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**Math Musicians: Exploring the Impact of Content Integrated Pop Music on Students'
Attitudes and Engagement During Math Instruction**

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Abstract

Traditional methods of math instruction have been consistently linked to students having negative feelings about math, as well as decreased motivation and engagement during math instruction. This study investigated how arts integration, specifically integrating pop music, impacted students' attitudes about math and students' motivation and engagement during math instruction in a fifth-grade classroom. This study was mixed methods, with quantitative data collected through an adapted version of a student dispositions survey to assess students' attitudes, motivation, and engagement, and qualitative data collected through a short response question about how students feel music impacted their math experiences. Results indicated that the integration of pop music had a significant impact on students' attitudes about math. Students also noted how pop music integration made math more enjoyable and helped them memorize the information better.

Key Terms: Music, Math, Student Attitudes, Engagement, Motivation, Arts Integration

Math Musicians: Exploring the Impact of Content Integrated Pop Music on Students' Attitudes, Motivation, and Engagement During Math Instruction

“Music is the universal language of mankind” (Longfellow, 1835, as cited in Šabec, 2016, p. 7). Music is integrated in almost every aspect of our lives, whether it be for entertainment, cultural practices, or celebratory occasions. While music holds such power and meaningfulness in our lives, music is often limited in the classroom due to the push to prioritize standardized testing and academic standards (Scripp & Gilbert, 2016). If we know that music has such an impact on people, why does it get turned off when students enter the classrooms?

Statement of the Problem

Research has shown that students are struggling with some of the traditional methods of instruction and standardized assessments, especially in math (An, Capraro, & Tillman, 2013). Examples of traditional methods of instruction include teaching from the textbook and providing only one way to solve problems, as well as assessing each student in the same manner (Furner & Berman, 2005, as cited in An, Capraro, & Tillman, 2013). As a future educator, it is frustrating to know that students are struggling with these methods of instruction, yet they are still being used. Students' attitudes toward the content directly impacts their motivation to learn and their engagement level in the classroom (DiDomenico, 2017). A student's academic performance is only going to flourish if the student is motivated and engaged in the content and the methods used to teach it. Within the constraints of the curriculum objectives, teachers are trying to find ways to make instruction more accessible, relevant, and engaging (Vasil, 2020).

Research Purpose

Given the constraints of teaching and students' motivation to learn, I looked at how music integration impacts students' attitudes during math instruction. Music integration during

math instruction has been shown to increase positive attitudes and motivation to learn by making learning fun (DiDomenico, 2017). Music is also very relevant to students' lives, which serves to form and enrich connections to students' emotions, feelings, and mood (Hesmondhalgh, 2013). To ensure the math standards and content are being addressed and students' music interests are relevant, this research utilized pop music songs that were adapted to include the content.

Type of Study and Research Questions

This study used a mixed-method approach (Johnson & Christensen, 2019). One survey (pre-intervention and post-intervention) and a short response exit ticket (post-intervention) was conducted to collect qualitative and quantitative data on students' attitudes towards learning math, including their engagement levels and motivation to learn during math instruction. My research was carried out in a 5th grade classroom during my full-time student teaching internship. My research questions were:

- How does integrating pop music into math instruction impact students' attitudes towards learning math in a 5th grade classroom?
- How does integrating pop music into math instruction impact students' engagement and motivation during math instruction in a 5th grade classroom?

Definition of Terms

Arts integration is “an approach to teaching in which students construct and demonstrate understanding through an art form. Students engage in a creative process which connects an art form and another subject area and meets evolving objectives in both” (The Kennedy Center, n.d.). Arts integration includes music, movement, drama, literary arts, and visual arts. Music integration in the classroom can include activities such as singing, creating new music and songs, playing instruments, learning about musicians, and much more. Pop music can be defined as a

wide variety of different music styles. For the purpose of this study, pop music was defined as songs that are popular or currently trending (e.g., TikTok, Billboard) in the United States.

Students' attitudes are emotions or thoughts about math experiences, which could be positive or negative (Larkin & Jorgenson, 2015). Student engagement during math is their participation or completion of assignments. Students' motivation to do math is attributed to intrinsic and/or extrinsic reasons (An, Capraro, & Tillman, 2013).

Theoretical and Conceptual Framework

Gardner's theory of multiple intelligences states that there is not one form of intelligence, but eight forms (Gardner, 2008). A form of intelligence is the preferred method in which someone learns or performs best (Gardner, 2008). This theory is related to teaching because if one method of instruction does not work for specific students, there are other approaches that can be used to enhance students' learning. Music is one of the eight intelligences mentioned by Gardner, which means that people with musical intelligence enjoy and understand musical aspects, often appreciating music in their daily lives (Gardner, 2008). Music integration could be the key to motivating students to learn without jeopardizing the required standards and content instruction that the students are entitled to.

