Literacy and Science: How to produce personal science story podcasts with teachers and students

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1. Introduction

At the 2016 ASTE meeting in Reno, NV, we presented our research on elementary and secondary teacher candidates using a personal science story podcast assignment to reflect on how science connects to their lives, the needs of language learners, and their understandings of culturally responsive pedagogy. We discussed the types of stories our students told, and the extent to which they connected with the content. We also shared examples of podcasts created by our teacher candidates. The audience for our traditional paper session had some thoughtful comments about our findings, and also asked quite a few questions about how we guided our students to create their personal science stories. In the year since, we have made several changes to the assignment based on feedback from our students and colleagues (including those at ASTE), and these changes have resulted in an assignment that gives our teacher candidates more support in thinking about how science connects to their lives, how they use language, and how to connect with their students. For 2017 we wanted to share the revised assignment with our colleagues in an experiential session, with two hands-on foci: 1) the "story circle", which allows students to talk about their stories with their peers and share ideas about how to connect science, and 2) technology which allows teachers more opportunities to analyze how they are using language, reflect on whether changes should be made, and justify their decisions.

The purpose of this experiential session is to give teacher educators an opportunity to 1) experience how the story circle works in practice, and how it can be used to enhance the science community in the classroom; 2) practice using AntWord Profiler and/or readability-score.com to analyze language use; and 3) discuss the use of Audacity and various options for producing audio podcasts. This paper will provide support for the experiential session as well as some additional

resources to help other science teacher educators develop their own personal science story podcasts.

2. Literature Review

2.1 Digital Storytelling

Digital storytelling is the process of using multi-media to tell a story, and is used in the field of public health as well as education. As Dip (2014) wrote, digital storytelling is useful for "giving a voice to the vulnerable and enabling their story to be told," (p 30). In our methods courses, we seek to empower our teacher candidates to share their lived experiences and seek to learn from others' experiences. As a way of learning about our teacher candidates (and modeling methods by which they may learn about their own students), and giving our candidates an opportunity to practice science inquiry in a real-life context, we designed the personal science podcast assignment.

Research has shown evidence that engaging in the process of creating a digital story can help students collect information, organize their conceptions, and become more motivated to learn (Burmark, 2004; Hung, Hwang & Huang, 2012; Robin, 2008). However, we acknowledge that this research on digital storytelling includes an approach of integrating photos, videos, and other images along with audio narration to tell a personal story, and our approach has a primary focus on the audio narration. This focus was intentional: observations during other technology-related studies have provided evidence that students spend a great deal of time and effort on finding and editing the "perfect" image when presented with a digital storytelling assignment, and writing the script and polishing the narration were given much less attention. We wanted our teacher candidates to think about the language: written and spoken, so we chose the podcast vehicle to frame the assignment, and our own preliminary research data seems to be consistent with the findings noted above. We consider the assignment to be under the umbrella of digital storytelling because Joe Lambert, one of the pioneers of the method, identified seven "elements of digital storytelling", including point of view, dramatic question, emotional content, gift of your voice, pacing, soundtrack, and economy (2002). Each of these elements can be well-represented in our personal science story podcast structure:

1. the point of view is the perspective of the writer/narrator

2. the dramatic question is the science-based inquiry framing the story
3. the emotional content is how the narrator shows evidence that the story has meaning in the narration
4. the 'gift of your voice' is present both figuratively and literally in that the candidate narrates her/his own story in her/his own words
5. the pacing of the story can be adjusted if needed as the writer analyzes her/ his language use
6. Candidates are encouraged to include (creative commons or self-created) music and sound effects to enhance their story
7. The final podcast must be under 10 minutes in length

The digital storytelling skills of remembering, creating, connecting, and sharing are interwoven within the assignment, and each of these practices can help our students deepen their understanding of their own culture as well as give them an opportunity to learn about and show respect for the stories of others (Willox, Harper, & Edge, 2012).

