared or independent reading time. The students were also highly encouraged to take books home to read outside of classroom assignments and exercised choice in writing by choosing what they wanted to include in their journals. Writing prompts were provided as supports for students who struggled to find an idea for a writing assignment, but students were regularly encouraged to write about any topic that interested them. This choice extended into published writing in class anthologies, in which students selected what they wanted to include, while the general format itself was assigned (example: poem or essay).

*PURPOSES FOR READING.* Enjoyment was one of the most frequently identified purposes for reading. Students wanted to be entertained by a story, or as Miguel wrote: *“get into a book ... [to be] part of it.”* Marisela explained that she reads *“because I feel relax and happy.”* Other students stated that they chose to read on their own because the book kept them in suspense, they forgot about other things while reading, and because the book was funny. Myine reported that she liked to read a particular book *“because was so funny like HAHHAHA.”* Antonio explained that he liked to *“imagine about the book and forget about other things,”* while Ana stated, *“I couldn’t stop read it that book it was good all the things it had was interesting.”*

A secondary purpose for reading reported by the students was to learn something new. Like other adolescents, many of the ELs in this study learned about romantic relationships through reading. They were able to learn, specifically, about American dating norms through literature, which is why Lay mentioned she most enjoyed reading love stories. Emilio responded that his reason for reading about sports was because *“I want to learn more,”* and Alan said that he chose to read about soccer because *“the world cup is so important.”* Other students stated that they read to acquire important and helpful information regarding things like careers: *“I wanna read... something the hospital or for instruction for a nurse.”*

These young adults were in the dynamic process of acquiring English, a language they know they need to master in order to successfully graduate from high school and navigate many worlds outside of school, such as their jobs. Consequently, many mentioned they read to improve their second language skills. María said she reads *“because it helps me to learn more English,”* and Tomás wrote that he reads *“to get more skills and learning English.”*

Students also wanted to read to relate to others—to see their own lived experiences reflected back to them. Perhaps this is validation of who they are or a way for them to make sense of their own worlds. The students stated that they sometimes chose books because they *“related to my own life”* and *“they talk about immigrants and I am a immigrant.”* Myine said she read about the U.S. Supreme Court Justice Sonia Sotomayor, because her situation was similar to Sotomayor’s as someone learning English. Khine stated that he wanted to read more books with immigrant youth protagonists because *“I’m almost like them because we came from other countries and sometimes we feel different.”*

**PURPOSES FOR WRITING.** The students wanted to write to share their learning or to demonstrate their knowledge to others. Students wrote to learn and make sense of their own learning. Some students stated that they wrote to improve their English and understand what they were learning in class. Sometimes the learning was personal, as students wrote to understand their own feelings about issues such as discrimination. Camille said she wrote to *“express feelings”* and Alex stated that he wrote *“poems about my feelings or about some situation that I’m [going] through.”* Most of the students wrote about their countries and/or migration journeys during the intervention. Karina wrote about her past so she could *“know what I want for the future.”*

Most importantly, students reported that they wrote to be known. Win explained that he enjoyed writing during the intervention, because *“my classmates start to know me, what I like, and what I don’t like.”* In classrooms with students from very different backgrounds, the students wanted to share what made them unique. Ana wrote: *“I like to write about my daily experiences. To express my daily life to other peoples.”*

During the intervention, students wrote poetry and essays about their childhoods which took place in many different countries. On the post-survey, most students stated that they enjoyed writing to tell others about themselves. Nadia said her purpose for writing was to explain to others how hard it is to learn another language. Ale stated that she liked to teach other people about her culture, specifically Mexican music, through her writing. The following quote sums up students’ reason for writing: *“I want my friends to know about me.”*

## HOW STUDENTS WANT TO READ AND WRITE

There are many different ways reading and writing activities can be structured in and out of the classroom. Even within best practices, there are options such as a teacher-led read aloud, shared reading, guided reading, or independent reading. In writing, options include writing for oneself in a journal, writing on the Internet, writing for the teacher to provide feedback, or writing for publication in various outlets. Students were exposed to all of these forms of reading and writing



before or during the intervention and they expressed their preferences and which forms they perceived to be most beneficial in helping them to learn English.

**READING PREFERENCES.** Students preferred independent or shared reading. For many ELs, teacher-led shared reading, when the teacher models fluent reading and stops frequently to clarify concepts while students follow along in their own texts, helped make the content comprehensible for students at lower levels of English proficiency. However, students also stated that they wanted to be able to choose their own books and read independently. Myine, a student who was at the Advanced stage of English proficiency, stated: *"I like the books that I read by myself."* Even though she read on her own, she enjoyed discussing her reading with others. In general, students closer to the beginning stages of English language acquisition preferred for the teacher to read aloud, but strongly suggested that they also have a copy of the text, so they can follow along, providing them with simultaneous oral and visual cues. Students with higher levels of English acquisition preferred independent reading time in class. None of the students preferred a traditional read aloud, when the teacher read, but they could not see the text.

**WRITING PREFERENCES.** How students prefer to write is perhaps the area with the least amount of consensus. Some students enjoyed sharing their writing with others through publishing in class anthologies and sharing for peer editing, but other students preferred to keep their writing private. Marco stated that he wanted to share his writing with others because *"I want to other persons read it and they will tell me what I'm wrong,"* indicating that he valued shared writing experiences as a way to improve his writing and second language acquisition. Marco specified that he preferred to work with someone who spoke his language and could help him express exactly what he wanted to communicate in English. Other students expressed similar sentiments, wanting to share their writing with classmates in order to improve it. They also valued shared writing as a way to hear other students' writing and generate ideas. Many of these students were also eager to share their final writing products with family members to demonstrate what they had learned in school.

However, this position was not agreed upon by all students. Some students did not like to share their writing, particularly when it was personal in nature. Victor wrote that he did not want others to read his writing *"because what I write is personal."* Ana stated *"I don't like telling people my thoughts."* This indicated that shared writing may not be appropriate for all contexts and that students should be allowed the opportunity to determine for themselves if their writing is appropriate text for others to read. Students also expressed appreciation when teachers let them know in advance if their writing was intended to be read by others.

## IMPLICATIONS FOR THE CLASSROOM

The findings implore us to take an asset-based perspective (González, Moll, & Amanti, 2005) of multilingual youth, in which educators value the knowledge, skills, language, culture, and background students bring to the classroom as a foundation upon which to grow language and literacy skills. Most of the youth in this sample stated that they wanted to read and write. Indeed, Nathan, a student from the Democratic Republic of the Congo, said he wished that students had

more opportunities for reading and writing in class. Additionally, these youth are committed to acquiring language and literacy skills. Many of these students engage in literacy activities outside of school, such as reading to younger siblings, for the explicit purpose of improving their own language skills. Other students actively seek literature in their L1.

Our job as literacy researchers and educators is to set conditions in which students can develop first and second language literacy skills through authentic engagement with reading and writing. Through the iterative data analysis and modifications made during the interventions, we conclude that there are four main areas that contribute to adolescent English learners' engagement in reading and writing. The conditions for engagement may be set through providing students with 1) high expectations, 2) culturally relevant, self-selected literature, 3) authentic response opportunities, and 4) the opportunity to share their voices.

### HIGH EXPECTATIONS

In general, our findings show that high school ELs do indeed want to read and write, yet the expectations for them must remain high. Some students indicated that they never wrote in class prior to the intervention and were shocked that their teacher expected them to write in a notebook. Most of the students indicated they did not have reading and writing homework requirements for their language arts classrooms. In general, prior to the interventions, students did not take home books from the classroom, signifying that they were not expected to read outside of class. However, survey responses indicate that students are interested in reading and writing enough to do so outside of class, particularly if that is an expectation. We encourage teachers to expect students acquiring English to be engaged in reading and writing in and out of school every day, making these practices a life-long habit.

### CULTURALLY RELEVANT, SELF-SELECTED LITERATURE

Students are clear about what they want to read, although the things they want to read are not the same across the board, demonstrating that adolescent ELs are not a homogenous population. It is important that students have the agency to choose books based on their interests and language levels. Many students indicated that they wanted to read about other youth from their countries or those who shared the immigrant experience, but they also wanted to read about fantasy, sports, and American culture. Educators should provide literature that connects to the many different worlds these young adults inhabit, purposefully providing texts in various languages and genres.

