Teaching A Computer To Sing

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Bartlett Community School Collaborators
- Music Teacher Rachel Crawford
- Math Teacher Firas AL-Rekabi
What We Tried To Do

Simple Overall Goal

- Get middle school students programming

What We Tried To Do

Not-So-Simple Environment

- After-school, that is, after they’ve already been in school for about 7 hours
- All they really want to do is hang out with their friends
- So how can we “hook ’em”?
Our Approach
The Magic Music Teacher

- We enlisted the assistance of a dynamic music teacher whom the children loved

Step 1: Get ‘Em Singin’

“Stitches” by Shawn Mendes
Step 2: Find Appropriate Songs
Step 2: Find Appropriate Songs

SHAKE IT OFF

Words and Music by TAYLOR SWIFT, MAX MARTIN and SHELLBACK

I stay out too late,
got nothing on my brain,
I'm lightning on my feet.

But I can't make 'em stay;
I make the moves up as I go.

What do we really have here?
Step 3: Teach Reading a Simple Score

The musical alphabet uses seven letters: A B C D E F G

After G you start over again at A.

The notes on the staff are on a line or in a space.

Remember the line notes by the saying: Every Good Boy Does Fine
Remember the space notes by spelling out: F A C E

Sources:
- http://music.milbth.webbly.com/notes-on-the-staff.html
- http://www.piano123.com/~/Treble-notes_Grand-Staff.png

Understanding Note and Rest Values

<table>
<thead>
<tr>
<th>Note</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole Note</td>
<td>Whole Rest</td>
</tr>
<tr>
<td>Half Note</td>
<td>Half Rest</td>
</tr>
<tr>
<td>Quarter Note</td>
<td>Quarter Rest</td>
</tr>
<tr>
<td>Eighth Note</td>
<td>Eighth Rest</td>
</tr>
<tr>
<td>Sixteenth Note</td>
<td>Sixteenth Rest</td>
</tr>
</tbody>
</table>

ABC Notation

<table>
<thead>
<tr>
<th>A4</th>
<th>whole note (4 beats)</th>
<th>z4</th>
<th>whole rest (4 beats)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2</td>
<td>half note (2 beats)</td>
<td>z2</td>
<td>half rest (2 beats)</td>
</tr>
<tr>
<td>A or A1</td>
<td>quarter note (1 beat)</td>
<td>z or z1</td>
<td>quarter rest (1 beat)</td>
</tr>
<tr>
<td>A/ or A/2</td>
<td>eighth note (½ beat)</td>
<td>z/ or z/2</td>
<td>eighth rest (½ beat)</td>
</tr>
<tr>
<td>A/4</td>
<td>sixteenth note (¼ beat)</td>
<td>z/4</td>
<td>sixteenth rest (¼ beat)</td>
</tr>
</tbody>
</table>
**Step 4: Teach How to Code the Score**

**ARE YOU SLEEPING**

Traditional  
Arranged by CATHERINE DELANGY

\[ \text{\textbf{\textit{Singing Themselves}}} \]

\[ \text{\textbf{\textit{Teaching Their Computer to Sing}}} \]
Software Choices

Audacity

EasyABC

ARE YOU SLEEPING

Arranged by CATHERINE DELANOT

Demonstration(?)

Documentation
Software Choices

We truly love Scratch, but ...
Software Choices

Scratch Minuses
- MIDI numbers
- Synchronization issues

What does this code play?

Software Choices

Scratch Minuses
- MIDI numbers
- Synchronization issues

Scratch Pluses
- Looping structures
- Variables, even Arrays
- Conditional statements
- Branching via “broadcasts”
- Indirect referencing
- and other such constructs
Can we have it all?

Dream it. Code it.
Learn professional programming languages using an editor that lets you work in either blocks or text. Create art, music, games, and stories. Or invent a program that will change the world.

Let's play!

Draw
Create art

Jam
Make music

Imagine
Code an adventure
What does this code play?
Software Choices

Pencil Code Pluses

- Virtually all the features of Scratch, at least as far as music is concerned
- Dynamic keyboard available
- Completely web-based in native JavaScript
- Code view as well as block view

Pencil Code Minuses

- Not as intuitively obvious as Scratch
  – Neither is “Snap! (Build Your Own Blocks)”
- No longer under active development
Software Choices
Pencil Code

- As with all software, doing complex stuff is complex
- We therefore created templates with prewritten functions that students could copy and edit for their own purposes

Demonstrations(?)