2.2 Academic Language

As science educators, we have felt constraints on the time we have for our methods courses, much as our candidates feel time pressure to "cover" large amounts of science content when they teach. For many of us, our efforts to make sure that our candidates are equipped with a wide variety of research-based best practices for teaching science inquiry has meant that we have not spent much of our time giving our candidates an opportunity to think about how they will support science literacy in their classrooms. The widely-used teacher candidate assessment, edTPA, as well as our efforts to give our candidates more tools to support English Learners in science classrooms, have made us more aware of the need to provide opportunities to think about academic language and science literacy.

We want our teacher candidates to feel prepared to let their students do science; equally important is that they are ready to support their students in writing, reading, speaking, and listening to science talk (Pearson, Moje, and Greenleaf, 2010; Silva, Weinburgh, and Smith, 2013). Science reform efforts can sometimes result in a de-emphasis of these literacy skills, but reading and writing about science does not have to mean doing workbook pages.

Academic language includes both the vocabulary and the syntax that we use primarily in a school-based setting, rather than conversational language. Scientific language is not the same as academic language, though there is some overlap in that both forms of communication require formality, conciseness, and a "high density of information-bearing words" (Snow, 2010, p. 450). Pre-service teachers' focus tends to be on these information-bearing words- the vocabulary of science- rather than on the words and concepts that are still academic in nature but not strictly science-based. For example, our teacher candidates might make the assumption that their students already understand the difference between "analyze" and "interpret" and not spend time explicitly teaching these ideas. By giving teacher candidates a chance to analyze their own language use, both academic and conversational, we can model the process of explicitly teaching academic words and skills like "analyze" and how analyzing data is different from simply displaying data. The language analysis component of this assignment supports this kind of reflection.

Teacher-created podcasts are one way to use the assignment; our teacher candidates could use the podcasts with their students. Audio podcasts can be an effective way to reinforce academic language, both in terms of vocabulary and in language function and fluency. Putman and Kingsley (2009) found that fifth-graders who used teacher-prepared podcasts that focused on science vocabulary performed significantly better on vocabulary tests than students who received classroom instruction alone. Student responses indicated that students both enjoyed the podcasts and found them helpful in terms of reviewing words they had forgotten. Borgia (2009) found that fifth-grade students who were given access to teacher-created podcasts as a supplementary tool were able to increase their vocabulary retention.

An extension of the assignment, in which our teacher candidates give their own students opportunities to create podcasts, could be even more powerful- both for learning language and inquiry. Dong (2002) observed that effective biology teachers provide English Learners (ELs) with assignments that offer authentic practice in speaking, reading and writing in the context of biology learning, and this additional practice (especially if done in groups) can reduce speaking anxiety and enhance students' ability to communicate about science. Another goal of the assignment is to give teacher candidates skill in creating the kind of podcast that can enhance

understanding of both scientific and academic language, and to gain self-efficacy in supporting their students to make literacy gains as well.

Significantly, teacher candidates are encouraged to use their own language, in the context of their own stories, for their podcasts. We want to value the story as we value the person that tells it (Hendry, 2007). Transitioning between the conversational and the academic in a podcast requires a kind of code switching, and teacher candidates can use this assignment to reflect on different uses of spoken and written language, how they are useful, and what they might miss. The process of using the kind of "real life" language to think about more academic topics can be useful to help students increase understanding and skill in how they use language (Amicucci, 2014), and possibly how they go on to teach language use.

3. Procedure for the Personal Science Story Podcast

3.1 Engage: listen to some podcasts

To introduce the assignment to the audience (whether that audience is teachers, teacher candidates, or K-12 students), we engage them by giving them an opportunity to listen to an example personal science story podcast. The first author of this paper has produced two podcasts to use as examples: one is 5 minutes (**https://soundcloud.com/jennifer-frisch/episode-1-worms**) and another is 10 minutes (**https://soundcloud.com/jennifer-frisch/episode-2-hubris-and-the-helicopter**). For our presentation, we will share the worm podcast. Both are available on SoundCloud for public use. We also have written permission from one of the first (secondary science) cohorts who produced podcasts to share their podcast episodes and Teachers' Guides; these are available at this link: **http://telbionoyce.weebly.com/podcast.html**. As more of our teachers give permission to use their podcasts, we intend to include more on a SoundCloud channel.

