# Musical Manipulatives

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# Musical Manipulatives

**Manipulatives** are physical and virtual objects that are used as teaching tools in mathematics and music education.

**Music Blocks** software is designed for teachers and learners to explore the fundamental concepts of music in a visual-coding environment, largely through the use of **virtual manipulatives** that target powerful ideas in music theory and practice.

# Virtual music manipulatives

**Virtual music manipulatives** have been part of the Logo repertoire since the 1970s.

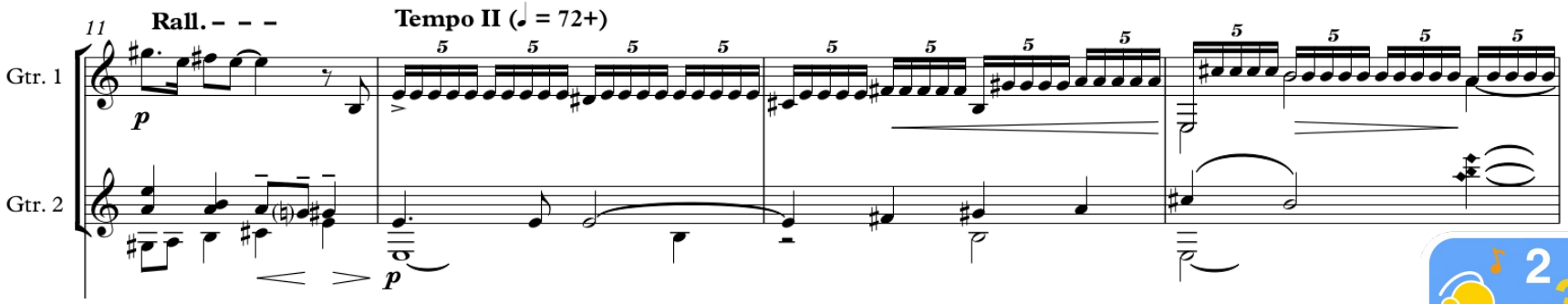
Jeanne **Bamberger**, Hal **Abelson**, and Terry **Winograd** created MusicLogo, “whose commands controlled a sound-emitting box, allowing a tune to be written in code and then immediately played aloud.”

MusicLogo exposed some “powerful ideas”, such as some of the **higher-level structural elements of music**.

# Music == Programming

Music composition and performance require practitioners to follow basic control flow such as:

- **sequences**; **conditionals** and **loops**;
- **data abstractions** such as changes in timbre, tone, and meter; and
- **functions** and **operators** such as transpositions, inversions, and retrograde.



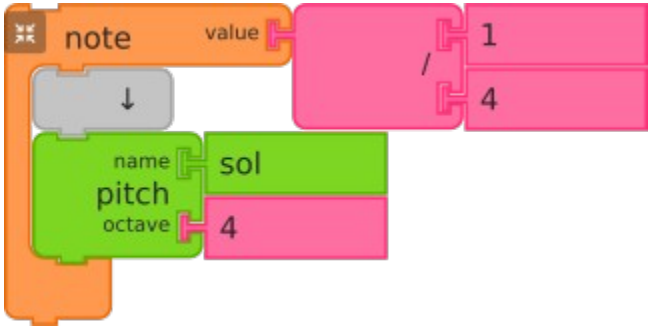
# Debugging

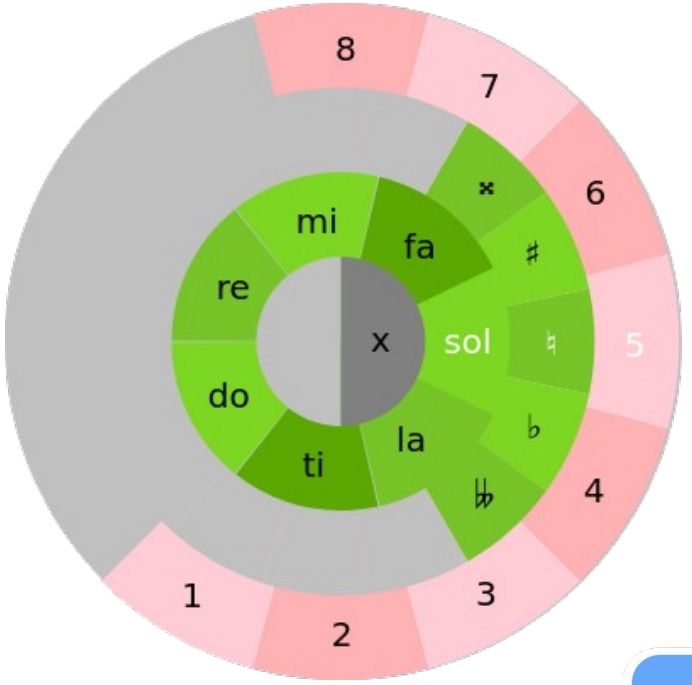
**Debugging**—making corrections to a composition, perfecting a transcription, or working through a section of music on an instrument—leads to a deeper understanding of music (and computation) theory.