Motivation, specifically intrinsic motivation, is another framework that relates to the purpose of this research study. Intrinsic motivation refers to the motivation inside the individual because of interest in the task itself (Csikszentmihalyi, 1996, as cited in An, Capraro, & Tillman, 2013). Intrinsic motivation would increase during music integrated math instruction because it creates a more engaging and enjoyable learning experience (An, Capraro, & Tillman, 2013). Students would take more initiative in math through intrinsic motivation, as opposed to extrinsic motivation where the students would participate in math for an external reward, such as a good

grade (An, Capraro, & Tillman, 2013). Intrinsic motivation provides students with a more purposeful learning experience that is relevant to their lives.

Literature Review

Students are currently struggling with traditional and standardized methods of instruction, which are not accessible, engaging, or relevant to the students' lives (An, Capraro, & Tillman, 2013; Vasil, 2020). Arts integration, specifically music integration, is an instructional tool that can help increase students' engagement, motivation, and attitudes during math instruction (DiDomenico, 2017). The following literature review introduces research that falls into three main themes: music in math instruction, student attitudes about math, and student motivation and engagement.

Music in Math Instruction

Extensive research connects music with math instruction. Advances in brain mapping and other neuroscience technology have shown increased activation in the brain during math and music performance (Cranmore & Tunks, 2015). This increased activation often has a positive impact on learning in the two disciplines. Both math and music are content areas that can be easily integrated across other disciplines or subject areas (An, Tillman, Shaheen, & Boren, 2014). With the current issue of students struggling with the traditional methods of math instruction, music integration offers an alternative approach to teaching math (An & Tillman, 2015).

Previous research has found many natural similarities between math and music. Cranmore and Tunks (2015) asked high school students to share their experiences with music and math but also share their perceptions about how music and math are related. Students in this study expressed that math helped foster music skills, supporting the idea that math and music are

related to each other. One of the similarities found in this study was that the musical element of rhythm was connected to math; the students who participated in that study thought that math influenced rhythmic aspects of music and that musical skills (rhythm) can help improve mathematics skills. These findings suggest that mathematics skills and musical skills go hand-in-hand and can help build and improve upon such skills when integrated together.

Students have connected math content within music curriculum, but also in real life situations (An & Tillman, 2015). An and Tillman (2015) created an experimental design study where one second grade class received music-mathematics integrated lessons and another second-grade class received traditional math lessons. The researchers found that students in the experimental group thought about math meanings from reasonable and logical perspectives, and they solved math problems using a variety of different problem-solving strategies when music was integrated.

In a similar study that looks at teachers' perspectives, An, Tillman, Shaheen, and Boren (2014) interviewed preservice teachers at a large public university about their experiences and opinions after a series of music-math integrated lessons. From a teacher perspective, preservice teachers had positive reflections about music integrated in math instruction since it allowed them to teach and extend beyond the limitations of traditional math instruction (An et al., 2014). Music integration presents and applies math instruction in a more contextualized approach where students have more opportunities to understand math concepts in an enjoyable and meaningful way (An et al., 2014). Music integration is a powerful and compatible instructional tool that provides many benefits for math instruction.

Influence of Pop Music

Some research has found that pop culture, including music, has a positive impact on education. In a qualitative study by Güven & Keleşoğlu (2014), they examined the teaching practices and view of teachers on pop culture. Teacher participants in the study who included pop culture in their teaching practices mentioned that the usage of pop culture in education makes connections between students' personal, real-life experiences and students' academics. Connecting students' personal experiences with their academics helped capture the interests of the students during instruction. In a similar study, Jones and Pearson (2013) explored the use of pop culture in the classroom by integrating pop music in math instruction to teach the basics of music theory, including identifying notes while learning their fractional values. Since students' interests in pop music were included during the math instruction, they were more motivated to participate in the math activities. These findings suggest that pop culture, such as pop music, is an important factor to consider when designing educational content and activities to help connect math objectives to students' lives.

Student Attitudes About Math

There is a general consensus that students' attitudes towards math are often negative (An, Capraro, & Tillman, 2013; Larkin & Jorgenson, 2015). Larkin and Jorgenson (2015) used iPad video diaries to record students' attitudes and emotions towards math. The study was conducted in a Year 3 and Year 6 classroom in Australia. The typical emotional response towards math stems from anxiety, which can contribute to negative feelings (mentally and physically) during math instruction. To express their attitudes towards math, students used highly emotive language, such as hatred, frustration, and boredom, as well as wanting to cry or feeling sick during math. These negative emotional responses towards math can often impact students' math achievement and participation during math.

Student Attitudes About Math with Music Integration

One of the ways to change students' attitudes towards math is music integration. Using music to change the mood in the classroom can be easy to implement since there are similarities in skills shared by both content areas (DiDomenico, 2017). In one study, teachers were asked why they used music in their classrooms (DiDomenico, 2017). Many teachers said they used music to alter students' mood and attitudes, and that music promoted positive feelings about school and learning. These positive feelings have the potential to alter students' attitudes about math instruction and activities. The teachers also noted that when students connected music with positive feelings about school and learning, they were more likely to be motivated and engaged in the lesson and instruction. Integrating music into math instruction has the potential to improve students' attitudes towards learning mathematics, which creates a more positive learning environment and learning experiences for the students.

