OctoLooper: A Compositional Tool to Empower Children to Create Their Own Music

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***Abstract*—Composing original pieces of music can be an impactful part of early music education. However, logistical challenges such as noise and levels of pre-existing music knowledge make it challenging to incorporate using traditional methods. To bridge this gap, OctoLooper was developed, a tool to make the composition of a short musical loop more approachable for young children. Its design was inspired by research on Creativity Support Tools (CST) and techniques to convey meaning through visualization. Results from an initial evaluation are included, which was targeted towards parents and caregivers, as well as adults with limited musical experience.**

1. INTRODUCTION

1.1. The benefits and challenges of composition in early music education

Music can be a powerful outlet for creative expression for people of all ages, a way to reflect, develop and express ideas, and an important aspect of creative development. Musical composition, the process of creating a new piece of music, can be a rewarding, impactful, and immersive aspect of music education for young students (Johnson-Green, 2020). Composition is a key opportunity for creative exploration, going beyond attempts to perform or reproduce an existing song or musical piece. Curriculum that incorporates students' own musical voices can also engage students who might be otherwise disengaged in the music education classroom (Norman, 2021).

Despite these benefits, a survey of music teachers found that only a small percentage of these teachers used composition activities often in their classrooms. These teachers cited challenges such as lack of classroom time, logistical concerns over space and noise levels, as well as uncertainty over effectiveness, tools, and teaching strategies (Strand, 2006). Composition can also be seen as something that is only achievable by students with a certain level of music the-

ory knowledge, or only accessible to "gifted musicians", which may discourage teachers from including it in music education in primary school settings (Laato et al., 2019).

1.2. Why creative expression matters, and how to encourage it

The creative development of students can have wide-ranging impacts on important learning outcomes, including problem solving and their ability to generate novel ideas (Hagen et al., 2023). Opportunities for musical expression have important cognitive benefits even from a very young age (Zadnik & Habe, 2017). Expressive activities like songwriting can also have positive effects on social-emotional skills of children, enhancing the social skill benefits already present in typical music education (Dweck, 2023). Project-based learning approaches in music have been shown to have beneficial impacts on the creativity, engagement, and motivation of students by allowing them to incorporate areas that are personally meaningful to them into their work (Cahyani, 2021; Tobias et al., 2015).

1.3. The promise of "Low Thresholds, High Ceilings, and Wide Walls"

Digital tools can be used to supplement and enhance human creativity, leveraging technology to assist people in expressing their ideas in more innovative and productive ways. The study of Creativity Support Tools (CST) spans multiple disciplines, just as these tools have applications in countless disciplines, including art, music, engineering, science, and countless others (Shneiderman et al., 2006). From this interdisciplinary research, design recommendations have been proposed, and these recommend a focus on creating tools with "Low Thresholds, High Ceilings, and Wide Walls" (Resnick et al., 2005), which can be summarized as follows:

- **Low Thresholds**: Tools should be easy for novices to get started with, with interfaces that are accessible and non-intimidating
- **High Ceilings**: Tools should support a sufficient complexity for the level of sophistication needed by expert users
- **Wide Walls:** Tools should support a variety of use cases and explorations, enabling a diversity of creative outcomes

2. RELATED WORK

2.1. Traditional composition methods in the classroom

The process of creating a new piece of music can take many forms, and in classrooms a variety of approaches have been taken when incorporating composing tasks into music education. Often these have involved some amount of creating musical notation using either physical sheet music or, in more recent years, the use of music notation software (Laato et al., 2019). When paper-based approaches are used, instruments are often available to allow the students to hear explore possibilities and hear what their piece sounds like (Wong & Lim, 2017), though this is not always the case (Strand, 2006). A certain level of instrumental proficiency is needed to support this form of paper-based classroom activity, making technology-based approaches more approachable and accessible (Laato et al., 2019).

