

## **Employing Music as an Entry Point into Classes**

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## **Employing Music as an Entry Point into Classes**

For the past 10 years, music has been employed as an entry point into classes at The Citadel. Using music as an entry point into classes has been an effective icebreaker. As class begins, students are energized and ready to learn; they are also ready to figure out how the music relates to the topic of the day. The musical prelude to class has pedagogical benefits in enhancing the readiness of students to start the intellectual work of the day. Typically, the music played is thematically connected to the specific course contents in terms of lyrics-daily syllabus topic. This paper discusses the playlist of songs used in Mechanics of Materials, Introduction to Geotechnical Engineering, Engineering Economy, and Engineering Probability and Statistics. In addition, it discusses the survey of students' perception of playing music before a lesson. The result of the survey shows that at least 90% of students are strongly agree or agree with the statement "music improves learning and increases positive classroom experience."

### **Literature Review**

There have been concerted efforts in recent years to change STEM focused K-12 educational programs to STEAM focused programs by adding an arts program [1,2]. The goal is to infuse more creativity into the STEM focused programs at early ages. The newest effort is to change STEM focused K-12 educational programs to STEMM focused educational programs. The second M in K-12 programs is for music [3] which has been shown in numerous research efforts to enhance cognitive abilities (mathematical understanding) [4]. Other STEAM programs keep the A with a focus on music. With this effort, the goal is to improve equity in STEM education through inclusion of music programs in all school districts, even the less affluent ones [5]. The primary issue is most music programs are euro-centric in the choice of band, orchestra, and choir music. There have been a few recent efforts to apply music the students listen to as a modality to learn STEM topics. The most successful program is using Hip Hop music to teach basic mathematical and engineering skills in high minority school districts [6]. The students write their own words to a beat based on learning mathematical and engineering principles [7]. STEM knowledge and understanding appears to have a longer effect when the students use music they enjoy listening to. The program has been used in school districts where the minority student population is low with the same lasting understanding of STEM topics. Within the university arena, STEMM uses the second M for Medicine engagement to increase the number of minorities in the medical fields [8].

Most of the art and music additions have been in the K-12 arena and little work has been done within college level STEM programs to improve understanding using art or music. Most of the possible enhancement has been through required General Education requirements where a STEM student can opt to take a freshmen art or music appreciation class.

When researching into the use of music within engineering focused courses, the majority fall into high school (Project Lead the Way) courses and/or college courses (freshmen and sophomore level) electrical engineering courses where the professor is using music to assist students in a fuller understanding of amplitude, wavelength, etc [9-12]. Some programs even require students

to build guitars with basic components while mirroring the electrical equipment amplitudes and wavelengths.

A promising area of work appeared to be The Metal Hour [12]. It is a radio talk show where students and faculty discuss metallurgy and play some heavy metal based on the title of the talk show. However, the actual music is not as important as the ability to educate a large audience about the importance of metal behavior. There have been several courses being taught by engineering faculty as general education classes that pull in social justice, music, and an area of STEM to assist students seeing the connection to improving social justice mentioned is so many different music genres through our STEM skills [14-17]. Another course used Stevie Wonder's song "Superstition" as a metaphor for computing levels of abstraction. [18] Of course, all programs are efforts to improve STEM learning to inspire students to enter STEM careers [19-20].

The one research effort that focused on playing music before class (pre-class period) focused on using topical music to improve rapport with the instructor as well as improve performance on learning objectives [21]. There were three groups: verbal talking with students prior to class; topical music and no verbal interaction prior to class; and no student-faculty interaction or music. Interestingly, the results did not show any statistical improvement in student learning outcomes. The issues could have been the application and type of music by the different instructors and the fact the course was a project-based freshman course. However, there appeared to be some improvement in rapport when using the music.

This paper is also focusing on the pre-class time to engage the students in critical thought about the current STEM lesson by playing topical music. Music can motivate (increase dopamine) and increase blood flow to key areas of the brain [22-24]. The students at The Citadel are asked, quizzed, or surveyed on how the music (title, lyrics, and beat) ties into the current lesson using the posted lesson objectives in the classroom or the lesson objectives posted on CANVAS. The music is referred to numerous times throughout the lesson to draw the students to how well music highlights STEM topics.