Rosenblatt (1978) wanted all students to have the experience of "living through" a book, not just to read the text, but to have a transaction with it that changes the reader in some way. This desire was highlighted by Isela, who said that a book she read during the intervention "*touched my heart.*"

Students need access to a wide variety of literature, but providing access to these texts goes beyond developing a classroom library. Access alone will unlikely impact student reading, unless it is accompanied by high expectations. In some of the classrooms, the shelves were replete with a large variety of literature that represented various levels, genres, and cultures before the intervention. However, students did not begin reading them until access was accompanied by high expectations—the notion that they will read in and out of class regularly. Books cannot just sit on shelves but need to frequently find their way into students' lockers, backpacks, and hands.

Additionally, teachers should be prepared to make recommendations to students and suggest books they will be able to comprehend while attending to their interests. This requires that teachers themselves model active reading habits—taking part in independent reading and sharing with students what they are reading at home. It is also useful if teachers stay current in their reading of young adult literature and other accessible texts for all levels of ELs, facilitating purposeful and impactful text recommendations.

### AUTHENTIC RESPONSE OPPORTUNITIES

Students want authentic ways to respond to reading via writing, yet they prefer scaffolded writing opportunities. During the intervention, students engaged most in writing when they were provided with mentor texts (Calkins, 1986) that showed that their own lived experiences were worthy of appearing in stories. Students needed to know that they could, indeed, write about their everyday life, such as the students in Newman's (2012) study. Scaffolding was further provided as students took advantage of linguistic support in the form of sentence frames to create "Where I'm From" poems (Christensen, 1994; Lyon, 1999) and graphic organizers to write their migration journeys (Stewart, 2015).

Students also need a genuine reason to write and to know they are writing for someone other than their teacher. They should be able to take ownership of their writing by writing for reasons that move beyond getting a grade or receiving credit for an assignment. Sharing their writing with the class, the principal, other teachers, or their families gives them purpose. Students might be eager to teach others, including teachers, about their knowledge—their countries, traditions, abilities, and interests. Authentic writing to teach, inspire, persuade, or entertain others can be shared with a specific audience. Responding authentically might also entail creating products in response to reading through technology (Danzak, 2011) or the arts (Verner & Faltis, 2013).

### OPPORTUNITIES TO SHARE THEIR VOICES

Finally, despite language and cultural barriers, adolescent English learners have much to tell us that could and should affect our literacy research and instruction. When we listen to student voices to guide literacy curriculum and instructional practices, we are not only more effective in engaging students, but we send the message that their voices matter. Essentially, we are telling them that they matter. We need to let them tell us what interests them and how they would like to read and write in the class, instead of deciding ourselves. It is also important to not stick with just one strategy or method, but continually evaluate what might prompt further engagement, positive attitudes, and literacy achievement while responding to student feedback.

### CONCLUSION

Acquiring academic language and literacy takes time (Cummins, 1979; Faltis & Arias, 2013). Therefore, adolescent ELs need multiple encounters with self-selected literature (Krashen, 2004) that provides them special insight into the stories (Brooks & Browne, 2012). They need books they can comprehend and enjoy in and out of class in order to acquire necessary academic language in the short amount of time they have to meet academic requirements for graduation. We believe that students will read when they are expected to be readers and when they are provided with

interesting and accessible literature that they select. Secondly, students need to write regularly, for fluency and not just accuracy, which might occur through daily, ungraded writing in a journal or notebook. They need authentic opportunities to write what is meaningful to them in a variety of settings such as shared writing and for publication.

As advocates of adolescent ELs, we are encouraged by many of the results of this survey. Students want to read. They want to write. They have purposeful reasons for engaging in literacy. The imperative for us is to rise to the challenge and listen to our students, rather than listening to the voices that speak for them, and provide them with second language and literacy instruction that will most impact their engagement and abilities. We should privilege their voices as we consider how to provide them with effective second language and literacy instruction.

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## Appendix

### Excerpts from Pre- and Post-Surveys Relevant to This Study

(There were multiple lines under each of the open-ended questions for students to write in their responses.)

#### Pre-Survey (Used to guide intervention)

1. Have you read a book in school you enjoyed? If so, why? What is the name of the book?
2. Have you ever read a book about someone you could relate to? If so, what book?
3. Do you ever share your writing from school with anyone?
4. What would you like to read about in this program?
5. What would you like to write about in this program?

#### Post-Survey (Data analyzed for this study)

1. What did you read in the program?
2. Did you like it? Why or why not?
3. Could you relate to any of the characters in the books you read? If so, which ones?
4. What is something you wrote about?
5. Did you enjoy writing it? Why or why not?
6. What do you want to read and write about in the future?

# FOSTERING A GREATER UNDERSTANDING OF SCIENCE IN THE CLASSROOM THROUGH CHILDREN'S LITERATURE

MASOMEH MAHZOON-HAGHEGHI, ROXIE YEBRA, ROBIN D. JOHNSON,  
AND LUCINDA N. SOHN

## ABSTRACT

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*The purpose of this article is to provide preservice and new STEM teachers with an understanding of the benefits of using science trade books to foster comprehension of the science content in the classroom and explain how to supplement science instruction with children's literature. By using children's literature in the science classroom, students have an opportunity to make connections between science content and reading and writing. In this article, tools for selecting children's literature to use in the science classroom are discussed and ways to incorporate literacy skills and strategies alongside science standards are provided.*

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In 1985, James Rutherford established Project 2061, which called for all Americans to be literate in science, mathematics, and technology. It also challenged them to meet this goal by the next appearance of Hailey's comet. For much of its history, STEM, an acronym used to describe science, technology, engineering, and mathematics, has been divided into two categories: STEM education and STEM workforce (Gerlach, 2012). It was first introduced as "the next big thing" because there was a growing concern that the United States was not preparing enough students, teachers, and practitioners in the STEM fields. By 1996, STEM standards were reevaluated and changes were made to ensure students were ready for careers in STEM. The National Science Education Standards emphasized a higher value a more student-centered approach to science instruction, calling for inquiry-based learning as a core philosophy. It was in the 1990s when the National Science Foundation (NSF) finally framed science, technology, engineering, and mathematics as STEM.

STEM education is defined by the National Science Teachers Association (NSTA) as an interdisciplinary approach to learning, where rigorous academic concepts are coupled with real-world lessons as students make connections between school, community, and work. According to NSTA (2014), the initiative for the Next Generation Science Standards (NGSS) was to ensure a sound foundation of science knowledge embedded in the K-12 science curriculum. Each standard

has three dimensions: disciplinary core ideas (DCI) (content), scientific and engineering practices (SEPs), and cross-cutting concepts (CCs). Currently, most state and district standards express these dimensions as separate entities, leading to their separation in both instruction and assessment. The integration of rigorous content and application, however, reflects how science and engineering is practiced in the real world (NSTA, 2014).

One tool educators can use to supplement learning various STEM concepts both in and out of the classroom is children's literature. As an educator, it is important to remember that each classroom is made up of a unique set of students. These students have varying degrees of background knowledge, reading levels, and even learning styles. It is because of these many differences among students that teachers utilize a plethora of tools to meet the needs of all of their students.

For the purpose of this paper, children's literature will be used interchangeably with informational text and trade books. As defined by Duke (2000), informational texts are used to "communicate information about the natural or social world, typically from one presumed to be more knowledgeable on the subject to one presumed to be less so," and having the features and structures of such texts, e.g., "factual content," "timeless verb constructions," "technical vocabulary," "classificatory and definitional material," "topical theme," and "graphical elements" (p. 205).

Informational trade books appeal to children because of their interesting formats, text arrangement, descriptive language, and intriguing illustrations and captions (Galda, Cullinan, & Sipe 2010; Kiefer, 2010; Moss, 2005). Through the use of trade books, students can gain background knowledge and critical thinking skills that will help them as they continue their education and strengthen their ability to comprehend. The purpose of this article is to provide preservice and new STEM teachers with an understanding of the benefits of using science trade books to foster comprehension of science content in the classroom and explain how to supplement science instruction with children's literature. To ensure successful incorporation of national science standards through the use of children's literature, the authors analyzed a wide range of literature with a focus on science instruction.

