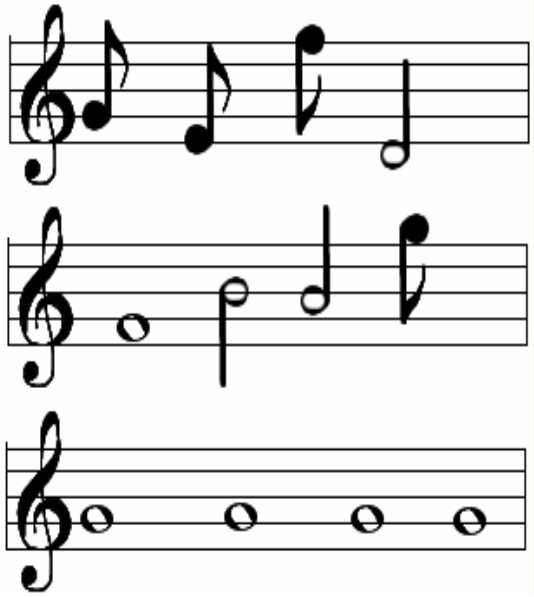
Teaching & Learning Science Through Song: Exploring the Experiences of Students & Teachers



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Initial Concept

Teaching Experience:

- Early Childhood experience
- Success with songs in middle grades

Eric Jensen Advocates:

- Societal-Cultural aspects
- Emotional impact
- Brain-based learning theory

Existing Research:

- Calvert and Tart, 1993 – Schoolhouse Rock
- Wallace, 1994 – Melody helps remember text
- Campebello, et al. 2002 – Gaines in subject matter knowledge

Research Questions

- In what ways do teachers use science-content music in the curriculum to enhance instruction in the middle school science classroom?
- How can the use of science-content music as a teaching strategy impact student interest, engagement and understanding of science content and concepts?
- What does the experience of students and teachers using science-content music suggest about its potential for teaching and learning science?

Methodology: Multiple Case Study

Theoretical framework:

- Constructivism

Case study research:

- Constructs understanding of phenomena based on related experiences.
- Explores the phenomenon in its natural setting.

Multiple case studies:

- Examine a single issue, illustrated by multiple cases.
- Four to ten cases is ideal.
- Observes the ***"quintain"*** – the common concept (use of science content music for learning)

Cases boundaries:

- Middle school science classroom
- Teacher and students
- Use of science songs for teaching/learning

Participants

TABLE 3.1: Site Demographics

School	Caucasian	Hispanic	Other	Disadvantaged
A	84	13	3	29
B	67	22	11	44
C	84	11	5	41

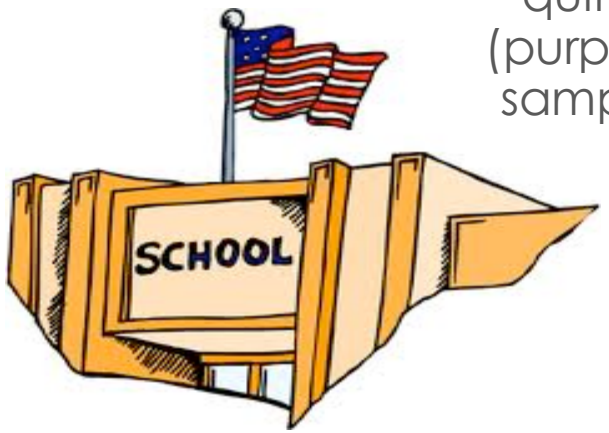
Participating teachers where selected based on the following criteria:

- Participating school district
- Middle school
- Science
- Implementation of strategy

Teachers included:

- Sixth grade - 2
- Seventh grade - 1
- Eighth grade - 3

According to Stake (2006), sampling is not an appropriate strategy for multiple case study research. Cases are selected based on opportunity to observe the quintain (purposeful sampling)



Data Sources

TABLE 3.2: Data Collection Methods

	Research Questions		
Primary Methods of Data Collection to Address Research Questions	In what ways do teachers use science-content music in the curriculum to enhance instruction in the middle school science classroom?	How can the use of science-content music as a teaching strategy impact student interest, engagement and understanding of science content and concepts?	What does the experience of students and teachers using science-content music suggest about its potential for teaching and learning science?
Teacher Interviews	X		X
Classroom Observation	X	X	
Student Focus Groups		X	X

Data source triangulation was included within cases in this study by collecting multiple types of data: classroom observations, teacher interviews and student focus groups.

