Personal Science Story Podcasts: Enhancing Literacy and Science Content

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Abstract

Podcasts (like “You are Not So Smart”, “99% Invisible”, or “Radiolab”) are becoming a popular way to communicate about science. Podcasts often use personal stories to connect with listeners and engage empathy, which can be a key ingredient in communicating about science effectively. Why not have your students create their own podcasts? Personal science stories can be useful to students as they try to connect abstract science concepts with real life. These kinds of stories can also help pre-service elementary or secondary teachers as they work towards understanding how to connect science concepts, real life, and literacy. Podcasts can be powerful in teaching academic language in science because through producing a podcast, the student must write, speak, and listen, and think about how science is communicated. This paper describes the personal science podcast assignment that I have been using in my methods courses, including the literature base supporting it and the steps I take to support my teacher candidates in developing, writing, and sharing their own science story podcasts.

Introduction

I think my science teaching methods courses must feel like “drinking from a fire hose” for teacher candidates at times. These preservice teachers are often balancing a full course load, a field placement, and a job or two; meanwhile, I am trying to give them opportunities to practice teaching science as inquiry, when they might still be struggling with their own grasp of the science content. Many of the elementary preservice teachers in my methods classes struggle to see the connection between their lives and science. On the other hand, many of the secondary preservice teachers in science methods classes struggle with the need to teach literacy while they teach science. One assignment that has given me an opportunity to enhance these connections– between students and teachers’ lived experiences and science, and literacy, and between themselves– is the personal science story podcast. This assignment can be used with elementary or secondary preservice teachers, and a modified version is available for students.

Stories are “at the heart of how we make meaning of our experiences of the world” (Huber et al., 2013, p.214). As a teacher explains in Lisa Delpit’s (2005) Other People’s Children, “teaching is all about telling a story. You have to get to know kids so you’ll know how to tell the story…” (p. 120). The stories we tell can show others who we are and what we value, and giving our students opportunities to tell their own stories shows them that we value them

and their stories, and that we want to learn more. In modeling teaching methods for my preservice teachers, I seek to show them that their stories matter, so that they may do the same for their own students. First, however, I need to help them figure out how to tell their stories, and why their stories are worth sharing. The stories come first, and then they connect the science.

Digital Storytelling

Digital storytelling is the process of using multimedia to tell a story, and is used in many different fields, including education, public health, and law. 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 science 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 teacher candidates, modeling methods by which these candidates can learn about their own students, and giving candidates an opportunity to practice connecting science to a real-life context, I designed the personal science podcast assignment. In collaboration with other methods colleagues, I have used the assignment with both preservice elementary and secondary teachers. These teacher candidates have used the assignment to reflect on their connections to science, and how they use language with their students (Frisch, Cone, and Callahan, 2017).

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). Much of the research on digital storytelling includes an approach of integrating photos, videos, and other images along with audio narration to tell a personal story (e.g., Couldry, 2008; Robin, 2008), and the approach detailed in this paper 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. One focus of this assignment is to encourage teacher candidates to think about the language they use: written and spoken. This led to the podcast vehicle to frame the assignment. Despite the auditory focus, the assignment can still be placed under the umbrella of digital storytelling because it includes each of the seven "elements of digital storytelling" (Lambert, 2002): point of view, dramatic question, emotional content, gift of your voice, pacing, soundtrack, and economy.

To frame lessons in methods courses, we refer to Social Justice Standards developed by Tolerance.org and based on Derman-Sparks' (1989) four goals for anti-bias education: identity, diversity, justice, and action. The personal science story podcast assignment provides teacher candidates an opportunity to engage with and reflect on the domains of identify and diversity as they relate to science teaching. The digital storytelling skills of remembering, creating, connecting, and sharing are interwoven within the assignment, and

each of these practices can help teacher candidates deepen their understanding of their own cultures and identities as well as give them an opportunity to learn about and show respect for the stories of others (Willox, Harper, & Edge, 2012).