Partner Songs

One Bottle of Pop

Don't Throw Your Trash

Fish and Chips

(Images and musical notation are not transcribed here.)
### Culminating Project

#### Bartlett Community Partnership School

#### Teaching A Computer To Sing Program

#### December 2016

<table>
<thead>
<tr>
<th>1. Are You Sleeping? (0:42)</th>
<th>recorded by the TACTS Chorus, December 1, 2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Are You Sleeping? (0:41)</td>
<td>recorded by the TACTS Chorus, December 1, 2016, with original lyrics composed by the TACTS Kids</td>
</tr>
<tr>
<td>3. Are You Sleeping? (round) (0:20)</td>
<td>programmed by Saif Al-Rekabi</td>
</tr>
<tr>
<td>4. The More We Get Together (1:02)</td>
<td>recorded by the TACTS Chorus, December 1, 2016</td>
</tr>
<tr>
<td>5. The More We Get Together (0:25)</td>
<td>programmed by Hessell Rivera</td>
</tr>
<tr>
<td>6. The More We Get Together (0:24)</td>
<td>programmed on two synchronized computers by Hessell Rivera and Tallya Chan</td>
</tr>
<tr>
<td>7. The More We Get Together (0:24)</td>
<td>programmed on Kathryn Pen</td>
</tr>
<tr>
<td>8. Let It Snow (1:02)</td>
<td>recorded by the TACTS Chorus, December 8, 2016</td>
</tr>
<tr>
<td>9. Let It Snow (0:39)</td>
<td>programmed on Angelina Kong &amp; Isabella Burigo</td>
</tr>
<tr>
<td>10. Let It Snow (0:56)</td>
<td>programmed on Breanna Tim</td>
</tr>
<tr>
<td>11. Let It Snow (0:58)</td>
<td>programmed on Saif Al-Rekabi</td>
</tr>
<tr>
<td>12. Rudolph the Red-Nosed Reindeer (1:40)</td>
<td>recorded by the TACTS Chorus, December 8, 2016</td>
</tr>
<tr>
<td>13. Rudolph the Red-Nosed Reindeer (1:26)</td>
<td>programmed by Ethan Samthomath</td>
</tr>
<tr>
<td>14. When the Saints / This Train Medley (1:22)</td>
<td>recorded by the TACTS Chorus, November 29, 2016</td>
</tr>
<tr>
<td>15. When the Saints Go Marching In (0:32)</td>
<td>partner songs programmed by Nelle Feliciana</td>
</tr>
<tr>
<td>16. Dona Nobis Pacem (0:16)</td>
<td>programmed by Jacqueline Hernandez-Coban</td>
</tr>
<tr>
<td>17. Candy (0:38)</td>
<td>original song programmed by Fernanda Lozano</td>
</tr>
<tr>
<td>18. Fight Song (2:35)</td>
<td>recorded by the TACTS Chorus, December 10, 2015</td>
</tr>
</tbody>
</table>
Primary Research Questions

1. Can middle schoolers follow the connections from singing to digitized sound to computer notation and back to music to help them learn to program using songs they like to sing?

2. Conversely, can programming their individual parts help students learn to sing in three- and four-part harmony?
Secondary Research Questions

3. What resources, models, and tools are necessary to integrate STEM into a middle school, after-school choral program?
   - restricted network and Internet access
     - YouTube and music sites blocked
   - software installation prohibited
   - from laboratory model to clubhouse model
   - need for additional university student assistants
     - one-on-one instruction

Secondary Research Questions

4. Can the involvement of older students and teachers who match the students’ racial and/or cultural backgrounds have a positive effect on the “people like me don’t (or can’t) do that” belief that some researchers claim is a factor in underrepresented groups’ disproportionally small participation in STEM?
Secondary Research Questions

Formal Research Evaluation

Table 1. Facilitators’ Perspectives on Program Objectives

<table>
<thead>
<tr>
<th>Objective</th>
<th>Year</th>
<th>N</th>
<th>Mean</th>
<th>Std.Err.</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow connections both ways</td>
<td>1</td>
<td>4</td>
<td>2.00</td>
<td>0.577</td>
<td>p &lt; .05</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>3.88</td>
<td>0.350</td>
<td></td>
</tr>
<tr>
<td>Learn to program using songs</td>
<td>1</td>
<td>4</td>
<td>3.50</td>
<td>0.289</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>8</td>
<td>4.13</td>
<td>0.295</td>
<td></td>
</tr>
<tr>
<td>Improve efficacy for programming</td>
<td>1</td>
<td>4</td>
<td>3.50</td>
<td>0.289</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7</td>
<td>3.71</td>
<td>0.184</td>
<td></td>
</tr>
<tr>
<td>Racial/cultural matching positive</td>
<td>1</td>
<td>4</td>
<td>2.75</td>
<td>0.479</td>
<td>no</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>7</td>
<td>3.71</td>
<td>0.184</td>
<td></td>
</tr>
</tbody>
</table>
What makes is all worthwhile

thank you

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