2.2. Digital Audio Workstation (DAW) software use in classrooms

Digital Audio Workstation (DAW) software is a category of applications designed to support the creation of various types of digital audio. This proposal will specifically be referring to the subset of DAW software aimed at music creation. An example of a DAW, GarageBand, can be seen in ***Figure 1***.

These applications often support a host of features to make the process of music creation easier, such as notation editing, recording, editing, mixing, and exporting musical pieces. In addition to recording through microphones, these applications will include a suite of virtual instruments, including synthesizers, sampled traditional instruments, and various combinations of sounds.

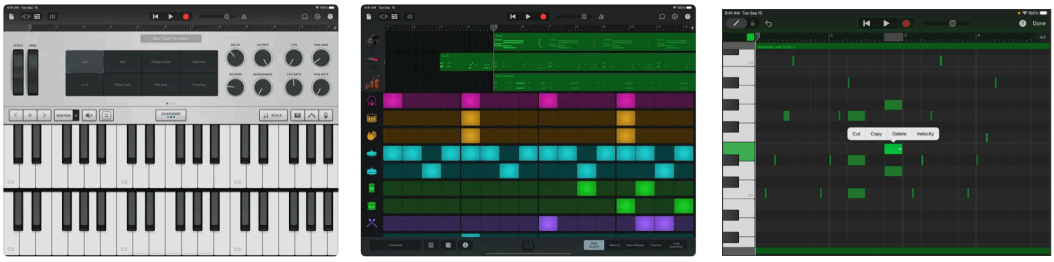


Figure 1—Screenshots from the GarageBand app on iPad, a free and popular DAW application. Source: Apple App Store

For these virtual instruments, DAWs support a variety of input methods, such as adding notes directly to a "Piano Roll" representation of the song, as shown in ***Figure 1 (right)***. In a Piano Roll interface, the pitch of notes is represented by its vertical position, and its timing is represented by its horizontal position, similar to traditional western musical notation.

When technology is used to enable composing in classroom settings, tablet applications like GarageBand for iPad are often used (Huovinen & Rautanen, 2020; Norman, 2021) due to its availability and relatively simple interface. Using tablet software for composing tasks addresses some of the practical difficulties with traditional composition methods in large classroom settings, as headphones can help make noise levels more manageable, and a variety of input levels can help support students with various amounts of music theory knowledge. This ease of access, combined with the input and visualization techniques used (such as the Piano Roll interface discussed above) may help students develop a deeper understanding of music theory through the process of music composition (Laato et al., 2019). However, there are also drawbacks to their use in classroom settings, as DAW interfaces may interrupt creative flow and require more pre-planning in their use, particularly in collaborative environments (Huovinen & Rautanen, 2020).

2.3. Musical composition tools for children

Multiple attempts have been made to create music compositional tools for use by children, often using graphical interfaces to enable young children without knowledge of music theory to create novel pieces of music (Screenshots of the tools discussed in this section can be found in *Appendix 10.1: Related Work Visuals)*. In some applications, such as GraphickScore and Paynter, the inclusion of cartoon illustrations as options for this musical drawing was found to inspire children in the process of music making. In other words, the students would use the stickers to "draw" a story that would then be reflected in the musical piece that they created (Hart, 2017; Hart & Williams, 2021).

Some musical applications aimed at children are created with a surprisingly rich feature set, such as Synth4Kids. In addition to containing adjustable synthesizer sounds, filters, and effects, this app allows users to draw a graphical score, customize arpeggios (musical chords broken up into individual notes) and program drum patterns. Elements of its design are inspired by various

pedagogical techniques from music education, including its use of the pentatonic scale for easier improvisation and its pairing of pitches with colors (Mygdanis, 2022).

Another example of the use of visualization to develop understanding of musical concepts can be seen in the "Groove Pizza" application, where the steps of a repeated rhythm are illustrated on a circular grid. By connecting the notes of each instrument in that circle, geometric lines, angles, and shapes are formed that reflect complex musical information about their timing and patterns. This design direction is continued by incorporating it into the interface input methods, as users can add either individual notes to the existing pattern or add a "shape" of notes all at once. Users can also rotate patterns of notes to experiment with rhythmic displacement, showing how novel interfaces can make advanced musical concepts more accessible (Hein & Srinivasan, 2019).