Student Motivation and Engagement

Past research explores how connecting math to students' interests and creating more positive feelings about school and learning through music helps students become more motivated to learn and more likely to be engaged in the instruction. Deveci and Karademir (2019) investigated how 5th grade students' engagement in a math course related to their opinions about the course, and they found that engagement in the course was grouped into three categories: cognitive, social, and emotional. These three themes are related and depend on each other; if students did not have positive emotions towards a course (and/or even the teacher), they found it more difficult to be motivated and engaged in the learning activities. This relates back to students' attitudes toward math and strengthens the argument that if students do not have positive

feelings towards math or any interests related to math, they will not feel motivated to learn and participate, and therefore will not be engaged.

When looking at students' engagement in math, active involvement and participation is very important. Lovemore, Roberson, and Graven (2021) used music integration, which included teaching musical note values, to enrich the teaching of fractions, and they found an increase in student motivation to be engaged and participate in the lessons. The students found the music examples and integration to be intriguing, so they were more likely to actively participate, which was also beneficial for the teachers to make observations about the students' engagement and to monitor and evaluate the students' understanding of the material. The researchers also found that even the shy students who were normally less likely to participate were motivated to learn and be more engaged in the practical activities, such as music games, during math instruction. This study emphasized the importance music integration has on improved math engagement and motivation.

Interactive music activities are a great resource to integrate into math instruction to create a highly motivated environment in which students are engaged through active participation (An, Capraro, & Tillman, 2013). In An, Capraro, and Tillman's (2013) study, they had two teachers integrate music activities into their regular math lessons. They found that both teachers were able to design and implement a variety of different music activities and connect them to the math content areas. Students in those teachers' classes showed significant math improvements in three areas (model, strategy, and application), and factors such as increased engagement and motivation could have played a part in that improvement (An, Capraro, & Tillman, 2013).

Math Achievement

Improving student motivation and engagement during math can also help improve students' math academic achievement. One experimental design study integrated music into fraction lessons in one 3rd grade class and had a control group in another 3rd grade class to learn fractions using the traditional methods of instruction (Courey, Balogh, Siker, & Paik, 2012). Courey et al. (2012) found that students who participated in music-integrated fraction lessons outperformed students who received traditional instruction to learn fractions. These findings also suggest that using music instruction to teach math can serve as a motivator for students and provide more engaging activities for students to participate in. Without motivation or student engagement, students do not benefit academically.

Conclusion

As previously stated, students are not benefitting from traditional methods of instruction (An, Capraro, & Tillman, 2013; Vasil, 2020). These traditional methods often lack students' interests; therefore, students are not as engaged and motivated to learn but may find these methods challenging and develop negative feelings about the content or school. While there is very little research on integrating pop music into math instruction, related studies show that music integration has positive outcomes on students' attitudes about math, and students' motivation and engagement during math. Research has also shown that music integration can help improve math achievement scores because of its effect on students' motivation and engagement when learning math. This study explored how music integration in math instruction, specifically the integration of pop music, impacted students' attitudes about math and students' motivation and engagement during math.

Methodology

This study was a mixed methods action research project that investigated the following research questions:

1. How does integrating pop music into math instruction impact students' attitudes toward learning math in a 5th grade classroom?
2. How does integrating pop music into math instruction impact students' engagement and motivation during math instruction in a 5th grade classroom?

A mixed-methods methodology design was utilized because the data collected was both quantitative and qualitative. Quantitative data was collected through a survey about students' attitudes about math and students' motivation and engagement during math. Qualitative data was collected through an open-ended question asked on an exit ticket.

Participants

This study was conducted at a public elementary school located in the Commonwealth of Virginia. The school is an arts integration school. The research was conducted in a 5th grade classroom during my full-time student teaching internship. There were 24 students in the classroom; however, only 16 students participated in this study. Nine students identified as white, three students identified as Hispanic, two students identified as Black, one student identified as Pacific Islander, and one student identified as Asian. Of those who participated in the study, one student received services under an IEP (EBS supports and full-time para), five students were gifted, and one student was a Level 5 English Learner. Participants were selected using convenience sampling since I used available students in my classroom as my participants (Patton, 2002). Students who received parental consent (Appendix A) and gave assent (Appendix B) to participate in the study were included and only their data was collected.

Data Instruments

Quantitative data was collected using an adaptation of An (2012)'s adapted version of the *Fennema-Sherman Mathematics Attitude Scales* (1976). An's adapted version of the tool was adapted to fit the needs of this study in order to collect quantitative data about students' attitudes towards learning math and students' motivation and engagement during math instruction (Appendix C). Qualitative data was collected through an exit ticket after the intervention that asked the students, "How does music influence your math experiences?"