Academic Language

Much as teacher candidates feel time pressure to “cover” large amounts of science content when they teach, those of us who teach science methods courses feel pressure to discuss a wide variety of topics in a limited amount of time. My own efforts to meet teacher preparation standards and make sure that my candidates are equipped with a wide variety of research-based best practices for teaching science inquiry has sometimes meant that I have not given my candidates much of an opportunity to think about how they will support science literacy and language development in their classrooms. The widely-used teacher candidate assessment, edTPA, as well as efforts to give teacher candidates more tools to support English Learners in science classrooms, have made me 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 less time for inquiry. The type of science inquiry that involves doing science– making predictions, designing investigations, and collecting and analyzing evidence—can be enhanced by conceptualizing science literacy as a form of inquiry (Pearson et al., 2010). The process of composing an appropriate, science-based question to ask and reading through and paraphrasing science texts and journals to communicate what is already known about the answer can be thought of as components of science inquiry (Frisch, Jackson, and Murray, 2017).

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). Preservice teachers initially focus 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, teacher candidates might make the assumption that their students already understand the difference between “analyze” and “interpret” rather than 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; once created, teacher candidates can 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 teacher candidates give their own students opportunities to create podcasts, has the potential to 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.

In this podcasting assignment, teacher candidates are encouraged to use their own language, in the context of their own stories. 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.

Procedure for Facilitating the Personal Science Story Podcast

Engage: Listen to Some Podcasts

To introduce the assignment to the audience (whether that audience is teachers, teacher candidates, or K-12 students), engage them by giving them an opportunity to listen to an example personal science story podcast. I have produced two podcasts to use as examples: one is 5 minutes (http://bit.ly/ISTE_worms) and another is 10 minutes (http://bit.ly/ISTE_helicopter). These examples are available on SoundCloud for public use, and the accompanying teachers' guides (discussed later) and podcasting resources are available on this website: http://storiesandatoms.weebly.com. Each semester, we ask our

teacher candidates for permission to post their podcasts on the SoundCloud channel, and we now have several other example podcasts available with permission (https://soundcloud.com/jennifer-frisch).

Another option is to share episodes from The Story Collider (http://www.storycollider.org/podcasts/), a podcast that allows scientists to share personal experience stories and connect these back to science. We note, however, that this podcast series was designed for adult audiences, and as such, some episodes are labeled “explicit” (usually for language and sometimes content). StoryCorps is another podcast that can be used in a variety of ways with students or teachers to demonstrate the idea of personal story podcasts; it uses an interview format to tell stories, and there are some examples of stories that reflect on personal science as well.

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. When we started doing this assignment, we noticed that many of our teacher candidates (particularly elementary preservice candidates) were struggling with connecting their real lives to science, and their stories started out either heavily expository (explaining a science concept in somewhat stilted language) or without any connections to science (e.g., a personal story without explicit connections to science concepts). Using a structured story circle early in the process has helped strengthen both the science and the narratives in candidates’ story podcasts, while also increasing their collaboration skills and sense of their class as a scientific community.

Students come prepared to participate in the story circle by bringing two ideas for stories from their lives that they want to tell; encouraging candidates to think of a story or stories that tell the audience something about their identity (who they are as a person, where they come from) can be helpful. 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. The guidelines posted by Roadside Theater found at https://roadside.org/asset/story-circle-guidelines?unit=117 (Roadside Theater, 2016) can be helpful to review with students before the circle begins.

After participating in the story circle, teacher candidates begin writing the script for their story. Although this process should be iterative, with opportunities for feedback and revision, some teacher candidates may need some initial support in constructing the backbone of their stories. 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 her 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 the story.

Explain: Researching the Science

Once students have begun to map out the general structure of their stories, the next step is to decide on a science concept they would like to research and connect 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: in fact, 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 lecture on the science concepts and their connections. 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.

