

Worcester Polytechnic Institute

Creating a Composition Tool to Inspire Youth to Explore Musical Arrangement

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This project report is submitted in partial fulfillment of the degree requirements of Worcester Polytechnic Institute. The views and opinions expressed herein are those of the authors and do not necessarily reflect the positions or opinions of WPI. This report is the product of an education program, and is intended to serve as partial documentation for the evaluation of academic achievement. The report should not be construed as a working document by the reader.

Abstract

This project was conducted from the 15th of May to the 20th of August 2018, and it focuses on the development of a free composition tool for middle school students as an introduction to music theory. The tool was created in 3 steps: the interview and research stage, the creation stage, and the interviewed response stage. The result of the first stage determined the lack of development and accessibility to music programs in the United States. The second stage of development created a basic, 2 octave composition tool with 4 rhythm, 4 polyrhythm, and 2 melody lessons intended to teach the students the fundamental ideas behind counting rhythm, overlapping rhythms, creating keys, and creating chords. Stage three aimed to gain feedback from music educators for use in future versions of the project.

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Background

In this section, we will identify the need for music in conventional society and explore the current methods, setbacks, and issues with teaching elementary and middle school students music theory and composition. Through formal and informal methods of teaching, the level of music education received by this age group can be taught through classroom material, homework, playing a musical instrument, or even through video games.

Importance of Music Education

In western society, most students receive their musical education in elementary school. They learn the basics of playing the recorder, sing in small choirs, and learn the elements of music through basic solfège. For those interested after elementary school, students may partake in the various ensembles or bands offered. However, most formal in-classroom musical education ends there [1]. By the time these students reach high school, less than 25% have continued their music education inside of the academic setting [2]. Like the arts and foreign language, there is a serious lack of focus on music, which is integral to modern society. When looking at music education we must understand the importance of re-integrating music into our educational systems: music develops fine motor skills and improves cognitive and social skills creating a well rounded and academically successful individual.

Whether it be strings, brass, woodwinds, or percussion, the process of learning an instrument requires hours of dutifully practiced precise movements and patterns. When properly mastered, a student is able to define an emotional and musical experience. This repetition in practice, in combination with practicing dynamics and tempo, allows students to drastically increase the precision of their fine motor skills [3]. These skills, while directly applicable to music, have other positive impacts on the modern person. Art students gain precision in their drawing, painting, and sculpting, allowing for accuracy and nuanced dynamics in pressure, flow, and rhythm. In engineering and industrial design, students may more readily communicate ideas to form designs or prototypes.

While the physical action of playing an instrument gives students much needed hand eye coordination, creating music also increases students' mental capabilities. When learning and applying music theory from a young age, students enhance their mathematical abilities, increase their spatial awareness, and extend their language abilities [4]. By counting and subdividing rhythms, students learn and intuit the use of basic fractions, a skill that nearly one fifth of adults lack [5]. These students gain real life reinforcement of what many would already be learning in mathematics through use of chord tones and chordal creation. Furthermore, advanced students learn applications and intuitions of complex ratios through polyrhythmic studies. When playing an instrument, these students must translate tones and intervals to physical distances, understanding such spatial reasoning problems. This practice leads to a high increase in spatial reasoning skills. The study of music can be comparable to the study of a foreign language. By learning vocabulary and repertoire, students expand their comprehension. This vocabulary is then linked to an auditory response in music. Similar to a language, the meaning changes based on intonation, tempo, and dynamics. The brain responds in the same way as learning a language, enhancing fluid and crystallized intelligence [4]. Students who participate in music programs have also been shown to retain and organize more of the information they are given, drastically increasing their memory and test taking abilities [3], [4], [6], [7].

Students who participate in band, orchestra, and other ensembles develop strong communication skills, increase self confidence, and boost social awareness [4], [7], [8], [9]. To perform a piece of music with multiple people, students must create a social connection with their peers. Not only must students follow the direction of other musicians throughout a work, they must make decisions about dynamics and intonation on the fly. This large scale collaboration forces students to socialize and teaches them strong leadership skills, showing students when and where to take initiative [4], [7], [10]. When a student masters and performs a piece of work, they are met with intense, enthusiastic attention and bravado. By proving a mastery of a performance and by the engagement and positive response of others, students may take pride in their work, bolstering their self confidence dramatically [4]. With greater self confidence, students are able to take the initiative to overcome fear and stretch their limits, leading to personal success [11]. Exposing students to other musical styles allows them to gain

an intimate understanding of other cultures. In addition, the teaching of western music theory is widespread enough that it may act as a universal language, allowing students to directly interact with cultures other than their own. In doing so, they gain an understanding of other peoples, allowing them to create stronger and more diverse connections [4].

Music greatly improves the motor and cognitive abilities of students, giving them hard and soft skills that they may readily employ in everyday life. Their test taking skills increase, their english and math skills increase, they become more sociable and more conscientious, and they become well rounded individuals who have a much greater chance at personal success in life. More than that, they get to experience one of life's great inspirations: music.

Importance of Music Composition

Music composition plays an important role to the student and culture of a society. Along with the benefits of a musical education, the composer contributes great cultural works which advance a culture and provide much to the remainder of the world.

As mentioned previously, music education and experience institutes great cognitive growth in students. The acts of studying the systems within music, composing music, and performing compositions challenge the student physically and mentally.

In *Frames of Mind: The Theory of Multiple Intelligences*, psychologist Howard Gardner proposed nine forms of personal intelligence: The naturalist is nature smart, musical is music smart, logical-mathematical is able to reason and work with numbers, the existential is life smart, interpersonal is people smart, bodily-kinesthetic is body smart, linguistic is word smart, intra-personal is self smart, and spatial is picture smart [12]. One could argue the positive influence of music education, performance, and composition on each type of intelligence (See Appendix IV).

The benefits imposed on students of music are outlined by the National Association for Music Education (NAfME). Among the benefits are higher mental cognition and emotional intelligence, more engagement in school, and higher intelligences outlined by Howard Gardner [13]. By promoting the study of music, students developing their minds can benefit from music. Creating music also spreads the benefit of music to others.

Current Middle School Education

The NAfME is “among the world’s largest arts education organizations...the only association that addresses all aspects of music education.” The organization advocates for the importance of music education in schools from Pre-K up to the collegiate level. They also partner with music education associations in each state, such as the Rhode Island Music Education Association (RIMEA) [14]. The organizations at the state and national level drives music education initiative and curriculum across the country. For example, RIMEA hosts scholastic band festivals across the state, and provides rubric templates for schools and teachers to follow when instructing on music topics [15]. These organizations produce the foundation and timeline on which most formal music education is based. The NAfME provides a series of rubrics and expectations for students at all grade levels. Rubrics are broken into the following categories: Creating, Performing, Responding, and Connecting. Under the “Creating” rubric, the guideline and timeline of composition education is provided. In Pre-K, students should “With substantial guidance, explore and experience a variety of music.” In grade 4 students should “Improvise rhythmic, melodic, and harmonic ideas, and explain connection to specific purpose and context (such as social, cultural, and historical).” Finally, by the end of grade 8, students must “Generate rhythmic, melodic and harmonic phrases and harmonic accompaniments within expanded forms (including introductions, transitions, and codas) that convey expressive intent.” [16]

Students are entering the academic setting with wildly different musical backgrounds. Some enter middle school with no education while some enter high school with none, but students at all levels wish to receive a musical education [17]. With a range of experience and abilities, teachers are forced to teach to the “Middle of the curve” [18]. This teaching style forces teachers to deviate from the rubrics by the NAfME, leading to a lower quality educational experience.

With a disconnect in expected versus actual music education timelines, there is no coincidence the music composition abilities of a student suffers. This is to no fault of the

educators or students, but instead of varying levels of interest in music, both individually and societally [19].

Background Conclusion

As the priority for a music education varies widely throughout America, the benefits of music education and composition is lost to many students in the public sector. As stated above, the lack of consistency of students taking middle and high school level music classes creates difficulty in teaching material. The retention of students moving from middle school to high school music education is also within 25 percent. The lack of higher level education, musicians, and educational priority creates issue for music composition interest and education. In order to reach a broader audience, engage students, and teach music composition, an extracurricular tool is needed.

Methodology and Development

Our methodology included interviews with a focus group of four professional music educators to get a sense of their views regarding music education games and the role of informal composition techniques. We used this data to inform the development of an original music education game prototype. We then formally allowed two professional music educators to preview the game and interviewed them to get a sense of their views regarding the effectiveness of our game and the role of informal composition techniques it employs. In this section, we will identify the goals of development, review the information gathered through our interviews, and describe the processes taken to create the composition tool.

Interviews

We started by interviewing a focus group of four music educators of different schools, all organized at 7th Regiment Drum and Bugle Corps. The educators all have experience teaching at varying levels, from middle school to college, within the drum corps. Appendix 1 contains the questions asked during the interview and the transcribed interviews with each of the instructors.

The information gained during the sessions was used to gain an appreciation for, and a timeline of the music composition education process, as well as background information and resources for gaining a broader understanding of that process.

Goals

The goal for the development of software was clear: provide a medium in which middle school students can learn to create- and subsequently compose- music. The two areas of the software would include a composition tool for users to compose a piece from scratch, and a series of scenes that could teach a student the fundamentals of composing music. The objectives and timeline of teaching music composition lay in syllabi and interviews from music educators.

The first step in educating students is to understand the importance of teaching the subject, as well as the importance of students learning and practicing the subject. From a societal and educational standpoint the reasonings are stated above. The task of learning to compose may be challenging to understand, but understanding the benefits of composing music can keep students interested. Learning and composing music has several health benefits including higher mental cognition, helping to stay more focused in school, and higher SAT scores [20].

The first step in teaching music composition is having students understand rhythm. In the interview with Stephen Klepner (Appendix I), he stated “Weakness for a lot of students even into college- you see it right at middle school there- is rhythm reading.” In a syllabus written by Alexander Koops, associate professor at the Azusa Pacific University School of Music, he outlines a learning regimen for middle school students. After listening to several forms of music and a range of instruments and sounds, the syllabus directs students to dive into observing, modifying, and creating rhythms [21]. Koops suggests using one pitch to create a rhythm, changing timbre and dynamics to vary the musicality. Klepner also recommended forms of interactive media to teach students to read rhythms and learn timing before creating original content.

The next step in the process is exposing the students to scales and having them create basic melodies with the notes from the scale. Koops recommends for those in concert band or orchestra to perform a scale on their instruments and improvise rhythm with those notes

afterwards. For those without access to an instrument, he suggests giving students a rhythm and asking them to choose pitches of a scale to create a melody based off that rhythm. Progressing further, students may be able to form their own melodies from their own rhythms and scales. Klepner also recommends using a simple melody- such as “Mary had a Little Lamb”- and only allowing the student to manipulate the last note. In this manner, “the piece will sound nice... and that will limit the choices and make very nice music really quickly.” It is important to also note the “spiral curriculum” mentioned in his interview. This method introduces new concepts to students while calling back to previous knowledge. In introducing melody, the callback to rhythm is important, but so is the importance of, and interest in, creating music. Delving deep into theory is important, but so is getting students to see the benefits of their knowledge by creating music quickly.

While there are more advanced topics in music composition education, the scope of this project will allow for the extent of education to end there. By teaching notes, rhythms, harmonies, and perhaps chord progressions, students will be able to create music to their own satisfaction. Other topics may be offered in future versions of the software, but for this project, the composition tool and basic topics will be sufficient. By creating several modules for teaching the topics listed above, we can guide the students through basic music education and eventually to composing their own original piece.

Current Music Composition Video Games and Tools

When one creates a piece of music, they think about the rhythmic, dynamic, and harmonic texture of the music they wish to create. The tools used while composing, whether they be digital like software environments or traditional like pianos and other acoustic instruments, have the potential to dictate and influence the way in which individuals compose. For example, when a musician uses a digital audio workspace to compose an idea, they must have previous knowledge of of the software environment in order to represent their musical idea. Ideally a digital-audio workstation (DAW) is intuitive enough that it is immediately accessible to beginners who may come in with an idea already in their head, and complex enough that masters are not limited by the software. Unfortunately, current conventional music creation programs

tend to have high costs and learning curves [22]. This section will look at Ableton, Musescore, and Hooktheory, analyzing the pros and cons, and discussing their influence on the final composition tool.

Ableton

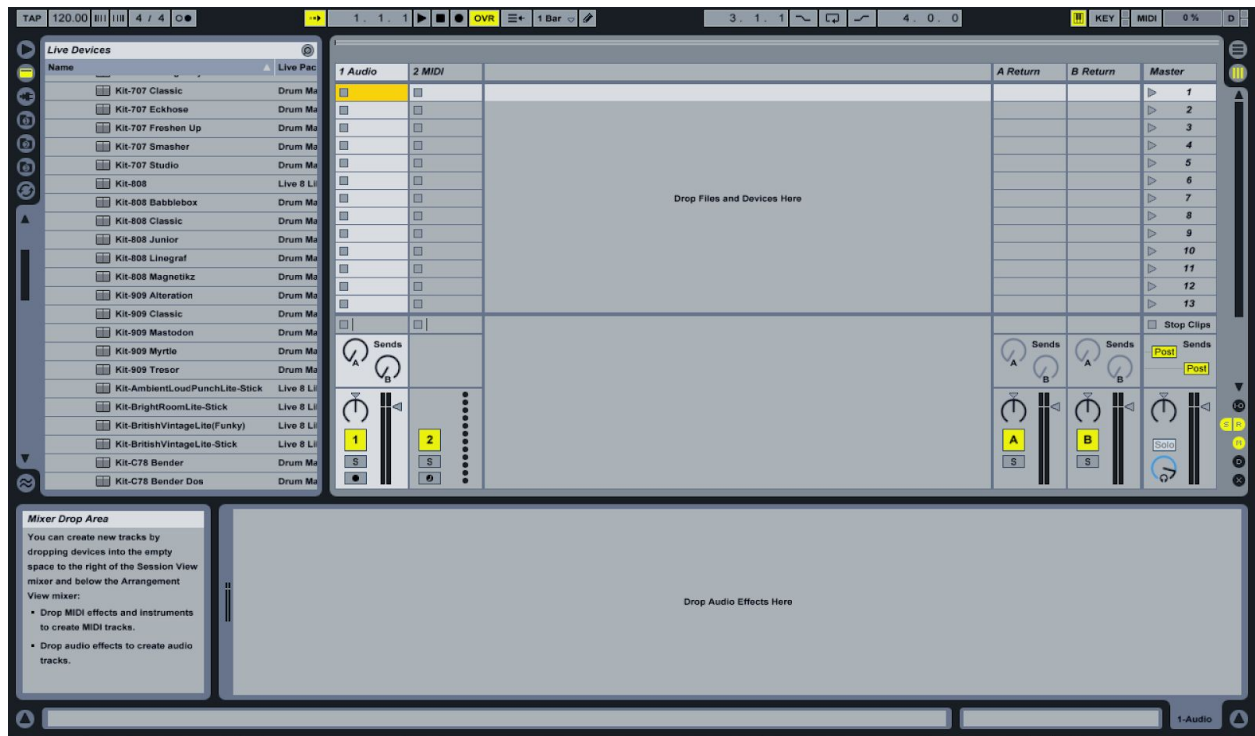


Fig 1: Ableton

Ableton Live, along with Pro Tools and Logic represent the top tier of DAWs [23]. These are a series of professional tools that allow manipulation of every aspect of the song creation process. Again, there exists a tradeoff between the complexity of the tool and the control a composer has over the music. This software allows a musician to have complete control over the music, including the manipulation of individual notes, mixing, fading, and any other professional music creation aspects. For students beginning to understand music composition, this poses an overwhelming number of options. In addition, as these are professional tools, they tend to have a high overall cost, sitting in the hundreds [24].