Data Collection

Initial Meeting:
- Consent & IRB protocol
- Orientation & Incentives
- Initial Interview

Observation:
- Twenty to thirty minutes each

Focus Groups:
- Following observation
- 57 students 9 groups; 4 – 9 students each
- Incentive given: CD

Second interviews:
- Shared observation/focus group analysis
- Discussed experience to date

Third & Final Interviews:
- Dec. 8, 2010 – Jan. 3, 2011
- Shared data analyzed from prior interviews
- Inquired about teacher experience & perspective

Data Analysis for Individual Cases

- Interviews transcribed
- Inductive, open coding method
- Analytic memos
- Themes identified based on research questions
- Summary of each case prepared using thick, rich description
- Member check process for validity

Case 1: Derek Martin's Classroom

Background:

- 12 years experience
- Advanced content, eighth grade, physical science

Implementation:

- "Atom Shack"
- "Some Kind of Energy"
- "Conduction, Convection, Radiation"

Observation:

- Energy – Mini-posters

"I could tell that these were not just songs that mention science words… the lyrics themselves were packed with information and concepts and examples."

Themes:

- Understanding of scientific terms
- Lots of content in short time
- Examples & explanations
- Important to analyze songs
- Easy to use
- Multiple levels of understanding
- Connects ideas in science

Case 2: Sandy Kingston's Classroom

Background:

- Tenth year teaching
- On-level, sixth grade, earth science

Implementation:

- "Conduction, Convection, Radiation"
- "Lonely Fossil"
- "Water Cycle"

Observation:

- Heat transfer – Dance

"There was not, I mean out of all the students, there wasn't one student that did not want to do this. Not one. And that's what… I kept waiting for every period. There's going to be somebody that's going say, 'I don't want to do this!' And it never happened. They were all like, 'Wow!' They had a great time."

Themes:

- Perception of improved test scores
- Active learning
- Earworms engage longer
- Uses as a study strategy
- Instructional contagion
- Help reinforce concepts
- Universal appeal

Case 3: Martha Russell's Classroom

Background:

- Fourteen years teaching, 8 early, 5 recent
- On-level, sixth grade, earth science

Implementation:

- "Rock Cycle"
- "Tectonics Rocks"
- "Conduction, Convection, Radiation"

Observation:

- Plate tectonics – PowerPoint & interpretation

"It was something to look forward to; it was something they could relate to, because of the music. It is cool. It was cool to them, and therefore it's cool to me, because we're getting the ideas across."

Themes:

- Visualization of concepts
- Enhances vocabulary
- Active learning
- Mnemonic device
- Repetition builds ownership
- Content presented in way students care about

Case 4: Betty Taylor's Classroom

Background:

- Thirty years teaching
- Advanced content, eighth grade, physical science

Implementation:

- "Some Kind of Energy"
- "Conduction, Convection, Radiation"

Observation:

- Heat transfer – Note taking & comparing to text

"It's 'speaking science' because I think it's the vocabulary that brings them down…. They know what they experience, they know what they witnessed in the lab and activity, but attaching the language to that is where they [fail]."

Themes:

- Promotes science discourse
- Opportunity to address misconceptions
- Active learning
- Mnemonic device
- Socio-cultural appeal
- Connects ideas and organizes knowledge

Case 5: Anna Darcy's Classroom

Background:

- Eighteenth year teaching
- On-level, seventh grade, life science

Implementation:

- "Cell Castle"
- "Mendel the Mighty Monk"
- "Evolution"
- "Evolution Revolution"
- "The Lonely Fossil"
- "Kingdom, Phylum, Class & Order"

Observation:

- Evolution – Underline, hand motions

"I want them to have it, I guess in their mind. Not only that little jingle, but what it meant. Why would he choose to put that in a song?… And then it makes a connection and then they're like, 'Oh!'"

