

The Atoms Family: Using Podcasts to Enhance the Development of Science Vocabulary

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Podcasts can be valuable tools when used to reach students outside the normal school day and enhance their science vocabulary.

1st verse:

They're tiny and they're teeny,
Much smaller than a beany,
They never can be seeny,
The Atoms Family.

Chorus:

They are so small. (snap, snap)
They're round like a ball. (snap, snap)
They make up the air.
They're everywhere.
Can't see them at all. (snap, snap)

Chorus

2nd verse:

Together they make gases,
And liquids like molasses,
And all the solid masses,
The Atoms Family.

Chorus

3rd verse:

Neutrons can be found,
Where protons hang around;
Electrons they surround
The Atoms Family.

Chorus

—Kathleen Crawford (1994, p. 20)

The idea of using a tune that is over 40 years old to help today's students learn about science may not sound all that appealing or effective upon initial consideration. However, after discovering Crawford's (1994) clever interpretation of the theme

song from the classic television show *The Addams Family*, we decided to use "The Atoms Family" as part of a project we were conducting to investigate a relatively new information and communication technology (ICT), the podcast, on science-specific vocabulary development in fifth graders. Using the song as a method to "hook" students, our project used these increasingly popular audio broadcasts to reinforce and extend information on vocabulary that had presented challenges to students in prior years through repeated exposures to the terms and concepts. Our efforts were intended to address the current lack of research on podcasts and the limited research on vocabulary instruction in content area classrooms (Gunning, 2003; Scott, Jamieson-Noel, & Asselin, 2003), and to provide a potential tool to help students having difficulties with the increasing demands associated with reading informational texts in the content areas. In framing our research, we asked the following questions:

1. How does access to weekly podcasts of science-specific vocabulary affect fifth-grade students' vocabulary development compared to those who receive only regular instruction?
2. Do fifth-grade students given access to podcasts view them as effective in enhancing their vocabulary development?

Podcasting: Moving Instruction Beyond the School

Today's students are immersed in a world providing constant access to various ICTs, and application of this technology is rapidly becoming a regular part of their everyday lives. Thus, it is natural that educators, including those who focus on literacy, increasingly

seek ways to integrate various technological innovations, including digital media, into their instruction to reach this new generation of learners (Gagliolo & Nansen, 2008).

One of these technological innovations, podcasting, has taken the traditional audio broadcast and transformed it into a portable, digital media that is similar to a radio show, but one that people can subscribe to over the Internet to receive “shows” directly on their computer. The shows can then be transferred to a portable music player, like an iPod, offering the listener opportunities to hear content whenever and wherever they want (Rose & Rosin, 2006). Originally used primarily for entertainment or within higher education settings, podcasts have now become more common and there are numerous examples of teachers and students from kindergarten through high school using them to enhance learning (see Table 1).

In podcasting, educators have a new method to reach their students outside the school walls and to extend learning beyond the traditional school schedule like never before (Bongey, Cizadlo, & Kalnback, 2006). Referring to ICTs, like podcasts, Wyatt-Smith and Elkins (2008) expressed that “the home has become a key site for...learning” (p. 901). However, the question remains: Are we using podcasting effectively? Certainly using audio in education is not a new development, but from a practical standpoint, content presented in a podcast is inexpensive to produce, simple to use, portable, reusable, and beneficial to auditory learners (Smaldino, Russell, Heinrich, & Molenda, 2005). Podcasts offer opportunities to introduce or reinforce information from the classroom, to remediate students who need additional instruction or access to content discussed in the classroom, or to feature content experts or guest speakers under the guidance of a teacher external to the actual school building. Ultimately, content is designed to reach students in their zone of proximal development, to scaffold learning and support emerging capabilities (Vygotsky, 1978).