3. OCTOLOOPER

3.1. A simplified tool for music creation

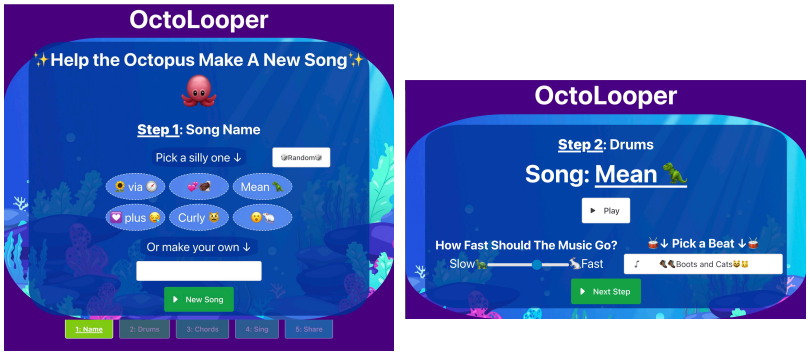


Figure 2—A screenshot of OctoLooper's interface, showcasing the use of an Octopus emoji in the Name Step (Left) and The "Drums" step (right), which determines the rhythmic nature of the song

OctoLooper (shown in ***Figure 2***) was designed to make the creation of short musical pieces more accessible to young children, such as those learning music in elementary and primary schools. OctoLooper is a web-app that's publicly accessible and simplifies the composition of a short musical loop by selecting and experimenting with various musical parameters. This iterative, guided

process is intended to deepen the users' understanding of music theory, as the loop (by default) is playing back throughout the process, so the music creator will hear the musical effects of their changes quickly.

The app is designed with an underwater-inspired theme to make the visuals fun and engaging for children. OctoLooper uses an octopus as a narrative companion for the user, and as the center of the circular interface used for chord creation. An octopus was chosen as the number 8 has several relevances in popular music and western musical traditions:

- An octave contains 8 notes in Major and Minor scales
- For musical pieces in 4/4 time signature (also referred to as "common time"), each bar can contain 8 eighth notes.
- For many step sequencer or looper tools, 2 measures is common length option for repeated patterns, which results in 2 sets of 4 beats

3.2. Step-based workflow for the creation of a musical loop

To reduce the need for technical proficiency, OctoLooper functions as a simplified version of a musical sequencer, where musical notes (or chords) are placed on a series of *steps* (equal time intervals). The musical sequence is replayed on a loop as it is being constructed, so that users can hear the loop as it is being constructed.

The created loop is referred to as a "song" throughout the app's interface, because repeated loops often are the building blocks of larger pieces in the musical structure of songs, a repeated loop may make up the entirety or bulk of a verse or chorus of a popular song, for example. Referring to this loop as a "song" reflects the idea that the patterns users are creating can be thought of as simple songs, and to frame their creations in an encouraging way.

The music creation workflow is broken down into the follow simplified steps:

1. **Name**: The user chooses a name for their musical piece, either from a list of generated options, or through typing in a custom name.
2. **Drums**: The tempo of the piece can be adjusted to make a loop faster or slower, and the backing rhythmic track can be selected from a number of basic options representing different musical styles.

3. **Chords**: Discussed further in the **Circular interface for chord selection** subsection.
4. **Sing**: The user is encouraged to sing along with the musical loop and come up with lyrics inspired by their chosen title.
5. **Share**: Optionally, the song created can be shared by copying a URL which can be sent to others.

The default musical loop in OctoLooper is 4 measures long, which was selected due to many common basic chord progressions fitting in 4 measures, while still being short enough to minimize the delay in hearing the changes users make in their short pieces.