## BENEFITS OF USING SCIENCE THEMED CHILDREN'S LITERATURE

According to Barclay, Benelli, and Schoon (2012) and Wells and Zeece (2007), children's literature has the potential to generate interest and motivation, provide context, invite communication, and connect science information in ways that students can relate facts to their world. Incorporating children's literature, more specifically science trade books, provides a situated perspective that results in cognitive functions, such as reasoning, remembering, and thinking critically (Carr et al., 2001; Monhardt & Monhardt, 2006; Sackes, Trundle, & Flevares (2009). By incorporating this type of literature, teachers can introduce different contexts, concepts, and cultures that can initiate discussion about a science topic. Using trade books with students not only help them make connections to their world, but also helps build reading comprehension. According to Broemmel and Rearden (2006), studies have shown that integrating science and literacy not only results in higher performance scores; it also boosts enthusiasm for science.

## CHOOSING SCIENCE THEMED CHILDREN'S LITERATURE TO SUPPLEMENT SCIENCE CURRICULUM

Selecting appropriate books to supplement teaching a new concept can sometimes be a challenging task for teachers. According to Hug (2010), many teachers feel their knowledge in science is not sufficient to determine if the content represented in a book is accurate or inaccurate. Donovan and Smolkin (2002) state that there are three major categories to consider when selecting children's literature for science, which include genre, structure, and content. Paying close attention to these three categories, most importantly content, is key to selecting appropriate books to supplement science instruction.

When selecting fiction books, it is important to ensure the content is accurate, without bias, and with realistic illustrations to avoid any misconceptions (Mayer, 1995). However, Ansberry and Morgan (2010) mention that scientifically inaccurate children's books can be helpful when students analyze them after they have gained a complete understanding of a scientific concept. Opportunities to correct the misconceptions transport students to a higher level of thinking (Ansberry & Morgan, 2010). The selection of books is an imperative process when weaving them into the science curriculum.

Illustrations are also an important consideration when selecting books. The illustrations in texts provide learners with a more comprehensive way of reading by providing more information related to unfamiliar words or concepts (Carr Buchanan, Wentz, Weiss, & Brant, 2001). This visual representation of concepts can reduce frustration during the learning process and build a foundation of knowledge for further learning of concepts (Carr, et al., 2001). By using engaging illustrations, depictions of other children, and characters that draw a reader in, children's book authors create a powerful means of building understanding and offer a "situated perspective for knowledge, thinking, and learning" (p. 147). Trade books, according to Donovan and Smolkin (2002), provide readers with genre, content, and visual features that enhance science instruction and encourages young readers' interest in science-related topics. Through the fusion of text and art, the reader can integrate their own experiences and interpretations into each element and create a unique experience (Wolfenbarger & Sipe, 2007).

According to Feathers and Arya (2012), children use illustrations to help process difficult concepts or words within text. As an educator, it is important to supply students with the tools they need to understand the visual features of text in order to extract meaning from the text. Nodelman (1981) describes "visual grammar" as the way our understanding of pictures is dependent on our knowledge of the convention by which they operate (p. 57). In other words, when sharing with students a variety of text formats, they come to understand that knowledge can be represented in numerous ways. This is an important skill for students to develop, especially in science, because of the way scientists combine, interconnect, and integrate text with a variety of visual representations (e.g., diagrams, photos, graphs) (Smolkin & Donovan, 2005). By incorporating this idea of visual grammar when reading, students grasp the importance of illustrations and how to use them as a form of information within the text. Since illustrations play a significant role in both science

concept formation and the building literacy skills, they are a key factor for teachers when choosing appropriate books.

Some ways to alleviate the frustration of choosing books that are appropriate for science instruction are using checklists, selection criteria, rubrics, evaluation scales, and bibliographies. Many samples of these are widely available to evaluate fiction and nonfiction children's books for science education (Atkinson, Matusevich, & Huber, 2009; Carr et al., 2001; Donovan & Smolkin, 2002; Mayer, 1995; Price & Lennon, 2009). Mayer (1995) developed a series of 10 questions for evaluating fiction trade books for science class (Figure 1).

✓	Is the science concept recognizable?
✓	Is the story factual?
✓	Is fact discernible from fiction?
✓	Does the book contain misrepresentations?
✓	Are the illustrations accurate?
✓	Are characters portrayed with gender equity?
✓	Are animals portrayed realistically?
✓	Is the passage of time referenced adequately?
✓	Does the story promote a positive attitude toward science and technology?
✓	Will children read or listen to this book?

*Figure 1: Checklist for choosing children's literature to teach science*

Other resources for selecting science books include Teacher's Choices from the International Literacy Association and Children's Book Council, Outstanding Science Trade Books for Students K-12 from NSTA, and the Notable Children's Book List from the American Library Association (Atkinson et al., 2009; Brommel & Rearden, 2006). Table 1 consists of a selection of books compiled from the NSTA (2014) – Outstanding Science Trade Books for Students K-12.

Table 1.  
*A Selection of Books Related to STEM Topics*

Book	NGSS science and engineering practices	Science content
<i>Boy, Were We wrong About the Solar System</i> by Kathleen V. Kudlinski	Engaging in argument from evidence; obtaining, evaluating, and communicating information	Earth and solar system
<i>Energy Island</i> by Allan Drummond	Engaging in argument from evidence; constructing explanations and designing solutions	Alternative energy sources
<i>Ladybugs</i> by Gail Gibbons	Engaging in argument from evidence; constructing explanations and designing solutions	Food chains and adaptations
<i>Next Time You See a Spiderweb</i> by Emily Morgan	Constructing explanations and designing solutions	Inherited and acquired traits
<i>Papa's Mechanical Fish</i> by Candace Fleming	Planning and carrying out investigations; constructing explanations and designing solutions	Engineering design process
<i>Star Stuff</i> by Stephanie Roth Sisson	Engaging in argument from evidence; obtaining evaluating, and communicating information	Astronomy
<i>The Boy Who Harnessed the Wind</i> by William Kamkwamba	Constructing explanations and designing solutions	Alternative energy sources
<i>The Inventors' Secret</i> by Suzanne Slade	Planning and carrying out investigations; constructing explanations and designing solutions	Engineering design process; Contributions of scientists

## CONNECTING LITERACY SKILLS TO SCIENCE CONTENT

In their book *Picture Perfect Science Lessons: Using Children's Books to Guide Inquiry*, Ansberry and Morgan (2010) explain ways to model and explicitly teach reading comprehension strategies within the science curriculum. The teacher explains the strategy, demonstrates how and when to use the strategy, explains why it is worth using, and thinks aloud to model mental processes. Using these techniques with children's literature in the science classroom reinforces the strategies students learn during reading instruction and helps them apply those skills to a variety of texts and curricular areas (Ansberry & Morgan).

Ansberry and Morgan (2010) suggest several reading comprehension strategies that can be taught while using children's books during an inquiry-based science lesson. Some of the strategies include: making connections, questioning, visualizing, inferring, determining importance, and synthesizing. By using children's literature in the science classroom, students have an opportunity to practice making connections, which can help them comprehend text and relate their background knowledge to what they read. Students should be taught how to ask themselves questions while reading as a tool to build meaning and eliminate confusions as they read. Since asking questions is also an important skill in science instruction, understanding how to transfer these strategies can help them be successful reading across any content. Ansberry and Morgan further mention that when readers ask questions, it is a sign that they comprehend what they are reading.

Teaching students to visualize the text can engage them in the lesson and may provide them with a memorable learning experience. Making inferences is another important science skill that can be reinforced during reading instruction (Ansberry & Morgan, 2010). When using books that feature science concepts, students show gains in reading comprehension, vocabulary development, and enthusiasm for reading (Wallace & Coffey, 2016). Each lesson provided in the *Picture-Perfect Science Lessons* series has appropriate reading comprehension strategies for the book that is suggested. Examples of activities and graphic organizers that may be used to improve science and reading comprehension include anticipation guides, Observe – Wonder – Learn (O-W-L) charts, and Venn diagrams, just to name a few.