Another option is to share episodes from The Story Collider (**http://www.storycollider.org/podcasts/**), which is a podcast that allows scientists to share personal stories and connect these back to science. A caveat to using these podcasts is that they are designed for adult audience, and as such, some are labeled as "explicit" (usually for language and sometimes content). These episodes can be shared with teachers, but should be used with students with caution. StoryCorps is another podcast that can be used in a variety of ways with

students; it uses an interview format to tell stories, and there are some examples of stories that reflect on personal science as well.

Once you have completed some personal science story podcasts, ask your teacher candidates for written permission to share their podcast episodes (either with future classes, or on the internet, or both), and then you can share teacher-created podcasts as well. If you plan to do this activity with K-12 students, it is preferable to keep the podcasts private at first, perhaps sharing the episodes with families at a "listening party" at the end of the semester or school year, and then asking families for permission to use the audio later if you wish.

3.2 Explore: the story circle

The “story circle” is a small group discussion in which students share ideas for their stories, listen to other students’ stories, and provide constructive criticism. This component was not originally included in the personal science story podcast assignment. However, after discussing the results of our first iterations of the assignment, we found that many of our teacher candidates (particularly elementary teachers) were struggling with connecting their real lives to science, and their stories would become either heavily expository (explaining a science concept in somewhat stilted language) or would not include connections to science (*e.g.*, a personal story without any explicit connections to science concepts). After discussing this with colleagues and reflecting on the literature on digital storytelling, we thought that using a structured story circle early in the process would help strengthen both the science and the narratives in our students’ story podcasts, while also increasing their collaboration skills and sense of their class as a scientific community. Students can collaborate in story circles at multiple times during the semester.

Students come prepared to participate in the story circle by bringing two ideas for stories from their lives that they want to tell. Some prompts from the “Digital Storytelling Cookbook” (Lambert, 2010) may be provided for those students that are struggling to think of a story. Although students can write down some notes if they wish, the objective is to have them tell the stories, briefly, in a conversational tone to the group. For example, a teacher candidate participated in the story circle by saying, "I was thinking about two different things, but I'm not sure. One story was about this time when I got sleep paralysis, but then I have another story

when I broke my arm falling out of a tree." The other participant-listeners in the story circle then asked questions about the stories, helping her to tell a little more about each incident, and giving her feedback on which story they wanted to hear more about. As a natural part of these discussions, other candidates started coming up with ideas about the science concepts that might be connected with each story.

An important rule of the story circle is that each participant comes prepared to listen to colleagues' stories and ask respectful questions. A facilitator should be present in the story circle to help remind participants to be respectful of others' stories and work, and be receptive to suggestions of others. We followed the guidelines posted by Roadside Theater found at *https://roadside.org/asset/story-circle-guidelines?unit=117* (Roadside Theater, 2016) and will model these guidelines during the experiential session.

After participating in the story circle, teacher candidates begin the process of writing the script for their story. Although this process will be iterative, with opportunities for feedback and revision, it can be helpful to give teacher candidates some initial support in constructing the backbone, the "personal" part of the story. To this end, one could use Ohler's expansion of Dillingham's (2001) "Visual Portrait of a Story" (Ohler, 2013; also available online at *http://www.jasonohler.com/pdfs/VPS.pdf*). The Visual Portrait of a Story diagram can help the writer map out their story's problem, conflict, and conclusion. For some students, having this structure in place will lead to writing a full draft of the story, but others will prefer to begin working on the science portion before fleshing out the rest of their story.

3.3 Explain: researching the science

Once students have begun to map out the general structure of their stories, the next step is to think about a science concept they would like to research that could be connected to the story. This step typically comes much easier for secondary science teacher candidates and those elementary candidates who are already enthusiastic about science content: these candidates often have to be cautioned to focus on just ONE science concept to connect to their story, rather than turning their podcast into a sort of lecture on the science concepts and their connections. In a science methods course that uses the 5E's as a structure, I reinforce the idea that the language function for the podcast is primarily to ENGAGE the audience, and secondarily to EXPLAIN the

science. This reminder serves several functions: 1) to help explain and reinforce the idea of language function; 2) to help students who might be more inclined to write more exposition remember that an engaging story is the more important part of the podcast; and 3) to reassure those students who do not have strong self-efficacy in their own abilities to learn and explain science that the personal story itself is valuable and important.