Teacher candidates identify one or two ideas that their 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 a 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, an 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 questioning: find a question you want to know more about, and then research the answer to the question. This is a good time to discuss (or review) the difference between science questions that can/should be answered using experimentation and science questions that are better answered with library-based research.

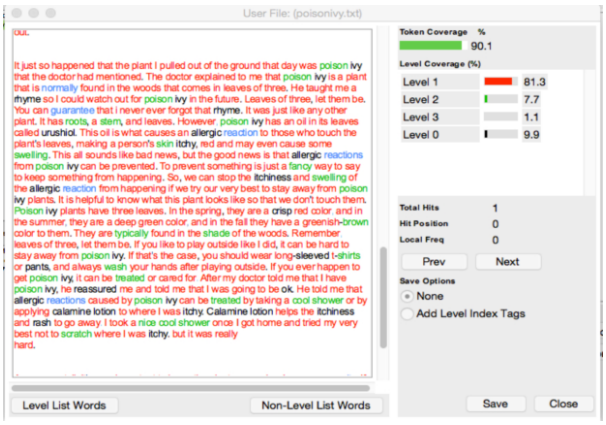
During this part of the project, talk about how to identify valid and reliable internet sources to help with research, and how to cite sources appropriately. As the candidates conduct their research, they often find more information than they need to answer their question. The next step is to add the science to the story podcast script. Examine the Next Generation Science Standards and identify standards that fit the science focus– these could be disciplinary content standards, science and engineering practices, or integration. Then the candidates can do their research on the science ideas, and work on putting their findings into appropriate language for the grade level band(s) they are targeting. At this stage it is helpful to 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.

Elaborate: Language Analysis, Justification, and Teachers' Guide

After teacher candidates have revised their podcast script to include both the story and the science, they 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.

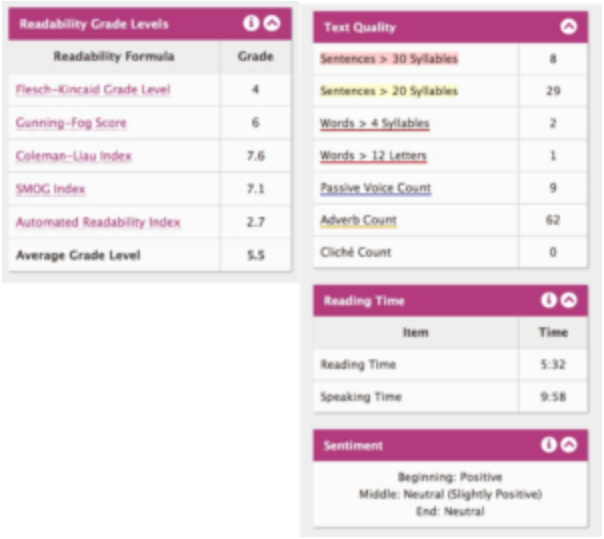
The academic vocabulary is analyzed using AntWordProfiler (Anthony, 2014), an open-source program that is available for free at (http://www.laurenceanthony.net/). Students input their script as a text file, and the output is color-coded (Figure 1), showing the number and percentage of words that are Level 1, or in the first 1000 most common words (red font color) in the English language according to the General Service List (GSL, West & West, 1953); Level 2 words, or the second 1000 most common words (green font color) from the GSL, Level 3 words (blue font color), or words on the Academic Word List (AWL, Coxhead, 2000); and Level 0 words (black font color), which are not found on any of previously mentioned lists. AntWordProfiler 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 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 (other "level 0" words could be proper names, slang, misspelled words, or other uncommon words: candidates have to determine which words they think are "scientific" and justify their responses).

Figure 1 (Click on image to enlarge). Sample output from the AntWord Profiler (Anderson, 2014) program after teacher candidate input her draft script.