Due to the relative newness of the podcast as an educational tool in K–12 settings, data to support its effectiveness is limited. Examinations of student-produced podcasts have revealed increased motivation and higher-level thinking, and improvement in writing and listening skills (Dlott, 2007; Halderson,

Table 1
Examples of Educational Podcasts and Resources

Radio Willow Web
www.mpsomaha.org/willow/radio
Ten-minute podcasts featuring information on literature, geography, and math
Gadsden City Schools
www1.gcs.k12.al.us/~podcast
Several grade levels provide a variety of content including Readers’ Theater performances
Small Voices
kinderteacher.podomatic.com
A kindergarten teacher allows her students to express their growing literacy skills in a number of creative ways
Eagan High School: Honors Chemistry
www.eagan.k12.mn.us/fletcher/acn
Enhanced (video) and audio podcasts produced by students demonstrate and/or teach scientific concepts
Just Vocabulary
www.justvocabulary.com
A podcast to facilitate new vocabulary learning by introducing two challenging vocabulary words per podcast

Reflection Questions

- How did the teachers in this study ensure that their students were active learners using podcasts?
- Knowing that active learning is critical, how could podcasts be used to increase student interaction?
- In this study, the teachers created the podcasts. If you were to revise this strategy such that students themselves created podcasts to demonstrate their vocabulary learning, what would be the critical elements they should include?
- How could the supervised use of other electronic tools such as Twitter and YouTube be used to enhance vocabulary learning in subject area texts?

2006). However, this evidence was primarily anecdotal, and, with the current educational focus on accountability, podcasting needs to be linked specifically to achievement. To date, research providing this link is not available nor is research specifically addressing teacher-produced podcasts.

Vocabulary Instruction

Although the limited research on podcasting is representative of a relatively new area of inquiry, research on vocabulary instruction has a long history and was included as one of five fundamental components of reading instruction in the report by the National Reading Panel (National Institute of Child Health and Human Development [NICHD], 2000). Recently, Pearson, Hiebert, and Kamil (2007) noted, “After a nearly fifteen-year absence from center stage, vocabulary has returned to a prominent place in discussions of reading, and it is alive and well in reading instruction and reading research” (p. 282).

Research has shown that vocabulary knowledge is a critical factor in comprehension, fluency, and achievement (Alvermann & Phelps, 2002; Ehri & Rosenthal, 2007; Stahl & Fairbanks, 1986). However, researchers have concluded there is no single best method for vocabulary instruction (NICHD, 2000)—students should encounter both direct and indirect methods of instruction when learning new vocabulary (Blachowicz & Fisher, 2000; Graves & Watts-Taffe, 2002). Indirect methods include providing multiple opportunities for reading or listening to text within a rich verbal environment (Baumann, Kame’enui, & Ash, 2003; Graves, 2000). Direct instruction, on the other hand, can take various forms including teaching specific vocabulary prior to reading (Harmon, Hedrick, Wood, & Gress, 2005; NICHD, 2000); fostering word consciousness (Graves & Watts-Taffe, 2002); teaching word learning strategies, such as structural analysis (Baumann et al., 2003; Graves, 2000); providing multiple exposures to words in various contexts (Baumann et al., 2003; Stahl, 1999) and teaching definitional information (Juel & Deffes, 2004; Stahl, 1999). Researchers estimate instruction explicitly focusing on vocabulary development can lead to an increase of up to 400 words per year (Beck, McKeown, & Kucan, 2002). Dunn, Bonner, and Huske (2007) found students initially scoring around

the 50th percentile increased their reading comprehension scores as much as 30 percentile points after receiving direct instruction in vocabulary.

Examinations of vocabulary instruction with regard to the content areas have also revealed it is beneficial to student achievement (Vacca & Vacca, 2005). However, teachers often find it difficult to schedule time for direct instructional activities related to content-specific vocabulary (Anderson & Nagy, 1991; Scott et al., 2003). This is problematic in that content area textbooks contain increasingly sophisticated vocabulary and terminology that is crucial to learning concepts presented in the various content areas (Blachowicz & Fisher, 2000; Harmon et al., 2005). Scott et al. were only able to identify five studies that were conducted in content area classrooms and have called for further research to examine vocabulary development in the content areas.

