Science Song Project: Integration of Science, Technology and Music to Learn Science and Process Skills

Jiyoon Yoon
Department of Curriculum and Instruction, University of Texas, Arlington, Texas USA
E-mail: jiyoon@uta.edu

Kyoung Jin Kim
Department of Early Childhood Education, Wheelock College, Boston, Massachusetts USA
E-mail: kkim@wheelock.edu

Abstract

It has been critical to find a way for teachers to motivate their young children to learn science and improve science achievement. Since music has been used as a tool for educating young students, this study introduces the science song project to teacher candidates that contains science facts, concepts, laws and theories, and combines them with music for motivating their young children to learn science and improve science achievement. The purpose of the study is to determine the effect of the science song project on teacher candidates' understanding of science processing skills and their attitudes toward science. The participants were 45 science teacher candidates who were enrolled in an EC-6 (Early Childhood through Grade 6) program in the teacher certification program at a racially diverse Texas public research university. To collect data, this study used two instruments: pre-and post-self efficacy tests before and after the science teacher candidates experienced the science song project and final reflective essay at the end of the semester. The results show that while developing their songs, the participating teacher candidates experienced a process for science practice, understood science concepts and facts, and positively improved attitudes toward science. This study suggests that the science song project is a science instruction offering rich experiences of process-based learning and positive attitudes toward science.

Keywords science education; interdisciplinary approach; early childhood; teacher education; science song project

Introduction

As students lose their early love of science when it becomes a subject to memorize at school with its complicated formulas and difficult vocabulary (Angier, 2007), science teachers face many challenges in that students are unmotivated in science from an early age (Swarat, Ortony, & Revelle, 2012). This lack of motivation and interest in science could result in societies having difficulty in filling Science, Technology, Engineering and Mathematics (STEM) careers (Rosenthal, 2012; Wyss, Heulskamp, & Siebert, 2012). The U.S. Bureau of Labor Statistics projects that Asia and many other countries are growing in STEM talent while United States student interest in STEM careers is not increasing (National Governors Association, 2012). Thus, Jackson and Ash (2012) pointed out that it was critical to find a way for teachers to motivate their young children to learn science and improve science achievement.

The Importance of Science in Early Childhood Classroom

There are several reasons to begin teaching science during the early years. First, "children are naturally scientists" and their natural curiosity lead them to constantly wonder, explore, examine, describe, manipulate, compare, and question things relating to the natural environment (Eliason & Jenkins, 2008). They are motivated to explore the world around them, and early science experiences can capitalize on this inclination (French, 2004).

However, left entirely to themselves, they are not quite natural scientists. Children need guidance and structure to turn their natural curiosity into something more scientific so that they can practice and engage in rich scientific inquiry. Therefore, developmentally appropriate engagement with quality science learning experiences is vital to help children understand the world, organize information, apply and test ideas, and develop positive attitudes toward science that will provide a solid foundation for the development of scientific concepts that they will encounter in school settings (Eshach & Fried, 2005).

Secondly, young children have the capacity for conceptual learning and the ability to use the skills of reasoning and inquiry as they investigate how the world works (NRC, 2012). Engaging in science experiences allows for the development of scientific thinking (Eshach & Fried, 2005). Children need to begin to build an understanding of basic concepts and how they connect and apply them to the world in which they live (Worth, 2010). Therefore, supporting children as they develop scientific thinking during the early childhood years can lead them to easily transfer their thinking skills to other academic domains, which may support their academic achievement and their sense of self-efficacy (Kuhn & Pearsall, 2000).

Lastly, young children develop an understanding of science best when given multiple opportunities to engage in science exploration and environments facilitating science exploration, to focus their observations, and to provide time to talk about what was done and seen (Bosse, Jacobs, & Anderson, 2009; Gelman, Brenneman, Macdonald, & Roman, 2010). These allow children to question, explore, investigate, create meanings, construct explanations, and organize knowledge by manipulating materials within developmentally appropriate environments that take advantage of what children do as part of their everyday lives prior to entering formal school settings (NAEYC, 2013). These skills and abilities can provide helpful starting points for developing scientific reasoning (NRC, 2007).