The instructor begins each class with a music video related to the day's topic or day's learning objectives and plays loudly over the classroom's speakers. Instructor invites students to guess its relevance. For instance, one day the instructor played the Beatle's "Twist and Shout" because they were covering the "Angle of Twist" in Mechanics of Materials course. The result: Students started the class curious and thinking ahead to the topic of that day's lecture.

Table 1 shows the learning objectives or the topic of the day along with the song played before the Mechanics of Materials class. For example, to connect to the Mohr's Circle concepts, as students enter the classroom, an instructor plays a song with the word 'circle' in its lyrics, such as "Circle in the Sand" by Belinda Carlisle; or "Draw Me a Circle" by Barbara Streisand to stimulate learning and build students' enthusiasm about Mohr's circle. Before the start of the first day of class, "Here I go Again" by White Snake is played signifying the students' struggle with concepts such as trusses, frames, 3-D equilibrium.

Table 1. Song played before class in Mechanics of Materials

Topic /Learning Objectives of the Day	Song of the Day
Review of Statics	“Here I Go Again” by White Snake
Compute Internal Forces	“Breaking Inside” by Shine Down
Introducing Stress	“Pressure” by Billy Joel
Determine Compressive Stress	“Under Pressure” by Queen
Determine Tensile Stress	“Tension” by Vivian Girls
Calculate Factor of Safety	“Safety Dance” by Men Without Hats
Determine Poisson's Ratio	“Changes” by David Bowie
Determine Thermal Stress	“Heat is on” by Glenn Fry
Indeterminate Thermal stress	“Heat of the Moment” by Asia
Calculate Angle of twist.	“Twist and Shout” by Beatles
Torsional Stress and Angle of twist	“The Twist” by Chubby Checker
Draw Bending Moment Diagram	“Stuck in a Moment with You” by U2
Determine Shear Stress	“Sheer Heart Attack” by Queen
Design a Beam	“Strong Enough” by Sheryl Crow
Combined Loading	“Come Together” by Aerosmith
Stress Element	“Different Point of View” by Pet Shop Boys
Mohr's Circle	“Circles in the Sand” by Belinda Carlisle "Draw Me a Circle" by Barbara Streisand
Pressurized vessels	“Under Pressure” by Bowie & Queen

Tables 2 and 3 illustrate the list of songs played in Engineering Economy and Probability and Statistics. Prior to each lesson, a song about money was played from a list of all-time greatest hits (i.e., “Money” by Pink Floyd, “If I had Million \$” by Barenaked Ladies, “Take the Money and Run” by Steve Miller Band, etc.) to stimulate learning and get the students excited about engineering economy.

Table 2. Engineering Economy

Topic of the Day	Song of the Day
Introducing Time Value of Money	"Money" by Pink Floyd
Applications of F/P, F/A	"If I had Million \$" by Barenaked Ladies
Applications of P/F, P/A	"Money" by ABBA
Applications of P/F, P/A	"Money" by Pet shop boys
Present Worth Analysis	"Take the Money and Run" by Steve Miller Band

Table 3. Engineering Probability and Statistics

Eng Probability & Statistics Topic	Song of the Day
Risk Analysis	"Take a Chance on me " by ABBA
Descriptive Statistics	"Mean" by Taylor Swift
Probability Rules	"Poker Face" by Lady Gaga
Conditional Probability	"Desperado" by Eagles
Probability Distributions	"Roll the Dice" by Bruce Springsteen

Table 4 shows a list of songs played before lessons in Introduction to Geotechnical Engineering. The song's title or lyrics are focused on rock, sand, changes, landslide, pressure. To convey the consolidation settlement, song such as "Like a Virgin" by Madonna (virgin compression curve), "Come Together" by the Beatles (bringing together concepts such as overburden pressure, geostatic stresses, induced stresses, history of soil, etc.) was played before class.

Table 4. Songs played before class in geotechnical Engineering.