MuseScore:

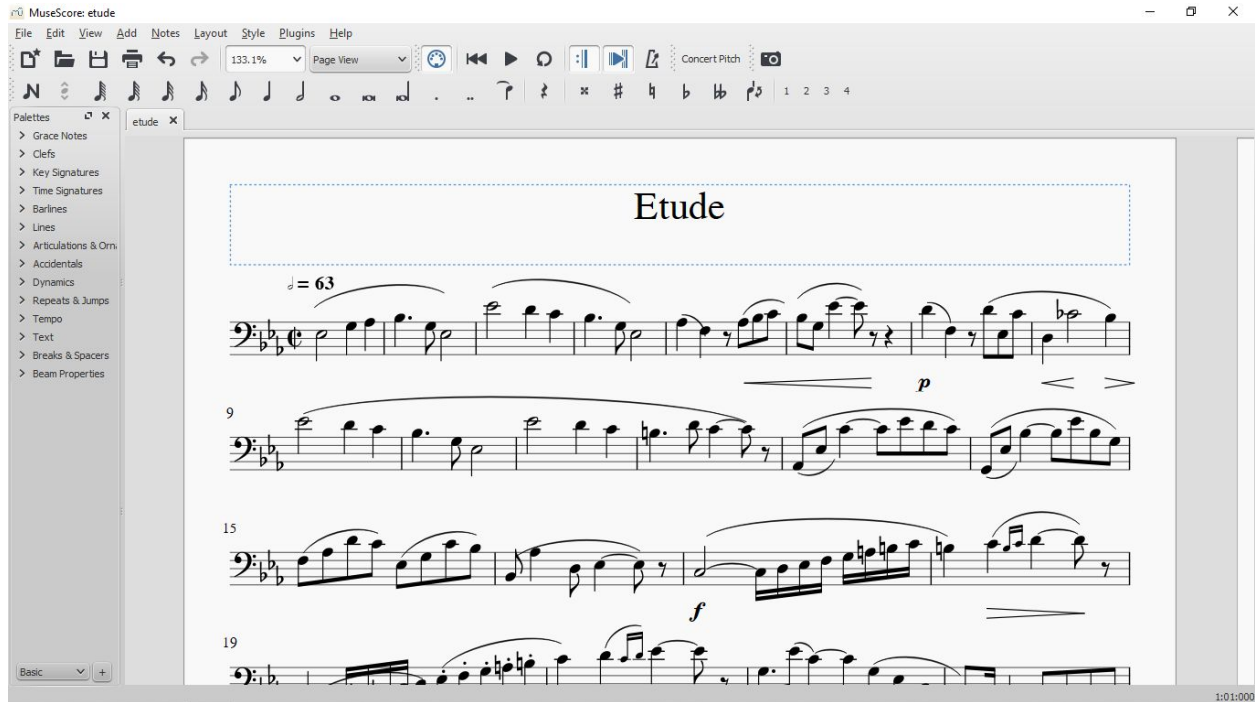


Fig 2: MuseScore

MuseScore, along with Sibelius and Finale, are series of scoring programs which allow for professional compositions, particularly for live performance. With a smaller set of midi instrument tracks and very little playback control, this type of software allows for users to understand the sound of pieces without the fine control of software like Ableton. The purpose of musescore is not to create a final product, but to create a product that can be interpreted by others and prepared for live instrumentation. However, these products can be difficult for beginners and intermediates creating music. First of all, in order to compose, students must have a strong understanding of sheet music including the notes in each scale, time signatures, beat fractions, and more to begin composing. While it is feasible for any student to learn, the process of understanding sheet music can be comparable to learning to read. This process takes a non-zero amount of time, and would be a precursor to creating music with this type of software [25]. Second, the systems take one or two keystrokes to subdivide music. This can cause a problem for beginner users creating longer pieces. As the piece gets longer, beginners tend to add something

to enhance the song when they start to run out of ideas for variations. Because of the ease and accessibility of subdivision, the students tend to increase their use through a piece without motifs of use earlier. While this can be effective, the idea is usually abused, creating lackluster pieces [26]. Finally, this system can easily cause many problems if the user were to attempt to play the pieces live. The staff system does not give the user any idea of feasibility of the instruments, and the limited midi data does not translate to the actual timbre or dynamics used in the final piece. Many pieces that sound adequate on paper may be impossible to play, or sound unexpected in real life [27].

HookTheory/HookPad/TheoryTab

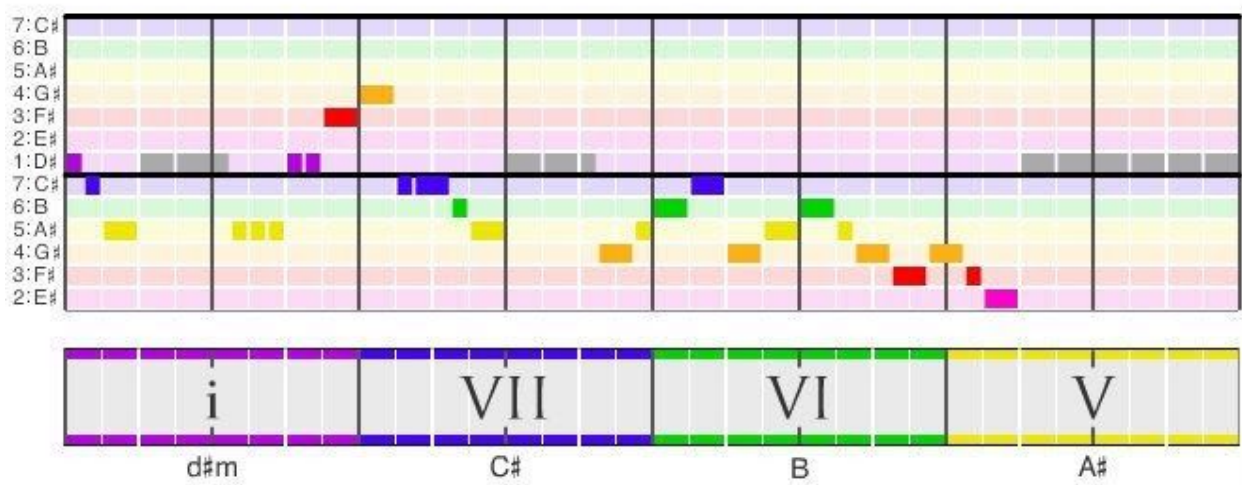


Fig 3: HookTheory

HookTheory is another music notation software designed for both beginner composers and professional musicians. The drag and drop style, as well as pitches relative to chords, makes composing melodies faster than plain sheet music. Chords and chord progressions are suggested to the user based on statistics Hooktheory has gathered on music from popular media. Their weighted recommendation system is based on a percentage of how many times a particular progression has been used in their database [28].

In the books Hooktheory I and Hooktheory II, the company uses their music composition tool, Theorytabs, to teach the reader about the fundamentals of music theory [29]. They do so, first by teaching the student how to compose a scale, then converting everything to relative notation. From this point, for the majority of the remainder of the course only roman numerals are used [30].

Melody A (Stable Scale Degrees)

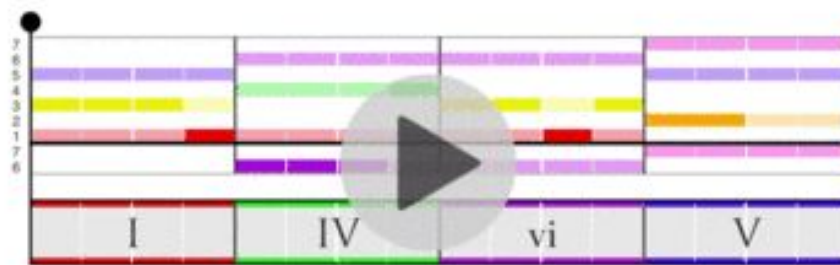


Fig 4: HookTheory I Content

In this regard, the software and teaching method does not reinforce music notes, sheet music, and key signatures, as everything is kept relative. As there is a lower focus on those elements, students may take longer to recognize this information, instead of being able to recall it [31].

However, the software spends a lot of time going over why songs are created in certain ways, and what elements are used with what intentions [32]. The easy to read interface, coupled with suggested chord progression, allows students to quickly create pieces. The single track allows users to focus on the one melody and one chord voicing.

SugarPucks Compose! Production

SugarPucks: Find and Squeak is a video game currently in development under Professor V.J. Manzo, professor in the music department of Worcester Polytechnic Institute. The game has characters (SugarPucks or Pucks) that each emit a noise and aim to be discovered within a landscape, and is aimed at improving tone recognition and pitch for the players. This project transferred the idea of the Puck characters to a composition educational environment. The

current SugarPucks tool was created in two separate segments: iteration 1 and iteration 2. The purpose of iteration 1 was to complete the composition tool in its entirety, which would allow users to create and structure notes in an entirely free play mode. The purpose of iteration 2 was to apply concepts from the feedback we were given during the interviews, and create a set of rhythm teaching mini-lessons. Both can be broken up into 2 further components, asset generation and code creation.

Iteration 1 Assets

The first UI concept that was created consisted of 4 main pieces: the grid, the timeline, the Piano Pucks and the timing buttons. We initially decided the program would follow a suit similar to that of a typical digital-audio workstation (DAW), in standard piano roll format. To use the tool, the idea was that users would be able to grab Pucks from the Piano Puck Note Selection section, and drag and drop them onto the grid, where the pucks would snap into place. They could drag the bar on the timeline to view any section of music. If they hit the front or back buttons, the timeline would go to the very beginning or very end of the song. If the play sticker was clicked, the current notes on the grid would play. The Pucks on the Note Selection Section were to be set in such a way so when a key was chosen, notes on the right were in the key, and notes on the left were outside of the given key.

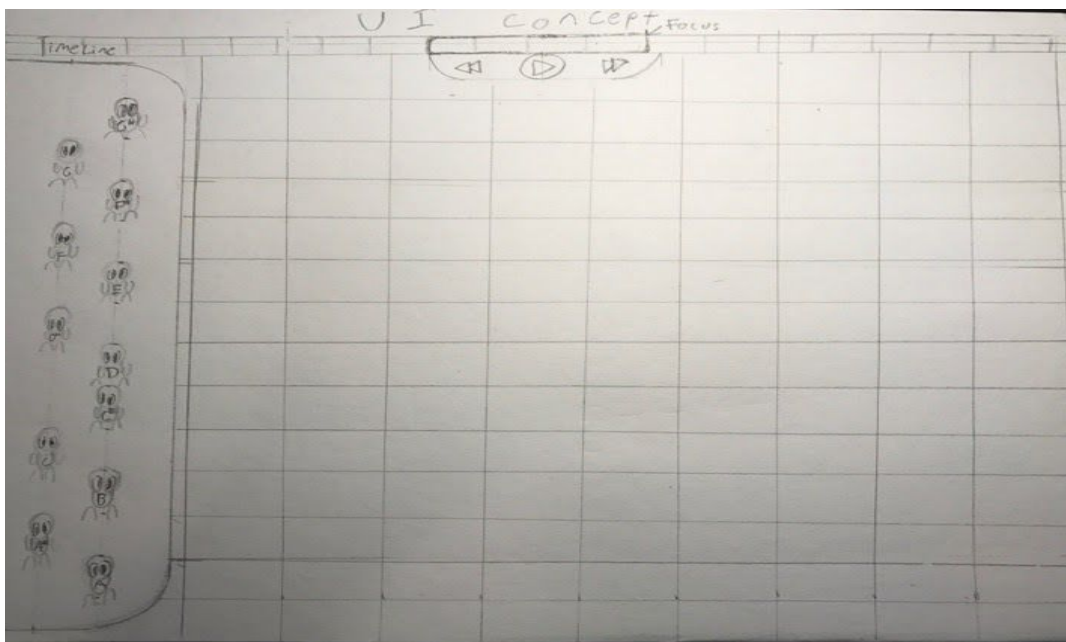


Fig 5: Initial UI Sketch

We also decided that each SugarPuck should have the name of the note it represented on its body so that users would be able to immediately identify it, and new musicians would be able to use the values as reference for audio-visual relationships. Overall the design featured a crayon, hand drawn effect with both light and muted colors. For the artistic style of the game used, we drew influences from Magic Pen and Fancy Pants Adventure, both marketed towards early-to-mid middle schoolers, along with the crayon identity. The imprecision of the hand-drawn style also allows for all of the game elements to be unique, which can better capture the users attention. A filter was added on top of this style to have it mimic the style of crayons.

There are several reasons for a child to be familiar with crayons: the multitude of colors, the distinct patterns on paper, the non-toxicity, or the cost effectiveness [32], [33], [34]. By using that which they have seen before, we had hoped to bring a sense of subconscious homeness and familiarity with the device. Knowing this, we decided to look for popular games that utilized the same style to better understand how to effectively implement said style into the composition tool.

Magic Pen is a Coppa Certified kids game that allows students to focus on critical thinking and problem solving techniques to get a ball to a goal in each successive level [35]. Created in early 2008, it has had multiple million plays, and has modern day sequels on IOS and Android [36], [37], [38].