The Benefits of Music in Science Education

Young children experience science in a variety of ways including reading, singing, drawing, physical movement, and play through their natural sense of curiosity and discovery. One way to keep science fun, seize students' interest, and consequently increase achievement is through the use of music. Music has been used as a tool for educating young children because it enables them to enjoy science instruction and introduces science to students who may otherwise not be interested in the field. Researchers assert that "music is facilitative because it is a pleasurable and motivating experience for young children" (Kouri & Winn, 2006, p. 294) that creates an engaging and exciting atmosphere where students actively and collaboratively participate and learn to value their science experiences in classrooms (McCammon, 2008). In addition, music can be seen as "organizational mnemonic devices in the sense of structuring information according to meter and rhyme, limiting the possible lyrics that would fit and thus making recall easier" (Crowther, 2011, p. 26). Therefore, the benefits of music are varied from cognitive aspects (i.e., improving classroom atmosphere, facilitating learning and remembering of facts/ enhancement of recall, improving students motivation and inquiry, and exploring content in depth) to affective aspects (i.e., reduction of stress, increased enjoyment, and enhancing student teacher relationships (Crowther, 2011; McFadden, 2012).

Many studies have been conducted that show the positive impacts of music on student's learning and development in science education when music was properly utilized. Smolinski (2010) conducted research to see how music impacted student learning and assessed the impact of a content-rich song on students' knowledge. This research indicated that many students found music helpful in learning about cell parts and functions. Governor (2011) carried out a study to see if there were positive attitudes toward the use of music during science instruction related to attention, engagement, and deeper learning experiences. In interviews with teachers, most teachers viewed musical lessons, when based

on the standardized curriculum and reinforcement with meaningful activities as very meaningful teaching supplements. In addition, McCammon (2008) and Pyeatt (2015) found that there was not a statistically significant impact on overall student achievement; however, there was a statistically significant impact on the engagement of the students. These research studies show that significant differences were found in student engagement and motivation, positive attitudes, and attention and deeper learning experiences.

Science Process Skills

Today, early childhood educators are emphasizing that the effective use of scientific process skills are essential requirements for exploration and problem-solving at early ages (Jirout & Zimmerman, 2015). In order for teachers to raise children as young scientists who can analyze, solve problems, and use scientific process skills to reach for knowledge, teachers should know how to give their students the "what" about scientific process skills.

Science education reforms and standards require science teachers to teach science process skills to their students (Chabalengula, et al., 2012). The science process skills are the skills that scientists use in the process of doing science and this forms the foundation for scientific methods. Six basic science process skills are observation, communication, classification, measurement, inference, and prediction (Yoon, 2015). Young children naturally use one or more of these process skills as they investigate everything that attracts their attention.

However, teacher candidates did not have sufficient conceptual knowledge of science process skills and understanding of such processes (Emereole, 2009; Lotter, Harwood, & Bonner, 2007). Even many primary school teachers showed greater need in finding an interest in science process skills and having sound conceptual understandings of science process skills in order to effectively create positive learning conditions for students.

There is a significant positive correlation between teacher candidates' abilities to perform science process skills themselves and their attitudes toward science (Downing & Filer, 1999). Early childhood teachers consider science as a difficult subject (Bahar & Polat, 2007). The teacher's feelings about teaching science were negative and these negative feelings toward science negatively affected teaching self-efficacy even for those participants who had previous high achievement experiences in science. Since confidence levels are low, teachers may keep questioning, brainstorming, and class discussions to a minimum and expository teaching becomes the method of choice for those teachers who are not confident in addressing science skills and concepts in a more hands-on approach (Lloyd, et al., 2000).

Purposes of the Study

Teaching science with music, especially when accompanied by visuals and/or movement, like dancing, have the potential to reach diverse participants with multi-modality delivery (Crowther, 2011). The playing and singing along with a science song seeks to motivate the teachers to learn science and to engage actively in the process of carrying out science, the same as students do in their classrooms. Using science-content music and even creating their own science songs could provide an effective teaching strategy for teacher candidates that engages and helps them understand science process skills and learn content material and science concepts. Based on these participating teacher candidates' experiences with the science song project, teacher candidates will provide more meaningful and engaging science instruction in the early childhood classroom.