3.3. Composition as a method for teaching music theory

While the musical choices currently present in OctoLooper are limited for simplicity, the tool is intended to expose children to several important musical concepts.

3.3.1. Tempo and Rhythm

Presented in the interface through the question "How Fast Should The Music Go?" with a slider (shown in ***Figure 2***) from "Slow" (represented by a turtle) to "Fast" (represented by a rabbit). The music gradually speeds up or slows down when the slider value is changed, conveying the idea that the same pattern can be played at different speeds.

The inclusion of the "Funk" pattern is particularly notable as it features sixteenth notes compared to the eighth note structure of the other patterns, showing that musical pieces of the same "speed" can be divided up into notes of different lengths.

3.3.2. Chords

While the interface is intentionally designed to have minimal text to make it more approachable for young users, a short informational section was created to teach basic information about what chords are (a series of notes) and how they have change the feeling of a musical piece.

Major chords are represented by a smiling emoji (😊) as they are typically associated with happier emotions, while minor chords (typically associated with

darker or more complex emotions) are represented by a "Shaking Face" emoji (😗). This emoji was chosen as it can be used to reflect emotions such as "shock, fear, confusion, disbelief, anticipation, or excitement" (Emojipedia, 2024).

3.4. Name generation for creativity scaffolding

Inspired by research on creativity scaffolding's effectiveness in supporting creativity (Lee et al., 2023; Resnick et al., 2005), OctoLooper was designed to include design elements that would serve as open-ended prompts. The first step of the process, where the user selects a name, includes random generation (a mix of simple words and emojis) so that the name of the song can serve as a prompt when the user is making later musical choices. This chosen title is displayed throughout the process, to help spark ideas when choosing elements such as the speed or tempo of a piece, or the chords that create the emotional feel of the loop.

3.5. Circular interface for chord selection, conveying musical meaning through visualization

The third step of the OctoLooper workflow, Chords, is the step that currently provides the most musical choices to the user. The musical loop is represented in a circular interface (shown in ***Figure 3***), with the Octopus in the center serving as a rotating play-head to mark the current location of playback within the

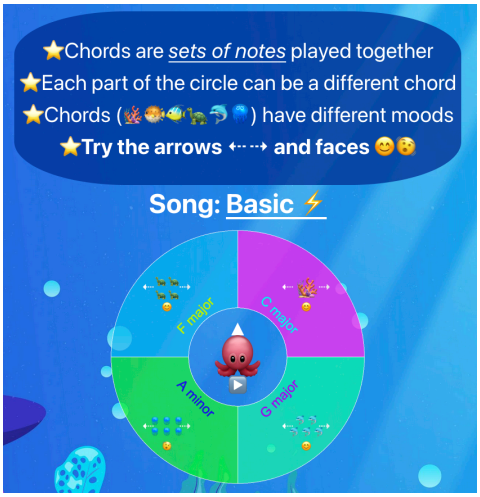


Figure 3—The Chord Step of OctoLooper, showing a popular I-V-vi-IV chord progression represented in the circular interface.

larger loop. Each measure (or bar) in the chord progression is represented by a section of the outer circle, each of which can correspond to a different chord.

Each type of chord is represented by a certain emoji and color combination, to represent and communicate information about the chord in multiple ways. The number of emoji represent the degree of the chord in the key of C Major (for instance the C major chord is represented by one coral emoji (🪸), while the D minor chord is represented by two pufferfish emoji (🐡🐡), and so on).

In addition, certain emojis were chosen to represent certain chords based on those chords harmonic function within the key. For example, the rock-like coral was chosen because the tonic chord C major is considered the most "stable", while for G major, a chord which has a strong tendency to "return" to C major (Hanvey, 2019), the dolphin emoji (🐬) was used due to its depiction of the dolphin leaping into the air in a curved shape, reminiscent of a looping arrow.