Fig 6: A level of Magic Pen

The main mechanic of the game is that users hand draw each of the shapes they utilize to get said ball to the goal. Each drawing made had a nice little crayon texture to it, making the

game feel like a kids drawing. From this, we realized that we could texture our drawing tools, and subsequently decided to create a textured pen alpha image to utilize in photoshop for the art.

Fancy Pants Adventure, created by Brad Borne in 2006, is a platformer story-telling game about a young boy whose sister in one game, and who's ice cream in another were taken, and he takes it upon himself to get them back. The story is told from the boy's perspective with little knickknacks and toys guiding him along the way [39]. Its popularity became great enough that in 2011 it was purchased by EA and ported to IOS and Android.

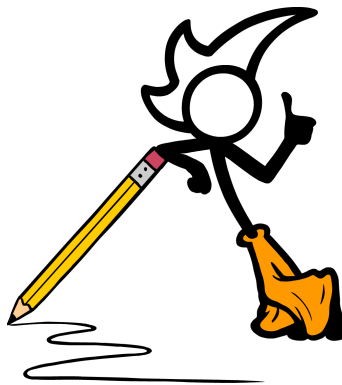


Fig 7: The main character of Fancy Pants

While the game uses a uses vector drawing for all of the graphics, its use of heavy rotoscoping style for most of the game gives an imprecise nature to each of the frames, as if they were hand drawn animations [40]. In this way, Borne attempts to capture the feeling that this game was created by a young child's imagination, making the game relatable to the target audience. The game's popularity proves the effectiveness of this idea [41]. As the idea appeared simple- all one had to do was hand trace the image and human error would change the outcome- and effective due to the popularity of the game, we decided to implement the idea. This had two main influences in composition tool: the animation and the approach taken for the art style. The animation influence can be seen most heavily in the home screen title: SugarPucks Compose!, which was made up from a set of two tracings of the name in the sans-serif font *Hobo*. This follows directly into the art style, using the brush tool mentioned earlier. In the application, everything was first defined with vector lines, to insure the spacing and positioning of the application. Then, anywhere the format was just a vector- the sugar pucks, the lettering, the

gridcells, timeline, keychanger, tempobar, playbutton, ect. - the art was re-traced, introducing human error.

Using a previous version of the SugarPuck as a guide, we decided to start off by modifying the characters to include these elements [42], [43].



Fig 8: Sugar Puck Design Process

We created the background in a similar effect, first using the original pucks as placeholders. From the paper draft to the first version, we replaced the Backwards button with a Key button, and the forwards button with a tempo slider. In addition, we replaced the grid with vertical lines, each marking the position for 1 beat of the song. Temporarily, a button was added which would transpose the song *Twinkle Twinkle Little Star* into the current given key, and a clear button would clear all of the given notes currently on the grid.



Fig 9: Initial And Final UI For Iteration 1

Iteration 1 Code

Before creating the playable prototype of the composition tool submitted, the team created a quick class diagram of what we wanted for basic functionality. In the initial design, the intention was for there to be a home screen that would house the composition tool and allow for 4 basic functions on start: choose a key for the entire composition, dictate the number of measures, choose how many notes could be played at once, and choose the tempo. Once these basic functions were chosen and confirmed, the settings would be translated to the main composition tool, which would then open up. The home screen itself contained an instance of the composition scene, which it would edit, then call the scene's "Awake" functionality, which

would interpret the data.

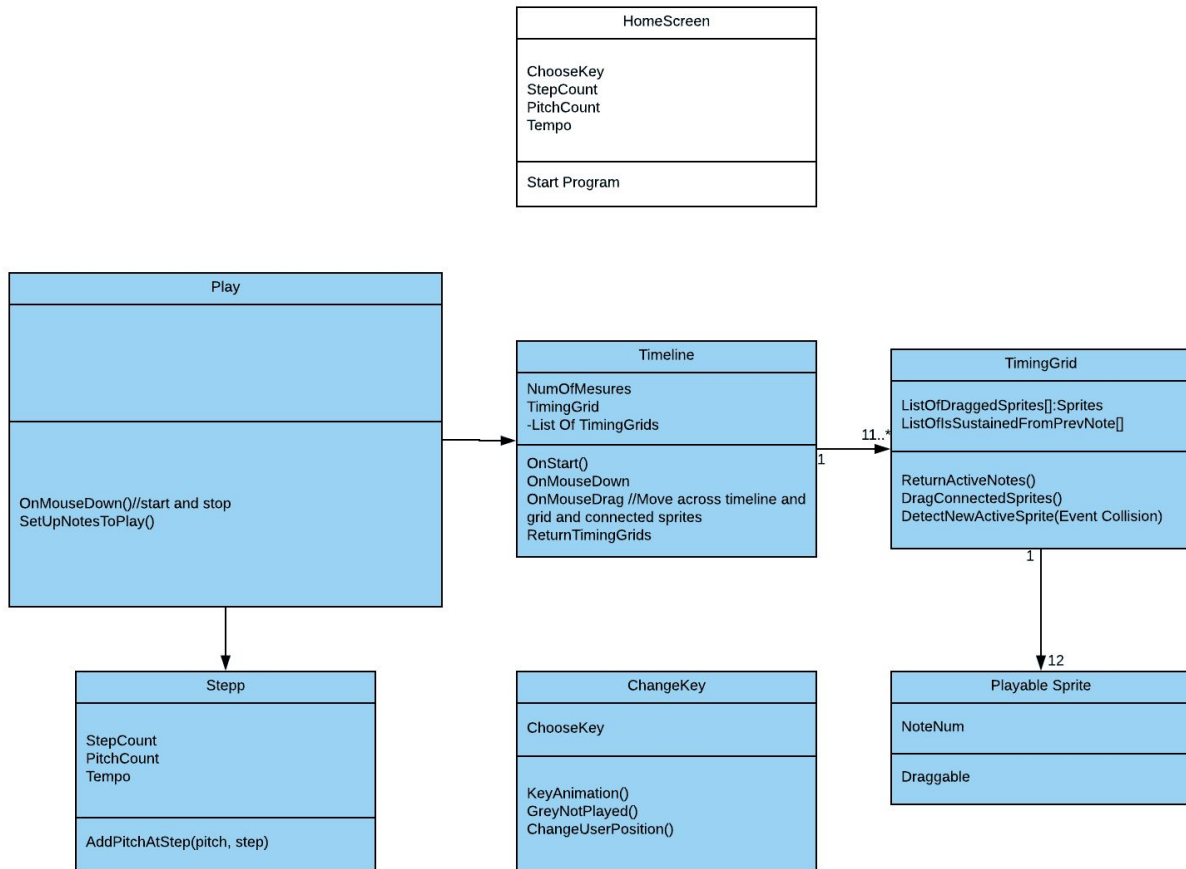


Fig 10: Initial Class Structure Concept

The composition tool had 5 main components in the first iteration, from the class concept. The components were: Play, Timeline, TimingGrid, Playable Sprite, and Stepp.

Both the timing grid and Playable Sprite implemented a “draggable” script, that would allow them to move back and forth exclusively on the x axis.

On the Piano Puck Note Selection section were 12 instances of “Playable Sprites”, each that contained a note number and a tone that would be played on click. When the pucks were dragged off of the Note Select space, the sprites would then be moved over the timing grids.

Each timing grid represents one beat in time in the song. When a puck was moved into the vertical column created by the gridspace, a collision would detect the puck’s location, snap

said puck into the gridspace, and add the tone relevant to the puck to a list of tones for that particular beat. All of these grids were held together in a timeline class.

The timeline class was responsible for keeping track of all timing grid objects, and controlled the movement of the grids as the user scrolled through the measures and beats.

The Play Button contained both the Stepp program and the overall Timeline. When pressed, the class would interpret the timeline data -- the positions where the pucks were placed -- and convert it to Stepp data.

Finally, the Step class is what allowed for the Music playing functionality. On initialization, Stepp is given a number of measures and a set of pitches. During play, one can directly change the tempo, and they can add notes to, or remove pitches from, the song at will. When confirmed, Stepp will play back the created piece at the given tempo.

Iteration 2 Assets

The second iteration of the composition tool saw a number of small improvements to its aesthetics, relating to the pucks themselves, the voices used, scene titles, gridspace and keys. It also saw the creation and iteration of a homescreen.

First, all of the letters on each of the Sugar Pucks were reversed. As a problem with the first iteration, the pucks were facing leftwise instead of rightwise, towards the actual grid. In iteration 1, this problem was solved by mirroring the pucks. However, as each puck was identified with a letter that corresponded to its note, those letters were also mirrored. This iteration corrected that problem.

Second, another set of pucks were created with the labels 1 through 8 and 'e', '&', and 'a'. This was for counting beats in the rhythm and polyrhythm sections.



Fig 11: Counting Puck

Third, a new set of tones were generated for each note that was to be played, generated in Ableton from the Toy Kalimba instrument. These tones spanned three octaves, from A2 to A4, and were used both when the puck was clicked and when the composition sequence was played.

Fourth, the word Key and the note names A through G# were created to indicate the meaning of the note arrangement with respect to the standard Major Key.

KEY

Fig 12: Key

Fifth, a set of arrow pointers were created for the two Melody scenes, to be placed on the Note Selection Pucks to indicate the processes of generating a key, and generating a chord. Each arrow was labeled with a number- the number of pucks to skip over to reach the indicated puck.



Fig 13: Puck Indicator Arrow

Sixth, a green vertical bar was created, spanning the size of the screen. This was created to sit between timing grid measures, and was intended to show the current beat of the song during play.



Fig 14: Shortened Timeline Tracking Bar.

Seventh, the generic blue grid bars were re-generated as set with 3 separate heights, this was to be used in a way such that a user could tell where in the measure they were, especially in longer time signatures.

Finally, two iterations of the main menu were generated, the first for pure functionality and the second to thematically match the tool. Both iterations had a set of 3 buttons, Learn Compose, and Quit. The first iteration had each button in simple black, while the second matched the crayon style in the unsaturated yellow used for the background. The learn button was changed into a dropdown which listed the other scenes. Finally, a title, *SugarPucks Compose!* was added in 2 slightly different styles, which it would animate between.



Fig 15: Home Screen Iterations



Fig 14: Full Composition Tool

Iteration 2 Code

(See Fig 16)

Iteration 2 lasted far longer than iteration 1, and included individual lessons on top of the basic composition tool. The composition tool itself received a number of improvements. Included in timekeeping: visual timekeeping, tempo bar, time signatures, and appending measures. Included in composition: changing octaves, deleting notes, info screens, changing keys, and chord suggestions.

When the play button is pushed, a green bar that spans the vertical column space of a timing grid appears in the 0th position on the timeline. As each beat is played, the bar first continues to the end of the screen, showing the note currently played, then scrolls the timeline until the end is reached.

When clicking a SugarPuck, one will first hear the tone of the corresponding note, then, on second click, they are able to drag the puck. If the puck is dragged back onto the piano piece,

where all of the pucks sit, the note will then be deleted from the piece. When a puck is in a gridspace, if the puck is double clicked, the puck itself will change voicing up a single octave. If clicked again, the puck will revert down an octave.

A clear button was implemented into the top right hand corner of the game screen. When the clear button is pressed, the program will go through every gridspace and remove all pucks from all the grids.

A tempo slider was placed in with both the Key and the Play button. The minimum and maximum for the song was placed at 70 and 750 beats per minute with the slider allowing for the spectrum between those.

When the composition tool would start, each user input method of the software would be circled, and a blurb next to it would explain the functionality: press play to update and listen to the composition, move the tempo bar to make the song go faster or slower, ect. In addition, on the top left hand corner, and Info button was circled, this blurb stated that, when the button was clicked, the info would be turned on or off correspondingly.

Also at the very beginning of the program, when the composition tool first starts up, all of the sugar pucks are arranged in a single line. At any point during the composition of the song, a user can first click the key button, then click any single puck on the scale. At this point, the clicked puck will become the tonic. All notes in the scale will be shifted forwards on the piano roll, and the notes on the scale will start to fade, not becoming invisible, but becoming far less opaque than the notes in the scale.

When a key is chosen for the composition, the sugar pucks display a second interesting feature: they wiggle to encourage the user to build a triad. To do this, each puck looks at the last occupied gridspace in the song. If the note is in the key, and the current puck is two scale degrees above the original, the current puck will wiggle. A puck will also wiggle if it is two scale degrees off of the corresponding chosen Dyad. These pucks will also recognize and wiggle to complete any inversions of the triads in the given key.

Another necessary feature to implement was the ability to add measures at the end of the current composition. When a user scrolled to the end of the timeline, they will see one final bar,

followed by 3 sets of numbers, each circled: +1, +4, and +X. This will append 1, 4, and 10 measures to the end of the document.

The final feature for the composition tool was implemented to the home screen, itself. Before launching into the application, there is an optional text entry portion where one would be able to enter a time signature. Based on the value entered, each gridspace would have a longer or shorter vertical line, repeating every signature amount of spaces. The 0th place would have a bar across the whole screen. Any multiples of 2 would represent the shortest gridspace. In this way, users could see where in the song they were.