Therefore, this study introduced the benefits of music to teacher candidates through a science song project that promotes early childhood teacher candidates' attitudes through experiencing processes of doing science, understanding science concepts and facts better, and improving positive attitudes toward science. The research questions are as follows: (1)

To what extent does using *science songs* improve teacher candidates' understanding of science processing skills? (2) To what extent does using *science songs* positively enhance teacher candidates' attitudes toward science?

Methods

Participants

The participants for the study were 45 science teacher candidates from the EC-6 (Early Childhood through Grade 6) program in the teacher certification program at a racially diverse Texas public research university. The university is a comprehensive four-year university with the following ethnicities: 40% of the student population is non-Hispanic white, 22% Hispanic, 15% African American, 11% international (ethnicities not specified), 10% Asian American, and 2% others. The participating students had sixteen weeks of field experience (eight hours per week) in addition to course work in classroom management, instructional strategies, math, and science education. The participants were divided into ten groups competing in the science song project.

Instruments

In this study, a pre- and a post-self efficacy test and final essay reflection were used to measure the effects of the science song project on the teacher candidates' attitudes toward science and their understandings of process skills. (See Appendix)

Self-efficacy test

The purpose of the STEBI-B (Science Teaching Efficacy Beliefs Instrument Form B) was to measure the effects of the science song project, especially in the teacher candidates' personal science teaching efficacy (PSTE) and Science Teaching Outcomes Expectancy (STOE). It consists of 23 Likert items, each with five response categories – strongly agree, agree, uncertain, disagree, and strongly disagree. High scores on the PSTE indicate a strong belief in one's ability to teach science. High scores on the STOE indicate high expectations in regard to the outcomes of science teaching on students' achievement.

Final essay reflection

The purpose of the final essay reflection was to investigate the teacher candidates' insights about their experiences with the science songs, at the end of the semester, the participants answered two essay-type reflective questions: "What was good?" and "What needs to be improved?" Their reflective responses were categorized based on the major themes.

Procedure

The teacher candidates had two weeks to develop their songs following these procedures: 1) to form groups, 2) to select a science concept, a scientific fact, or a theory for their science song, 3) to choose a tune or develop a tune for their science song, and 4) to write lyrics for their science song. During the preparation period of time, they learned about the interdisciplinary approach for better science practice and content standards and teaching standards were reviewed. Examples of ways to integrate science with other subject areas were provided, such as story-telling with science, artful learning, science/technology/society (STS), and so on. Handouts for preparing song development and reference sites for science song lyrics were provided to the participants as well.

A concept map was used to explain the science concept(s) logically and scientifically for their songs. This concept map was a helpful tool for them to set a range and create an orderly combination of science with other subject areas. Figure 1 shows the concept map for the states of matter that was developed by one of the teacher candidates' groups. Figure 2 shows an example of the states of matter song lyric that they developed.
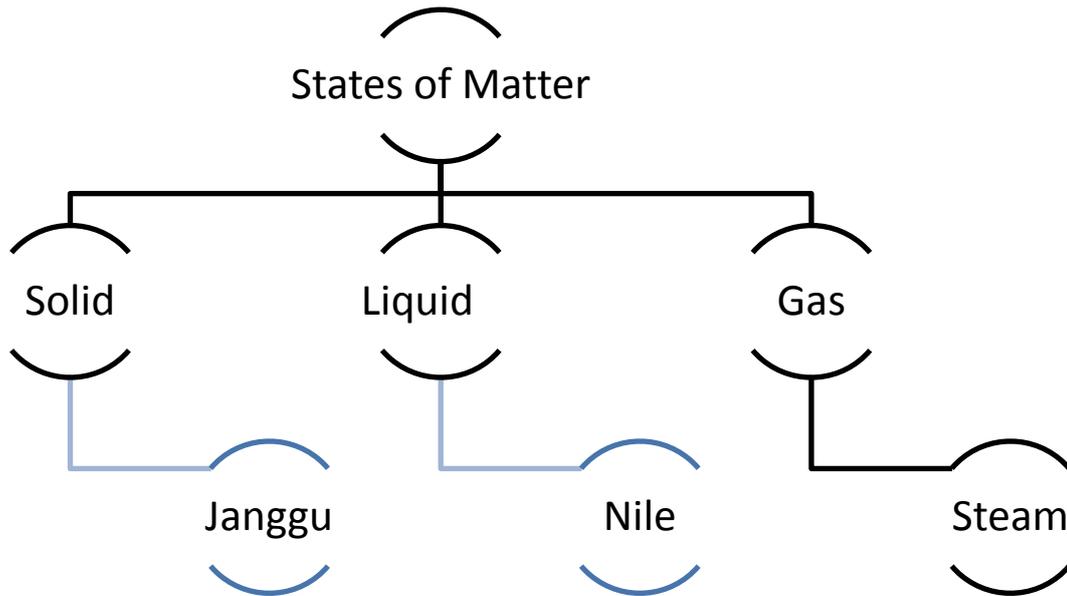
Figure 1. Concept map