The use of trade books in early education is quite common and has shown to be useful in developing language, reading, and writing skills (Bishop & Hickman, 1992). Teachers can also help students build reading comprehension skills by modeling the strategies during read-alouds of both fiction and nonfiction books (Ansberry & Morgan, 2010).

According to Olness (2007), picture books are rapidly gaining popularity among older readers. Reiker (2011), states, "there may be a perception among educators and administrators that picture books do not meet the level of rigor required in a high school setting." Beckman and Diamond (1984) similarly point out that secondary teachers may avoid using picture books for fear their administrators might not consider them appropriate for adolescents. However, along with helping students process difficult concepts, reading science books also helps them develop content specific terminology, which then provides a foundation for future science learning (Kurtz & Bartholomew, 2012). By helping students develop these skills, they become more comfortable discussing their understanding of scientific content (Price & Lennon, 2009).

Implementing children's literature to enhance science curriculum captures students' interest in learning and aids in the development of literacy skills. Wilson and Bradbury (2016) conducted several lessons in which they integrated the use of informational texts in an inquiry-based science unit about plant parts and their functions. Some of informational texts the students used to guide them through their investigations included *The Vegetables that We Eat* by Gail Gibbons and a book series of plant parts by Melanie Waldron. According to Wilson and



Bradbury, the use of informational texts in a science context can be leveraged to review text features, read for information strategies, and address English Language Arts Common Core or state standards.

Using children's literature offers benefits that support oral reading and understanding (Feathers & Arya, 2012). According to Feathers and Arya, teachers need to read authentic literature to students, and children need many opportunities to read independently in order to be exposed to different ways that visual and verbal texts are used to create a story. During an interview with author/illustrator Gail Gibbons, Smolkin and Donovan (2005) gathered that pictures not only maintain children's interest but also help present science concepts accurately. When teachers take the time to learn about the authors and illustrators of informational text, along with the features of nonfiction texts, they will be better prepared to foster children's comprehension of informational texts (Smolkin & Donovan). According to Ansberry and Morgan (2010), students are usually more familiar with reading narrative text, which explains why they skip over some text features (e.g., captions, headings) when reading. Explicit instruction on how to interpret the information in these types of texts is crucial when helping students understand the content.

With the growing popularity of informational texts, trade books are an easy and creative way to incorporate children's literature as a means of teaching concepts in the content areas. The use of science-themed children's literature can improve the understanding of science concepts in the classroom. In primary education, read-alouds using nonfiction text can be an effective way to familiarize children with expository text. According to Daisey (1993), read-alouds bolster literacy at any age, and it provides teachers with "a reading strategy to promote an intergenerational continuity of lifelong reading to others" (p. 437). Routman (1991) explains, "reading aloud should take place daily at all grade levels, including junior high and high school" (p. 32). Trade books are designed to appeal to children. They focus on specific science concepts and are often more up-to-date and have a higher production quality than textbooks (Ford, 2006). When selecting books to supplement a science lesson, it is important to remember that, although non-fiction trade books are the most widely available, fiction books can also enrich science concept instruction (Mayer, 1995). By incorporating narratives, students are able to "make sense of individual and collective experience and construct knowledge through story-telling" (Arizpe, Farrell, & McAdam, 2013, p. 245).

## IMPLICATIONS

From the research gathered, it is evident that by incorporating children's literature, teachers can foster learning and reading comprehension in the K-12 science classroom. As a preservice or new teacher, it may be overwhelming to imagine having to incorporate children's literature purposefully apply national and state standards, all while keeping students interested in learning. Since the state and national standards are the basic guidelines of what students need to know, one way to ease into the process of incorporating children's literature is to find books using checklists (see Figure 1). Checklists can help teachers identify books for each of the major categories of science concepts, which then allows the teacher to make more informed decisions in incorporating these books into STEM instruction.

Many science teachers may not be aware of strategies used to teach reading comprehension strategies or how to teach students to use visual representations; however, they should have opportunities to plan with other teachers and participate in professional development to develop these skills. In a study conducted by Wallace and Coffey (2016), the preservice teachers indicated that they achieved a new understanding of how science and literacy can be integrated when they took time to collaborate with each other.

More research is needed to show the connection between student academic performance and science instruction using children's literature. Possible studies may include both quantitative and qualitative methods to determine academic achievement, to foster efficacy of the teaching and learning of science content, and to promote an interest in STEM careers.

## CONCLUSION

According to the National Research Council (2012), reading and writing skills are essential to science instruction. By using an array of books to link content learning with literacy, teachers can help students learn to "read the world" by providing them with literacy learning tools that will last a lifetime and allow them to thrive in the technological age and encourage them to pursue STEM careers (Moss, 2005). When teachers select appropriate books and model reading strategies during science instruction, students develop reading comprehension skills relevant in the science classroom. Picture books are invaluable for teaching reading comprehension strategies because they engage readers and provoke them to use higher order thinking (Ansberry & Morgan, 2010). Using a checklist such as the one provided in this article may help teachers who find it difficult to choose the appropriate literature to foster learning and promote an interest in science. It is important to remember that students of all ages enjoy exploring science through children's literature. When teachers take the time to teach science through the use of children's literature, students of varying degrees of background knowledge, reading levels, and even learning styles will be more capable of developing a better understanding of science concepts.

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# LITERACY & ARTS INTEGRATION IN SCIENCE: ENGAGING ENGLISH LANGUAGE LEARNERS IN A LESSON ON MIXTURES AND SOLUTIONS

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## ABSTRACT

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*Students who struggle with vocabulary knowledge often see a decline in comprehension of content. Even students who receive strong reading instruction in the early elementary years may still experience the fourth-grade slump (Chall, 1983), which more often affects students from underserved populations. Many of those same students are also affected by the 30-million word gap (Hart & Risley, 2003), or the difference in the number of words heard by young children in homes from varying socioeconomic statuses. When working with culturally and linguistically diverse (CLD) students, it is important to provide opportunities for conversations that allow students to draw on their own cultural wealth (Au, 2000; González, Moll, & Amanti, 2006; Moje, McIntosh Ciechanowski, Kramer, Ellis, Carrillo, & Collazo, 2004; Yosso, 2005). In a recent pilot study, fifth-grade students engaged in Reciprocal Teaching (RT) (Palincsar & Brown, 1984) strategies to determine effective supports for English language learners (ELLs) when reading expository text. Multiple science lessons were developed and embedded with RT strategies. Two additional components were added to a lesson on mixtures and solutions: arts integration and literacy integration. This lesson further supported ELLs' comprehension of content material. Students in both classrooms had mixed levels of English proficiency, but all ELLs spoke Spanish as their first language. The use of RT supported students' active engagement in learning, vocabulary acquisition, and academic growth. Researcher's analysis of student-participants' assessments and engagement, across multiple lessons, demonstrated students had increased understanding of content, particularly students with higher English proficiency. However, a lesson on mixtures and solutions provided a more engaging learning environment and practical application of new content knowledge for students by adding literacy and arts integration; this lesson will be the focus of this article.*

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**A**cross the United States, elementary science teachers provide opportunities for students to engage in a learning environment, conduct investigations, and think critically about content. Students need opportunities to explore the world and make connections between content learned in school and how that knowledge applies to their lives. It is essential that all elementary students are motivated to learn and that instruction in science classrooms is engaging and accessible to all students (Bathgate, Schunn, & Correnti, 2014). However, ensuring that English

language learners (ELLs) are engaged and able to access content is critical (e.g., Artiles & Ortiz, 2002; Klingner & Vaughn, 1996; Lindquist, & Loynachan, 2016). A metacognitive strategy such as Reciprocal Teaching (RT) (Palincsar & Brown, 1984) embedded in a science lesson which is further enriched with arts and literacy components to allow students to elaborate on learning may provide ELLs with greater opportunities for critical thinking and enhanced comprehension of science content. During a series of collaborative teacher/researcher lessons in an elementary school situated on the U.S.-Mexico border, the first author/principal investigator (PI) introduced higher-level, content area material to student-participants using RT strategies. In one lesson on mixtures and solutions undergirded with RT, the PI added arts and literacy extension activities. Student-participants' outcomes were enhanced, as demonstrated by researcher reflections, post assessments, and finished products.