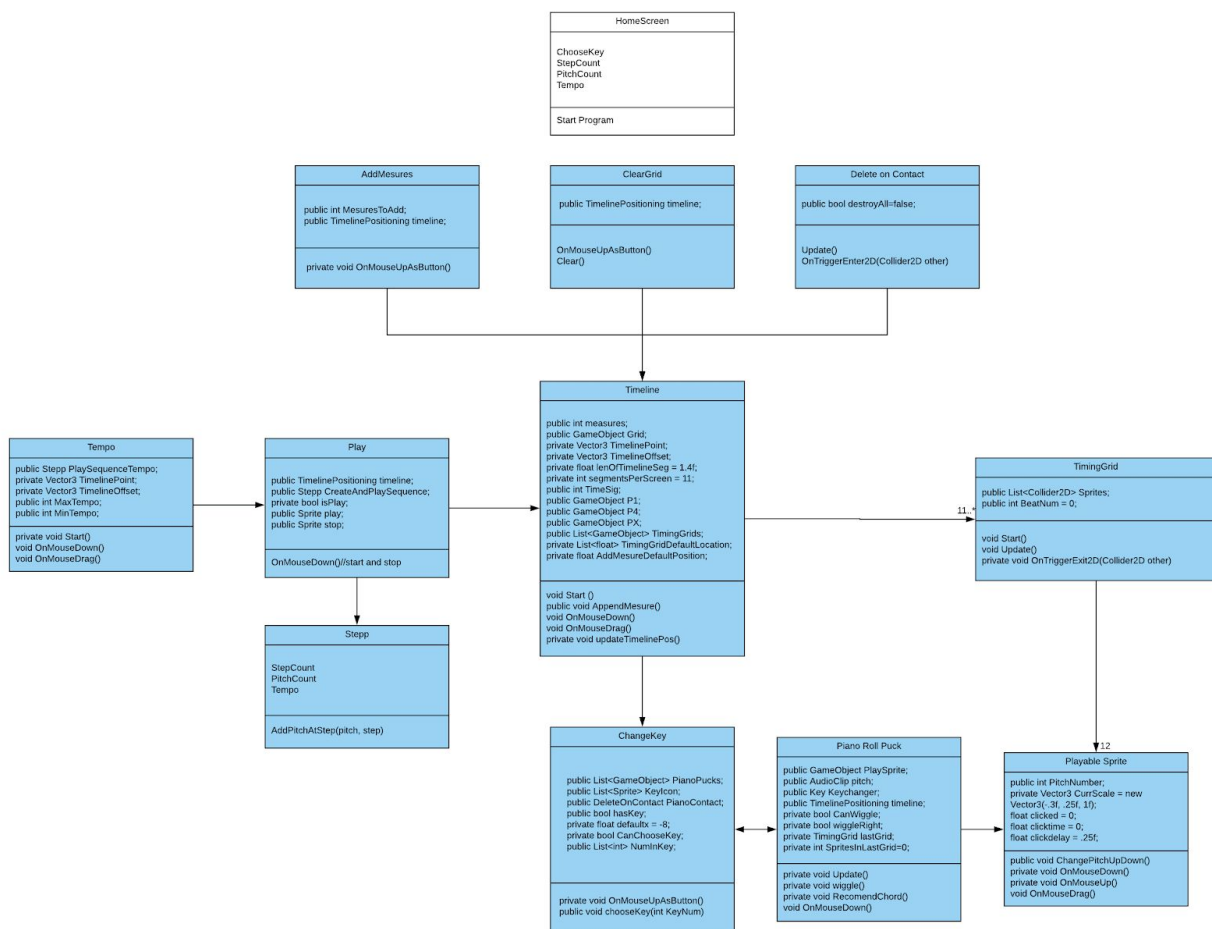


Fig 16: Final Code Class Diagram

Additional Scenes:

Overall there were 9 additional scenes created as mini-lessons for the composition tool: 7 rhythm lessons and 2 melody lessons. The rhythm section contained lessons on quarter, 8th, and 16th note counting, syncopation, and 2:3, 3:4, and 4:5 polyrhythms. The melody section had lessons on key creation and transposition, and chord creation.

Each of the lessons were set up in the same fashion. When play is clicked for the first time, the users will first hear a monologue of the topic at hand, then will be prompted with a series of instructions. On the second click, the current project will be played. For the counting rhythm section, all but one sugar puck has been removed. For the Polyrhythm section, all but 2 pucks have been removed. See Appendix III the transcribed quotes for each scene, followed by a picture of the initial scene.

The largest influence for the design of these lessons was Andrew Koops, who had devised a set of methods and lessons for meaningful study. He suggested to first, start by splitting up both the rhythm and the harmony sections of the music. This split allows the student to get to the point where their knowledge is concrete, before they start to play with any melody line. Steven Klepner states that music students both have the most trouble with, and have spent the least amount of time, studying rhythm. Because of this, we created the separate Rhythm section to give a chance for the focused study.

The first 3 lessons show the users how to count quarter, 8th, and 16th notes. The display screen for the lesson has the same structure as seen before in the main composition tool with one sugar puck in the piano roll. As expected, at the end of every measure there is vertical bar indicating the next measure and the repetition of counting the measure. In each measure when the sugar puck is in a particular gridspace, the sugar puck name and color will change to correspond to the current beat. While these lessons are oriented towards beginners, the nature of the composition tool allows it to become much more open ended and customizable. If the user had a particular song or rhythm they wanted to use or work on, they would be able to add measures or remove grid spaces and measures as needed. In this way they would have a system that would both display the count of each beat and speak the beat count as the song was playing. Users

would be able to feel the rhythm used, along with hearing the corresponding count. This exposure would allow them to be more familiar with it in the future [44].

The next lesson, syncopation, aims to improve counting skills. In the previous lessons, pure eighth and sixteenth notes occupied the bars. In this lesson, students are introduced to rhythms with rests, transforming the counts from “1 & 2 & 3 & 4 &” to “1 & 4” for example. The second goal is to teach complex rhythms, and let students discover the timing of the counting system described above. The final goal, while at a complex composition level, aims to introduce syncopated rhythms into a student’s theory vocabulary. Again, the students may not choose to use this type of rhythm in their own composition, but the introduction serves other educational goals.

The final set of rhythm lessons follows a similar setup to the basic rhythm lessons, however there are two horizontal spaces with Pucks. These horizontal bars contain Pucks in particular syncopated rhythms according to the chosen lesson. These lessons allowed for two separate rhythms to play in sync, and was created to teach users an introduction to polyrhythms. The point of this polyrhythm section was to give the user a taste of more complex rhythmic possibilities in an attempt to inspire them to experiment with the rhythmic possibilities available to them.

The Melody Section is constructed of two lessons: a complex lesson on creating chords, and a more basic lesson set on creating chords. The chordal lesson was set up to be tested as follows. First, the user was instructed to choose a key. Once a key was chosen, the student instructed to choose a note in the scale and drag it onto the grid. Once a first note was chosen, two things would happen: an arrow would point to the next puck to create a triad, indicating the number of steps between them, and the pointed to puck would begin to wiggle. The user was then instructed to drag the second note out to the same gridspace as the first. As before, a third arrow and other sugarpuck would be indicated, thereby showing if the chord was major or minor. The user would then be instructed to drag any puck they wished to the second grid space, repeating the process over again. This mini lesson fulfilled the purpose of a minor introduction to harmonic theory, informing users how to create and feel the difference between major, minor, and diminished triads. This followed Koops’ third step for effective theory instruction: teach the

students elementary harmony and harmonic variance [45]. By teaching the students about chords, they gain a tool for adding variance to an already created melody, inserting full or partial triads into the work. This harmonic progression allows them to experiment with form, creating different phrase structures, which is an essential step for creating more complex works.

The more complex Key lesson had the users first choose a key, then click the Twinkle button. When the key was chosen, a green arrow would point to the tonic. A set of arrows in the major step pattern would indicate the number of half steps needed to go to each note in the key. When the twinkle button was pressed, the song, twinkle twinkle little star, would be transposed to the key. The purpose of this was to show students one of the fundamentals of music theory: the intervals of the notes determines the cadence of a song, not the individual notes [45]. A song in D major will be recognised as the same song B major. In addition, this lesson allows the user to work with steps one and two of Practical Techniques: providing the user with a recognizable melody, and allowing them to manipulate the melody using compositional techniques [46]. By providing the user with a tune they already know, the user can better understand how their actions influence the piece [47]. The users are then easily able to practice diatonic and chromatic movement, mutation, and melodic inversion, thereby keeping the rhythm intact and varying the melody. Once again, this gives the users the tools they can use when creating a work, and the frame of reference allows them to understand how the changes affect the feel of the song.

Methodology Conclusion

All features of the composition tool were based on background educational materials and interviews with music educators from across New England and varying grade levels. Given the shortcomings of music education and the processes outlined by educators from research, goals were set before development of the project.

Several aspects were implemented to create a medium through which students could learn the basics of composing music. Beginning with quarter notes and working up through sixteenth notes and polyrhythms, scenes are available for the students to interact and learn about the different counting systems. Next, students can begin to interact with creating chords and

melodies in the same group of lessons. When the lessons are complete, the student can then navigate to the composition tool to apply their knowledge and create a song of their own.

Of course, the main focus of the project remained to keep students interested in the concept of learning music theory. As stated in interviews and research, students lose interest in music education with grade and age level. Any effort by the software to retain interest will be serving the musical career of the user.

The software is still in the starting stages. Later, we will discuss future development objectives and ideas to improve the education experience of the user and student.

Results and Discussion

In creating the composition software, the group sought after two main goals: to create a medium in which students of limited background could learn basic music theory, and to create a medium in which students could apply their gained composition knowledge to create pieces of their own.

Lessons

To understand how effective the environment created potentially could be for students learning music theory, the team turned to Koops, as described above, and the reviews of music educators from interviews. For this we took them through the through rhythm and chord lesson sections and asked them for their responses and impressions. Overall, we found we should further constrain the lessons, focus on multiple counting methods and subdivisions, move the polyrhythmic lessons, and introduce lessons on scale creation. By constraining and telling stories with the lessons such as a chord indicating the “Pixies have friends” we would give a goal to the users (Appendix I). In this way, we create a better direction for the tool, and through storytelling, give users a reason to stay engaged with it, and relate to it [48]. For the first three rhythmic lessons, Stephen Klepner stated that we should indicate subdivisions, and add other, easier to conceptualize subdivision counting methods. He states that the lessons, such as the 16th note lesson, are “not representing 16th notes, [but is instead] representing sixteen quarter notes [at a higher tempo]”, and suggests that we “find a difference between the quarter and eighth notes...

[such as] color.” He also states that “very few elementary schools” exclusively use the direct counting method and recommends also integrating the “Gordon Method” (Appendix I). By correcting the first of the two comments by Klepner, we bring the lesson to the current standard imposed by musical notation. By doing this, students will be able to move from the software to other music programs with ease. Secondly, by adding other rhythmic devices, students may find a system that works better for them (besides standard counting) and may also choose to use the same variant that they are in the classroom. For the overall organization of the lessons, Sebastien de Carbonnel, a student at Berklee College Of Music, and a teacher at Mockingbird Youth Theatre, states that the polyrhythmic section should come last, after the rest of the lessons, however, he believes the counting lineup of the polyrhythm section is well structured: “the UI does a really good job of making it clear how the polyrhythms work” (Appendix I). While interesting, polyrhythms are a far more “advanced concept” than the rest of the lessons. By putting them last, they are still accessible, and may still inspire the students, without getting in their way. de Carbonnel also suggests another lesson to go hand in hand with the key construction lesson: informally teach them Scale construction. He suggests to start with major and minor then go on to whole note scales, and have an activity where they can construct, then use their own scales. By doing this, students would be taught very advanced topics in ways where they’re fundamentally easy to conceptualize: its “Picking different notes and seeing how they sound”. By making these changes to the mini-lessons, and by developing them further, we create a self contained, structured lesson plan for student to work off of individually and, with the composition tool, provide them with an environment where instructors may immediately directly influence the lessons themselves.

Composition

Next, the second goal (the free play composition tool) was reviewed by the educators. Klepner’s interview began by giving him the program to and allowing him to navigate to the composition. He was then asked a few guiding questions, allowing him to evaluate the aspects he enjoyed and areas which could use improvement in the second iteration and future versions of the project. After using the program for a few moments, he was easily able to drag Pucks onto the screen, change keys, and use other basic features of the program.

While he enjoyed the kid-friendly aspect of the game, the areas for improvement most appealed to this project to improve the existing design and have a more clear path for future development. In the composition tool, he made two suggestions from a graphical interface standpoint. First, the location of the Key button should be moved to above the Puck Piano Roll instead of the play bar. Second, the key should be a dropdown feature which includes all major and minor keys. In this manner, switching between keys is more intuitive, and the distinction between keys, major, and minor scales are all apparent.

de Carbonnel had similar views on the composition tool. Like Klepner, he felt that the aesthetic of the tool was very friendly, and the drag and drop system was very intuitive. While there was a way to change the notes up an octave, he was disappointed that there was not an extra octave down, suggesting that to allow for a greater sonic flavor. In addition, he suggested having “3 or 4” tambric options for each of the tones. In this way, the “kids can feel like they own [the work]”. He felt like, while the drag and drop system for the notes felt clumsy for a DAW, it felt ideal for a learning tool, and was the intuitive decision for the beginner student (Appendix I). This student would be able to directly see and hear the note they were about to use, forcing them to be aware of the note names and their relationship to the surrounding notes.

A consistent question arose from the educators: “What are these characters?” Perhaps in future versions of this project the link between the two SugarPucks game will be strengthened, and we can make it easier to intuit personification of the musical note.

Conclusion

While the original goal of the project remains, the scope of this iteration evolved with time. The initial goal of the project was to “provide a medium in which students of middle school age can learn to create- and subsequently compose- music” and still remains. The base composition tool was created and is functional to the original goal of the project: however, the educational aspect requires development in future versions of this project.

Educationally, the team’s idea involved taking students from a place of learning rhythms to creating basic melodies. The interview with Steven Klepner provided several concepts through which the curriculum could be based, including ideas for an interactive medium. Currently, the

software users can access several rhythm learning screens in which they are able to view basic and syncopated rhythms.

In future versions of this project, developers should consider the user experience and interactive portion of the project. Students can drag and drop notes in place and create their own melodies, but as Klepner and Matthew Pacheco suggest, the learning process should focus on restriction and interactivity. For rhythms, an interactive portion should judge the accuracy of timing and reading rhythms, as the game Rhythm Heaven incorporates. Continuing, the students should learn about different types of scales and chords. Then experimenting with basic rhythms and melodies should occur. As Pacheco stated “I start with phrases instead of doing whole long compositions...things will get really crazy if I don’t give them a little bit more parameters.” By giving these restrictions, students will create basic melodies worthy of singing. Creating parameters, such as allowing the change of a few notes in an existing melody, is a method for slowly allowing students to explore their creativity and keeping interest in the subject.

Along with the responsibility of adding additional curriculum for students, future versions of the project should add additional features to the composition tool. The user has the ability to create notes of any length, but not to use multiple different lengths in the same composition. For example, if the chosen standard note length is eighth notes, the user has no option to create any longer note- quarter, half, and whole notes are not viable. Creating the ability to use such note variations in the same composition will greatly impact student and user creativity and ability.