States of Matter Song

(Sung to the tune of B-I-N-G-O)

There are three states of matter
That everything is made of
Solids, liquids, gases
Solids, liquids, gases
Solids, liquids, gases
These are the states of matter!

There was a drum from Korea and its name is Janggu.
S-O-L-I-D
S-O-L-I-D
S-O-L-I-D
The Janguu is a solid.

The Nile is a river in northeastern Africa
L-I-Q-U-I-D
L-I-Q-U-I-D
L-I-Q-U-I-D
The Nile is a liquid.

There is a pot of water that is boiling on the stove.
G-A-S
G-A-S
G-A-S
The steam is a gas.

Figure 2. Science Song Lyric

Teacher candidates, while participating in the science song project, fully experienced the process of scientific practice. They developed a question about which science topic they would sing about (questioning) and researched those science concepts and facts (observing and classifying). After their research, the teacher candidates discussed together in groups (communicating). Once they developed a science song, they predicted whether the song clearly presented the science concepts or facts (predicting). After their prediction, they modified and then presented their science song (measuring/experimenting). They had a chance to think about the ways in which their science song was successful and how the science song could be improved (inferring) after the science song presentation.

All the performances during the science song project were recorded by a digital camcorder and edited in the program iMovie. Their songs were digitized by the Sound Recorder/Sound Editor. All of the songs can be found on the Internet developed in Dreamweaver and are downloadable on portable computer devices. The students' works were uploaded on Youtube so that they could view each other's work. Figure 3 shows the technology used for the science project.

Technology Used	Purpose
Youtube	Song Uploading Tool
iPhone/iPad	Song Downloading Tool
Dreamweaver	Website Development Tool
Digital Camcorder/iMovie	Movie Developer
Sound Editor/Recorder	Song Editor/Recorder
Google Doc/Online Chat	Communication Toll

Figure 3. Technology used for the science song project.

Before and after they worked with their science songs, the teacher candidates were asked to take the pre- and the post-self efficacy tests. After the science song contest, the teacher candidates turned in their final reflections.

Data Analysis

All responses from the self-efficacy pre-test and post-test were collected and reviewed. After the scores for each question were calculated, a matched sample *t*-test was used to determine if the teacher candidates had significantly different scores on the pre-test than on the post-test. To analyze their final reflection, we used the constant comparative method (Creswell, 2015) to create codes and categories from the teacher candidates' written responses.

Results

Self-Efficacy Tests

A paired-*t* test was used to compare the pre- and the post-test results with subscales of PSTE and STOE. Descriptive statistics are shown in Table 1.

Table 1. Descriptive Statistics of the Self-Efficacy Tests

	N	Mean	S.D.	t-Value	P	a-Significance
PSTE						
Pretest	13	3.554	.807	1.3628	.1980	.05
Posttest	13	3.808	.813			
STOE						
Pretest	10	3.49	.528	1.3416	0.2126	.05
Posttest	10	3.59	.520			

