INTEGRATING MUSIC INTO MATH LESSONS

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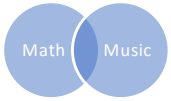
BACKGROUND and OBJECTIVE

If you ever ask a high school student about what they think of Math, they'll probably say that Math is one of the hardest and most boring subjects in high school.

However, if you were to ask the students about what do they think of their music classes, the answers can be very different.

So, what happens if musical elements are integrated into a math lesson?



This can be carried out in many forms. However, in this project, we'll be looking at the lesson for *exponential and logarithmic functions*, a Pre-Calculus lesson.

The math formulae students have to use to calculate the frequencies of every note they want to use are:

$$f_n = f_0 \times \sqrt[12]{2^n}, \qquad n = 12\log_2\left(\frac{f_n}{f_0}\right)$$

Where:
f_n is the frequency of a note;
f_0 is the frequency of the reference note, i.e. A440.
n is the number of half-steps between the two notes (f_{ref} to f_n)

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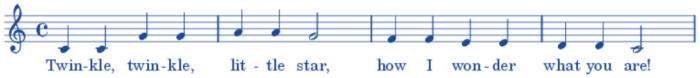
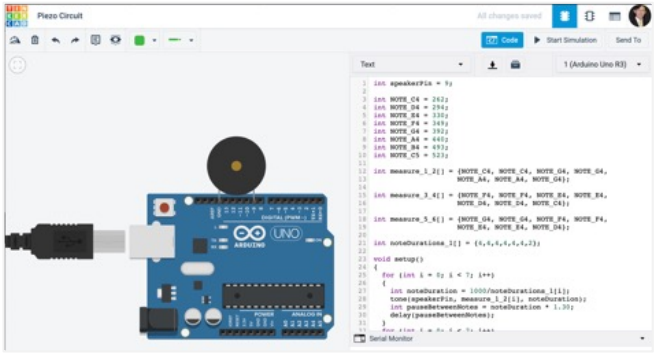
ACTIVITY and WORKFLOW

For the project, the class was divided into teams, and each team was being assigned to perform a musical piece (i.e. Twinkle Twinkle Little Star) using Arduino.



The music sheets were given in the form of staff notation, therefore some basic knowledge of reading music is required to continue.
Once they know what each note is called, they'll need to calculate the frequencies using the formulae.
Everything is then inputted into an Arduino simulator (i.e. Tinkercad).
This part is meant for students to dive into some computer programming and engineering.

Here's a screenshot of what the setup may look like from a student's perspective:



The activity is done using the online tinkercad interface (an Arduino simulator), the Arduino components are shown on the left, coding on the right. The frequency values need to be recalculated for each piece. Once everything is ready to go, students will click on the 'Start Simulation' button to hear what they've created.

RESULT and DISCUSSION

After going around the classroom and observing what students were able to learn and complete, here're a few things that might be worth highlighting:

Observations:

- The student-engagement was close to 100% since most of them have not seen it before and are curious.
- Many students who's interested in Music but not Math were still engaged or lead their teams, because they believe this is their field of expertise.

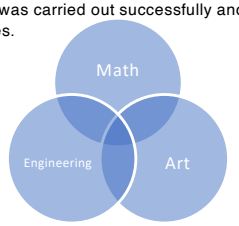
Potential challenges:

- The teacher will need to have some level of basic knowledge in music theory in order to carry out the lesson.
- The learning curve might be a bit steep for some students, to grasp and handle in just one class-period.

Future improvements:

- After students are familiar with how Arduino works, they might be able to work with more complicated problems using physical hands-on models.
- Looking into more variations to combine art, math and engineering.

Overall, the project was carried out successfully and safely in the Pre-Calculus classes.



ACKNOLEDGEMENTS
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REFERENCES
- Tinkercad.com
- What are the frequencies of musical notes. https://www.intmath.com/trigonometric-graphs/music.php