Other features should also include tracking and conversion tools. Tracking students’ progress through lessons can reward student by allowing them to see progress, and will also indicate which lessons to encounter next. In this way, the students can follow a set curriculum instead of choosing random lessons. Should the educational aspect be expanded so should the depth in theory education. Tracking the progress through this also ensures students will understand concepts before attempting a more advanced lesson, and the lessons will be able to correctly “spiral,” or call back to previous lessons. The conversion tool should also be implemented to challenge the students to apply such knowledge to real life. For example, the composition tool could contain functionality to convert a user’s in-game composition to that of

real sheet music. For the lessons, perhaps the same tool could convert chord progressions or rhythms into sheet music. In this way, the knowledge gained within the tool can be applied to formal music notation.

A focus on educational expansion, interactivity, and real life application should drive the focus of future projects.

References

1. Randel, D. (Ed.) (1986). Education in the United States. *The New Harvard Dictionary of Music* (pp. 276–278). London/Cambridge, MA: Belknap Press of Harvard University Press.
2. Elpus, K., Ph.D. (2017). The Status of Music Education in United States Public Schools - 2017. Give a Note Foundation.
3. 20 Important Benefits of Music In Our Schools. (2014, July 21). Retrieved from <https://nafme.org/20-important-benefits-of-music-in-our-schools/>
4. How Children Benefit from Music Education in Schools. (2014, June 09). Retrieved from <https://www.nammfoundation.org/articles/2014-06-09/how-children-benefit-music-education-schools>
5. Weale, S. (2016, March 07). A fifth of adults have forgotten how to do fractions or percentages. Retrieved from <https://www.theguardian.com/education/2016/mar/07/a-fifth-of-uk-adults-have-forgotten-how-to-do-fractions-or-percentages-mathematics-english-science>
6. How Children Benefit from Music Education in Schools. (2014, June 09). Retrieved from <https://www.nammfoundation.org/articles/2014-06-09/how-children-benefit-music-education-schools>
7. Matthews, M. (2011, August 28). 18 Benefits of Playing a Musical Instrument. Retrieved from <http://www.effectivemusicteaching.com/articles/directors/18-benefits-of-playing-a-musical-instrument/>
8. 20 Important Benefits of Music In Our Schools. (2014, July 21). Retrieved from <https://nafme.org/20-important-benefits-of-music-in-our-schools/>
9. Kalivretenos, A. (2015, March 18). The Importance of Music Education. Retrieved from <https://thehumanist.com/features/articles/the-importance-of-music-education>
10. Doyle, A. (2018, August 02). Top 10 Leadership Skills Employers Look For. Retrieved from <https://www.thebalancecareers.com/top-leadership-skills-2063782>
11. 10 Reasons Why Confidence Leads to Success. (2013, February 13). Retrieved from <https://timemanagementninja.com/2012/07/10-reasons-why-confidence-leads-to-success/>

12. Gardner, H. (2011). *Frames of mind: The theory of multiple intelligences*. New York, NY: Basic Books.
13. 20 Important Benefits of Music In Our Schools. (2014, July 21). Retrieved from <https://nafme.org/20-important-benefits-of-music-in-our-schools/>
14. About NAFME. (n.d.). Retrieved from <https://nafme.org/about/>
15. RIMEA - Rhode Island Music Education Association. (n.d.). Retrieved from <https://www.rimea.org/>
16. NAFME Core Music Standards: PreK - 8. (n.d.). Retrieved from <https://nafme.org/wp-content/files/2014/06/1-Core-Music-Standards-PreK-81.pdf>
17. Crooke, A., Ph.D. (2017, May 23). *The trouble with teaching music in our schools*. Retrieved from <https://pursuit.unimelb.edu.au/articles/the-trouble-with-teaching-music-in-our-schools>
18. Finegan, J. (2017). *Getting Personalization Right*. *ASCD Express*, 12(14). Retrieved from <http://www.ascd.org/ascd-express/vol12/1214-finegan.aspx>
19. Madden, B. (2014, February). *Why Music Education Actually Matters*. Retrieved from <https://nafme.org/why-music-education-actually-matters/>
20. 20 Important Benefits of Music In Our Schools. (2014, July 21). Retrieved from <https://nafme.org/20-important-benefits-of-music-in-our-schools/>
21. Koops, A., DMA. (1994). *Introductory Composition Lessons for Middle School Band and Orchestra*. *National Standards for Arts Education, Music Educators National Conference*.
22. Try, A. (2011, August 30). *What Is the Best DAW for Beginners?* Retrieved from <https://music.tutsplus.com/articles/what-is-the-best-daw-for-beginners--audio-11773>
23. Mayzes, R. (2018, May 30). *Best DAW 2018: Choose One of These Top DAWs Today*. Retrieved from <https://www.musicianonamission.com/best-daw-2016/>
24. *DAW Comparison Chart*. (n.d.). Retrieved from <http://www.thedawstudio.com/resources/daw-comparison-chart/>
25. *Learning To Read Sheet Music Is Not As Hard As You Think*. (n.d.). Retrieved from <http://www.piano-lessons-made-simple.com/learning-to-read-sheet-music.html>

26. Neely, A. (2018, May 28). 38 minutes of Jeff Schneider and me teaching you HOW TO NOT SUCK AT MUSIC. Retrieved from <https://www.youtube.com/watch?v=0aw3ydFM9N0>
27. Bruce, D. (2018, April 20). TOP 5 ORCHESTRATION MISTAKES. Retrieved from <https://www.youtube.com/watch?v=uNO05g-JotA>
28. Hookpad. (n.d.). Retrieved from <https://www.hooktheory.com/hookpad>
29. Theory Tab: Tabs that show the theory behind songs. (n.d.). Retrieved from <https://www.hooktheory.com/theorytab>
30. Miyakawa, R., Carlton, D., & Anderson, C. (n.d.). Hooktheory I. Retrieved from <https://www.hooktheory.com/music-theory-for-songwriting>
31. Memory Recall/Retrieval - Memory Processes - The Human Memory. (n.d.). Retrieved from http://www.human-memory.net/processes_recall.html
32. Py-Lieberman, B. (1999, November 01). The Colors of Childhood. Retrieved from <https://www.smithsonianmag.com/arts-culture/the-colors-of-childhood-36067809/>
33. Warren, J. (n.d.). Learning with Crayons. Retrieved from <http://www.preschooexpress.com/learning-station10/learning-with-crayons-august.shtml>
34. Crayon. (2018, July 14). Retrieved from <https://en.wikipedia.org/wiki/Crayon>
35. Magic Pen. (n.d.). Retrieved from https://www.mathplayground.com/logic_magic_pen.html
36. Magic Pen. (n.d.). Retrieved from <https://www.bubblebox.com/play/975/magic-pen.htm>
37. Ouyang, Z. (2012, May 24). Magic Pen II on the App Store. Retrieved from <https://itunes.apple.com/us/app/magic-pen-ii/id519007640?mt=8>
38. Magic Pen: Appstore for Android. (n.d.). Retrieved from <https://www.amazon.com/Air-Game-Inc-Magic-Pen/dp/B00AHARWR2>
39. Fancy Pants Adventures. (2018, August 15). Retrieved from https://en.wikipedia.org/wiki/Fancy_Pants_Adventures
40. Electronic Arts. (2010, November 10). The Fancy Pants Adventures - Teaser Trailer Retrieved from <https://www.youtube.com/watch?v=JgOaQLwsd78>

41. Au, W. J. (2008, December 15). 10 Most Popular Flash Games of 2008 - Mochi Network. Retrieved from <https://gigaom.com/2008/12/15/10-most-popular-mochi-network-flash-games-of-2008/>
42. Manzo, V. J. (2018, April 25). Private: Sugar Pucks. Retrieved from https://vjmedia.wpi.edu/Private:Sugar_Pucks
43. git@solar-10.wpi.edu:sugarpucks/3dnotation.git
44. J. (2017, October 05). Why Does Repetition Improve Memory? Retrieved from <https://noocube.com/blog/repetition-improve-memory/>
45. Koops, A., DMA. (1994). Introductory Composition Lessons for Middle School Band and Orchestra. *National Standards for Arts Education, Music Educators National Conference*.
46. EarMaster - Music Theory & Ear Training on PC, Mac and iPad. (n.d.). Retrieved from <https://www.earmaster.com/music-theory-online/ch06/chapter-6-4.html>
47. Moon, J. A. (2009). *A handbook of reflective and experiential learning: Theory and practice*. London: RoutledgeFalmer.
48. Hernandez, P., Patch, M., Walker, T., M., Harel, T., Ali, I., . . . Morgan Howard. (2017, May 08). The Science of Storytelling & Memory and Their Impact on CRO. Retrieved from <https://conversionxl.com/blog/the-science-of-storytelling-memory-motivation-and-its-impact-on-cro/>
49. Harvey, L. (1960). Art and the Existential in en Attendant Godot. *PMLA*, 75(1), 137-146. doi:10.2307/460435

Appendix I

Interview Questions Round 1

What kind of music classes do you teach?

Do you use any current composition tools such as ableton or garageband? If so, what is problematic about current composition tools from a beginner's standpoint?

How do you engage with students inside of the classroom? How do you keep them engaged outside of the classroom?

What concepts do you feel students have the hardest time grasping when beginning their music education?

What is the importance of having students create music?

What is the process of teaching students to compose music? Are there any specific activities or lessons that may aid in this process?

How and why do we teach students music theory formally? Informally?

How does a student go from knowing basic theory to creating musical pieces?

What theory does a student need to know to create a compelling piece?

How do students learn basic rhythmic concepts in a classroom setting?

How do we inspire students to keep creating music?

Interview Responses Round 1

Steven Klepner

K: Awesome, so you teach at?

S: Castleton University

K: And what kind of music classes do you teach there?

S: So I'm the director of athletic bands, so I teach all their athletic courses, for band I teach intro to music theory and intro to piano.

K: So any music composition going on in there?

S: Yeah, in the theory classes there is a lot of composition and in the piano there's minimal.

K: So what range of music education do you have coming in?

S: I have a varied range. A lot of these students are non-music majors in my courses. They're people- they're intelligent, they're in college- but it might be their first music experience with theory and composition.

[banter]

K: What kind of music composition tools do you use? Do you use MuseScore?

S: We use online NoteFlight, we use a lot within it which is tough for new students and then we use GarageBand which is the other option.

K: Awesome, we were looking into GarageBand actually. Do you see any problems with students using GarageBand?

S: It's- educationally- it's a yes and no type thing. They're able to manipulate music in a way which they can't without extensive theory training and extensive work within that, so it's a lot easier for them to do that. It depends on my goals in the class. Is it to create something and have a tool that's with minimal invasiveness? Sometimes, but then

sometimes I want them to understand the process behind it as well. So they know they tools they're using.

K: Okay, so it's not as much theory, more....

S: No, so theory and composition are kind of together, though. You have to be working with both together. That's something we're really conscious about- introducing theory and composition at the same time.

K: Got it. So engaging students inside the classroom, obviously you're up there teaching, but how do you keep them engaged outside of the classroom?

S: Well, outside of the classroom - it's a good thing I'm in college so it's really their time that's happening there- the engagement is I hope that they're taking a class that they enjoy within it. We tend to do a lot of project based learning, so a lot of what will happen in my theory intro to theory classes and intro to music classes like that in appreciation will be project based. So it'll be them getting an introduction- a quick introduction- and then working with tools hands on. So we'll do stuff like that. Sometimes we'll even work in things like Logic, we'll analyze music scores through watching movies and analyzing as we go, but they're doing a lot of hands on work instead of me lecturing at them, so we hope that that engages them.

K: So what we're trying to do is something similar to that- right now we're targeting middle school age students. So what we're trying to do is give them a series of levels so they can-

S: Ultimately when I'm teaching, my goal is to hit a concept in many different ways. So a lecture might work for some people but sometimes manipulating material will work better. And sometimes just hearing or seeing something will work better for people. So if

I'm hitting that same concept across a curriculum- a spiral curriculum- I'm hitting it. Instead of going "okay, today we're learning this, today we're learning this, and today we're learning this" instead I can hit concepts that are kind of going around throughout. So an idea of tone and an idea of- that's always there- an idea of instrumentation- I can hit that in different ways in different lessons. So I always plan my stuff that way, which is called spiral curriculum.

K: Got it, so you call back to previous lessons.

S: Exactly. And I think that's very important for recollection and understanding what's going on.

K: So I think what we're trying to do is have a series of- basically, we're trying to take them through the entire music composition process. Assuming they have kind of limited music theory knowledge so we can take them from just learning notes and rhythms, we can have them- we can have twinkle twinkle little star and have them manipulate that to change up the rhythm or change the key or the notes and that kind of stuff. Do you do any of that?

S: So when I student taught I did a lot of that. It's a lot for them- I use something called the Gordon Method which is like a "do" and "do-day" method where you're speaking and clapping at the same time, which is still useful within that. Weakness for a lot of students even into college- you see it right at middle school there- is rhythm reading. Being able to understand time, so being able to teach space in time, the idea of rests versus whole notes and things- that's actually very abstract concepts that are tough to teach.

K: Yeah, that's what I've heard from everything too, every single source we've found about teaching music composition always starts off with rhythms, because if they can't understand rhythms how are they going to build off of it?

S: It's the weakest part of it- I've seen some success with rhythms and color being associated together, or rhythm and even tone associated together within things. So you might have- so you're starting to associate things with it, and that's what the Gordon Method does with "do's" and "do-days" so the idea of downbeats being always "do" and upbeats being "day" and between being "tah" so "do tah day do tah day do tah day" like that, well that's a triplet. It'd be "do tah day tah do tah day tah do tah day tah" like that, and being able to speak what you're seeing, it's very very important. So being able to translate what you're seeing into something else which is what really music is, and being able to read music is being able to speak it at some point. So being able to do that is very important.

K: Right, so just translating it from notes to paper.

S: So using more than one sense is important when I'm teaching. Whether it's kinesthetic or whatever else.

K: So you're trying to appeal to all three learning modes at the same time?

S: For middle school what would be really beneficial to me, let's say I have an iPad app or something like that, where the rhythms are coming up and the kid is- it's playing the notes with that- and the kid is able to clap along and it can hear the claps or give some feedback that way, and judge what's happening somehow. Now I'm not giving an evaluation, just some feedback, like "yeah you hit right in the middle" like what Rock Band does or something like that.

K: Right, I know there's some apps that will do that, for teaching you to play guitar or piano and you just play along on the piano.