In the circular interface, chords can be toggled between using either arrows (to switch between the 3 major triad chords or 3 minor triad chords in the key of C), or the face button directly below the emoji(s). The happy and shaking faces buttons are used to switch from a major chord to its corresponding minor chord, or vice versa. Both forms of toggling represent movement within the Circle of Fifths (see ***Figure 4***), while skipping over chords that would fall out-

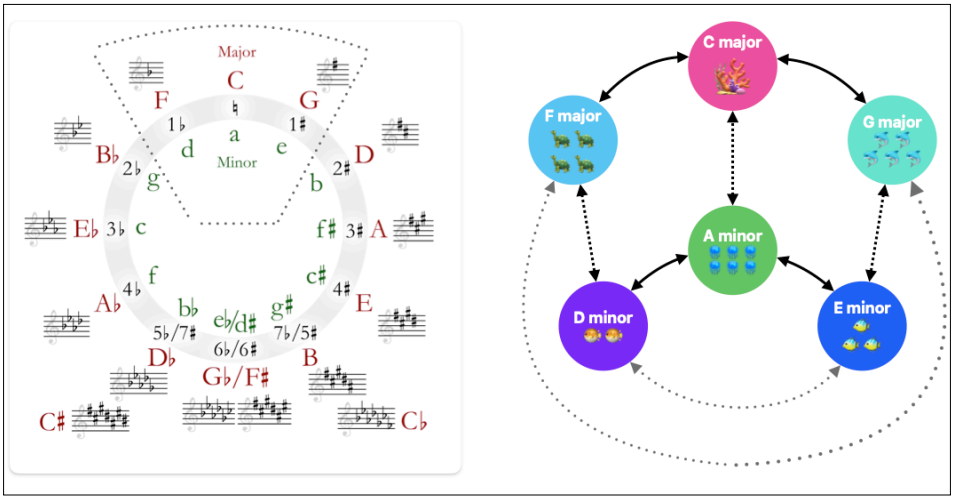


Figure 4—The Circle of Fifths (Left), edited to mark the boundaries of the major and minor chords accessible through OctoLooper (Right). The arrows in the right diagram mark the possible orders in which chord options are toggled between in OctoLooper. Original Source for Circle of Fifths: Wikipedia

side the key of C major, potentially resulting in harsh dissonant transitions that might be discouraging to users.

4. METHODS

4.1. Public demo and evaluation survey

To evaluate the potential effectiveness of OctoLooper, a demo of this preliminary version was released publicly alongside an evaluation survey. Due to the difficulty in recruiting participants within the tool's target demographic, this survey was open to all ages. However, parents, caregivers, close relatives and educators of children within the target demographic were especially encouraged to participate, as well as those with minimal exposure to music training.

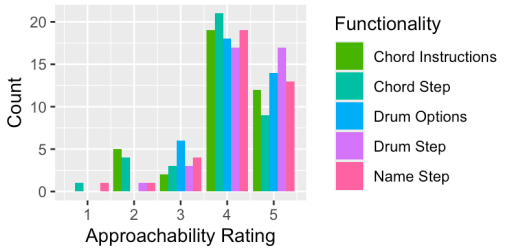
Each step of the tool was evaluated separately, with multiple questions about the approachability, intuitiveness, and appropriateness of the app's interface, rated on a 5-point Likert scale from "Strongly Disagree" to "Strongly Agree". Questions on the same 5-point scale were included to gauge the effectiveness of OctoLooper as an educational tool, such as *"The song title I chose affected how I used chords to shape the feeling or sound of the musical loop"* and *"When switching between [chord options], I could hear the differences between the different option choices at the bottom"*.

In addition, questions were included to gauge interest in a similar tool aimed at adult learners of music, as well as space for a variety of open-ended feedback, suggestions, and concerns arising out of participants' evaluation of the tool.