Data Collection

After receiving IRB approval, parental consent and student assent, I administered an adaptation of An (2012)'s adapted version of the *Fennema-Sherman Mathematics Attitude Scales* (1976) to collect data on students' current attitudes towards learning math and students' current perception about their motivation and engagement during math instruction. After the pretest, I integrated pop music with the math content. Over the course of one month, two songs were introduced across two different two units. One unit was on descriptive statistics and one unit was on shapes. For each song during each unit, I first sang the song to the students, and then over the course of that unit the students sang the songs as a class during math as either a warm-up or ending activity (see Appendix D and E for song lyrics). After the intervention period, I administered the adaptation of An (2012)'s adapted version of the *Fennema-Sherman Mathematics Attitude Scales* (1976) again to collect data on students' new attitudes towards learning math and students' new perceptions about their motivation and engagement during math instruction. Also, after the intervention, students were asked to complete an exit ticket to answer a short response question ("How does music influence your math experiences?") on Google Forms. Students were asked to put their name in the Google Form to make sure that data to be

analyzed came only from students who had permission to participate. See Table 1 for a general timeline of this study.

Table 1

Proposed Research Timeline

Date/Deadline	Goal/Action
December (2021)	Obtain IRB approval.
Mid January (2022)	Obtain consent/assent from participants.
Early February (2022)	Administer pre-assessment survey (adaptation of An (2012)'s adapted version of the <i>Fennema-Sherman Mathematics Attitude Scales</i> (1976)).
February (2022)	Implement instruction/intervention: incorporate pop music that integrates math content into math instruction.
Early March (2022)	Administer post-assessment survey (adaptation of An (2012)'s adapted version of the <i>Fennema-Sherman Mathematics Attitude Scales</i> (1976)) and administer the exit ticket ("How does music impact your math experiences?").
March-April (2022)	Analyze data.

Data Analysis

To analyze the quantitative data on students' attitudes towards learning math and students' engagement and motivation during math instruction, I calculated the mean and standard deviation for the pre-survey and post-survey. I used Excel to run *t*-tests to see if there are any significant differences between the scores on the two surveys. I completed a thematic analysis

using the constant comparative methods to find what themes emerge from the open-ended Google Form question (Strauss & Corbin, 1998).

Results

Research has shown that students have negative feelings about math, including math anxiety, and suggests connecting culturally relevant activities to boost students' feelings about math. This study investigated how the integration of pop music impacts students' attitudes about math and students' motivation and engagement during math. The following data for my research fell under both quantitative (math dispositions survey) and qualitative (students' exit tickets) data collection and analysis, which will be further explained throughout this results section.

Math Dispositions Survey

Prior to the integration of pop music in math, students were asked to complete an adaptation of An (2012)'s adapted version of the *Fennema-Sherman Mathematics Attitude Scales* (1976). This survey includes 18 questions that can be equally categorized into three themes: Attitude, Engagement, and Motivation. The survey included some reverse scored questions and was out of 90 possible points, where a score of 90 represents the greatest positive feelings of math. This survey was also given to the students after the pop music intervention.

The students' scores on the pre-intervention survey had a mean score of 72.31 and standard deviation of 10.75. The students' scores post-intervention survey had a mean score of 75.875 and standard deviation of 8.793. A *t*-test was run to determine any significant differences between the class' mean scores of the pre-intervention and post-intervention survey. The *t*-test had a *p*-value of 0.014, which indicates that there was a positive and significant change across students' attitudes, motivation, and engagement. See Table 2 for students' individual scores.

Table 2*Students' Overall Sum (Pre-Intervention and Post-Intervention)*

Student	Pre-Intervention	Post-Intervention	Change
1	76	76	0
2	59	63	4
3	47	51	4
4	72	74	2
5	55	72	17
6	78	83	5
7	70	72	2
8	70	78	8
9	79	78	-1
10	81	81	0
11	79	87	8
12	86	84	-2
13	81	77	-4
14	80	81	1
15	78	82	4
16	66	75	9
Mean	72.31	75.88	3.56

Several other *t*-test were preformed to determine significant change in students' attitudes, motivation, and engagement. Students' scores were averaged as a class for each sub-category

pre-intervention and post-intervention. Attitude was the only sub-category found to be significant, where $p = 0.008$, indicating positive change. Engagement ($p = 0.089$) and motivation ($p = 0.161$) both had a positive change in scores, but did not indicate significant differences between scores. See Table 3 for a breakdown of this data for each student.