## STATEMENT OF THE PROBLEM AND POTENTIAL SOLUTION

Students who speak English as a second language are often from culturally and linguistically diverse (CLD) backgrounds. It is important to note that many ELLs across the United States may not have opportunities to engage in culturally relevant pedagogy (Gay, 2010; Ladson-Billings, 1995b). Likewise, ELLs may not be able to access their own cultural wealth (Kanagala, Rendón, & Nora, 2016; Valdez & Lugg, 2010; Yosso, 2005), which can be used to support and enhance academic learning. Furthermore, educators may not be aware of Yosso's (2005) Cultural Wealth Model that can guide teachers in supporting CLD students. Yosso's model includes six key components: (a) aspirational—supporting students in their dreams, (b) linguistic—supporting students' communication skills, (c) familial—inviting families into the educational process, (d) social capital—assisting students in staying connected with communities, (e) navigational—acknowledging that institutions have a history of being unsupportive and/or hostile to families, and (f) resistance—preparing students for a diverse democracy (Locks, n.d.). Kanagala, Rendón, and Nora (2016) adapted the model to provide a framework for understanding the cultural wealth Hispanic students can draw on to support educational goals. Students from CLD backgrounds, including ELLs, need access to their cultural wealth to help ensure they successfully navigate through the school system and into college classrooms.

Culturally responsive pedagogy is well researched (Gay, 2010), and teachers who use this pedagogy can assist students in drawing on their cultural wealth to include native language and to support academic growth. For a variety of reasons, including English-only policies in some districts, students may remain silent in a classroom (Casey & Gillis, 2011; Casey, 2014). Educators need to prepare environments where CLD students can capitalize on their cultural wealth to support academic, social, and emotional growth (Au, 2000; Au, 2013; Gee, 1996; Kanagala, Rendón, & Nora, 2016; Yosso, 2005). Gay (2013) argued that “the education of racially, ethnically, and culturally diverse students should connect in-school learning to out-of-school living” (p. 49). This idea beautifully identifies the foundation of culturally responsive pedagogy.

Although they are not synonymous, there are intersections between the terms ELLs and CLD students. It is essential educators understand how to support CLD students, many of whom are ELLs, to address one of the underlying problems of inequity in educational systems. This study focused on supporting ELLs in using the cultural wealth they bring into a classroom via a culturally



responsive pedagogical approach. Teacher-participants and/or PI provided student-participants with explicit instruction in RT to support students in (a) acquiring new vocabulary and (b) comprehending dense science content. Students had opportunities to engage in conversations with peers, in Spanish and/or English, as they read and summarized portions of text using RT strategies.

## REVIEW OF THE LITERATURE

This study took place in a school on the U.S.-Mexico border, where 96% of the population is Hispanic. The use of culturally responsive pedagogy is critical in supporting CLD students. Likewise, understanding how a research-based strategy can support students' academic success with a variety of student populations is also necessary.

### *RECIPROCAL TEACHING*

Educators and researchers using Reciprocal Teaching (RT) (Palincsar & Brown, 1984) have determined there is a positive effect on students' academic growth across a variety of settings. Palincsar and Brown (1984) designed RT to provide students with four strategies to support learning; their theoretical framework drew heavily upon the work of Vygotsky (1978). Strategies include (a) making predictions about text, (b) summarizing portions of text, (c) creating teacher-like questions, and (d) clarifying unknown vocabulary words. RT can assist students as they navigate dense science content material. Furthermore, RT can be used in whole group or small group instruction. After explicit instruction in strategies, students take on more of the learning of content (Palincsar & Brown, 1984).

Analysis of studies included in a review of the literature indicated that RT enhances students' comprehension of metacognitive strategies (Hacker & Tenant, 2002; King & Parent Johnson, 1999; Lederer, 2000; Olson & Land, 2007; Rosenshine & Meister, 1994). Studies focusing on RT interventions with ELLs were fewer. However, metacognitive strategy instruction has enhanced ELLs' academic outcomes as noted by several studies in this literature review (e.g., DaSilva Iddings, Risko, and Rampulla, 2009; Jiménez, 1997; Klingner & Vaughn, 1996; Muñoz-Swicegood, 1994). Jiménez (1997) designed one study that pulled five ELLs out of the regular classroom and taught RT strategies directly to students using code-switching (Lantolf, 2000) during the process. Code-switching is the act of moving between two languages, and students engaged in dialogue in English, Spanish, or both languages. Students' dialogues about texts improved and Jiménez recommended further similar research in inclusive settings. DaSilva Iddings, Risko, and Rampulla (2009) also conducted a RT intervention with ELLs with positive results.

Unlike Jiménez (1997), who spoke English and Spanish, DaSilva Iddings et al. (2009) conducted a RT investigation with three elementary-age ELLs using a code-switching approach with an English-only teacher. The purpose was to determine if monolingual teachers could effectively introduce a RT intervention using a dual language approach. The teacher encouraged students to share social and cultural experiences while conversing about the story in continuous dialogue that extended conversations; students discussed ideas with each other and extended their own and other students' ideas (Da Silva Iddings et al., 2009). The authors concluded that ELLs could improve in English proficiency and have meaningful discussions about text with support from monolingual teachers.



Muñoz-Swicegood, (1994) designed a RT study to test the effects of a RT intervention on ELLs' reading performance in Spanish and English. The study included 95 third-grade ELLs split into control (n=47) and treatment (n=48) groups. Students were taught metacognitive reading strategies in Spanish (Muñoz-Swicegood, 1994). Initially, classroom teachers in treatment groups modeled this strategy, and students moved to small groups, where they took turns being group leaders. The groups eventually became smaller until students worked in pairs. Results demonstrated a slight increase in growth on *La Prueba Spanish Reading, Test* for students in treatment groups over control students, but it was not significant.

Padrón (1992) noted that specific metacognitive strategies should be selected to match ELLs' ability levels, and that use of the strategies, i.e., when and how to use the different strategies as described by Meyers and Paris (1978), must be made explicitly clear to the students. In this manner, responsibility is transferred to students (Padrón, 1992). As U.S. schools become more diverse, research-based instructional strategies and interventions to support the academic needs of ELLs, a diverse population of students, are necessary.

**Culturally Responsive Pedagogy and Language.** Researchers (e.g., Artiles & Ortiz, 2002; Bernhardt, 2003; Genesee, Lindholm-Leary, Saunders, & Christian, 2005; Jiménez, 1997; Moll & Diaz, 1987; Moje & Hinchman, 2004) have noted that ELLs can improve their use and understanding of the English language by maintaining and improving their native language. ELLs who are not yet fully proficient in English may struggle with Basic Interpersonal Communicative Skills (BICS) and Cognitive Academic Language Proficiency (CALP) (Cummins, 1999), but access to their native language will support English acquisition (Krashen, 1981). An effective intervention such as RT that includes culturally responsive pedagogy via a sociocultural framework (Vygotsky, 1978) and/or a dual-language approach may be key in supporting the academic needs of ELLs.

Cummins (2008), in an argument toward a better understanding of language development, proposed, "The most productive direction to orient further research on this topic, and one that can be supported by all scholars, is to focus on creating instructional and learning environments that maximize the language and literacy development of socially marginalized students" (p. 79). Thus, ensuring ELLs have access to research-based strategies such as RT is important. However, it is essential that teachers use a culturally relevant pedagogical approach to ensure students can access their cultural wealth as they acquire new vocabulary, language, and content.

Through increased opportunities for conversations in small groups using RT strategies, students had opportunities to access cultural wealth (Au, 2000; Moje et al., 2004), such as searching for cognates. When RT is used with small groups, a bilingual or monolingual teacher can act as a facilitator, moving between groups to provide support as needed. Along with a RT intervention, educators who work with ELLs may need to utilize a dual language approach by allowing students to converse in Spanish (L1), English (L2), or a combination of both languages to achieve greater understanding (Riojas-Cortez, Huerta, Flores, Perez, & Clark, 2008). In this manner, ELLs working in small groups have opportunities to clarify unknown words (Quinn, Lee, & Valdés, 2012) through dialogue in L1 and L2, drawing on their cultural wealth to support educational outcomes with support from peers and/or teachers.