5. RESULTS

5.1. Intuitiveness of the interface

Among survey participants, initial results were very promising on the ease of music creation using OctoLooper. As seen in ***Figure 5***, the participants agreed with statements that the steps, instructions, and options of OctoLooper were



One Sample T-Test

One Sample T-Test

		Statistic	df	p
drumStepApproachable	Student's t	10.97	37.0	<.001
drumOptionsApproachable	Student's t	10.61	37.0	<.001
chordStepApproachable	Student's t	5.40	37.0	<.001
chordInstructionsApproachable	Student's t	6.43	37.0	<.001
nameStepApproachable	Student's t	7.62	37.0	<.001

Note. H_a $\mu > 3$

Figure 5—Survey responses on questions about if they found various elements of OctoLooper's design "approachable and intuitive"

intuitive to a statistically significant degree across all steps those questions were asked for. The open-ended comments frequently described the app as "easy to use" and "fun", though a number of participants found the interface for manipulating the chords more "confusing".

5.2. Effectiveness of song name for prompting

More mixed were the results for the question *"The song title I chose affected how I used chords to shape the feeling or sound of the musical loop"*, which was of the few questions to not have a statistically significant difference from a mean of "Agree or Disagree". It's unclear if this was the result of an ineffective naming mechanism or influenced by the difference between the survey participants (adults) and the target demographic (children).

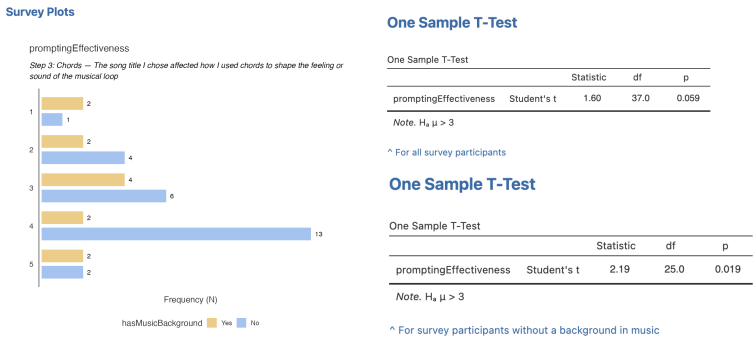


Figure 6—Survey results assessing how effective the name was as a prompt.

Interestingly, as shown in ***Figure 6*** there appears to be a sizable difference in how effective the prompting was considered between those participants with musical experiences and those without a background in music, and filtering participants to those without results in a statistically significant effect.

5.3. Parent feedback

Feedback from parents and caregivers on children's potential usage of Octo-Looper was mixed. While many responded that they found the tool fun and useful, several suggested that aspects of the design (particularly the circular chord interface) might be too complicated for their children to follow.

Some parent or caregiver participants noted that the limited text content in the app may still be more than young readers are willing to read, and that more could be done to mark the interactive elements as clickable.

5.4. Adult music learner feedback

While OctoLooper was developed with children in mind, the overall goal of the project is to be a platform and starting point for tools to help those starting to learn music at all age points. Feedback from participant's own experience learning with the app was very encouraging, with many participants expressing that their short evaluation of the tool taught them things about music, such as "what a chord is", "the impacts chords and beats can have", and to better understand "a system for putting together a song".

Feature requests from this feedback for a potential version aimed at adult learners included styling and UX refinement, along with expanding the educational content, sound, and musical options included in the tool.

6. LIMITATIONS

6.1. Lack of evaluation by children and music educators

The most noteworthy limitation of this pilot study of OctoLooper is that there was only minimal evaluation of the tool by the target demographic of children. One survey participant went through the tool with a young relative and passed on that child's feedback, but otherwise no child (un-related to this paper's author) has given their feedback on the tool.

While time limitations and the difficulty of recruiting child participants to evaluate prevented their inclusion, further efforts to recruit child participants or parent-child participant pairs will be essential to effectively measuring OctoLooper's effectiveness as a teaching tool to be incorporated into Music Education. Additional efforts to survey music educators would also be extremely useful in directing the future development of this tool.