S: But it doesn't really apply it into- it doesn't take that from that abstract kind of success. So the reason why you can't use Guitar Hero or Rock Band as a music learning app is because it doesn't take anything out of the abstraction. You're not really doing anything, because that is not happening. Then taking that skill, that idea of seeing something then being able to feel rhythm and know and timing within that music, because that's really what you're doing is timing within music, feeling that. Or counting- or learning how to count rhythms in general. Both of those skills- that's your hurdle. If you can solve that, you're set.

K: That's exactly what we focus on here [Drum Corps] too first, forget the notes. If you're not coming in on time what are you even doing?

S: Exactly.

K: So this is more of an abstract, societal-based question, but what is the importance of having students create music?

S: I mean, you're talking to somebody who's obviously biased in his answer within that.

K: Right, that's what I want.

S: So my answers are going to be biased. But, the benefit to it is the same as saying "Why paint?" or "Why sculpt?" or "Why have art class, why express yourself as a person, why have a hair cut?" It's important because, deep down, creativity is a way for people to take abstract concepts in their head and create something that's in the real world with that. And that allows you to show emotion in a way that words can't, because words are only comparing things- and that's the thing- words can only compare to other things. I keep- you couldn't compare blue if you've never seen the color blue. But music is something you can compare without having that kind of- it's a very abstract language where you

don't need that kind of symbolism to get feeling across, and I think that's what music does, and that's why I think creating- man, if you can figure out how to get your feelings across in something, it can help people, especially in a time of stress.

K: I guess that's extremely important, especially at the middle school age, to develop pretty early so when everybody starts getting stressed out in high school they-

S: I think it's important because at that age people will choose to either be musicians or not be musicians. So I get the phrase "I can't play an instrument" or "I can't sing" or "I can't compose" or "I'm not an artist." Those identities happen when you guys are in middle school and elementary school when you're more successful at something else, and that's just an identity thing. But it's really not- anybody can compose, anybody can go to a piano and hit it, that's composition! It's just being able to use those tools.

K: Other than teaching notes and rhythms, which is often overlooked and kind of hard to teach, what's the general process of getting students to compose music? I know you went over the Gordon Method where you went back to previous lessons.

S: Yeah, well no so the Gordon Method is a rhythm method, spiral method is for curriculums.

K: Yup, my bad.

S: No it's cool, lots of terms. For me, it always starts with limitations first. I'm never going to put a kid in front of a piano and say "create a masterpiece within there." I'm giving them limitations of 3 or 4 notes at a time, but I'm also mirroring with them examples of what can happen. So sometimes I'll give them something- it's called scaffolding- you did an example of it, Mary had a Little Lamb, now you're allowed to move the last note of it. So [sings Mary had a Little Lamb but raises the last note up a

whole step]. That's composition now, it's a new composition by moving that, or making a choice of up or down, a very major- up a step or down a step, something that the piece will sound nice, or can you can do it in a pentatonic scale, where it's not moving scale-ular major or minor, and that will limit the choices and make very nice music real quickly. I do almost all of my early music off of a pentatonic scale, because it's 5 notes and you can really work with it and make some great pieces off of it. All of my first lessons are pentatonic with my students.

K: So it's all about the limitations. So first lesson, obviously I have no idea where to start.

S: You're not going to put a little kid inside a professional art studio and say "create a masterpiece."

K: Right, like he's got the switchboard in front of him.

S: Right, so it's not realistic and it's overwhelming. And that's what you don't want to do, you don't want to overwhelm.

K: So the music composition learning process is all about taking away some of those constrictions over time.

S: Well look at video games, how they teach mechanics in video games. You don't get all of them- good video games don't give you all mechanics at once. Good video games will ease you in one at a time. You first learn how to move forward then duck, and then all the basic stuff that we all now take for granted. It's the same with music within that and the composition. Give them rhythms first, give them- have them with a drum kit kind of idea and getting rhythms down in that way. And now now add in pitch to the rhythms, or build compositions that way. Don't give them- and do it quickly. It doesn't need to be a long, drawn out process. They'll figure it out real quick.

K: Do you have any suggestions, or in your experience have you seen a certain level of incoming theory knowledge that would help students create more compelling pieces? Like if a student came in with no knowledge at all, obviously they're not going to do super well, they're not going to compose like Mozart.

S: I mean, understanding chord progressions in music is important for composition. Being able to build a chord, understanding inversions, voice leading is very important within that, even if you're there to break it. My best students are the students who are mastering scales and modes. Specifically modes are important, because modes are how you get tone within things. So all my composition is- all good compositions are- all really technical stuff you see is really just scale-ular in one way or another. So understanding that, understanding placement and pitches and tones, and all that stuff helps.

K: So if they come in with a rhythm knowledge- they're able to clap rhythms fairly accurately- but they know the B flat scale, and that's it. Which I know is the case for my hometown.

S: Well at the middle school level? That would be exquisite for me. If I saw middle schools that could come in and read rhythms down, dotted eighth notes and stuff like that. That's the hardest thing is dotted rhythms for a lot of kids because of the time. So any of that down and up kind of feel to stuff, or up down and all that- getting those are very difficult for people. They're difficult for college students. Triplets are getting easier for people because almost every pop song is using a triplet feel behind it, so they're getting- it's getting a lot easier for people to feel triplets. That would be- getting them moving scale-ular, getting them not afraid of scales. I think we take scales in this very technical kind of way, always has to be up and down, kind of like that. Always having to play within the scales or within the constraints of the key like that- a lot of people don't understand key signature which would help them.

K: Yeah, I think scales are especially scary for middle school age because-

S: Well it's because of how they're presented. Instead you made it a game where you're going up and down like just two or three notes at a time, why do you have to learn all seven notes or eight notes or however you want to call it at a time in the scale. Why not just go [singing up and down scale by three notes] you know, just up and down, or just five at a time, just five note scales then add "ti do" at the end.

K: So I think the challenging part for middle school students at least, like the way I learned scales was as I learned to play them. I had no idea what any other scale was until we moved away from B flat, and all of a sudden it's different fingerings, a different slide position.

S: I also think the practicality of scales is lost when we don't immediately put it and work in keys and in pieces. So if you're teaching a scale you'd better have an etude- a band etude afterwards to back it. So that the band is working and rehearsing within a key. Because that's where you're really learning your scales, is when you're working within a key in a piece. Because you're not just going up and down, there's jumps and stuff like that, and that's where the mastery of scales comes in.

K: It's in the practice afterwards.

S: Yeah, and it's not going up and down a scale, it's being able to understand the in-betweens and being able to manipulate it.

K: So if we develop this, it's perfect, we have someone go from not even knowing rhythms all the way up to composing Beethoven pieces, I guess that's lost if we can't

convince them to keep following music, keep creating. So do you know of any methods, any ideas to inspire students to keep creating music?

S: Yeah, well first I think your goal is off. I think that anybody who tries to attempt to do that in one application or one method is wrong to begin with. You're not going to achieve that the way you're expected, because theory has different approaches to the way you have to teach things within that kind of thing. The way that I would do it- the way that would be most successful to me is look at video games that- there's a very big thing in abstract Japanese video games when they have all these mini games. Mario Party ended up adopting that on the mainstream, where it's a bunch of mini game kind of things, that are not even related to each other, but are building towards a goal or- what was that game called, I can't even remember- Rhythm Heaven it was called. Which was a video game that came out too, that did that same thing that got timing and stuff like that, but it had mini games within it. That was a Japanese game. There's a lot of these out there already, but I think that's the way you need to approach it. Having wildly different kind of levels to things, instead of trying to approach everything as one continuous thing. Add time manipulation, add manipulation to whatever you're doing.

K: So one of the first things we were thinking about doing was-

[interrupted]

Rhythm Heaven, have you used that at all?

S: As a game, not as- what I've been doing for composition recently is a game called DropMix that came out. It's by Harmonix, a company called Harmonix did it. It's a card based game that actually manipulates some DJ's cards from rhythms and different parts of it. I've been using that very successfully actually in teaching parts and different things like that. Look it up, it's going to blow your mind if you haven't done it yet.

K: Yeah, we've been trying to find as many composition sources-

S: Yeah, DropMix is what you're going to look at. So that's a mainstream retail version of that. Keep me posted on that as well, those two definitely.

K: Yeah, so after our first round of development I might come back-

S: I'd be glad to test it I'd be glad to get it to middle and elementary schools up in Vermont if you want to, I have some good connections up there.

K: It's going to be another review process to get it deployed to students, but I'd like to have you review it after we develop the first iteration assuming you guys are still in the area.

Matthew Pacheco

K: [What we're working on is a game based off one that is] already developed, it's called "Sugar Pucks" and it has these characters and what you do is you're standing there with the characters, each one is a note in the scale. They all sing out, then a tone plays and you have to go find the right character. So what we're doing is taking the same characters and making a music composition video game. So there's going to be a free-play mode where you can just put the characters on the staff and create their own compositions. But the part we're trying to achieve is getting them from learning notes and rhythms all the way up through creating basic compositions. So whether it's just learning rhythms- clapping along or tapping along- all the way up to manipulating stuff that's already been composed- stuff like twinkle twinkle little star. Just changing the last note or something like that. And then eventually create something from scratch on their own, hopefully using chords or at least a basic melody.

M: Is the game supposed to be to- who is it marked for? People who have never played an instrument just so they can learn more about music? Or is it people that already know about music and getting them more excited about composition?

K: It's more of the last one. We assume the students have some music theory, some instrument lessons- maybe some experience in music. Just trying to get them first of all inspired to create music, and then also to a place where they can create their own music melodies. So we're looking at middle school age, people who have already been playing an instrument for maybe a year or a few years. People with limited access to music theory education.

M: Alright.

K: So what kind of music classes do you teach?

M: I've taught in my career middle school through high school, sixth grade through twelfth grade. And I've done general music and band primarily, and I've taught all levels of within that six through twelve grade band. So a lot of the general stuff I do is I do the general music- one of the classes I teach now is called music fundamentals, we currently have a lot of kids who are non-native speakers who are only in the country for a year or two years or even less sometimes. So they're really going back to beginner level music education and talking about just what is a whole note, what is a half note, and they're learning the vocabulary of english along with the vocabulary of music, which is pretty cool.

K: So do they basic music theory, and they're just trying to learn the terms in english?

M: Sometimes I have kids like that, that they've already played guitar in Guatemala, and sometimes it's the opposite, where these kids didn't get any formal education at all. They

got a couple years down in El Salvador and now they're here and they're required to get a public school education until age sixteen. And so they're interested- they got to pick either music or art or physical education and some of them get put in my class. So they're learning everything at the same time.

K: Interesting. I don't really think we've considered a language barrier yet, but that might be something else to look into. So do you use, in your classes, any current composition tools such as Ableton or Garageband, or maybe Rhythm Heaven? And if so, do you see any drawbacks with those from a beginner's standpoint?

M: Yeah, I use Garageband- I have used Garageband before. I've used a bunch a bunch of different note composition things such as Noteflight, Finale, MuseScore works out really well. Our school just went to a "one to one" initiative so every single kid in the school gets a laptop. So it's just a matter of how best we utilize that. Because sometimes kids could do a really nice job creating a composition without necessarily knowing what they're doing, they're just trying to make it sound nice, versus some kids who are new to the technical aspects and couldn't necessarily explore creatively what the next step forward was. So I think that's what you were asking- about drawbacks.

K: Yeah, if there were any problems- I know Steve [Klepner] uses Garageband but he was talking about how it doesn't go enough in depth into music theory and composition enough for him.

M: I find that Garageband is a little general sometimes. The kids are- they just want to make it sound good right away. They don't want to necessarily spend time to make individual parts or whatever, they just want to get to the auto functions and strum chords or a drum beat or whatever, and get that automated and get that all together and make it sound like a cool composition. Which is nice, but from the perspective of a music educator I'm trying to teach them about all of those elements, not just the final product.

K: Yeah, you want to teach them all the theory behind it obviously. But there's clearly got to be some balance between keeping them interested and getting into the nitty-gritty stuff. So you engage with students inside the classroom using those composition tools and teaching and that kind of stuff, but how do you keep them engaged outside of the classroom as well?

M: I do a lot of assignments that they can do online, or- since we are a "one to one" initiative- one of the things that they use is Microsoft Teams. So every class of mine was on a team and they can post stuff, much like a social media outlet but it was very much school oriented. So I can provide files and a place for them to be able to login and see what I've posted up there, I could take kids' compositions or kids' recordings of stuff they've been doing or playing, especially for band classes. I'll post it up there and say "oh this is really good" or "take a listen to this" or even put up professional musicians and get them to see different things. It made sharing things easy and allowed kids to go home and actually work on something. So I use a site called "Sight Reading Factory" where there would be four bars or eight bars or whatever and would allow me to put the range of how hard do I want the music or how easy do I want the music and I would tell them "okay, I'm going to post it up tonight, you have until Wednesday the next time I see you" or whatever amount of time, and they would have to go online and interact there on the laptop and try to record them and everything. So I found some success rates through that. I do a lot of social media- I now am doing a lot of high school. We have facebook a general page, a closed group, we have an instagram page, I allow kids to take it over like the trumpets or something like that. So sometimes I do things like that to see how people are doing with different stuff and interact with them on their level- the things they're more interested in.

K: So you find that kids are more engaged online or computer-based methods rather than paper and pencil?

M: Yeah, generally. If I tell them to go and bring home this worksheet they're probably not going to be as interested. I teach an AP music theory class so I teach the opposite end. And even then, any time I can bring in any type of interactive element, Cahoot or something where they play games or when they actually know the knowledge. They interact with a puzzle game or something. They're that much more interested in that rather than pen and paper.

K: Assuming students come on with limited music theory. Say they know the rhythms and know maybe a few scales, what process would you take to get students from that point to composing music? I know Steve [Klepner] said the first step is manipulation, where you have a composition and they just- you put a restriction on to change the last note or last few notes. Do you have a process you usually follow to teach composition?