Combining Podcasting and Vocabulary Instruction: Our Study

As a result of our experiences and the general lack of research investigating content areas and vocabulary, we decided to test whether podcasts could be used to enhance science-specific vocabulary development in fifth-grade students. Research has already shown that digital tools can be used to support multiple exposures to words (Kamil, 2004), thus we felt the ease of use and portability of the podcast, coupled with the opportunity for students to access teacher-produced content outside the traditional school day, presented a viable educational tool to help students review and, subsequently, learn content area vocabulary.

We conducted our research in a suburban school that served primarily middle to upper-middle class families—fewer than 12% of the enrolled students received free or reduced-cost lunch. Of the 58 fifth-grade students who elected to participate, all indicated that they had access to a computer or digital media player in their home or at school. Approximately half of the students received access to the podcasts, while the others received classroom instruction only. This is an important characteristic for our study, as access to the podcasts was not based upon membership in individual classes. Instead, students were randomly selected from three sections of science classes,

which meant classroom instruction was the same for all students.

Organization of Classroom Instruction

Before we began instruction for the unit from which the vocabulary words were drawn, students' knowledge of 22 science terms was assessed using a multiple-choice pretest. We selected our words based upon their importance for understanding content from the text and the degree of difficulty previous students had encountered in learning and understanding them in the past.

For our instruction, we decided to use a specific weekly format that was based upon research-based strategies for teaching vocabulary. Each week, instruction began with an introduction to the vocabulary words and textbook definitions within classroom discussions led by the teacher (Harmon et al., 2005). This allowed us to establish common definitions for the class and to informally assess understanding prior to reading content featuring the words. To reinforce the vocabulary definitions and vocabulary-related content introduced in class, students were required to read passages within their textbooks, both inside the classroom and as homework. This activity also provided continued exposure to the vocabulary words in context throughout the week (Baumann et al., 2003; Graves, 2000; Stahl, 1999). To avoid reliance solely on conventional definitions, each week the students wrote vocabulary cards, which included definitions of the vocabulary in their own words and sentences that featured the word in context (Juel & Deffes, 2004). These vocabulary cards were maintained in individual student binders and used for review and reference within demonstrations and experiments.

Throughout the week, the students viewed demonstrations of the ideas and concepts associated with the vocabulary in experiments or with visual aids to provide interconnections between the concepts and vocabulary. In addition, students were given opportunities to conduct their own experiments or manipulate the visual aids as reinforcement for the information (Nagy & Scott, 2000). Directions for the experiments contained multiple references to the vocabulary words, allowing students to see the word used within different contexts (Juel & Deffes, 2004). The experiments were followed by question-and-answer periods where the students were encouraged to explain the

processes associated with the experiments using the vocabulary. Finally, near the end of each week, the teacher posed application-specific science questions to the students and required the use of the applicable vocabulary terms in the responses.

Creating and Incorporating Podcasts

The podcasts used within our project were created and published weekly for seven consecutive weeks. To provide a predictable pattern for the students, we also developed each podcast using a consistent format. We focused on starting each one with an engaging introduction, such as the song "The Atoms Family," to help immediately pull our listeners into the content. We felt this introduction was vital because if the students weren't immediately drawn to listen, they would be less likely to concentrate on the rest of the information in the podcast. To ensure retention of prior words, we followed the introduction with a review of the vocabulary that had been featured in prior podcasts (Baumann et al., 2003). Within this review, we posed questions that required the students to mentally recall their definitions or the words themselves. This was followed by a review of the new vocabulary words and common classroom definitions that were used on the first day of instruction for the week. Passages that featured the vocabulary words in context were included to reinforce the definitions (Baumann et al., 2003; Graves, 2000). To avoid continued passive listening by the students, after the presentation of definitions, students completed mental and active response activities. For example, within several podcasts, students were required to mentally supply a missing vocabulary word to complete a sentence (Juel & Deffes, 2004; Stahl, 1999). On the other hand, activities we categorized as active response typically required the podcast to be paused temporarily and included such activities as underlining the vocabulary words within "The Atoms Family" lyrics or writing a sentence using the selected vocabulary word (Baumann et al., 2003; Stahl, 1999). Each podcast concluded with a mixed review of the definitions for the current week's words—some common definitions were repeated verbatim, while other words were reviewed with mental response exercises, such as asking students to define thermal energy in their own words (Juel & Deffes, 2004).