Programmers review code and musicians critique performances.

Both musicians and programmers modify, improvise, and derive inspiration from the work of peers and mentors.

# The Music Blocks interface itself is a manipulative.



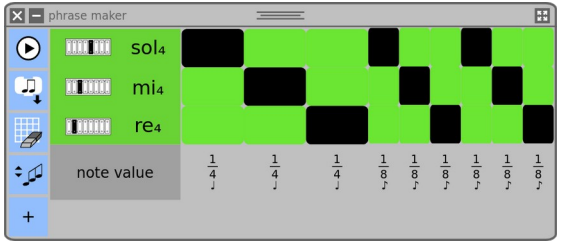



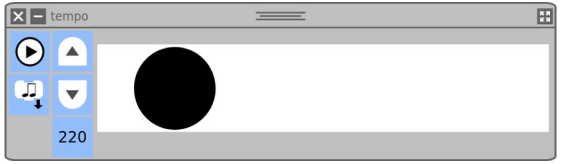
# Widgets

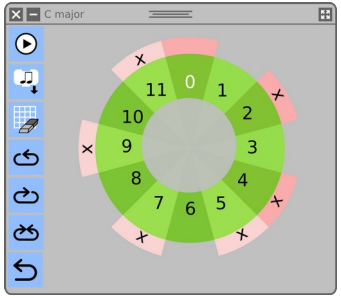
Music Blocks exposes powerful ideas, such as polyphonic rhythms, key and mode, intervals, tuning, and temperament, through manipulatives called “widgets”.

Widgets don’t just produce music, they output code that is descriptive of concepts found in music, such as generating rhythms, changing tempo, and using samples.

Most of the widgets are inspired by the things a music teacher might draw on a whiteboard—now in the form of a manipulative.



# We’ve been busy

When we presented Music Blocks at **Constructionism 2016** in **Bangkok**, we did not yet have much experience using the language in the classroom. In the years that have followed, Music Blocks has been used in large-scale deployments in **Japan** and **Peru** and we have developed a number of lesson plans that highlight its use as a musical (and mathematical) manipulative.

# Music Blocks Lesson Plans

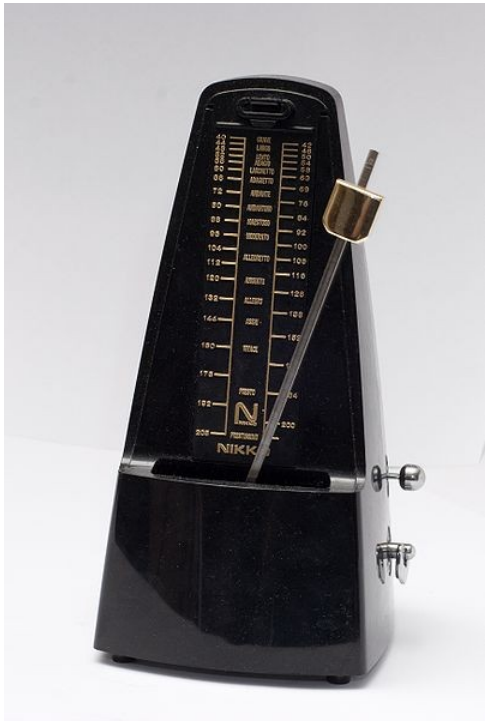
We have developed dozens of lessons for beginner, intermediate, and advanced students.

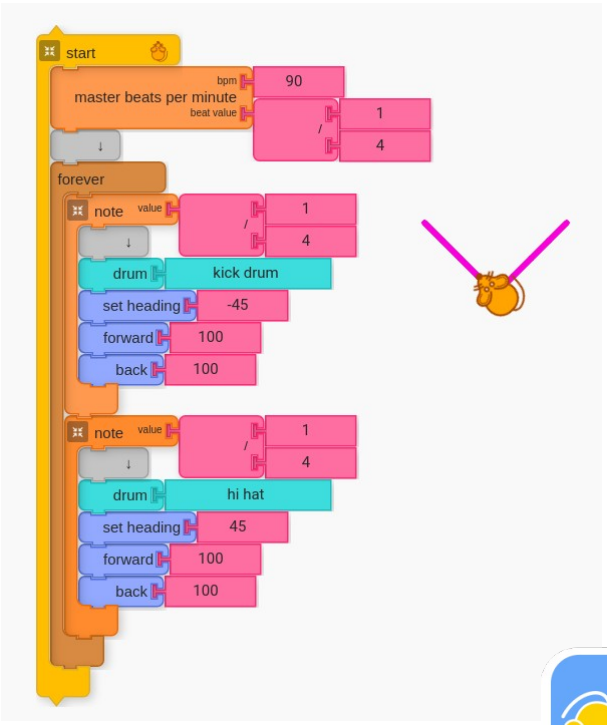
The typical Music Blocks lesson plan is a one-hour block, where:

- The first 15 minutes is a **hands-on activity** (often using a physical manipulative) and discussion;
- This is followed by a series of **programming activities**;
- The final 5–10 minutes are used for group **demonstrations, discussion, and reflection**.