M: Yeah, we- for our school we adopted a common set of languages of the process of doing things. Like we did a process called "think, write, pair, share" which everyone kinda does, we just standardized it. So basically the process was "okay, I'm going to give you something to think about. Think about it for a couple minutes, write something down, then pair up with somebody and exchange your ideas that you thought about, then let's share out to the class" versus like "does anybody know the answer to number 5?" So it gives everyone a chance to manipulate the information and work with it before- whether it's composition or learning to play an instrument or- so one of the things we did, and it works really well when I do compositions, is do a set of "Did I?" sheets. And basically a "Did I?" sheet- it needs to be a set of objectives that they need to be able to complete. And they can be vague, which is the point. Not necessarily "did my song have 49 notes" or something, it can be "does it have an appropriate amount of notes?" Kids can decide what's appropriate. I start with phrases instead of doing whole long compositions, and basically I give them a guideline like "could you leave this room singing that melody to your friends, like a favorite song of yours?" And if you can't, it's

probably way too complicated, way too high, way too low, too many jumps and so on. Once I get them doing that kind of thing, getting them experimenting singing on their own or playing, kinda making stuff up on piano or whatever they're playing, I'll expand the objective on that "Did I?" sheet. Now that you have a comfortable idea of what you want, let's pick a major or minor key, let's have five to six notes that you play of that key so it's not just the same note over and over through that piece, or just two notes. Varied rhythms- so let's call it whatever- syncopated, non-syncopated, things like that. And then I use that "think, write, pair, share" model that I was talking about and it really gets kids to think about composition differently because whereas they were thinking about four-four, four quarter notes in a measure, whole note at the end and so on, now they're looking at somebody who has something in six-eight or something that's in a minor mode versus a major mode, and it gets them to think a little bit harder. I generally- I have to cheat a little bit because I know that things will get really crazy if I don't give them a little bit more parameters, so I generally tell them- and I'll tell them why eventually- start and end on the same note. So if they're in the key of C major, start on C, end on C, we'll call it a day. And eventually when I get a little bit more advanced and want to do two phrases and have an antecedent and consequent phrase and have the first phrase and have the half cadence, you know what we'll just end on G for the first phrase and on C in the second phrase, have fun. That gets a little bit I feel like- it limits a little bit of the creativity but then they end up being "oh that's kinda cool. It's neat how we just did that."

K: But if you don't limit anything, they're just going to go way off the rails. Like they're- you'll have two measures, like keep it to quarter notes. Some kids are going to 32nd notes for 20 minutes.

M: I go back and forth, too, with making sure that they write it down sometimes and actually don't even listen to anything, don't play a note, like what do you think you'd like to have it, and see if they can oralize it. Sometimes, I'll do it the other way. I don't want

you to write a single thing. Here are the parameters on the “Did I?” sheet and you just make it up. And say- I’ll give you three minutes. Partner with somebody else, and some kids will say “oh, I already forgot it” but it makes them have to change things, they’ll modify it because they liked something better or they don’t like how many skips there were or something like that.

K: So I guess the last question I have, since you’ve pretty much answered everything else, is how do you inspire students to keep creating music after that class is over?

M: Oh man, that’s a- that’s the objective of any music teacher. Any person would want, hopefully, for those kids to have a love of music.

K: Right, so you can show them a bunch of different compositions that already exist, you can show them Mozart and Beethoven and they can have a goal like “wow, I want to compose with these 32nd notes for 20 minutes and have it sound good.”

M: I guess it’s challenging, I do get the unique perspective to have these kids for seven years from sixth grade through twelfth grade- I’ve had four classes of that throughout my career. Not every kid is going to walk away wanting to continue learning or playing music. I always try to get it in their head that music is not just for people who are going to be music educators or music performers, there’s so many opportunities- DCI, WGI, all those different things. But even now there’s so many community groups, community bands, they’re always looking for people to play, and that’s usually a small commitment and they take any ability level, and so many people I know DJ on the side and they make a pretty good living off of doing things like that. There’s so many music options out there. And especially to those kids not going into music- they’re going into some type of college- I just try to see if they know- did they sign up to be in that wind ensemble at their school and you’re an oboe player, they’re really excited to have you. Even if you’re going to a nursing school, you can just sign in to be the oboe player for the next four

years and they might even give you a scholarship, which has happened to a couple of my kids over the years. One of my kids went to UMASS Dartmouth and was the only horn player there. So the guy said “if you commit, I’m going to give you a bunch of money.” So she’s playing anyways, but realizing there’s more that you can do, regardless of your career, I hope expands their world a little bit that they don’t just have to play in their school band or play music in their composition class, AP music theory, music fundamentals. I don’t know if I have the right answer for that, I don’t know if that’s enough.

K: It’s challenging to inspire anyone for a lifetime.

M: Yeah, I think about that- that question could be asked to anyone. How do you inspire anyone to be interested in science and computer technology, math, english. So you’d hope that over the time that you’ve had them that they found it interesting enough and exciting enough that they’d want to eventually find how that would fit into their life however it does. And knowing that everyone goes through their cycle of life, they go through college or they end up finding a significant other, having kids or whatever, but they still can find time to read a good book or see a nice film that is inspiring and not just a cheesy action film. Something that is musically creative, whether that’s performing in a drum circle or going to see a live concert or participate in a concert. That’s the hope, but I’m not sure I can always project into the future of those people.

K: I guess it’s just about showing them one side of society, even just showing them the music composition behind movies and video games and hoping that they keep interest in that. Alright, that’s all I had, thank you.

Interview Questions Round 2

The second round of interviews focused on allowing the music educators and students to test out the software and walk through as a true user would. Some guiding questions were offered as follows:

- What are your first impressions of the software?
- Is this software easy to use? What part of the software was not intuitive?
- What strengths does this software provide to composition education?
- What could be improved in future versions of this project?

Interview Responses Round 2

Steven Klepner

K: Over the past couple weeks we've been developing the beginning of our music composition tool, we didn't get into as much of the education side because the coding ended up being more complex than we thought.

S: It always does

K: Yeah. So I can walk you through really quick. So we have this learning screen where we have a bunch of rhythms you can also create-

S: I want to create a chord.

K: So I'll give you control. I want to see how intuitive it is. There are your characters, you can drag and drop them into slots.

(Steve plays with notes for a new minutes)

S: How do I play?

K: You just hit the play button up at the top here.

S: That's awesome! Oh there's a clear all. I was just dragging things.

K: So the actual composition tool works very similarly to that. If you go to compose- the actual composition tool works in the same way. You can build chords, you can create simple melodies, we currently don't have functionality for anything longer than one time unit.

(Steve plays with composition tool)

S: Can you adjust tempo?

K: Yes, you can adjust the tempo by sliding that little bar up there to make it faster or slower.

S: Here's a pentatonic.

K: If you click on the word "key" then click on one of the notes it'll give you-

S: it's in that key!

K: Yes, you can grab the other ones, but all the notes in the major scale are brought out.

S: So if this is going to be a learning tool, you should make sure that it specifies major vs. minor. Because kids have issues with that if everything is major. It's really easy for me to see. I like this part of it here. I don't- so what was the choice behind the "pixies" essentially?

K: The professor that we're working with, he already has a game using similar characters, so we're trying to create a game in the same universe. It's called "Sugar Pucks" and what the 3d game does is you have a bunch of guys surrounding you, and one of them will jump up and down and give you a pitch, and you have to go find the one giving you the pitch. So these are the same characters from that game, just two-dimensional. He wanted something in the same universe, so that's something we tried to do here.

S: I think the challenge right now for me is- what would be a goal? There's no goal besides being like-

K: Besides playing around with it.

S: Right. It's a cool platform right now, but is the goal to- I think you should give something. Like give a chord and say "okay, the pixies have friends" or something like that. And then constrain, because right now I could technically throw in crunch chords the whole time. And kids will, if you give them everything, will just fill it up every single time.

K: So this is just the freeform composition tool.

S: Which is think is cool.

K: So for the learning screens, what we wanted to do was like I said last time. Take them from knowing basic scales and bringing them up through and creating different rhythms and just learning all the different stuff. So right now, we spent a lot of time just on the composition tool and getting everything laid out, so we're hoping to- either in the next iteration or in a different project- have them be able to create more learning screens. So our goal is to teach them how, and then the composition tool is something where they'll show off their knowledge.

S: (Looking at the eighth notes page) This is represented the exact same way that quarter notes are. If I did this (extends quarter note page) this is the same as your eighth note exercise right now. The best challenge would be to find a way to show the difference between quarter and eighth notes. And for sixteenth notes I bet you there's just sixteen of them. Technically in music this is not representing sixteenth notes, it's representing sixteen quarter notes. Or sixteen whole notes. So being able to create a- maybe color is your answer to that. So your one and two and three and are all there, but you would never see music with this like that especially at an elementary level. You would also- many elementary schools also- have you guys done research on systems still? So one e and a, two e and a, three e and a, four is what you're using here which is a counting system. Very few elementary schools, very few current programs exclusively use this, especially in general music. This is for general music, correct?

K: Yes.

S: Yeah, so you might want to use syllables where they talk or something when you press them. Like the quarter note ones say "do" or for eight "day" is your upbeat notes. That would be your Gordon method. Something like that might be a good solution to kids understanding up and downbeats. These guys when you get there say "do" and the ones that are up say "day" and "tah" is in between. So "do tah day do tah day" or "do tah day tah do tah day tah" that would be your sixteenth notes. So specifying it that way might be your solution. That would be something I see right away. I like this, I think it's cool. I like that it's easy to understand, it's obvious that this would translate to a touch screen very well. Right now, kids get frustrated when things don't drag. I think this is a really cool start. I can't wait to see what happens with it. The last part I would suggest would be translating the way from these characters in this system to a standard system. So involving both together in some way.

K: Yeah, that was some other functionality we were considering. Probably not in this project but in another version of this project. Adding on would be- you'd be able to take your composition and translate that to sheet music. So the next step for us is going to be working on the learning process, because we have some screens there just for basic tempos-

S: This is not intuitive to me: having a button (key button) over here and having to move back over here- it might be easier to do a drop down eventually. It's just something that would make sense to me, but I like the idea of selecting the note- maybe putting the key over here above the notes might be a good idea, just as a UI thing. Because pressing this then going back over here- you know what I mean? So for me that was the hardest thing to immediately pick up. And I have about the same technological skills as a toddler. Why do they waddle? Are they just giving us the next note in the chord?

K: Yup, so those are the next suggested notes in the chord. If you choose a root, it'll give you a third and fifth.

S: I like this tool I could have fun with this tool just as is. Cool, I like it.

Sebastien de Carbonnel

C: One thing to note with this is that it's a prototype, it's not meant to be a full, complete version, it's meant to show what's possible.

S: Yep

C: With this, what it states in the create a chord is that, choose a key, drag a note out, and it will show you

S: Yeah, yeah yeah

C: How to create a chord

S: oh, I thought it just told you how

C: This is something, the shaking, that's in the main composition tool. When you're in a key, it will show you

S: What the next note in the key may be

C: Yeah, that's in the basic triad

S: Ah, Yeah, I was doing some wonky Jacob Collier Sh*t in there. Is that still there by the way?

C: Uh, no, unfortunately, We never implemented a saving tool, which I should have told you about.

S: Big Problem, the 16th notes aren't 16th notes.

C: um, no, your right. I need to pull from git again. The problem is that the audio clips, with this version, there's like a half second delay at the start of the song. It's the same problem with the polyrhythms. You heard the one voice that was super loud and the other that was quiet. The next version has the levels balanced. The create a key points to the original key clicked, and then points to

S: And how to create it with its jumps. Whole Whole Half Whole Whole Whole Half.

...

S: I like the sound sample you used for the, the pucks.

C: that came off of ableton's audio library. Was there anything I felt particularly strongly about showing.. You can add as many measures as you want. Fun little bug is that the distance is slightly off, so when you add a high number rapidly, the offsets change just the smallest amount. Which is purely cosmetic.

S: I do like the aesthetic though, It's really friendly.

C: Um, let me, I'm going to bring up the questions on my phone, but I guess a place to start is, um, What are your thoughts on the intuitiveness of the UI?

S: I like the UI a lot

C: Was there any part of the UI that you felt particularly strongly about? For or against? Was there anything that was bad?

S: Well, when it wasn't functional, it wasn't ideal. But, otherwise. I like the idea of all of the guys on the left side colored, part of it felt kind of clumsy to navigate and drag, navigate and drag, but also, I like that more as a learning tool. Like it doesn't feel like a tool for serious composing, its made for like, teaching. And that I like a lot. And I would definitely give it to a kid who hadn't learned with it before.

C: What did you think of the organization of the mini lessons? Do you feel like, do you feel like, while they are very, very basic lessons, do they follow in a way you would think to learn, or to teach people?

S: I would do polyrhythms way after. Polyrhythms are a very advanced concept. Otherwise I would say to spend a lot more time with them.

C: They are definitely Mini Lessons

S: Yeah, if you were to develop this into a full thing, I think clicking this would open into its own menu with all of the different lessons. Otherwise, the one big thing would be the polyrhythms that are in there.

C: Our thought with the polyrhythms, when we came up with it as an idea, was, oh, this is a very advanced concept, um, but we decided to add it, not because we thought it was something that they should know, or feel strongly about, but as something to kind of have them go, wow, thats neat.

S: I think it's cool, and the UI does a really good job of making it clear how the polyrhythms work, and showing the structure behind it. I still think doing it last.

C: Yeah, thats fair.

...

S: Do you think you're going to develop this into a fully finished concept? Because I think you could.

C: Um, we're thinking about it, however its outside of the scope of the IQP. It definitely could be continued as a personal project.

S: I think it could be a great tool for music teachers.

C: What sort of things would you include

S: I'd include different sounds, 3 or 4 different sounds so that kids can feel like they really own it, you know? Not much else. Like I said, the design is explicitly for learning, and for learning you really don't need to go much further than this. You've got all of the basics covered. You have a really nice UI that's really friendly.

C: Would you have it be all self contained with this? Or would you have it with a instructor giving things for them to do?

S: I think it should be able to be self contained, like, I think the ideal would be to optimize for both situations. Like, have the learning lessons be self contained enough that you can dive deep into it and have a kid learn themselves, or, have an instructor come over and say, here's, here's a thing here's a thing, here's a thing, go into the composition tool and sort this out. And I like that you separated them. Because it's the same tool, but, um, ones a lot more free form and can have an instructor come over and man - handle the kids. So I like that a lot.

...

C: Oh yeah, Um, because I just started this recording and had it running from before, So, what's your name-

S: Oh, Yeah, Hi, I'm Sebastien de Carbonnel, I'm a second year at Berklee college of music, I'm a vocalist and Pianist, and I compose, teach, and perform [for Mockingbird Theatre] and I have a little bit of background in coding.

...

C: Um, what other lessons would you want to see from this?