Table 3

Survey Breakdown Data (Pre-Intervention and Post-Intervention)

Student	Attitude			Engagement			Motivation		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
1	24	24	0	27	27	0	25	25	0
2	19	21	2	19	21	2	21	21	0
3	13	13	0	18	18	0	16	20	4
4	24	26	2	24	23	-1	24	25	1
5	12	19	5	21	25	4	22	28	6
6	25	27	2	28	28	0	25	28	3
7	22	25	3	23	23	0	25	24	-1
8	25	25	0	22	26	4	23	27	4
9	27	25	-2	25	25	0	27	28	1
10	26	28	2	28	28	0	27	25	-2
11	29	30	1	24	28	4	26	29	3
12	30	29	-1	27	28	1	29	27	-2
13	26	26	0	27	26	-1	28	25	-3
14	21	25	4	30	28	-2	29	28	-1
15	26	30	4	24	24	0	28	28	0

16	22	26	4	19	22	3	25	27	2
Mean	23.1875	24.9375	1.875	24.125	25	0.875	25	25.9375	0.9375

Students' Exit Tickets

Students were asked to complete an exit ticket after the completion of the pop music integration in math. This exit ticket served to collect qualitative data about this open-ended question: "How does music influence your math experiences?" Students were asked to complete this exit ticket through Google Forms. After students completed the exit ticket, responses were analyzed and coded for response category (successes, challenges, and student suggestions) and emergent theme (memorization, enjoyment, student progress in math, unhelpful in math, and changes). See Table 4 for examples of students' responses.

Table 4

Students' Responses to Exit Ticket

Response Category	Emergent Theme	Example of Student Responses
Successes	Memorization	<p>"but the song does get stuck in my head and I can memorize it"</p> <p>"These math songs helped me remember different math stuff."</p> <p>"and it kind of made me feel like i could remember the math stuff i learned."</p> <p>"it could get very catchy and with all the things i need to know if i ever forget what they are but i like shorter songs more so then i can remember them"</p> <p>"it helps me remember for the sol's."</p> <p>"the song is sometimes stuck in my head"</p>
	Enjoyment	<p>"I liked having music in math because it made it feel a little bit easier for me and it was fun and because having music in math also made it a little bit funny to and got me A little bit excited to acully learn math! :)"</p> <p>"the song made the math lesson more enjoyable when we all sing"</p> <p>"it teaches me more fun math."</p>

		<p>“This math music thing was really fun and enjoyable!”</p> <p>“Its really cool to try something differint .”</p> <p>“I like that we got to learn about music because i am a big music fan”</p>
	Student Progress in Math	<p>“and it helps me on tests like the mean, median, mode, range I got a really good grade I got a 3 and 3+”</p> <p>“it influence me to be brave. now when i sing in a crowd now i wont be scare.and now i know a lot about math.”</p> <p>“it might mean progress and progress is great.”</p> <p>“sometimes it gets movated”</p> <p>“It helps when i need help.”</p> <p>‘i feel like it make me feel like i am working hard .’</p> <p>“and now i know a lot about math.”</p>
Challenges	Unhelpful in Math	<p>“I liked the songs, but personaly i don` t feel like it helped me with my math.”</p> <p>“I like music but not while I am doing math, it is distracting. I would like to focus more on the math than on the music.”</p> <p>“so music helps me focus when I am listening to music but when I am singing it , it dose not help that much.”</p> <p>“I feel like math is still hard for me sometimes . I feel like i am still not good at stuff in math.”</p>
Student Suggestions	Changes	<p>“i kinda wish we could learn math but with newer songs and i also thought it might be fun if the whole group could help make it but i still had some fun.”</p>

*Students’ responses were kept in their original writing and unedited.

Discussion

The purpose of this study was to determine if integrating pop music into the math instructional block had an impact on students’ attitudes toward math or students’ motivation and engagement in math. The results indicated that pop music integration did have a statistically significant difference overall compared to math without the pop music integration. These results are broken down into three areas: attitudes, motivation, and engagement. This discussion will also review students’ exit ticket responses.

Students’ Attitudes About Math

Attitude was the only specific category on the math disposition survey to be significantly different. This indicates that pop music integration had the biggest impact on students' attitudes and feelings about math. These findings aligned with DiDomenico (2017)'s study, which found that teachers used music to alter students' mood and attitudes, and that music promoted positive feelings about school and learning. Some students mentioned on the exit ticket that music in math made math more "fun" and "enjoyable," suggesting that this was a positive experience that enhanced more positive attitudes about math.

Students' Motivation and Engagement in Math

Students' scores in motivation and engagement increased after the pop music intervention, but not at a statistically significant level. While the difference was minimal, the findings suggest that students were more motivated and engaged during the math instruction. Past research indicated that there is a relationship between students' attitudes towards math and their motivation and engagement during math. Students must have positive feelings about math in order to be successfully motivated and engaged during math (Deveci & Karademir, 2019).

During the pop music intervention, students were asked to stand up and sing the songs as a class, which required some active participation of the students end. In the beginning, it was mainly myself singing; however, as time went on and students became more comfortable with the activity, the level of participation and singing increased. These findings are similar to past research where active participation increased students' motivation and engagement (Lovemore, Roberson, & Graven, 2021).