We ask the teacher candidates to choose which story they are going to turn into a podcast, and identify something that the story makes them wonder about. I ask the teacher candidates to stretch themselves and think about a connection they would like to learn more about, rather than an science concept that they already feel comfortable explaining. For example, if a teacher candidate has decided to tell a story about how she broke her arm, she might feel comfortable relating that story to a description of the names and sizes the bones in the arm. With some guidance, the instructor could help her think of some connections that she will have to do some research to answer: how much force would have to be applied to break a bone? How do bones repair themselves? The focus of this part of the assignment is on *inquiry*- find a question you want to know more about, and then research the answer to the question.

During this part of the project, we talk about how to identify valid and reliable internet sources to help with research, and how to cite sources appropriately. As the candidates conduct their research, they often find more information than they need to answer their question. The next step is to add the science to the story podcast script. We look at the Next Generation Science Standards and talk about how the podcast is going to be targeted to an audience of students for whom the science concept they chose would be appropriate, and that they should choose the language for their draft appropriately, and again reinforce the idea that the primary language function for the podcast is to *engage* the audience. Although we want the science concept to be well-connected to the story, the podcast story itself will only introduce the concept, and the Teachers' guide will expand on the concept.

3.4 Elaborate: language analysis and justification and teachers' guide

After teacher candidates have revised their podcast script to include both the story and the science, we ask them to analyze the language in their script. Students analyze the language in

their script in two ways: 1) they examine the vocabulary present in the script, and 2) they examine the reading level of their script.

The academic vocabulary is analyzed using AntWordProfiler (Anthony, 2014), an open-source program that is available for free at (http://www.laurenceanthony.net/). Students input their script as a text file, and the output is color-coded (Figure 1), showing the number and percentage of words that are Level 1, or in the first 1000 most common words in the English language according to the General Service List (GSL, West & West, 1953); Level 2 words, or the second 1000 most common words from the GSL, Level 3 words, or words on the Academic Word List (AWL, Coxhead, 2000); and Level 0 words, which are not found on any of previously mentioned lists. The program also allows you to program your own lists of words, so if an instructor or candidate would like to target Dolch words or words from a particular science language list, that can also be done. A ten-minute script is short enough for our purposes that we can ask teacher candidates to look through the words identified as "level 0" and select those words that they feel would be classified as "scientific" for the analysis.