Themes:

- Tell stories
- Emphasis of concepts through repetition
- Change of pace in learning
- Socio-cultural aspects can conceal engagement
- Lyric analysis important activity

Case 6: Max Cantor's Classroom

Background:

- Ninth year teaching
- On-level, eighth grade, physical science

Implementation:

- "Some Kind of Energy"
- "Conduction, Convection, Radiation"

Observation:

- Heat transfer – Mark terms & facts, add questions and content

"We have to apply our learning to them, and make it real for them, and with songs… they all have their iPods, they all want to listen to music, and it kind of makes them feel like, 'Okay, you know something about me. You know that I like music. You know so you're trying to teach in a way that you think I might enjoy.'"

Themes:

- Alternative explanations & examples
- Content-rich
- Novelty engages students
- Prolonged engagement
- Special appeal to students
- Analysis connects ideas

Cross Case Analysis

Common Characteristics:

- State standards and instructional framework resulted in common songs

Divergence Across Cases:

- Not all students like learning science with songs. One student preferred textbook learning.

Multi-Case Analysis:

- Merging of themes developed independently.
- Synthesis of findings from each case.

Table 5.2: Assertions from merging cases during Cross-Case Analysis

	DM	SK	MR	BT	AD	MC
Research Question 1: In what ways do teachers use science-content music in the curriculum to enhance instruction in the middle school science classroom?						
Assertion: Songs help students develop scientific vocabulary.						
• Build understanding of scientific terms	X					
• Build vocabulary base			X			
• Develops language of science				X		
Assertion: Songs provide students with an additional resource to construct meaning of science concepts.						
• Providing alternative examples	X					X
• Explaining key ideas						X
• Visualization of concepts			X			
• Telling stories					X	
Research Question 2: How can the use of science-content music as a teaching strategy impact student interest, engagement and understanding of science content and concepts?						
Assertion: Songs provide novelty and variety in the learning environment.						
• With novelty or change in environment	X				X	X
• With active learning		X	X	X		
Assertion: Songs are mnemonic devices that aid students in learning						
• As a mnemonic device			X	X		
• As a part of a study strategy		X				
Research Question 3: What does the experience of students and teachers using science-content music suggest about its potential for teaching and learning science?						
Assertion: Music has a socio-cultural appeal for students that can be utilized in science instruction.						
• Instructional contagion		X				
• Music has a universal appeal		X				X
• Students care about			X			
• Songs have socio-cultural appeal				X		
Assertion: Lyric analysis can help students connect ideas and build conceptual understanding.						
• Lyric analysis helps students connect ideas and organize knowledge	X			X	X	X

Assertion 1:
The use of science-content songs impacts learning by helping students develop scientific vocabulary.

Connection to the literature:

- Important to learn the language and discourse of science.

***Talking Science*:**

- "Every specialized kind of human activity, every subject area and field, has its own special language"
- Mastery of language is key to understanding any subject.

Taking Science to School:

- Learning to "talk science" involves a specialized structure and style.
- Requires opportunities to use the language in a variety of activities.

Supporting data:

- I think it worked for introducing them to you know, here's some important words or key ideas.
- It defined the words… it actually defined the meaning of them.

Assertion 2:
Science content songs impact learning by providing students with an additional resource to construct understanding of science concepts.

Connection to the literature

- Multiple examples and explanations builds understanding.

Taking Science to School:

- Use multiple resources and symbolic tools for building conceptual understanding

***Talking Science*:**

- Concepts developed during learning activities symbolically through language. Suggested strategy, "Repetition with Variation" to build conceptual understanding

Supporting data:

- Songs presented the material in a slightly different way… It kind of gave some other examples and used some other vocabulary.
- Sometimes we don't understand what the teacher says. Maybe you'll understand better how the song says it.

Assertion 3:
Songs provide novelty and variety in the learning environment.

Connection to the literature:

- Engagement influences attention, effort and willingness to participate.

Taking Science to School:

- Difference between engaging in the activity of science and in terms of interest in learning (2nd type applies)
- Novelty increases situational interest and has a positive effect on learning.