Students' Exit Ticket Responses

Multiple themes emerged throughout the students' exit ticket responses about how music influences their math experiences. Most of the responses were positive. Students mentioned how

much they enjoyed the pop music integration and thought it was fun. Students also communicated how much the pop music songs helped them academically as well. Students found that the music got stuck in their heads, were catchy, and helped them remember the content for the assessments. One student brought up how the activities helped them get motivated in math. One student mentioned how singing with the class made them feel “brave,” suggesting that pop music integration may have an impact on students’ feelings about themselves in their classroom.

Challenges

While most students’ math disposition scores increased, some students’ scores decreased after the intervention. A potential explanation for this decrease is that many students were already scoring in the 80th percentile or more on the survey, indicating high enjoyment, engagement, and motivation in math. The two students who went down in their scores were both gifted students who scored the highest on the pre-intervention survey, so there was not a lot of room for improvement.

The students who were gifted also mentioned on the exit ticket that they thought music had no impact on their math experiences or did not help them in math. This could suggest that students who already do well in math find that music disrupts their progress or has little effect on their attitude, motivation, or engagement since they already do so well.

Implications

Based on the results from this study, pop music integration during math had a significant impact on students’ attitudes towards math and a positive impact on students’ engagement and motivation during math. These findings revealed that when students find more enjoyment and have more positive attitudes about math, there was potential that these feelings influenced students’ motivation and engagement during math. This means that pop music integration during

math has the potential to alter students' attitudes and moods about math, therefore the motivation to learn math is higher in students and more learners are being engaged in math in a culturally relevant way.

Limitations

During the completion of this research study, there were multiple limitations. The classroom that this study took place primarily consisted of White middle class students. This sample is not reflective of the general population; therefore, the results cannot be generalized. While the sample size consisted of 16 students, which was most of the class, having a larger sample size would be useful in determining if this study had a true impact. Another limitation to consider was that there was a math unit taught between the math units that did not have any pop music integrated into it. This break could have gotten students out of the routine of singing a song at the beginning or end of each math instructional block, impacting their scores and experience. Another limitation to consider was absences. Some students missed days during the intervention, which could have impacted the data and the students' math experiences.

Future Research

Although this study's results were quite successful, there are still considerations for improvements that require future research. Future research should consider looking at a classroom that is more representative of the United States so that the findings can be generalized across the nation. Future research should also look at why students who are identified as gifted/advanced find pop music integration less helpful in terms of math achievement and their math attitudes, motivation, and engagement. One student mentioned how they thought it would be fun to include the whole class could help make the songs, so looking at student involvement

in the song choices or creating their own math songs is another potential research area to consider.

Conclusion

Since there is a general consensus that students' attitudes towards math are often negative, there is a need to increase students' feelings about math (An, Capraro, & Tillman, 2013; Larkin & Jorgenson, 2015). The purpose of this study was to explore how pop music integration during math can impact students' attitudes about math and students' motivation and engagement during math. The results from this study indicate that pop music integration has a positive impact on students' attitudes towards math and students' motivation and engagement during math. By connecting students' musical interests with their academics, there are more opportunities to capture the interests of students during instruction.

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Appendix A: Parental Consent

Parental Informed Consent Form

Brief Description of Research Study

The purpose of the research explained below is to investigate how integrating pop music into math instruction impacts students' attitudes towards learning math and students' motivation and engagement during math instruction. During this study, students will still receive normal math instruction, however pop music will be integrated and sung by both the teacher and the students. These songs will be to the tune of pop music songs, but the lyrics will be changed to fit the math content. Before and after the intervention, students will be asked to complete a survey, and complete a short response exit ticket after the intervention. The risks to the students in this study are minimal, but the benefits could be improved attitudes towards math and improved motivation and engagement during math instruction. **Please read the rest of this form before deciding if you will allow your child to be in this research study.**

My name is Megan Hook, and I am a graduate student at the University of Mary Washington and the student teacher in your child's fifth grade classroom. Because you are the parent or legally authorized representative of a child in this classroom, I am seeking your permission to let your child participate in this research study. Involvement in the study is voluntary, so you may decide whether to let your child participate or not. I will also ask your child if he or she wants to be in the study, and I will only use the information in my study if both you and your child agree. Before making your decision, please read the information below and ask me any questions that you have about the research; I will be happy to explain anything in greater detail.

Details of the Child's Involvement

Students who participate in this study will take a survey prior to the integration of pop music about their attitudes about math and their motivation and engagement during math instruction. After this survey, I will start to integrate pop music songs that I have written or have acquired online. These songs are to the tune of pop music, but lyrics are changed to incorporate the math content. Students will be asked to first listen to these songs and then over the course of the intervention be asked to sing along and practice these songs during the math instructional block. After two to four weeks (depending on the length of the unit(s)) using the songs, students will be asked to complete a survey, which consists of the same questions asked in the first survey. Students will also be asked to do an exit ticket using Google Forms, which requires them to answer a short response question about their experience.

All students in the class will receive the instruction they are entitled to, whether or not they are participants in this study. Even if your child does not take part in my study, they will still participate in the learning activities, but I will not use any data about them in my study.