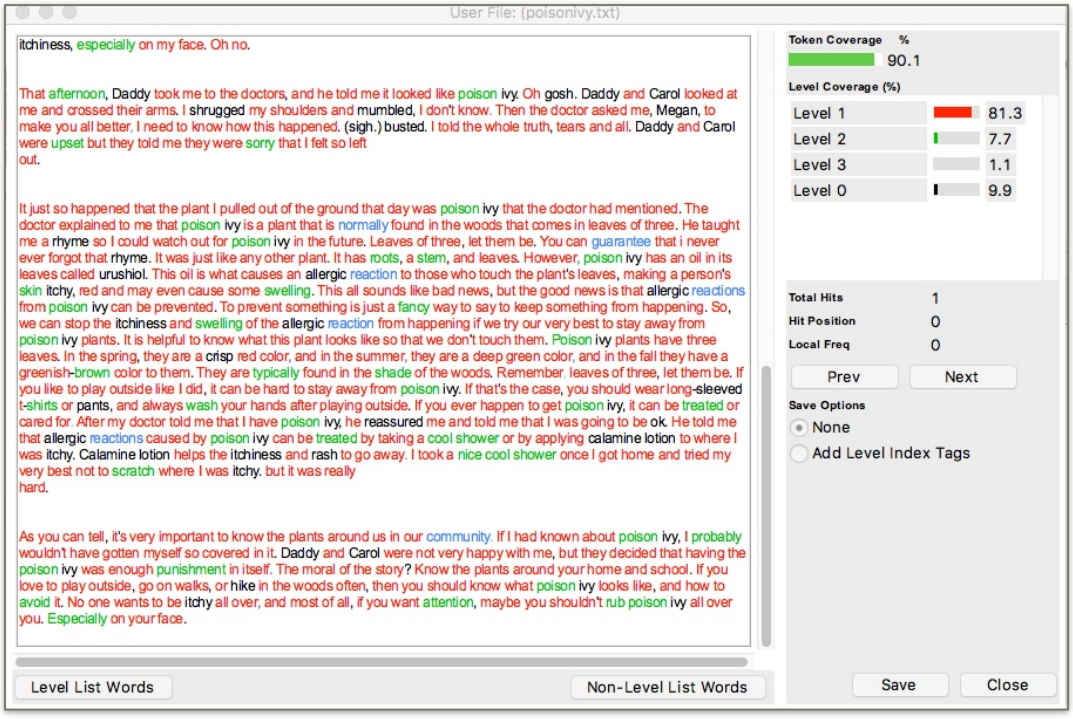
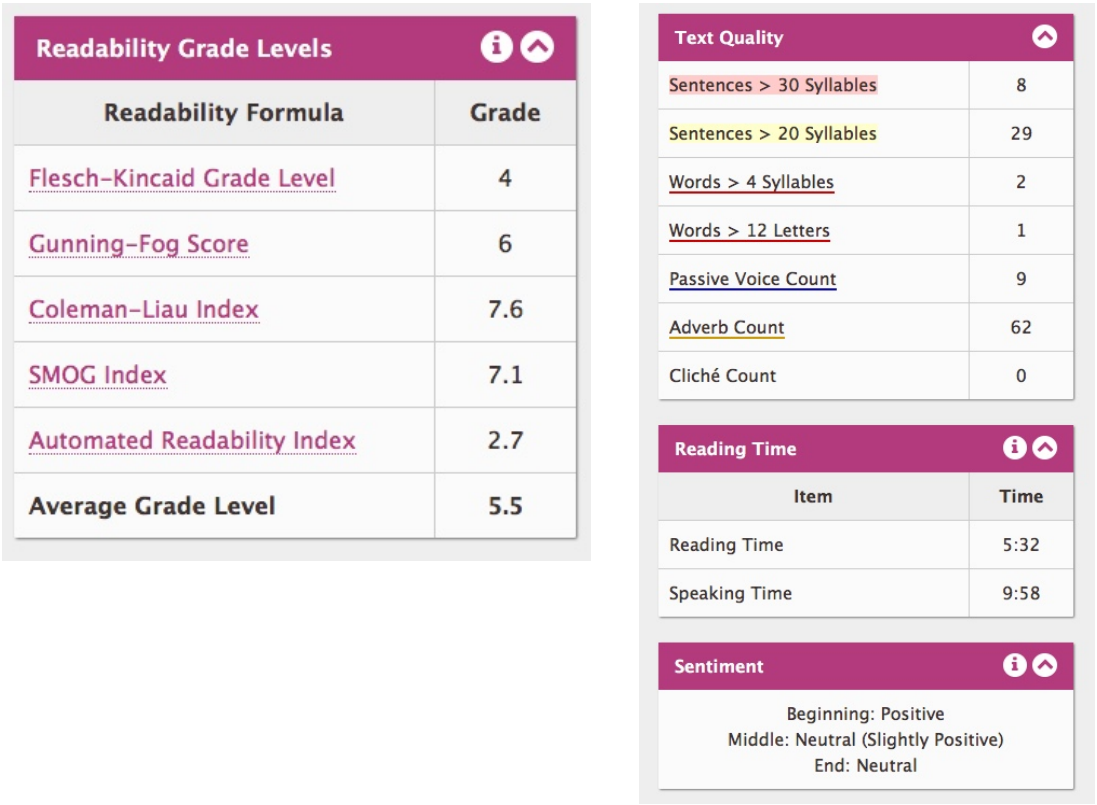