Once the script was prepared using this format, we practiced it several times and then recorded the

podcast. We posted the recorded audio file in .mp3 format to a blog that was specifically created for the purposes of this project. The use of a blog enabled us to communicate directions for downloading the podcasts and specific information about each podcast, and it allowed parents and children to comment on problems or ask questions regarding the podcasts. Parents and students could subscribe to the blog via RSS feed or through e-mail announcements to download a new podcast when it was published. A written reminder was also sent home to make sure that all parents and students were aware of the following week's vocabulary words and to note the date of availability of the next podcast, which was typically the first day of instruction for the week.

We did this to ensure the vocabulary words could be introduced within the classroom context before students listened to the podcast.

Instructions to students and parents asked them to listen to each new podcast at least once per week to review information on the vocabulary.

We also encouraged the review of all podcasts throughout the instructional period for the unit. To ensure students listened to new podcasts at least once per week, they were given an opportunity to listen to the podcast at school, but not as part of the regular classroom instructional time shared with students who did not receive access. Typically this occurred when students completed assignments early or during the regularly scheduled visit to the computer lab.

At the end of the unit, a posttest that assessed all vocabulary words was administered. We also asked the students who had access to the podcasts to complete a brief survey that provided us with information on their views of the experience and the perceived usefulness of the podcasts to them. Each of the questions used a Likert scale (1 = strongly agree, 2 = agree, 3 = disagree, 4 = strongly disagree) and was followed by a prompt for an open-ended response to gather general (anecdotal) information about the students'

views of the podcasts and their perceptions of the impact of podcasts on their learning.

Our Results

To begin our analysis, we computed the average scores of each group (with and without access to the podcasts) on the pre- and posttest. Analysis of these averages revealed that the group of students with access to the podcasts started with slightly higher vocabulary scores ($M = 12.59$) than the group that received only classroom instruction ($M = 12.28$). Posttest means revealed an average increase of seven correct answers ($M = 19.76$) compared with about five for the instruction-only group ($M = 17.21$). We followed these initial analyses with a more advanced statistical procedure, an ANCOVA, to eliminate the initial group differences and compare the posttest scores of the two groups. The ANCOVA revealed the increase in scores on the vocabulary tests for the group given access to the podcasts was significantly greater than those in the group that received only classroom instruction.

Our examinations of the survey responses revealed that the students held positive views of the experience. All students given access to the podcasts agreed or strongly agreed that the podcasts made them more motivated to learn science vocabulary. In addition, 76% of students agreed or strongly agreed with the statement, "The podcasts made science vocabulary interesting." One student commented, "You get to listen and learn more because it grabs you in." Perhaps more important, 86% of students indicated that the podcasts helped them learn their science vocabulary. Positive responses regarding podcasts included:

"It helped us learn more."

"We could learn at home and not just at school."

These responses are certainly encouraging, however, as we looked a little closer at students' answers to this last question, we found confirmation that not only did students view the podcasts as beneficial, but also that these benefits were best realized using the podcasts as a method to review material that was covered in class. For example, one student wrote, "The podcasts helped me to review what we talked about at school." Similarly, another commented, "I listened to them when I forgot what we talked about in



class.” Referring to the definitions contained within the podcasts, a third student wrote, “I listen to things that I may have missed, and repeat it to get things in my head.” We also found one comment especially insightful for a future use of podcasts. One student, who was absent on one of the days the vocabulary was introduced and discussed remarked, “The podcasts were really helpful the day I was sick because I could get caught up.”

Pulling It All Together: Why Did We Achieve Success?