Privacy and Confidentiality

This study will take place while the students are in their classroom, so they will not have privacy while learning or being observed. The students will be asked to sing the songs together, so the song activities will not be private. The students will complete the surveys and exit ticket at their desks individually so that other students will not see their answers. Students' responses will only be seen by me. Students will be asked to not share their responses to the survey or exit tickets with other students or other individuals in the school. When my study is complete, I will destroy all of the information I collected that identifies individual students. In any reports I make

about this study, I will not use your child's name or any other information that could be used to identify him or her directly or indirectly.

Risks and Benefits of Participation

There are very minimal risks to participating in this study. Some students may feel uncomfortable singing around their peers, but students will not be asked to sing alone. All the songs will be sung as a class or in small groups. There are no rewards or extra credit grades for students who take part in this study, and no penalties of any kind if they do not take part.

However, being in this research study might have important educational benefits for your child. Previous research has shown that integrating music into math instruction increases engagement and motivation during math instruction, and students' attitudes about learning math become more positive. If the results of this study show a positive impact on students' attitudes towards learning math and students' motivation and engagement during math instruction, it could improve education for more children in the future.

Participant Rights

You have the right to *ask any questions you have* before, during or after the study, and I encourage you to do so. If you do not want your child to be in this study, there will be no penalties or loss of benefits that he or she is entitled to. If you agree to let your child be in this study and later change your mind, you have the right to take him or her out simply by contacting me at the email address below, and I will destroy any research data collected about your child.

This research has been approved by the University of Mary Washington Institutional Review Board, a committee responsible for ensuring that the safety and rights of research participants are protected. For information about your and your child's rights regarding this research, contact the

IRB chair, Dr. Rosalyn Cooperman (rcooperm@umw.edu).

Contact Information

For more information about this research before, during or after your child's participation, please contact me (mhook@mail.umw.edu) or my research supervisor, Dr. Melissa Wells (mwells@umw.edu). To report any unanticipated problems relating to the research that your child experiences during or following participation, contact my research supervisor, Dr. Melissa Wells (mwells@umw.edu). **Please keep a copy of this form for future reference, and return the signed version to me by _____ (date).** (If we are in remote instruction, your typed signature in a Google Form will replace your handwritten signature.)

Before signing this form, please ask me any questions you have about participation in this study.

To be Completed by Participant

I have read all of the information on this form, and all of my questions and concerns about the research described above have been addressed. I choose, voluntarily, to permit my child to take part in this research study. I certify that I am at least 18 years of age.

Print name of child

Print name of parent or legally authorized representative

Signature of parent or legally authorized representative.

Date

To be completed by Researcher

I confirm that the legally authorized representative of the child named above has been given an opportunity to ask questions about the study, and all the questions asked have been answered to the best of my knowledge and ability. A copy of this Consent Form has been provided to the child's legally authorized representative, and I will keep the original at least until the research is completed.

Print name of researcher

Signature of researcher

Date

Appendix B: Student Assent

Child Assent Form

Dear Student.

My name is Miss. Hook, and the reason for this letter is to ask if you want to be in a research study I am doing. By “research” I mean that I am trying to find out more about something. In this study, I am trying to find out more about how integrating pop music into math instruction impact students’ feelings towards math and students’ motivation and engagement during math instruction.

I have already asked your parent or guardian if they will permit you to be in this study. If they did not agree, you will not be asked to sign this form. If they did agree, it is still your choice to make, and I am now going to describe what you will do if you agree to be in this study. I am going to read this information to you, so listen carefully and ask any questions you have before you decide whether to be in the study or not.

What will you do if you are in this study?

During the math instructional block for a period of time, we will be singing pop music songs that have been adapted to be about the math content. The lyrics of the songs we sing will be different from the original song in order to teach and be about the math content but will follow the original tune. If you agree to be in my study, you will be asked to sing these songs with your peers (whole and small group).

Before the intervention, you will be asked to take a survey that asks you questions about your feelings about math, your beliefs about your motivation towards learning math, and your engagement during math instruction. You will also take this same survey after the intervention. If you agree to be in my study, I will keep track of your answers to use in my research study.

You will also be asked to complete short response exit ticket through Google Forms at the end on the intervention. This is only one question that asks you about your feelings about how music impacted your math experience.

What will you do if you are not in this study?

Nothing bad will happen to you if you do not want to be in the study, and it will not hurt your grade in the class. You will still do the song activities and participate in the math instruction. You will also take 2 surveys and complete an exit ticket. I will not use your survey answers or exit ticket response in my study. These activities will have no impact on your grade

Will anything bad happen to you in this study?

If you decide to be in this study, you will not have any extra work, but you may feel uncomfortable singing the songs around your peers. I will be singing the songs with you and will mediate any issues that you find concerning.

You do not have to answer any questions on the survey or questionnaire that you do not want to answer. Since the whole class will be taking the surveys and exit tickets at the same time, you will not have to worry about missing out on any instructional time.