Figure 1. Sample AntWord Profiler output

The next part of the analysis uses readability-score.com to gather data on the readability of their script. Teacher candidates can copy and paste their text into the site (the free version will analyze the full text of a ten-minute podcast script, but one can only enter three files a day for free). The output includes readability grade level scores including the Flesch-Kincaid Grade Level, Gunning-Fog score, Coleman-Liau Index, SMOG index, Automated Readability Index, and an "average grade level" that takes each of the above indices into account. The site also provides assessment of text quality, syllable counts, adverb counts, and reading and speaking time (Figure 2). The language analysis worksheet (Appendix A) guides teacher candidates in reflecting on the extent to which this language-based evidence reflects the grade level they are targeting with their podcast, and whether they feel they should change some of their language. One goal of this portion of the project is both to get our teacher candidates to reflect on how they use language and to model the process of analyzing evidence and justifying their reasoning; these are skills we are also trying to teach candidates to support in their students.



Readability Grade Levels

Readability Formula	Grade
Flesch-Kincaid Grade Level	4
Gunning-Fog Score	6
Coleman-Liau Index	7.6
SMOG Index	7.1
Automated Readability Index	2.7
Average Grade Level	**5.5**

Text Quality

Sentences > 30 Syllables	8
Sentences > 20 Syllables	29
Words > 4 Syllables	2
Words > 12 Letters	1
Passive Voice Count	9
Adverb Count	62
Cliché Count	0

Reading Time

Item	Time
Reading Time	5:32
Speaking Time	9:58

Sentiment

Beginning: Positive
Middle: Neutral (Slightly Positive)
End: Neutral

Figure 2. Sample readability-score.com output

The Teachers' Guide is an extension of the podcast for our teacher candidates. We tell our candidates that while the audience for the podcast itself is a group of students, the audience for the Teachers' Guide is their teacher. There are required components in the teachers' guide, including: connections to Next Generation Science Standards, background and supplemental information on the science concept, vocabulary with definitions, and activities that could be used to allow students to explore and expand on the concept by doing science inquiry. Teacher candidates are also asked to provide references they used for enhancing their own understanding of the concept as well as any sources they used to develop the activity.

3.5 Evaluate: assessment

For the final step in the project, students record, edit, and 'produce' their podcasts, including (creative commons) sound effects or music to enhance the soundtrack if they wish to do so. Students are encouraged to use Audacity to edit their podcasts, because it is free and easy to learn with a variety of tutorials that are updated often on youtube (one current favorite is *http://wiki.audacityteam.org/wiki/Category:Tutorial* , however this could change by the time this paper is presented). If students have the access (e.g., through university computer centers) and the desire to use different software such as Adobe or Garageband, they are encouraged to do so, with the caveat that they will have to find their own tech support, and that the school they teach in may not have access to the software they are gaining skill in using.

The rubric we use to assess the personal science story podcasts (Appendix B) is a way to try to support both the product and the process. The assignment integrates a variety of skills and objectives, so it can be spread out through the semester. Teacher candidates seem to benefit from being provided with smaller deadlines throughout the semester, and that is also an effective way to model executive function; I use our learning management system to allow them to submit each small portion of the assignment and get quick feedback. At the end of the semester, we have a "science story listening party" where I have students share their final podcasts in small groups, and those that are comfortable doing so can submit their podcasts and teachers' guides for me to post online.

4. Conclusions: on sharing student stories

It probably goes without saying that posting podcasts online should only be done with the consent of the authors. If doing this activity with K-12 students, you will also need parent permission. Although voice-only podcasts are less problematic that posting video, voices and the stories they tell can be individually identifiable so care should be taken to make sure that authors are aware of that possibility.

There are a variety of different platforms one can use to post a podcast series online, and these come with advantages and disadvantages. If you want to make your podcast episodes private (so that only the students in your class can listen to them), it is easiest to just use a learning management system (*e.g.*, Moodle, Blackboard, etc.). Universities that have an iTunes U account often have tech support for uploading class-created podcasts to that platform as well. Another option is to develop a website that you can use to host your podcast (*e.g.*, Wordpress, Weebly), although if you plan to upload audio you will generally need to pay an additional fee to accommodate the extra storage. Each website builder may have a media hosting service it recommends (*e.g.*, Blubrry, Soundcloud) and these, too, will come with an additional fee.