PSTE. Hypothesis 1: There is no difference between the pretest and posttest means on the STEBI-B for the Personal Science Teaching Efficacy (PSTE) subscale (PSTE $\mu0 = \mu1$). There was not a significant difference between the pre-test and post-test means on the STEBI-B for the PSTE subscale because the P (=.198) value was not less than Sig. = .05 (shown in Table 1). Figure 4 presents the graph of PSTE pre- and post-test results.
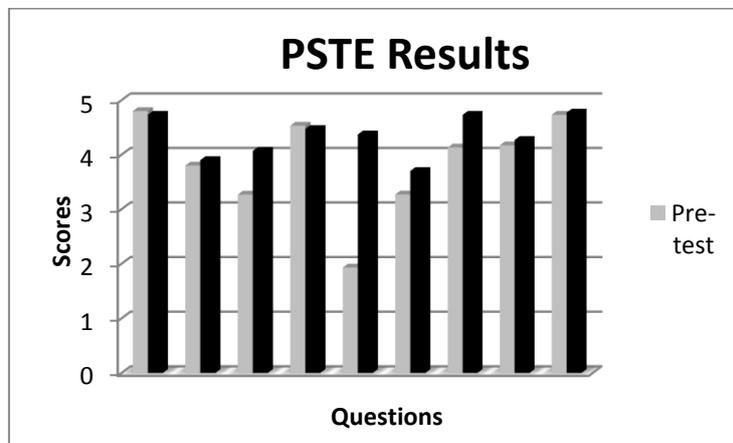

Figure 4. Graph of PSTE pre- and post-test results.

STOE. Hypothesis 2: There is no difference between the pretest and posttest means on the STEBI-B for the Science Teaching Outcomes Expectancy (STOE) subscale (STOE $\mu0 = \mu1$). There was not a significant difference between the pre-test and post-test means on the STEBI-B for the STOE subscale because the P (=.2126) value was not less than Sig. = .05 (shown in Table 1). Fig.5 presents the graph of STOE pre- and post-test results.
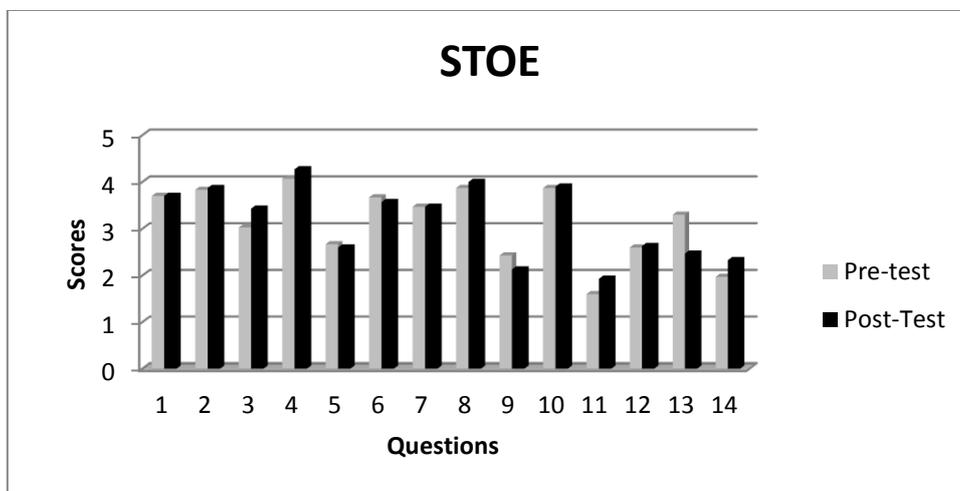

Figure 5. Graph of STOE pre-and post-test results.

Final Essay Reflection

Three major themes from the final reflection occurred, namely: Understanding process skills, Increasing attitudes, and Supporting roles of technology. In preparing their science songs, the teacher candidates had opportunities to think of science concepts by developing concept maps and by taking part in the process of science practice and harmonizing with others. The Science song project helped them to understand science better and provided them with an opportunity to develop the process skills for doing science.

"Being able to fully engage the students can be done not only through science, but through the integration of other subjects, such as music. I saw this work clearly through the science song contest that we performed in class. Many different groups showed how music could be integrated with science material to allow students to more easily understand multiple different concepts."

"Learning science allows students to have hands-on practice with different processes and to explore how various things in our world interact with each other."

Since teacher candidates naturally and practically experience six process skills during the science song project; it was a hands-on experience developing the process skills for doing science as well as helped them to understand science better by doing so.