The next part of the analysis uses readability-score.com to gather data on the readability of the 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). Although I note that students can often hear and understand text at a higher level than they can write or read, this step is helpful to get candidates thinking about some of their assumptions about what level of language they are using with students; secondary teacher candidates, in particular, often assume that students will understand complex words even if they are English Learners. The language analysis worksheet (Appendix A in the Appendices) 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 justify whether they think 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 data and justifying reasoning. In this case, the data is in the form of the information provided by the software: percentage of words at each level, readability scores based on different criteria, text quality and syllable counts. Based on these data, candidates make decisions while editing their script, and they must also justify their decisions using data. For example, a candidate that noticed that her script had 6 sentences in passive voice and 27 sentences with more than 20 syllabus decided to re-write all sentences to be in active voice and break up her long sentences to make the language both stronger and more accessible to her target group of students. Making and justifying decisions based on data are skills we are also trying to teach candidates to support in their students.

Figure 2 *(Click on image to enlarge)*. Sample output from the readability-score.com website after candidate submits the text of a draft of her planned story.



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

The Teachers' Guide is an extension of the podcast for teacher candidates. While the audience for the podcast should be a class of students, the audience for the Teachers' Guide is the students' instructor. If the podcast is used as an "Engage" activity, the Teacher's Guide can guide the "explore," "explain," and/or "elaborate" portions of a lesson: it provides a teacher with activities connected to the concept (explore) that students could do as well as background information about the concept (explain). Throughout the methods course, candidates have been practicing how to teach science by incorporating aspects of the Essential Features of Inquiry, and this framework is used to guide candidates in creating or adapting an appropriate activity for students that could connect science concepts with their story. Additional guidance provided to preservice teachers through the course includes practice with language supports such as graphic organizers, sentence starters, and sentence frames that could be used to enhance their students' developing science literacy. While developing their Teachers' Guides, candidates apply their skills in planning both inquiry-based activities that allow students to collect and make sense of data and language supports in the context of their science story. Required components in the teachers' guide include 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 collecting and/or analyzing data. Teacher candidates are asked to cite sources they used for enhancing their own understanding of the concept and any sources they used to develop the activities.

Evaluate: Assessment

For the final step in the project, candidates will 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). 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 used to assess the personal science story podcasts (Appendix B in the Appendices) is designed to support both the product and the process. At each part of the process, candidates are given extensive feedback to use for revision of the final project. The assignment integrates a variety of skills and objectives, so it is spread out through the semester, in connection with other methods being taught: for example, the story circle can be connected to an introduction to culturally responsive pedagogy, the language analysis component is connected to talk moves, and the Teachers' Guide construction is done in conjunction with practice with language and literacy supports. At the end of the semester, we have a "science story listening party" where 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.

On Sharing Student Stories

Many teacher candidates that have completed the assignment have found it to be meaningful in helping them gain skill and self-efficacy in using technology, in learning about science concepts and the Essential Features of Inquiry, and in language analysis. In addition, the process of creating and reflecting on individual (rather than group-created) digital stories can help preservice teachers show increased evidence of self-awareness and emotional engagement (Challinor, Marin, and Tur, 2017), and we have seen this in candidates completing this assignment through their final self-assessments, in which students report increased understanding of their identities and those of some of their colleagues. For some projects in the course, candidates express a strong preference to work in a group, but the "personal" aspect of the story podcast encourages them to push themselves, while still giving them a group "comfort zone" when making use of the story circle idea.

It 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 than 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, Canvas, Blackboard, etc.). Universities that have an iTunes U account often have tech support for uploading class-created podcasts to that platform. 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. One newer app/service, http://anchor.fm, shows promise for creating and publishing story podcasts using phones or tablets, including unlimited storage of episodes, analytics, and transcription, and it is free.

The preservice teachers with whom we have shared this project have found it engaging and valuable. Different teachers enjoy different parts of the project: some like the process of constructing a story, some enjoy researching and communicating about a science concept, 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. I ask them to reflect on what they learned from the project: many students reflect on the extent to which the project has taught them something about their colleagues, something about their connections to each other and to science, and something about the power of story to enhance or bring these connections to light.

Supplemental Files

Appendices.docx

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