## METHOD

Formative and design experiments are based on an architectural model and fall under design-based research (Van den Akker, Gravemeijer, McKenney, & Nieveen, 2006). Reinking and Bradley (2008) outlined one framework that can be used in a formative design experiment, which includes six questions to guide a researcher. The PI observed and/or taught in two fifth-grade science classrooms over a four-month period, using the aforementioned six questions to guide the research. Questions included: (a) What is the goal, why is it important, and what theory and prior research undergirds the foundation in accomplishing the established goal?; (b) What intervention, from research and theory, might effectively achieve the goal?; (c) What aspects might enhance or diminish achievement of the goal when introducing the intervention into a classroom?; (d) What modifications might make the intervention more appealing to all stakeholders, effectively achieving the pedagogical goal?; (e) Were there unanticipated results, both positive and negative, that the intervention produced?; and (f) What changes resulted in the instructional environment as a result of the intervention? (Reinking & Bradley, 2008).

Goals were selected to enhance student-participants' academic outcomes, and included (a) increasing student-participants' use of metacognitive strategies to enhance academic performance, (b) increasing student-participants' opportunities to engage in critical thinking and scientific inquiry with hands-on learning experiences, and (c) increasing students' self-efficacy in STEM inquiry. RT was the selected intervention. However, one aspect involved in introducing the intervention that diminished achievement toward goals included time involved in allowing students to use strategies in groups and still cover standards.

## SETTING AND PARTICIPANTS

This pilot study was conducted in preparation for a larger, grant-funded study. It took place in a Title I elementary school located on the U.S.-Mexico border. The population of the city is 96.5% Hispanic. Of the 804 students attending this school, 95% are identified as economically disadvantaged and 80% are ELLs. The school has not earned a distinction in science, math, or reading, according to state assessments.

The PI conducted this pilot study in two separate fifth-grade classrooms during the 2016-2017 school year. Approximately 50 students, with ages ranging from 10 to 11, and their two classroom teachers participated. Student-participants, including boys and girls, engaged in activities in classroom and lab settings, with instruction in metacognitive strategies embedded in all lessons. Five student-participants in one classroom had limited English proficiency. The two teacher-participants spoke Spanish and English. One of the participating teachers taught only science for three of the four fifth-grade classes, while the other teacher had a self-contained class and taught all subjects. The fifth-grade science teacher-participant had more than ten years of experience, while the other teacher-participant had less than five years of experience. The teacher with less experience required more support during the intervention and requested the PI to teach more lessons.

## MATERIALS AND PROCEDURES

*PROFESSIONAL DEVELOPMENT.* The PI provided professional development (PD) training to teacher-participants through meetings and literature. However, both teacher-participants preferred that the PI teach the initial lesson so they could observe a more knowledgeable other (Vygotsky, 1978) using RT strategies. In collaboration with teachers, the PI observed, prepared, and/or presented multiple science lessons embedded with RT strategies, which included the four aforementioned components: (a) clarifying unknown vocabulary, (b) making predictions, (c) summarizing texts, and (d) creating teacher-like questions (Palincsar & Brown, 1984). The PI embedded a culturally responsive pedagogical approach in the intervention, and students had access to support in their native language. The PI is not bilingual, however, it is important that a teacher/researcher provide space for students to feel comfortable using their cultural capital in a classroom. During the course of these lessons, students spoke in Spanish and English, and translations were provided by more knowledgeable others; in this situation, many of those were students.

*INTRODUCTION OF THE INTERVENTION.* Prior to the intervention, the PI observed in classrooms during late fall of 2016, collecting field notes on typical classroom instruction. With IRB approval and PD completed, the PI introduced a RT intervention into two separate classrooms; the study continued across four months during the spring of 2017. The PI continued to observe and/or teach in the two control and two treatment classes after introduction of the intervention. After PD training, the PI requested that teacher-participants develop lessons to ensure students had opportunities to (a) demonstrate content mastery or learning through pre/post or post-test, (b) write summaries, (c) create teacher-like questions to elaborate on content, (d) explain new knowledge and explore topics as they made predictions, and (e) engage in the learning environment in collaboration with peers. However, teacher-participants developed lessons that used RT strategies in a limited manner. Students had inadequate opportunities to use strategies unless the PI intervened, as was the case in prior studies (Casey & Gillis, 2011). To provide additional support for teacher-participants after the initial PD training and introduction of the intervention, the PI developed four complete, multi-part science lessons that included instructional materials to extend over a week of instruction. The PI designed these lessons to address multiple standards. One teacher-participant taught each of these lessons while the PI observed; the second teacher-participant requested that the PI teach these lessons, and the PI complied.

## PROCEDURE

All lessons incorporated student engagement. Along with lessons developed by teacher-participants, the PI developed four multi-part lessons to maximize student engagement and move students closer toward set goals. A lesson on mixtures and solutions was the third lesson developed by the PI in this pilot study on effective metacognitive strategies for ELLs. This lesson, developed and taught by the PI in one of the two classrooms, incorporated activities into a weeklong lesson to ensure student-participants learned, retained, and used content area vocabulary during instructional time, and again during follow-up teaching. The PI added arts and literacy components to the lesson to further engage students and extend learning through art-based activities. Analysis of post-assessments, students' products, and observational data demonstrated that this lesson had a greater effect on students' engagement and academic performance. Although students'

engagement in this lesson improved across both classrooms, student-participants instructed by the PI demonstrated a much stronger understanding of content, as well as an increased level of content vocabulary acquisition based on post-test data analysis. The PI looked at various aspects of this

lesson to determine effectiveness in achieving set pedagogical goals.

*STUDENT ENGAGEMENT.* It is important for students to have opportunities to discuss science content with peers to enhance vocabulary acquisition and increase comprehension of expository texts. For the lesson on mixtures and solutions, RT was an integral part of instruction. Students had opportunities to engage in learning by (a) reading and summarizing science content, (b) making predictions, and (c) creating questions with peers. The lesson on mixtures and solutions began by having students think aloud about science-specific vocabulary. Two vocabulary words were selected for explicit instruction on day one, with an additional four vocabulary words to be presented during the lesson, but not elaborated upon until later in the week (Table 1).

Table 1.  
Vocabulary Framework

Target Vocabulary	Students' initial predictions on word meaning	Common definition	Examples
mixture	S1: "When you mix things together like in a cake." S2: "Like when you mix sugar and water together."	A combination of two or more substances that keep their identities.	Fruit cup, salad
solution	S3: "When you solve a math problem." S4: "Like when you add two numbers together."	A liquid mixture that has components that are evenly distributed throughout.	Tea, kool-aid
Secondary vocabulary: solute, solvent, composition, and identity	S5: "A composition is when you write a poem or a paper." S6: "A composition is like music."		

Acquiring content area vocabulary is important, but critically so for students identified as ELLs (Artiles & Ortiz, 2002) and/or students from underserved populations (Chall, 1983). The terms *mixtures* and *solutions* were repeated multiple times throughout the lesson. After a think-aloud, discussion, and brief review of text definition, the PI and students developed an initial classroom definition using a modified explanation from the think-aloud (Somerén, Barnard, & Sandberg, 1994). During this 60 minute lesson, students were asked to (a) define both words aloud as a class

and individually, (b) use both words in sentences, (c) write down the classroom created definition in science journals, and (d) incorporate both words into an arts enrichment activity.

The first author/PI wanted to address possible misconceptions about mixtures and solutions, and thus, an active discussion during the pre-assessment phase was encouraged (Campbell, Schwarz, & Windschitl, 2016). When prompted, students provided varying definitions of the word *solution*, to include: “a solution to a math problem-like when you solve a problem” and “solutions to multiplication facts.” Likewise, students provided the following definition to one of the secondary vocabulary terms on day one, *composition*: “A composition is when you write a poem or write a paper” and “a composition is like writing music.” Once students began to acquire the content vocabulary more fully, students were asked to read silently from textbooks. With teacher/researcher support, students then worked in groups to write summaries in science journals. This took place just prior to an exploratory activity to further enhance content understanding (Shepardson & Britsch, 2001). Students had grown stronger at writing summaries after continuous use of RT strategies. Initially, writing summaries was a difficult endeavor for student-participants, and the PI had to model summarizing portions of text repeatedly. A “ten words or less” strategy assisted students in identifying important facts from text and then arranging facts into sentences of ten words or less.