Also, the teacher candidates improved their attitudes toward science. The science song project enabled the teacher candidates to understand that science is not difficult anymore, but fun and engaging. The responses of the teacher candidates showed clearly how much they enjoyed the science song contest and how they changed their attitudes toward science.

"It allowed children to be creative and fun and learn at the same time that my students would enjoy. I feel very confident in teaching science when I become a teacher. I want my students to be able to understand science and sing for it just like we did at the science song project."

"I saw how adding in different things allows students to get excited about science and to see concepts in a whole new light. I also saw that when science is viewed differently, by approaching learning in a unique way, students become more engaged in the learning process."

They perceived the integration of music in science education to be an effective way for their students to get involved and teach science in a more meaningful and interesting way. After creating their own song and hearing other groups' songs, they had ideas about how they could incorporate this into their future science teaching.

Through the science song project, further, the teacher candidates perceived more clearly the role of technology. The science song project provided an opportunity to integrate science, music, and technology.

"The science song contest helped us to connect science, music, and technology together, which was good for us to teach science."

"I think that us as future teacher we are lucky to be presented with teaching methods such as how to integrate technology in our science lessons and how to make science teaching interdisciplinary."

Participating teacher candidates described needed improvements for the science song project. They had a difficult time creating a schedule during which they could work together with other group members. Also, they wanted to have more opportunities to learn about science contents to describe through the songs.

Discussions

Science song promotes motivation along with higher levels of engagement, helps with memorization, offers multiple modalities for learning that deepen understanding of science content. Singing as a group motivates and empowers the teacher candidates to learn science that enables them to be dynamic learners who construct their own knowledge. The understanding of scientific inquiry and the construction of scientific knowledge were maximized with the use of science-content music which provided students with additional experiences in constructing knowledge through the interpretation of and interaction with songs presented during teaching (Governor, 2011).

Using songs for learning allows multiple ways in which they can be used to help students develop conceptual understandings (Governor, 2011). Letting students create their lyrics is a great way to incorporate music into the science classroom, include all the required contents and getting this information into a song format that is either entirely original, or for a parody of an existing song. Students can practice important vocabulary words to review with other students and it helps them with their content understanding (Smolinki, 2010). Since students participated in the process of song development, they were actively participating in the learning process that enables students to empower their learning and results in dynamic student learners who construct their own knowledge.

Conclusions and Future Considerations

This project elucidates the potentials of science song in science instruction. When age appropriate guidance is given, the science song project can be extended to apply not only to teacher candidates but also to their students, sharing their rich experiences of process-based learning. This study might form a basis for future studies that need to take into account the importance of using music/songs as a pedagogical strategy.

For future implementation of the Science song project in early childhood classrooms, the following things should be considered: First, teachers can include more musical instruments or visual aids for better integration of science with music. By bringing musical instruments (like digital keyboards, drums, guitars, and so on) or instrument photos as a background, the students can have more opportunities to carry out learning science concept(s). For example, the relationships between sound and vibrations could be experienced. Secondly, for young children who are nonmusical, suggesting lyrics or words for songs would be highly beneficial. Teachers could have children working together in groups, allowing them to socially learn while specializing according to their abilities and comfort zones. For example, those who do not like to sing might lead the dictating/writing of lyrics or creation of visuals to accompany the song. Also, teachers could ask children to develop group lyrics that can be sung as parodies of well-known nursery rhymes or familiar music that most of young children could sing together. Thirdly, teachers could create a trusting environment where creative risk-taking is supported and students can receive advice on their songwriting as well as science literacy. In addition, in such a safe and creative environment, children could see the link between taking risks with singing and taking risks with exploration/experimentation and discovery through science. Further, children who experience creative risk taking with their song creations can feel more confidence with their abilities that could lead to confidence in other areas. This confidence could equate to heightened competence as children explore and experiment more and more deeply.