The pre-service teachers with whom we have shared this project have found it very engaging. Different teachers enjoy different parts of the project: some like the process of constructing a story, some like the science inquiry element, and some are most engaged by getting a chance to record and edit their stories. The listening parties give the teachers a chance to share their work in their story circle (or with the whole class, depending on class numbers). I ask them to reflect on what they learned from the project, and this process can be thought-provoking as well: although many students report that they learned some science concepts, and others are more reflective about their language use, most students are most thoughtful about the extent to which the project has taught them something about their colleagues.

5. References cited

Amicucci, A. N. (2014). How they really talk. *Journal of Adolescent & Adult Literacy*, *57*(6), 483-491.

Anthony, L. (2014). AntWordProfiler (Version 1.4.1) [Computer Software]. Tokyo, Japan: Waseda University. Available from http://www.laurenceanthony.net/

Borgia, L. (2009). Enhanced vocabulary podcasts implementation in fifth grade classrooms. *Reading Improvement*, 263-272.

Burmark, L. (2004). Visual presentations that prompt, flash & transform. *Media and Methods, 40*(6), 4-5.

Coxhead, A. (2000). A new academic word list. *TESOL quarterly*, *34*(2), 213-238.

Dillingham, B. (2001). Visual portrait of a story: Teaching storytelling. *Juneau, AK: School Handout*.

Dip, J. M. R. B. P. (2014). Voices from the heart: the use of digital storytelling in education. *Community Practitioner*, *87*(1), 28.

Dong, Y. (2002). Integrating language and content: how three biology teachers work with non-English speaking students. *International Journal of Bilingual Education and Bilingualism, 5*, 40-57.

Hendry PM (2007) The future of narrative. *Qualitative Inquiry 13*(4): 487–498.

Hung, C. M., Hwang, G. J., & Huang, I. (2012). A Project-based Digital Storytelling Approach for Improving Students' Learning Motivation, Problem-Solving Competence and Learning Achievement. *Educational Technology & Society*, *15*(4), 368-379.

Lambert, J. (2002). *Digital storytelling: Capturing lives, creating communities*. Berkeley, CA : Digital Diner .

Lambert, J. (2010). *Digital Storytelling Cookbook.* Berkley, CA: Digital Diner.

Ohler, J. B. (2013). Digital storytelling in the classroom: New media pathways to literacy, learning, and creativity. Corwin Press.

Pearson, P., Moje, E., and Greenleaf, C. (2010). Literacy and science: each in the service of the other. *Science, 328*, 459-463.

Pegrum, M., Bartle, E., and Longnecker, N. (2015). Can creative podcasting promote deep learning? The use of podcasting for learning content in an undergraduate science unit. *British Journal of Educational Technology, 46*, 142-152.

Roadside Theater. (March 29, 2016). Imagining America: Artists and Scholars in Public Life. "Case Study: Story Circles as an Evaluation Tool." *https://roadside.org. https://roadside.org/asset/case-study-story-circles-evaluation-tool.*

Robin, B.R. (2008). Digital storytelling: A powerful technology tool for the 21st century classroom. *Theory into practice, 47*: 220-228.

Snow, C. E. (2010). Academic language and the challenge of reading for learning about science. S*cience*, *328*(5977), 450-452.

Silva, C., Weinburgh, M., and Smith, K.H. (2013). Not just good science teaching: Supporting academic language development. *Voices from the middle (20),* 34- 42.

West, M., & West, M. P. (Eds.). (1953). *A general service list of English words: with semantic frequencies and a supplementary word-list for the writing of popular science and technology*. Addison-Wesley Longman Limited.

Willox, A. C., Harper, S. L., & Edge, V. L. (2012). Storytelling in a digital age: digital storytelling as an emerging narrative method for preserving and promoting indigenous oral wisdom. *Qualitative Research*, 1468794112446105.