*EXPLORING SCIENCE.* After summarizing, students remained in groups for a five-minute activity that provided them with an opportunity to separate a *mixture* into individual components (Figure 2) and make predictions about the mixture using new vocabulary terms that would assist with acquisition and retention. Students removed items from baggies and spent time sorting items into their “identities”; students had to determine whether smaller and larger glass beads and pompoms belonged in the same group or different groups. All students were engaged in the activity, and when students were done sorting, the PI asked students if the mixture in the baggies could be turned into a *solution*. More than half of the students said yes, and a lively debate ensued. This occurred in both classrooms (Isabelle, 2017), but the conversations were relevant and cleared students’ misconceptions about mixtures and solutions. One student in each class was able to explain why the mixture could not be turned into a solution and acquisition of content vocabulary was further enhanced.



Figure 2

**EXPLAINING CONTENT.** Immediately following the *mixtures* activity, students watched a brief video, *The Great Picnic Mix-up* (Szymanski, 2015). Although the video was approximately three minutes long, the PI paused several times to (a) ensure students understood the narrator, who spoke at a rapid pace (b) review primary and secondary vocabulary terms and (c) allow students time to elaborate on narration in the video by summarizing science content presented. During the video, students' conceptions of physical and chemical changes were addressed. Likewise, students had another opportunity to hear about two secondary vocabulary terms: *solute* and *solvent*.

A lab entitled "Separating Mixtures" was led by the fourth author and teacher-participant later in the week; this further assisted students with content-area vocabulary acquisition. During the science lab, students had to demonstrate that mixtures could be separated; students then had to identify a solution as a type of mixture. Students used the physical properties of mixtures and solutions to decide whether the properties changed or remained the same. There were six stations with a different "mixture" bowl at each station; students were placed in groups of four to rotate easily between stations. Students had to determine which tools and method to use to separate each mixture. The tools were placed on a separate table, and this allowed students to make decisions to determine which tools they would need to complete the activity. Students also had to document the tools they chose and the method they used to separate the different mixtures. Students wrote down the choices they made on a science handout.

**EXTENDING LEARNING THROUGH ARTS AND LITERACY INTEGRATION.** The PI embedded a literacy and arts enrichment component into this week-long lesson on mixtures and solutions to allow students' opportunities to elaborate on learning in creative ways. All students had an opportunity to create persuasive brochures describing destination places (Figures 3, 4, & 5).



Figure 3

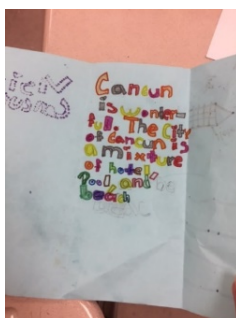


Figure 4

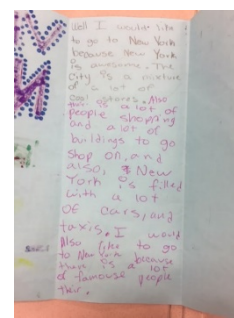


Figure 5

Students wrote with purpose and audience in mind. This activity began during the lesson on Monday, just after a review of the content. According to a study of creativity by George Land in 1968, students' creativity decreases significantly from age five to fifteen (Land & Jarman, 1992). Providing students with an opportunity to create a brochure links to the highest levels of learning, according to Bloom's revised taxonomy (Forehand, 2005). Likewise, embedding an ELA standard into the science lesson allowed students to apply newly acquired vocabulary in a fun and creative way. Students began their brochures after the lesson, and the teacher-participant/fourth author provided time for students to complete them during the week. The embedded literacy component



allowed students to demonstrate acquisition of content vocabulary in creative ways that correlated to a selected destination location. On Friday, when the first author gave all students a post quiz on vocabulary and content to assess learning, students were excited about their completed brochures. Several students wanted the PI to take their finished products, but students were thrilled that pictures of their creations were taken (Figures 6, 7, & 8).



Figure 6

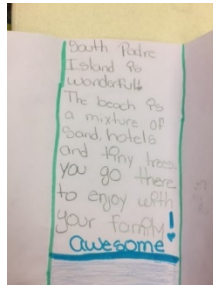


Figure 7



Figure 8

After the post-test, students were still talking about their brochures. “I want to go to New York,” one student commented, and other students made similar remarks about their destination choices. A discussion of how science can be found in and around destination places came up, and a conversation about the “science around us” brought up more questions from students. Students began to identify land forms, features, and space science. Getting students to see science all around them through connecting technical language, implicitly and explicitly, to real-world application is important, and the embedded arts-integration and literacy component did just that. Overall, students’ excitement over the embedded literacy component in the lesson on mixtures and solutions allowed them to elaborate on learning; it turned out that creating travel brochures using science content vocabulary terms was a big hit.

## RESULTS

For this formative experiment, the PI collected and analyzed quantitative and qualitative data, to include (a) researcher’s field notes/reflections, (b) observational data from informal questioning, (c) students’ finished products, (d) pre/post or post-tests, and (e) teacher interviews and feedback. The PI used grounded theory (Corbin & Strauss, 2008) to analyze qualitative data. Coding led to emergent themes. Analysis of observational field notes prior to the intervention revealed that in the class with the less experienced teacher-participant, students did not engage in collaborative learning and the teacher used an authoritarian approach to instruction. The more experienced teacher had students engage in cooperative learning groups for a few minutes prior to the beginning of almost every lesson. However, data analysis revealed both teachers most frequently asked students to engage in note taking via whole group instruction. Students were often off task and engaged in activities that detracted from learning content. Off-task behaviors included playing with objects in desks, resting head on desk, refraining from note-taking, and leaving seat to go to restroom, sharpen pencil, and/or retrieve items from backpacks. Cooperating teachers utilized few metacognitive strategies prior to the intervention. After PD training, cooperating teachers used



some RT strategies in a limited manner. When the PI was developing and teaching lessons in one of the two classrooms, all four strategies were used.

Quantitative data included pre/post tests or post-tests. Depending on the design of a lesson, assessments were given at varying times, with students taking pre/post-tests or only a post-test. Student-participants understood these tests were not part of their grade, but the PI determined that test-overload was a struggle for many student-participants. Students in all groups were preparing for state standardized testing, and state testing preparation was a factor in the test overload. Qualitative data was observational, reflective, and in many instances, recalled after the fact. Field notes contain researcher bias for a variety of reasons including (a) reflections written from memory, (b) researcher recalling events that she participated in, and (c) researcher's active engagement with one treatment group over the other. PI's reflections included observations, classroom activities conducted by the PI, and notations about students' excitement to see PI enter the classroom, with students asking what they would be doing. Likewise, field notes contained phrases such as "students were happy that they would be engaged in small group work" (March, 2017).

Although the purpose of formative design experiments is not to assume "the role of a teacher in another teacher's classroom" (Reinking & Bradley, 2008, p. 85), this pilot study resulted in just that in one of the classrooms due to a request from one of the teacher-participants. Thus, researcher-bias may be present in field notes and researcher's reflections. Likewise, small group instruction was a novel approach in one class, and it is unclear if student engagement would have continued if the teacher used small group instruction embedded with RT strategies on a regular basis.

Furthermore, comparing two groups of students in treatment classrooms, with one group being taught by the PI, presented a confounding variable (Denzin & Lincoln, 2000). Nonetheless, the PI tried to remove researcher bias to the greatest extent possible. Research-bias in analyzing field notes was lessened by the second author acting as a second reader. One final difficulty in this study was retrieving all pre/post and/or posttests from control groups. Often, the science teacher-participant would forget to give assessments to control students. It was determined that a comparison of science scores from state exams could be used to compare students. However, PI was not able to access the scores.

Qualitative data analysis across all RT lessons revealed positive correlations between student motivation, academic performance, and/or engagement. Lessons developed and taught by PI included (1) states of matter, (2) periodic table of elements, (3) mixtures and solutions, and (4) programming/coding floor-robots. The most significant and surprising lesson in this pilot study introduced student-participants to floor-robots. Data analysis of pre/post assessments demonstrated an increase in students' awareness of programming and code, as well as an increase in students' self-efficacy in science (Casey, Gill, Pennington, & Mireles, 2017).