Several studies (see Dlott, 2007; Halderson, 2006) have already shown us that podcasts are effective tools for motivating students. However, until our research, we didn’t have a specific link between podcasting and gains in achievement. Although the difference between our two groups of students is not tremendous and we must acknowledge that the gains could be attributed to students spending more time on the vocabulary words, the fact that the difference is statistically significant confirms that there is potential for using podcasts for vocabulary development. In our view, we are only scratching the surface of what can be accomplished and must continue to look at why this may have worked for our students and how it can be effective for others.

There are several reasons why we believe we met with success in this study. First, the format we chose to use for our podcasts allowed us to use numerous, effective vocabulary strategies in a digital format to help students review material outside of school. Typically, when students leave the classroom, the teacher no longer has control over how material is accessed or reviewed. However, podcasts allowed us to provide continued guidance and review of content in a manner that we knew was beneficial for student learning. As we noted, our podcasts provided the students with multiple exposures to the words using definitions (formal and informal) as well as contextual passages featuring the words. Keeping in mind that students wouldn’t listen to a string of definitions or passages, no matter how dramatically we presented them; we feel that including opportunities for students to stop and apply knowledge of the vocabulary in meaningful ways, as recommended by Scott et al. (2003), also made a significant difference. We also integrated specific information discussed in class,

which allowed the students to link the podcasts to the discussion and experiences that occurred in school. For example, pertaining to the word *combustibility*, we talked about what it means to be combustible and related this to a class discussion on fire and burning, which led to a review of the definition as it related to chemical properties.

Second, the podcasts were informal. We knew that we needed to capture student interest quickly to motivate them to want to listen. For unmotivated students, the podcast just becomes background noise with little overall comprehension of what is being said. We purposely made the feel of the podcasts relaxed, almost conversational. We included pauses for dramatic effect, used sound effects like clapping or cheering, laughed, told a joke once in a while, and used music that we thought fifth graders would enjoy within the opening and closing of the podcasts to draw them in. We have to admit, though, that the music part was a little challenging, as there was a definite difference in opinion about good music between us and the students!

Finally, we feel our attention to the aforementioned characteristics created the conditions necessary for student engagement. We do acknowledge the fact that because podcasts are a nontraditional educational medium, for students, doing something different is often motivating in and of itself. However, information from the survey and student comments reinforced that students accessed them to review the material discussed in class and, in the case of the absent student, chose to use them as a means to access material. If the students weren’t motivated to listen, neither of these activities would have occurred. In our only critical comment, one student responded, “Some times they were just a littel boaring [*sic*].” We can infer that even though the podcasts weren’t always as stimulating as this student would have liked, she still listened to multiple episodes.

Moving Forward: Creating Podcasts

We have a rich history of research on vocabulary, but a limited one when it comes to podcasting. As we look to increase the usefulness of this potentially helpful tool, we may need to examine how we can modify what we already know works in the classroom to a digital format useful outside the classroom.

To help others who have an interest in implementing and studying podcasts, we have synthesized a list of considerations for making podcasts (see Table 2) and included a list of resources to consult (see Table 3). We would also suggest examining the recent work of Davis and McGrail (2009), which provides examples

of several authentic activities using podcasts and an excellent overview of the process of making a podcast using Audacity.

We also think this is the proper time to address several important considerations to help continue the efforts started with this study. First is the important question of accessibility. We were fortunate that our students had access to computers or .mp3 players at home or school. All students do not share this access, so it's essential to consider methods to provide equal access and opportunities to all students. We have two recommendations to ensure all students have equal opportunities to listen. If there is access to a computer in the classroom, allow students to listen to the podcast as part of regular instructional time or within a free time period. We elected to allow students to listen at school, which we believe was beneficial in providing not only access, but also multiple exposures to the content. The other option is to bypass the computer and load the podcasts directly on an inexpensive audio player, which can be loaned out overnight or for short periods of time. This does not mean going out and buying several iPods, as we know this would quickly become too expensive. We

Table 2
Considerations for Teaching Vocabulary Using Podcasts

1. Don't rely on traditional definitions—use your own or have students develop their own and use them.
2. Include information that utilizes the words in context—periodically read portions of text that include the targeted vocabulary word.
3. Don't just lecture—Keep the tone light and create the podcasts to feel like a conversation.
4. Make them interactive—Students should have to stop the podcast periodically to process the information and complete a brief activity.
5. Be spontaneous—Students are not going to listen to the podcasts if they are not interesting or motivating, so add sound effects or an occasional joke.