Jiyoon Yoon *is Associate Professor of Early Childhood/Elementary Program of Curriculum and Instruction teaching science method courses at University of Texas, Arlington. Dr. Yoon has participated in research studies for establishing rich science teaching-learning environments with the aid of technology for global society.*

Kyoung Jin Kim *earned her Ph.D in the Department of Curriculum and Instruction at the University of Illinois at Urbana-Champaign. She is currently working as an assistant professor at Wheelock College, disseminating and publishing her scholarly works in many peer-reviewed journals.*

References

Angier, N. (2007). *The Canon*. New York: Houghton Mifflin.

Bahar, M., & Polat, M. (2007). The science topics perceived difficult by pupils at primary 6-8 classes: Diagnosing the problems and remedy suggestions. *Educational Science: Theory & Practice, 7*(3), 1113-11130.

Bosse, S., G. Jacobs, & T. L. Anderson. (2009). Science in the air. *Young Children, 64*(6), 10–15.

Chabalengula, V. M., Mumba, F., & Mbewe, S. (2012). How pre-service teachers' understand and perform science process skills. *Eurasia Journal of Mathematics, Science, and Technology Education, 8*(3), 167-176.

Creswell, J. W. (2015). Educational research: planning, conducting, and evaluating quantitative and qualitative research (5th ed.). Boston: Pearson.

Crowther, G. (2011). Using science songs to enhance learning: An interdisciplinary approach. *CBE-Life Science Education, 11*, 26-30.

Downing, J. E., & Filer, J. D. (1999). Science process skills and attitudes of preservice elementary teachers. *Journal of Elementary Science Education, 11*(2), 57-64.

Emererole, H. U. (2009). Learners' and teachers' conceptual knowledge of science processes: The case of Botswana. *International Journal of Science and Mathematics Education, 7*, 1033-1056.

Eliason, C., & Jenkins, L. (2008). *A practical guide to early childhood curriculum* (9th ed.). Boston: Pearson.

Eshach, H., & Fried M. N. (2005). Should science be taught in early childhood? *Journal of Science Education and Technology, 14*(3), 315-336.

French, L. (2004). Science as the center of a coherent, integrated early childhood curriculum. *Early Childhood Research Quarterly, 19*(1), 138.

Gelman, R., Brenneman, K., Macdonald, G., & Roman, M. (2010). *Preschool pathways to science: Facilitating scientific ways of doing, thinking, communicating and knowing about science*. Baltimore, MD: Brookes Publishing.

Governor, D. (2011). *Teaching and learning science through song: Exploring the experiences of students and teachers.* Unpublished doctoral dissertation, University of Georgia, Athens.

Jackson, J. K., & Ash, G. (2012). Science achievement for all: Improving science performance and closing achievement gaps. *Journal of Science Teacher Education*, *23*(7), 723-744.

Jirout, J., & Zimmerman, C. (2015). Development of science process skills in the early childhood years. In K. C. Trundle & M. Sackes (Eds.), *Research in early childhood science education* (pp. 143-165).

Kouri, T.A., & Winn, J. (2006). Lexical learning in sung and spoken story script contexts. *Child Language Teaching and Therapy, 22*(3), 293-313.

Kuhn, D., & Pearsall, S. (2000). Developmental origins of scientific thinking. *Journal of Cognition and Development, 1*, 113-129.

Lloyd, J.K., Braund, M., Crebbin, C., & Phipps, R. (2000) Primary teachers' confidence about and understanding of process skills. *Teacher Development, 4*(3), 353-370.

Lotter, C., Harwood, W. S., & Bonner, J. J. (2007). The influence of core teaching conceptions on teachers' use of inquiry teaching practices. *Journal of Research in Science Teaching, 44*, 1318-1347.

McCammon, DGL. (2008). *Chemistry to music: Discovering how music-based teaching affects academic achievement and student motivation in an 8th grade science class.* Unpublished doctoral dissertation, North Carolina State University.

McFadden, T. (2012). *Music in the science classroom: The impact of content-based songs on learning & engagement.* Unpublished master's thesis, University of Otago.

National Association for the Education of Young Children (NAEYC). (2013). *All criteria document*, 17–18. Retrieved from http://www.naeyc.org/files/academy/file/AllCriteriaDocument.pdf

National Governors Association. (2012). The role of informal science in the state education agenda. Washington, DC.

National Research Council (NRC). (2007). *Taking science to school: Learning and teaching science in grades K-8.* Washington, DC: National Academies Press.