6.2. Inability to add melodies

While OctoLooper in its current state includes the ability to select a drum beat and customize the chord progression of the musical loop, it does not provide significant support in composing a melody to accompany those two musical

features. This is often, compared to the chord progressions, a more unique musical choice, so creating novel melodies is a key part of the compositional process. To expand the scope of this tool to enable the creation of a full song, a step to aid in composing a melody will be necessary, as will adding functionality for combining multiple loops into a song (i.e. one loop for the chorus and another for the verse of a song).

6.3. Limited choices of sounds

Musical choices in OctoLooper were purposefully constrained to make the composition process more approachable, but the ability to engage and sustain children's attention will likely require expanding the sounds and instruments included beyond the initial synthesizer sounds. This will be important not only for novelty and enabling additional creative choices, but also so that the tool better represents the wealth and diversity of musical cultures around the world.

7. CONCLUSION

The creation of original music can be an important part of a music education curriculum, and have numerous benefits for development and emotional regulation. However, there are many logistical concerns that make traditional methods inaccessible for younger children, especially in classroom environments. Digital Tools can play a part in lowering the thresholds required to engage in music creation, making it approachable for younger children who are not yet proficient at an instrument. OctoLooper was created in the hopes of bridging this gap by breaking the music creation process into a series of simplified steps, using visualization techniques to better convey complex musical meanings. Initial results were promising in its ability to help adults inexperienced with music familiarize themself with musical concepts through creating their own musical loops. Additional study will be needed to evaluate its effectiveness in helping children compose their own songs and deepen their understanding of music theory concepts.

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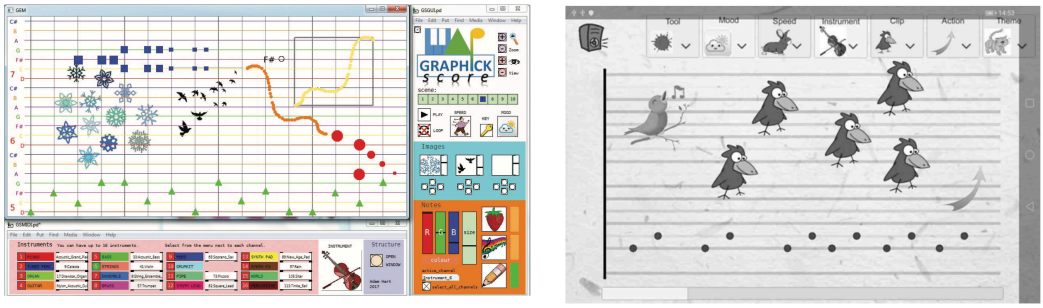
9. APPENDICIES

9.1. Related Work Visuals



GraphickScore (left) and Paynter (right), two examples of graphical composition tools designed for children. Source: (*Hart, 2017*; *Hart & Williams, 2021*)

Figure 3—Screenshots of the graphical score (left), arpeggio (middle), and drum sequencer (right) functions of the Synth4Kids application. Source: (Mygdanis, 2022)

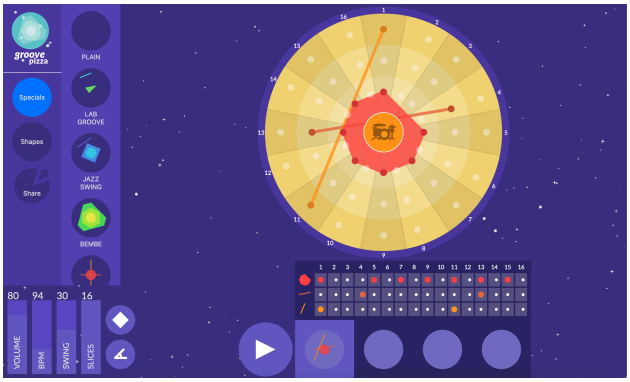


Figure 4—The interface of Groove Pizza, showing how the timing of notes in the "chameleon" preset contains certain geometrical relationships when arranged in a circle. Source: *Groove Pizza by NYU Music Experience Design Lab*