Will anything good happen to you in this study?

You will not receive any special rewards or extra credit points for agreeing to be in this study. In other research studies like this, some students did better in class because their attitudes were more positive about math and they became more motivated to be engaged during math, and this might or might not happen for you.

Will anyone else know what you do or say in this study?

In my study, I will not use the names of any students or give any other information that could identify you. I will not tell anyone else about what you say on your questionnaires unless I have

to for legal reasons.

What if you have any questions?

Be sure to ask me any questions you have before deciding whether to be in this study or not.

Even if you don't have questions now, you can ask me about this study at any time later. If you would like time to discuss it with your parents before making your decision, please tell me.

What if you change your mind?

If you decide to be in this study and later change your mind, just tell me that you want to stop. I will stop collecting information about you for my study and will take out all of the information I already have about you. I will finish my study on _____ (date), so that is the deadline when you should tell me if you want your information taken out of the study.

Print name of researcher

Signature of researcher

Date

To the Student: Your signature below indicates that you have read the information on this form [or that I have read the information on this form aloud to you], and that all of your questions about this research study have been answered. (If we are in remote instruction, your typed signature in a Google Form will replace your handwritten signature.)

Please put an X next to your decision:

____ I agree to take part in this research and I will let you make a recording of what I say

____ I DO NOT want to have any information about me used in this research

Print name of student

Signature of student

Date

Appendix C: Survey

Adapted Student Dispositions Test by Song An (Adapted from Fennema-Sherman Mathematics Attitude Scales).

The letter next to each question identifies which category that question falls under: Motivation (M), Engagement (E), and Attitudes (A). On the survey given to the students, the letter will be removed.

Students will be asked to circle one of the 5 agreement options for each question.

1. I am sure I can learn math. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

2. Math scares me sometimes. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

3. I finish all my math work. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

4. I use math in my daily life. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

5. I am always prepared with my materials and work for math. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

6. Math is boring. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

7. I participate during math lessons and activities. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

8. Math is my favorite subject. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

9. I learn math because it is useful in my life. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

10. Once I am working on a math problem, I find it hard to stop. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

11. Math makes me uncomfortable, restless, irritable, or impatient. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

12. I do as little work in math as possible. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

13. I would rather have someone give me the solutions to a difficult math problem than to have to work it out for myself. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

14. I would like to be a successful student in math. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

15. To learn math well, participation is important. (E)

Really Agree Agree I'm not sure Disagree Really Disagree

16. Math is enjoyable to me. (A)

Really Agree Agree I'm not sure Disagree Really Disagree

17. I work hard during math to earn a good grade. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

18. I liked to try challenging math problems and work ahead. (M)

Really Agree Agree I'm not sure Disagree Really Disagree

Appendix D: Descriptive Statistics Song

Old Town Road (Data Remix)*

By Megan Hook

Yeah I'm gonna take my data to the old town road
 I'm gonna solve 'til I can't no more
 I'm gonna take my data to the old town road
 I'm gonna solve 'till I can't no more

I got the data graph attached
 Yeah I can handle that
 The range is the difference
 The greatest from the littlest
 If I see most, then I know the mode
 Solving as I go, ha
 Gonna find the unknown

Can't nobody tell me nothing
 I'm interpreting data
 Can't nobody tell me nothing
 But I can tell you how to solve them

Mean's the average, central
 Fair share of the data
 What's the median?
 The middle is what you get
 My graph is a movie
 Line plots come right to me
 Values ice like Gucci
 Solving likes it's my duty

Can't nobody tell me nothing
 I'm interpreting data
 Can't nobody tell me nothing
 But I can tell you how to solve them

I'm gonna take my data to the old town road
 I'm gonna solve 'til I can't no more
 I'm gonna take my data to the old town road
 I'm gonna solve 'till I can't no more

Practice, perfect, yeah we're awesome students
 Spent a lot of time learning and doing
 Yeah we got a habit doing math and singing fun songs

Analyzing data like it's my very first job
Got no stress, I've been through all that
I'm like a mathematician I can't hold back
Wish I could solve all day on that old town road
I gonna solve til I can't no more

I'm gonna take my data to the old town road
I'm gonna solve 'til I can't no more
I'm gonna take my data to the old town road
I'm gonna solve 'till I can't no more

*To the tune of "Old Town Road" by Lil Nas X and Billy Ray Cyrus

Appendix E: Shape Song (Triangle)Mathematician in the Ocean*By Megan Hook

What you know about triangles in the 5th grade
When the sides are unequal, you can call it scalene
When two sides are the same, put that under isosceles yeah
I feel like a mathematician in the ocean ay
What you know about triangles in the 5th grade
When the sides are equal, you can call it equilateral
When these sides talk too much, gotta put them in slow motion yeah
I feel like a mathematician in the ocean ay.

*To the tune of "Astronaut in the Ocean" by Masked Wolf