Table 3
Podcasting Resources

- Learn to Podcast (Apple Computers)
www.apple.com/ilife/tutorials/#garageband-podcast-51
Provides an online tutorial of podcasting with Garageband, Apple's software for creating podcasts. See also www.apple.com/support/garageband/podcasts.
- Podcasting with Audacity: A Tutorial
www.teachertube.com/view_video.php?viewkey=23dc8f4753bcc5771660
A video tutorial for creating podcasts using Audacity, free software that can be used to create the audio files used in podcasts.
- Podcasting for Dummies
Located within iTunes, this is a free podcast that is meant as a companion to the book of the same title. Basic information for preparing podcasts is presented.
- PodOmatic
www.podomatic.com
A free website that allows registered users to create podcasts and hosts the podcasts on the website for listeners to subscribe to.
- KidCast: Learning and Teaching with Podcasting
www.intelligenic.com/blog/
A blog and podcast maintained by Dan Schmit to aid educators in learning to create and use podcasts in the classroom.

suggest looking around to find the models priced similarly to a quality hardcover book.

A second recommendation centers upon allowing students to create their own vocabulary podcasts. The benefit in providing students ownership within the creative process is that it allows them to use higher-level thinking skills as they create the content, formulate the scripts, and edit the final product. The literature base for vocabulary instruction is extensive; again, the challenge lies in modifying the activities to fit the new, digital format. One example we propose is to use Ruddell and Shearer's (2002) vocabulary self-collection strategy as it presents a unique opportunity not only to involve students in selecting their own words, but also to create podcasts designed to teach other students the vocabulary definitions and uses. Within the podcasts, students can share the essential components of the strategy: where the word is located, the meaning of the word, and the importance of the word for the rest of the students in the class. Once proficiency is gained in the audio-only format, this could be extended to visual components to reinforce information for students who exhibit visual preferences.

The final recommendation is not to let students' age influence decisions to use podcasts as a tool in the classroom. A quick search of iTunes will show that Dora and the characters from Sesame Street have joined the ranks of podcasters, thus this medium is not just for use with older students. This fact and the conclusions of recent research that revealed vocabulary instruction as missing from instructional programs for young children (see Neuman & Dwyer, 2009), may show the time is right to try podcasts as an alternative solution. There are several potential formats or activities that can be created and used to reinforce information for students. For instance, to facilitate sight word vocabulary growth, a recording of an adult reading an easy reader book could be made and published for students to listen to or read with. This would provide children multiple exposures to the words as well as opportunities to see and use vocabulary in context. It would also be beneficial for the development of fluency. This podcast could also include directions to locate a word that had been previously introduced on the page of the accompanying text to practice finding the word in context and to review prior vocabulary words. For teachers seeking the additional challenge of video podcasts, vocabulary could be reviewed using picture prompts to assist

students in connecting the words and their meanings. The possibilities are endless with a little ingenuity.

Addressing the Needs of 21st-Century Learners

Ehri and Rosenthal (2007) noted that it is "essential to advance our understanding about how student vocabularies can grow and how instruction can support this" (p. 390). With the current focus on accountability, we need to begin to explore our own understanding and use opportunities to reach students outside the normal school day with the variety of digital tools at our disposal. Podcasts created by teachers represent one such tool as they provide a method to address the needs of the 21st-century learner through access to educationally sound, class-related content like never before. With the growing popularity of podcasts and the creativity exhibited by teachers like Kathleen Crawford in developing songs like "The Atoms Family," we have a unique opportunity to grab students by the ears, but unlike the pioneer school teacher, this time it's in a positive manner—we just have to make that first podcast!

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