Link to our lesson plans for teachers: https://mapflc.com/lesson-plans/

# **Lesson Example:** Create a Metronome.





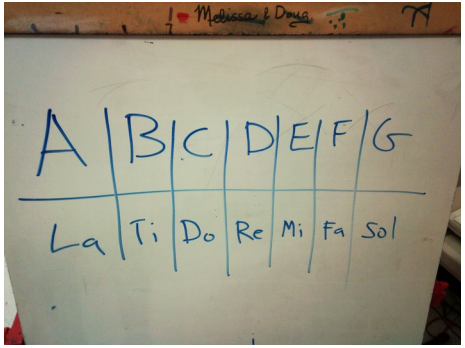
# **Lesson Example:** Create a Metronome.

# What have we learned from our lesson plans?

- Music Blocks adds **new manipulatives** to those currently used in music education. It also infuses math and programming with musical ideas.
- These manipulatives are Constructionist in their nature: they give the learner **opportunities to construct their own insights** (and goals).
- Learners are encouraged to create **personably meaningful experiences**.
- The lesson plans are designed such that these experiences lead to **engagement with traditional representations**.

# Key takeaway

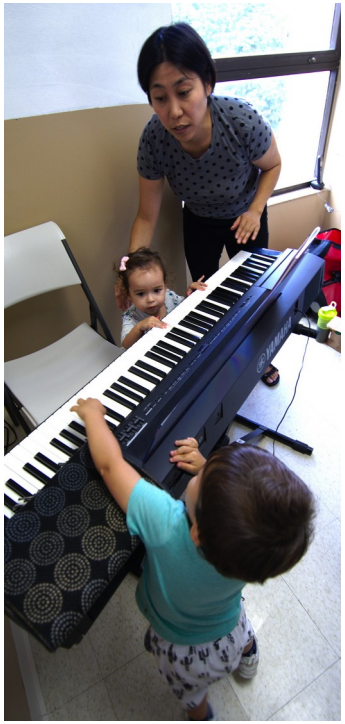
Unless there are familiar and veritable musical constructs, music teachers will not engage with the tools. **Familiarity and authenticity are paramount to adoption**.



# A hands-on experience

Learning to play an instrument is inherently a hands-on experience; it requires the student to physically manipulate the instrument in order to produce sound. This allows students to develop a deep understanding of how music works.

We have found that this experience is further enhanced through the application of supporting manipulatives, including computational manipulatives, such as Music Blocks widgets.



# Composition

While it is not typical for elementary music education to emphasize invention or composition, we can design numerous opportunities for learners to compose their own music or to incorporate music in their personal expression.

**Composition requires a learner to think creatively and to solve problems.** It allows students to develop an understanding of how music works, to realize its connection to math, to learn in more than one way, to have fun, and—very importantly—experience music's strong social and cultural ties.

# “There’s an App for that.”

There is an interactive Music Blocks widget for many (but notably not all) of the manipulatives commonly used in a music classroom.

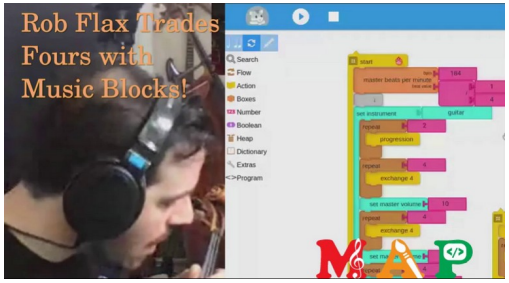
But Music Blocks goes a step further. Through Music Blocks lesson plans we encourage teachers and learners to **construct their own apps**, whether it be invented notation, metronome, listening exercise, or musical game.

The essential enablers of this musical construction are the affordances in the language itself—a musical microworld populated by “powerful musical ideas.”

# Final thoughts from a music teacher

Why music students do better in academics:

- Kids who take music lessons get more time with an adult mentor;
- Many academic concepts are learned first in the music class; and
- Music students are required to work in teams (band/ensemble/orchestra), which helps them build communal (and professional) skills.




# Thank you

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https://musicblocks.sugarlabs.org

https://github.com/sugarlabs/musicblocks

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