National Research Council (NRC). (2012). *A framework for K–12 science education: Practices, crosscutting concepts, and core ideas.* Washington, DC: National Academies Press.

Pyeatt, K. (2015). *The impact of music in science education: The effects on junior high students and achievement.* Unpublished masters thesis, University of Texas ar Arlington.

Smolinski, K. (2010). *Original Science-based Music and Student Learning.* Unpublished doctoral dissertation, Walden University.

Swarat, S., Ortony, A., & Revelle, W. (2012). Activity matters: Understanding student interest in school science. *Journal of Research in Science Teaching*, *49*(4), 515-537.

Worth, Karen. (2010). *Science in early childhood classrooms: Content and process.* Paper presented at STEM in Early Education and Development Conference, Cedar Falls, IA.

Wyss, V. L., Heulskamp, D., & Siebert, C. J. (2012). Increasing middle school student interest in STEM careers with videos of scientists. *International Journal of Environmental and Science Education, 7*(4), 501-522.

Yoon, J. (2015). *Life is full of science: An interdisciplinary and cultural teaching approach*, San Diego: Cognella.

APPENDIX

Self-efficacy Test

This instrument provides insight into how prepared you believe you are to teach. This knowledge can be quite useful to you, particularly when you compare your responses at the beginning of this program and then at the end. You will receive NO GRADE for your responses and the only right response is the one that honestly reflects your belief.

****

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

SA = STRONGLY AGREE
A = AGREE
UN = UNCERTAIN
D = DISAGREE
SD = STRONGLY DISAGREE

****

1. When a student does better than usual in the subject that you are teaching, it is often because you exerted a little extra effort.
    SA
    A
    UN
    D
    SD

2. I will continually find better ways to teach the subject I am teaching.
    SA
    A
    UN
    D
    SD

3. Even if I try very hard, I will not teach the subject that I am teaching as well as I will most other subjects.
    SA
    A
    UN
    D
    SD

4. When students improve their grades, it is often due to their teacher having found a more effective teaching approach.
    SA
    A
    UN
    D
    SD

5. I know the steps necessary to teach concepts effectively.
    SA
    A
    UN
    D
    SD

6. I will not be very effective in monitoring student activities in class.
   SA
   A
   UN
   D
   SD

7. If students are underachieving, it is most likely due to ineffective teaching.
   SA
   A
   UN
   D
   SD

8. I will generally teach ineffectively.
   SA
   A
   UN
   D
   SD

9. The inadequacy of a student's understanding can be overcome by good teaching.
   SA
   A
   UN
   D
   SD

10. The low achievement of some students cannot generally be blamed on their teachers.
    SA
    A
    UN
    D
    SD

11. When a low-achieving child progresses your subject, it is usually due to extra attention given by you.
    SA
    A
    UN
    D
    SD

12. I understand my subject concepts well enough to be effective in teaching the subject.
    SA
    A
    UN
    D
    SD

13. Increased effort in teaching your subject produces little change in some students' achievement.
    SA
    A
    UN
    D
    SD

14. The teacher is generally responsible for the achievement of students.
    SA
    A
    UN
    D
    SD

15. Students' achievement is directly related to their teacher's effectiveness in teaching.
    SA
    A
    UN
    D
    SD

16. If parents comment that their child is showing more interest in your subject at school, it is probably due to your performance in teaching the subject.
    SA
    A
    UN
    D
    SD

17. I will find it difficult to explain my subject concepts to students.
    SA
    A
    UN
    D
    SD

18. I will typically be able to answer students' questions.
    SA
    A
    UN
    D
    SD

19. I wonder if I will have the necessary skills to teach my subject.
    SA
    A
    UN
    D
    SD

20. Given a choice, I will not invite the principal to evaluate my teaching.
    SA
    A
    UN
    D
    SD

21. When a student has difficulty understanding my subject concept, I will usually be at a loss as to how to help the student understand it better.
    SA
    A
    UN
    D
    SD

22. When teaching, I will usually welcome student questions.
    SA
    A
    UN
    D
    SD

23. I do not know what to do to turn students on to my subject.
    SA
    A
    UN
    D
    SD