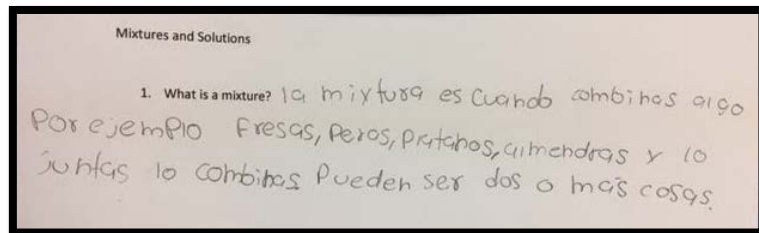
*EVALUATING A SINGLE LESSON FOR STUDENT SUCCESS THROUGH DATA ANALYSIS.* The PI kept a running journal after teaching and/or during observations in each classroom. These field notes were more accurate when the PI was observing a lesson. It was more difficult to teach a lesson, and

then recall from memory everything that occurred in a classroom after the fact. During the lesson on mixtures and solutions, student-participants took a post-test on Friday. The post-tests in both treatment classrooms were identical, however, there was a difference in content mastery between the two classes. Students who were taught by the PI demonstrated a higher level of understanding. There are several reasons that this might have occurred. First, the class that showed less improvement had a student population with a higher percentage of ELLs who were still acquiring the English language. Secondly, the PI is more familiar with RT strategies than the cooperating teacher who selected to teach lessons.

On Friday, four days after the PI introduced the initial lesson in one of the classrooms, all students took a five-question quiz. The post-test contained one short answer question and four multiple choice questions, some of which were developed by students when they created teacher-like questions in the lesson on Monday. Results demonstrated strong mastery in the class with students who were taught by the PI, with an average test score of 89% (n=22). Several students in both classes were absent. In the class taught by one of the two teacher-participants, mastery was not demonstrated, as indicated by the class average of 64% (n=20). However, many students in this second class had limited English proficiency. The quiz was in English, and language may have impeded their ability to demonstrate content mastery.

The short answer question: "What is a mixture?" was answered by 41 students, with one student leaving the question blank. Three students responded entirely in Spanish (Figure 9).

However, many students still acquiring the English language provided a response in English (Figures 10 & 11). On the four multiple choice questions, there was a significant difference in students in the two treatment classes. A higher percentage of students taught by the PI selected the correct answers (Figures 12 and 13) over student-participants taught by the teacher-participant (Figures 14 & 15) on all four questions. This presents a confounding variable (Denzin & Lincoln, 2000).



*Figure 9*

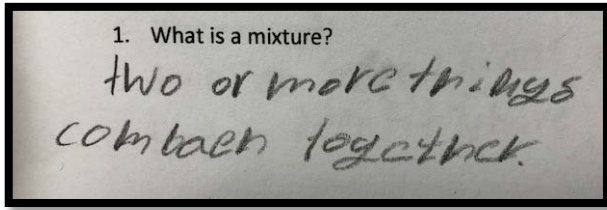


Figure 10

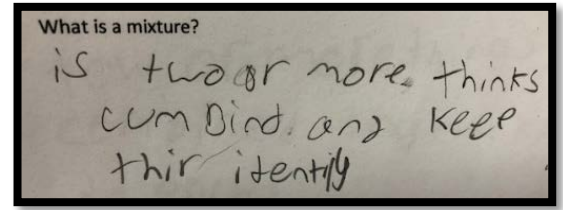


Figure 11

A substance has the same \_\_\_\_ throughout.

22 responses

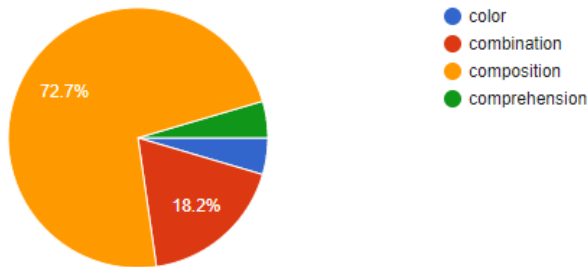


Figure 12

A substance has the same \_\_\_\_ throughout.

20 responses

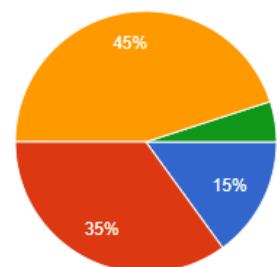


Figure 13

A mixture is an example of a \_\_\_\_ change.

22 responses

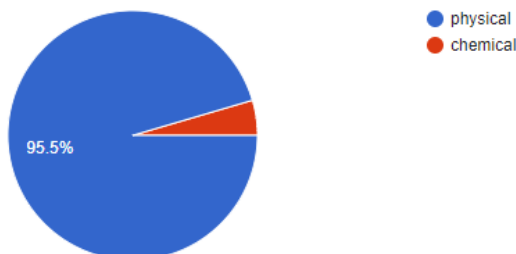


Figure 14

A mixture is an example of a \_\_\_\_ change.

20 responses

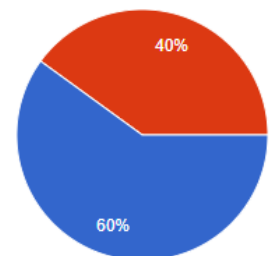


Figure 15

Although there were several variables that may have skewed results, RT has a strong research base that has demonstrated the effectiveness of the intervention. Introducing student populations that are largely Hispanic to metacognitive strategies such as RT is important. Students need support in becoming more aware of strategies that can assist with reading and comprehending content; and if these strategies are embedded with a culturally relevant pedagogical approach to support CLD students, this study has provided some evidence that students will achieve improved academic growth.

## DISCUSSION, LIMITATIONS, & CONCLUSIONS

This one lesson on “Mixtures and Solutions” was part of a larger pilot study that included multiple science lessons embedded with RT to assess the effects of a metacognitive strategy on ELLs’ academic progress in a science classroom. This lesson occurred toward the end of the study, and students were becoming adept at utilizing RT strategies. The embedded art and literacy standards were added to (a) increase opportunities for writing, (b) provide students with new purposes for writing, (c) generate opportunity for creativity, and (c) allow students to create a brochure with real-world application. These components added a layer of engagement that further enhanced comprehension of content. This lesson demonstrated how arts and literacy integration provided students with multiple strategies to make connections between academic content and personal, lived experiences. When taken as a single lesson, it is nothing more than that, a lesson in a science class. When taken as a multi-component lesson that goes beyond teaching a science standard, it may provide teachers with ideas for adding engaging and enriching experiences to enhance lessons involving expository texts.

There are several limitations to this study. First and foremost, student grouping for classroom instruction in this school is configured based on students’ academic achievement, aptitude, and test scores. The highest achieving students were all grouped in one fifth-grade class, and the lowest achieving students, many of whom had limited English proficiency, were all grouped together for all instruction. The control class in this study was made up of the highest achieving students, making it difficult to compare students in the control and treatment groups. Next, pre/post assessments were strong indicators of academic growth over the duration of the intervention, but constant testing of student-participants became problematic. Toward the end of the study the PI began using only post-tests and other observational data when possible. A third limitation the PI faced included the comparison of two treatment classrooms with dissimilar student-participants. One of the treatment classes had a much higher percentage of ELLs with limited English proficiency. Finally, comparing students’ academic growth when the PI was instructing student-participants in only one of the classrooms was challenging. However, when working with teacher-participants, ensuring that their voices and suggestions are heard is important to maintaining a feeling of collegiality and partnership in the study.

There is limited research on arts and literacy integrated science lessons (Graham & Brouillette, 2016; Gray, Elser, Klein, & Rule, 2016), and this research base is even less when adding in arts-integration research on effective supports for ELLs (Brouillette, Grove, & Hinga, 2015). Incorporating multiple standards across instruction, with an added arts activity embedded in a lesson, may increase students’ (a) engagement and interest in a lesson, (b) academic success with content and (c) content-area, vocabulary acquisition and retention. Further research on the effects of literacy-rich, arts-embedded science lessons when working with ELLs may be necessary to add to the knowledge base.

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