APPENDIX A: LANGUAGE ANALYSIS WORKSHEET

FIRST DRAFT SCRIPT ANALYSIS using AntWordProfiler and readability-score.com		
# of words in first draft		
What percentage of words are in Level 1?		Is this reasonable for your target elementary audience? Explain.
What percentage of words are in level 2?		Is this reasonable for your target elementary audience? Explain.
List the words from your script from the AWL (Academic Words list)		Is this reasonable for your target elementary audience? Explain.
List words identified as "Level 0" that you can identify as "Technical vocabulary" (you should sort through the Level 0 words and choose words you consider to be scientific vocabulary)		Is this reasonable for your target elementary audience? Explain.
On readability-score.com, what are your script's average grade level based on the readability formulas?		Which readability formula (Flesch-Kincaid, Coleman-Liau, etc) do you think most accurately represents your script? Justify your answer.
What stands out to you about your text's "quality" from the data shown? STATE ONLY DATA HERE, e.g., "there are 62 adverbs").		
Comment on what stands out to you from the other data generated from your script (reading time, sentiment, etc.) STATE ONLY THE DATA.		

FIRST DRAFT SCRIPT ANALYSIS using AntWordProfiler and readability-score.com	
Analyze the data above. Based on your information, will you revise your script? If yes, how so? Include specific examples from your script.	
If you have decided not to revise your script based on language analysis, defend your choices. How do you know your language will be appropriate for your audience? What evidence do you have to support this?	

APPENDIX B: PODCAST GRADING RUBRIC

	does not meet expectations	**meets basic expectations**	**exceeds basic expectations**
Story circle	Candidate does not provide suggestions to peers, or does not come prepared to participate in the circle	Candidate participates in both telling and listening to stories, and provides helpful feedback to at least one peer	Candidate meets basic expectations and provides multiple peers with thoughtful and useful feedback
Story script	Either the first draft or the final draft of the script is not submitted	Candidate submits both the first draft of the story and the final draft of the script showing changes	Candidate meets basic expectations and includes notes on the draft to show why s/he made the changes s/he did
language analysis	language analysis is not completed	language analysis is completed, includes data and analysis of data	meets basic expectations AND justifies decisions about language in a thoughtful way supported by evidence
Podcast basics	Podcast is not in an acceptable format OR is much longer than 10 minutes OR is less than 3 minutes	Podcast is recorded in Audacity, edited down to 10 minutes, and submitted to the instructor in .mp3 or .wav format	Podcast meets basic expectations AND includes music and/or sound effects that enhance the story
Science in the podcast X2	Science concepts included seem very loosely connected to the story or are explained in a way that could lead to misconceptions	Podcast includes general-audience appropriate explanation of relevant science concepts interwoven into the story	Podcast meets basic expectations AND explains science concepts in a way that is engaging and/or creative

Teacher's Guide: background information	Explanation of background concepts is lacking in detail OR is written at a level that is not appropriate for a general audience	Teacher's Guide includes brief explanation of background concepts that are relevant to the science concepts in the story	Meets basic expectations PLUS includes multimedia references to support learning (e.g., pictures, diagrams, links to videos etc.)
Teacher's Guide: academic language	Section on academic language includes only a few vocabulary words with general definitions (little/no attempt to tie to the story)	Teacher's Guide includes relevant academic language (both AWL words and scientific vocabulary) from the story, along with explanation of that academic language	Meets basic expectations AND academic language SUPPORTS are included in the teacher's guide (e.g., scaffolds to help students use the language)
Teacher's Guide: Activity/ Discussion	Activity included is only loosely connected to the science concepts OR discussion questions are superficial/rote in nature	Teacher's Guide includes inquiry-based activity relevant to the story/ concepts OR open-ended discussion questions that can help students discuss science ideas	Teacher's Guide includes inquiry-based activity relevant to the story/ concepts AND open-ended discussion questions that can help students discuss science ideas
Teacher's Guide: Standards and references	One of the elements in "meets basic expectations" is missing	Relevant NGSS standards and references are cited	Meets basic expectations AND includes a variety of interdisciplinary standards and/or extensive reference list