Topic/ Learning Objectives of the Day	Song of the Day
Describe Rock-Soil Relationships	"I am a Rock" Simon and Garfunkel
Geology "Rock Cycle"	"Built this city on Rock and Roll" Starship
Grain size distribution	"Enter Sandman" Metallica
Properties of Sand	"Mr. Sandman" Chordettes
Describe Liquid and Plastic Limits	"Changes" David Bowie
Analyze Slope Stability	"Landslide" Fleetwood Mac
Determine Overburden Pressure	"Pressure" Billy Joel
Calculate Induced Stress	"Got Me Under Pressure" ZZ Top
Dynamic compaction	"I Feel the Earth Move" Carol King
Shallow foundations	"Build Me Up Buttercup" The Foundations
Unconfined Compressive Strength	" Draw Me a Circle " Barbara Streisand
Develop Mohr's Circle	"Circle of Life" Elton John
Determine Elastic Settlement	"House of Sand" Elvis Presley
Determine Consolidation Settlement	"Come Together" Beatles
Virgin Consolidation curve	"Like a Virgin" Madonna

### Investigating Students' Perceptions of Playing Music Before Class

**Survey Methodology:** A survey consisting of five questions was developed (Table 5). The students were asked to rank perception using a five-point Likert scale (1-5), with '1' representing a strong disagreement with the survey statement and '5' representing a strong agreement with the survey statement. In total, 88 students (36 from the evening program and 52 students from the day program) participated in the survey. The survey was conducted at the end of each semester.

Table 5. Survey of student perception of playing music before class.

Q1. Music helps to create a positive affective, learning receptive mood.
Q2. As I enter the classroom, I am always energized and ready to learn.
Q3. Listening to music before class improves my cognitive performance in this course.
Q4. Music improves learning and increase positive classroom atmosphere
Q5. Songs played are connected to the assigned reading for the day.

**Research Question 1:** Does the perception of students in the day program about playing music before each lesson differ from the perception of students in the evening program?

Figures 1 and 2 show the results of student perception of playing music before class. The results of the survey of students' perception shows that 93% of students agreed with the statements that "music helps to create a positive affective learning receptive mood as well as music improves learning and increase positive classroom atmosphere." Almost 91% of students agreed or strongly agreed with question #2. 93.5% agreed or strongly agreed that listing to music before class improves their cognitive performance in the course. Almost 96% perceived that songs played were connected to the assigned reading for that day. Statistical analyses were performed to see whether the perception of day program students about playing music differs from those in evening program. The results showed that the difference between the mean perceptions between day and evening programs were not statistically significant at 5% level.