Effective Science Instruction:

- Principles of engagement can "hook" student interest in learning early in the instructional process

Supporting data:

- I had three emails that came in and just said this… they really enjoy learning and you've made it fun.
- We always go with the fun one, and that always works. We learn more stuff from that.

Assertion 4: Songs are mnemonic devices that aid students in learning

Connection to the literature:

- How information is stored and retrieved
- Prolonged engagement with concepts

Taking Science to School:

- Science is "both a body of knowledge… and the process whereby that body of knowledge has been established"

Effective Science Instruction:

- Metacognitive strategy to build understanding of science concepts.

***Science Framework for the 2009 Assessment*:**

- Some assessment items based on recall of knowledge
- More complex questions require recall of content

Supporting data:

- We can't help but sometimes have lyrics stick with us. So even just as an academic learning device, it's great.
- You think about it and sing in your head and you're like, "Oh, I knew that!"

Assertion 5:
Music has a socio-cultural appeal for students that can be utilized in science instruction.

Connection to the literature:

- Socio-cultural aspects of learning.
- Music is a part of the culture of digital natives ("it's worth something")

Taking Science to School:

- Personal interest is a form of intrinsic motivation and connects to achievement.
- Learning involves factors of engagement related to interest and attention.

Effective Science Instruction:

- Students learn when they are motivated "and intellectually engaged in activities and/or discussions focusing on what they already know"

Supporting data:

- I think they're more receptive to songs and music.
- We go on iTunes and buy music. It's worth something. If you associate learning with something that's worth something, then people will want to learn.

Assertion 6:
Lyric analysis can help students connect ideas and build conceptual understanding.

Connection to the literature:

- Importance of sense making activities to connect ideas and understand concepts

Taking Science to School:

- Conceptual scaffolds help students build understanding of new concepts and connect learning to prior understandings.

Effective Science Instruction:

- Sense-making activities:
  - Draw conclusions from experiences
  - Connect activities to content
  - Apply concepts to new situations
  - Organize new knowledge
  - Integrate learning into existing mental models of concepts.

Supporting data:

- They've got to see the lyrics to make some connections with what the science is and what they're currently learning.
- So you like you get into it and like really it's talking about what we've been learning.

Implications for classroom instruction

Socio-cultural appeal of Music:

- Music, like learning, is socio-cultural in nature and speaks to students in unique ways
- Teachers or strong student leaders must appear to be involved in order for some students to "buy-in."

Sense-making activity:

- The more ways science content is presented, the more opportunities students will have to connect ideas and organize knowledge.
- Songs work in the same way Banilower, et al. describes an interactive lectures.

Conceptual Scaffold:

- Lyric analysis activity is critical as students pull out key words, definitions, identify alternative examples, and explore analogies & puns embedded in the song.

Engagement:

- Interest can be personal or situational; it influences attention, effort & willingness to participate in learning.

Notes:

Songs can provide a lot of content in a short time.

Not suggesting songs replace other activities, but can supplement them.

Implications for science education

Importance of developing sense-making activities: *Effective Science Instruction:* important to include activities to promote sense-making, which are often inadequate or missing in instruction. Songs should be considered as a viable teaching strategy that can be used to fill that gap.

Nature of Learning: Teacher data concentrated on learning in terms of conceptual development. Students viewed science learning as a body of knowledge to be remembered, then recalled.

- Why the perceived difference?
- What are the implications?
- How do we address it?

Note:
Use of science music is valuable in bridging student goals for recalling content and educational goals of developing concepts.

Implications for further research

Qualitative research: Are there specific types of knowledge that science songs are most useful for developing?

Quantitative research: Are there measureable learning differences when students use songs for learning?

Other questions:

- Diverse populations?
- Genres?
- Instructional levels?
- Instructional implications?
- Songwriting for learning?

Conclusions

Science songs have a variety of uses at different levels of learning, and have the potential to enhance student understanding of science concepts in different ways.

Learning with songs has implications tied to best practices and research to help students construct meaning of science concepts.

Lyric analysis activities are critical for use as a conceptual scaffold.

Science content music has implications for instruction from different learning theories.

It can be used most effectively for conceptual development when implemented in a sense-making context.