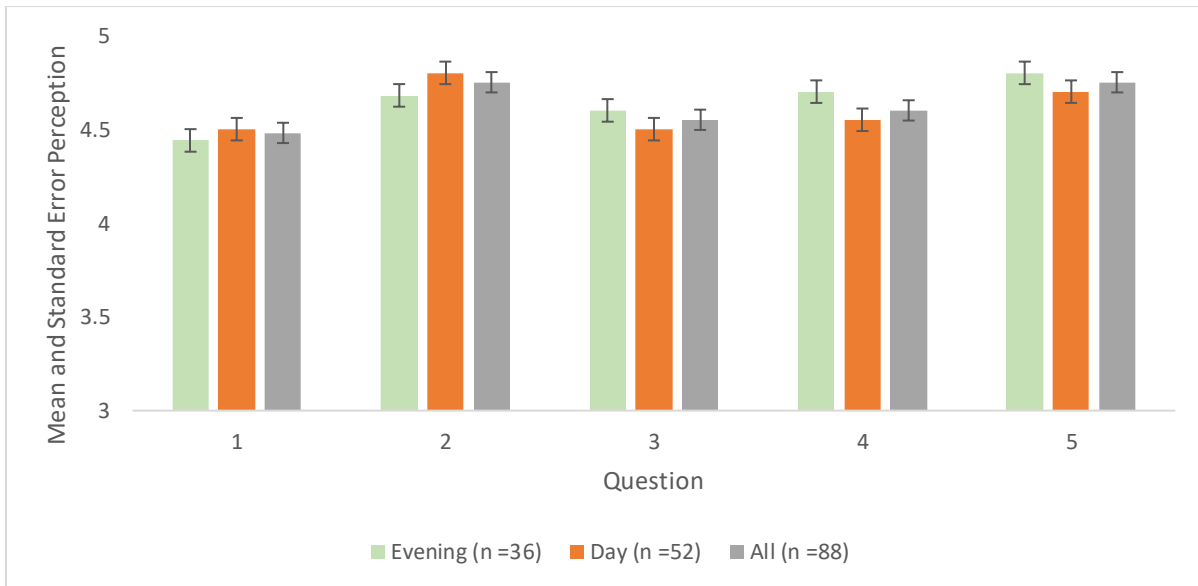
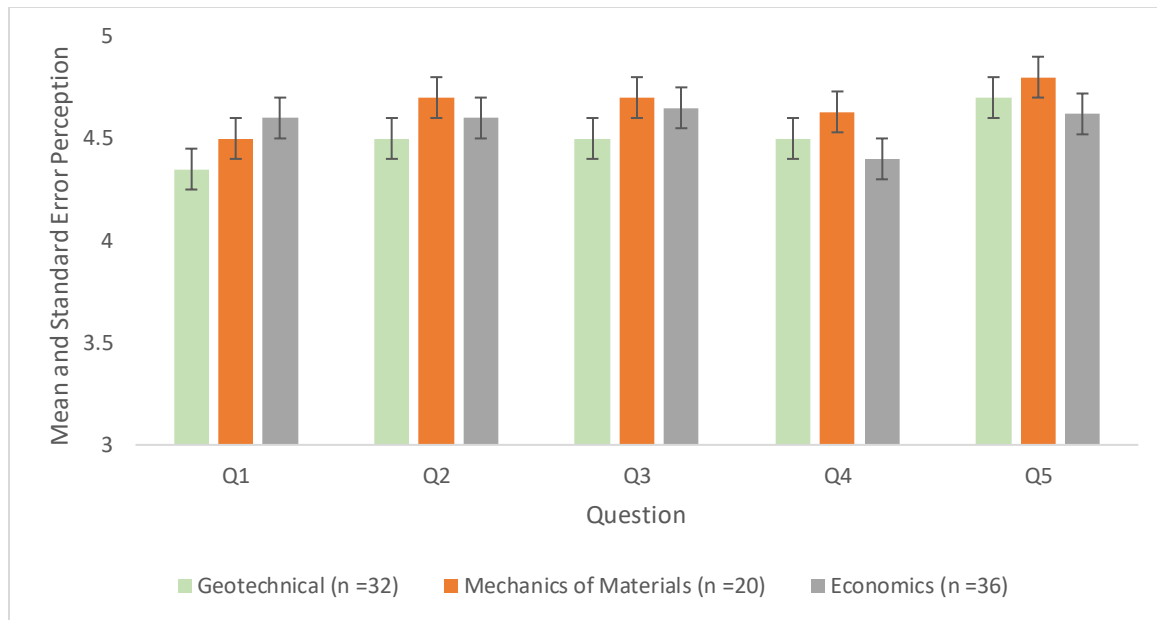


Figure 1. Means and standard errors for questions 1-5 of survey.

**Research Question 2:** Does the perception of students regarding playing music before each lesson differ across the three subjects?

One-way analysis of variance was performed to see whether the perception of students regarding playing music before each lesson differs across the three subjects. The results showed that the

difference between the mean perceptions among three subjects were not statistically significant at 5% level.



### Conclusions:

The musical prelude to class has pedagogical benefits in enhancing the readiness of students to start the intellectual work of the day. Based on the results of students' perceptions of playing music before each lesson, following conclusions

- Music helps to create a positive affective, learning receptive mood.
- Songs are connected to the assigned reading for the day.
- As students enter the classroom, they are always energized and ready to learn.
- Listening to music before class improves their cognitive performance.
- Music improves learning and increase positive classroom atmosphere

### Future work

It will be good to have the students pull in music they listen to be topical music for lessons (it is important to note that most of the current music is based on what the professors listen to). It will also be beneficial to ensure the lyrics are studied to see if any social injustices are being mentioned that can be tied to the role of engineering in society.

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