S: I like the idea of, not just learning about keys, but learning about scales. Not necessarily going into modes, but I like the idea of scales from the ground up. Like, here's how you compose traditional scales, here's the major scales, here's the minor scale, but if you want to do whole tone scales, you can do chromatic scales, and then you can still do the same structure as these major and minor scales, but starting on different notes. And just, introduce those ideas for kids to play around with. Because the thing with scales is that there's so much crazy sh*t that you can do that's not that hard to think about. Like, we act like it's this crazy complex idea, like modes, Oh my god, but really, if you think about it, it's just picking different notes and seeing how they sound. So introducing that as something that's not that big of a deal to kids is a really powerful idea.

C: Would you have that as like, some sort of, button, in the same way there's already the key button? Or would you show it in a lesson, and let them, just kind of free form use it in the composition tool.

S: I think you could do either way, based on how you approached it. Personally, what I latched onto was that they have an activity, like, *Make Your Own Scales*, and like, 5, 6, 7, 8 note scales that they can import into their composition tool to use later and transpose with. But like, make it an explicit invitation without forcing them.

C: I guess, following off of that, would you want to save anything else in any particular way, IE: like sheet music or anything like that?

S: I think that would be great, especially for more advanced kids I think having tools to let them save it as sheet music, or save it as midi, or whatever, or save it in its own format, because if they're learning in this format, that's what they're going to be comfortable with that UI and that's how they're going to want to see it in the future. And

then, potentially, an option to turn on sheet music mirroring, so they can see how it looks on sheet music and associate that.

C: Ok, cool. That looks like everything we have, do you have any questions for me, or any questions you think I should have asked about?

S: Not really, I think we touched on everything I can think of.

C: Ok, Well, thank you so much!

Appendix II

Initial Sketches Of Composition Tool

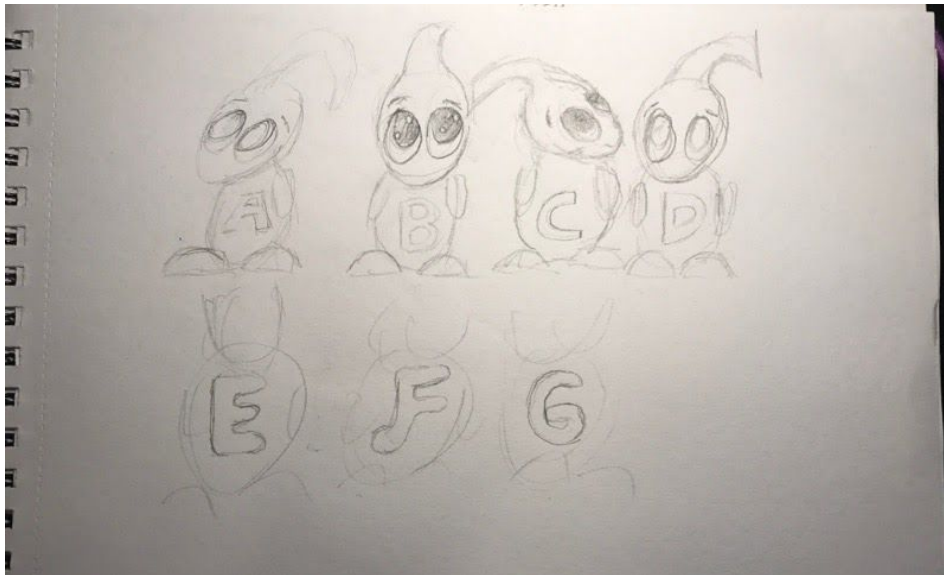


Fig 17: Initial Sugar Pucks Sketch

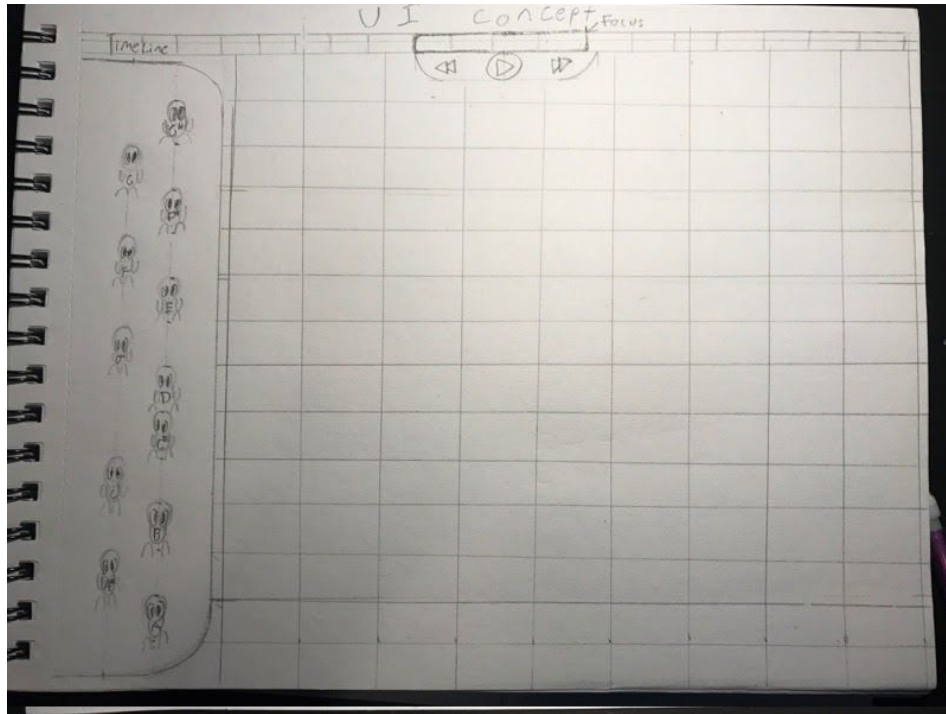


Fig 18: Initial UI Concept

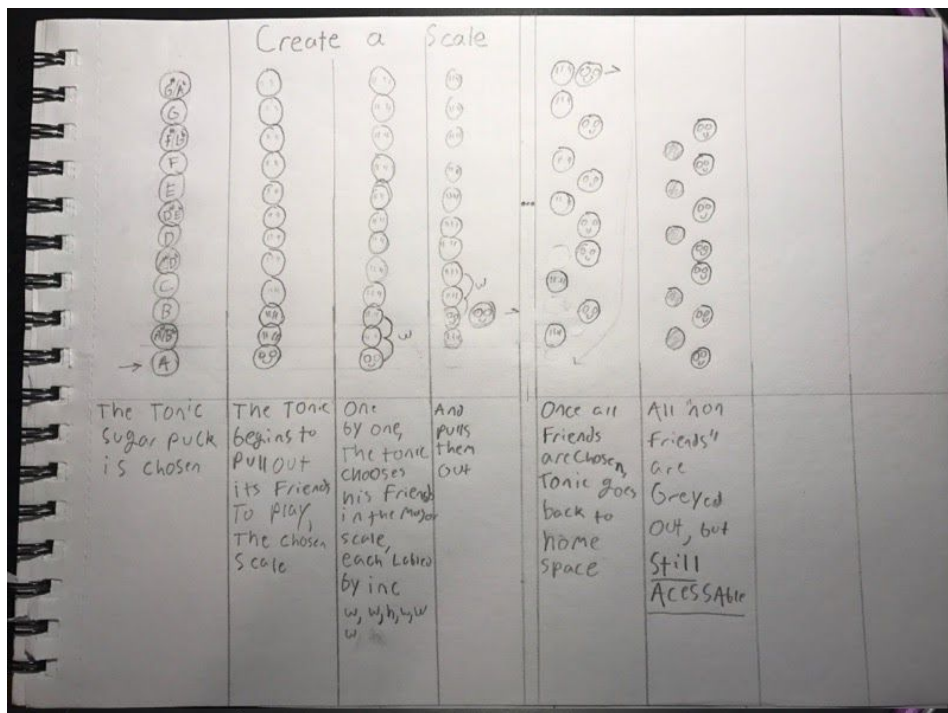


Fig 19: Initial Scale Creation Lesson

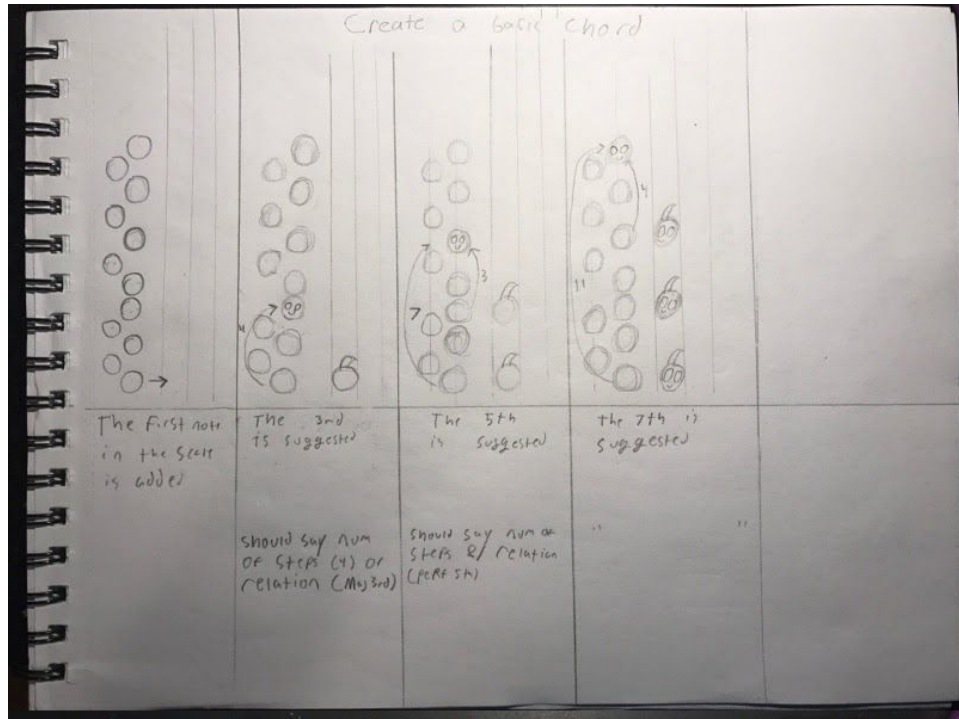


Fig 20: Initial Chord Creation Lesson

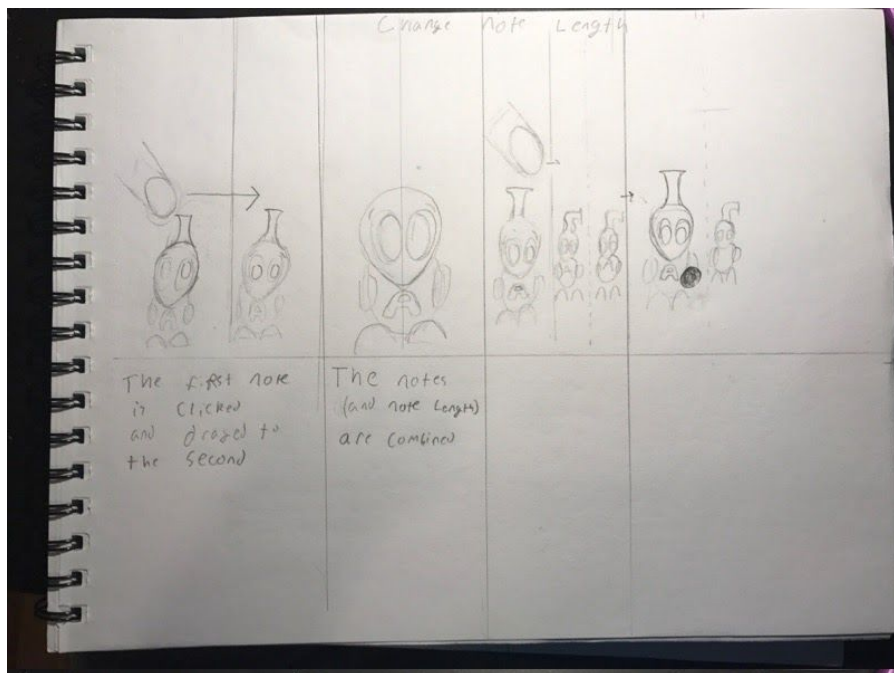


Fig 21: Initial Note Lengthen Concept

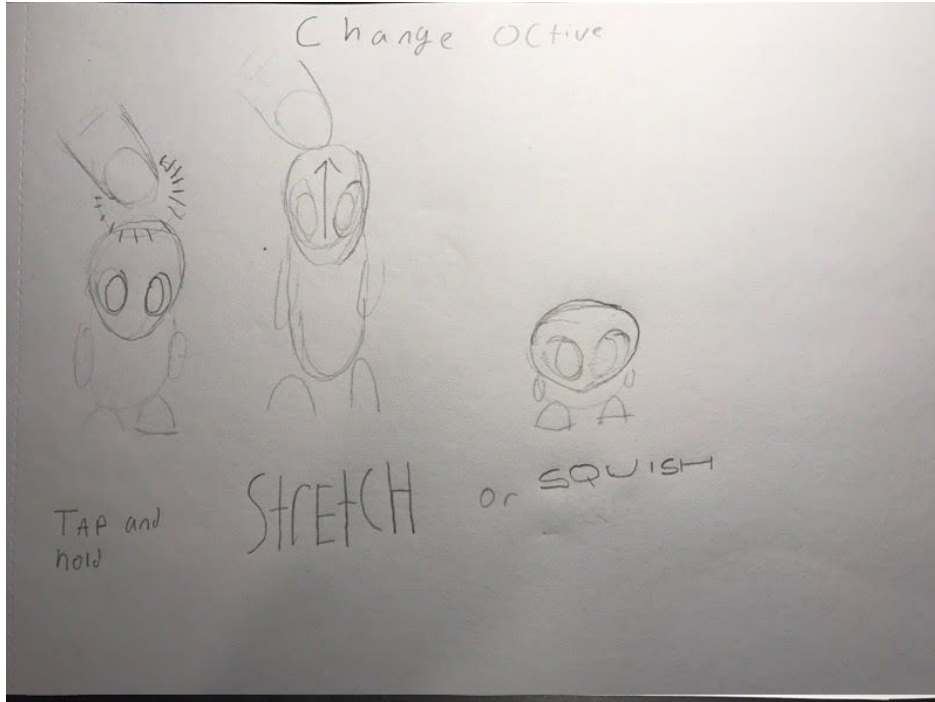


Fig 22: Initial Octave Concept

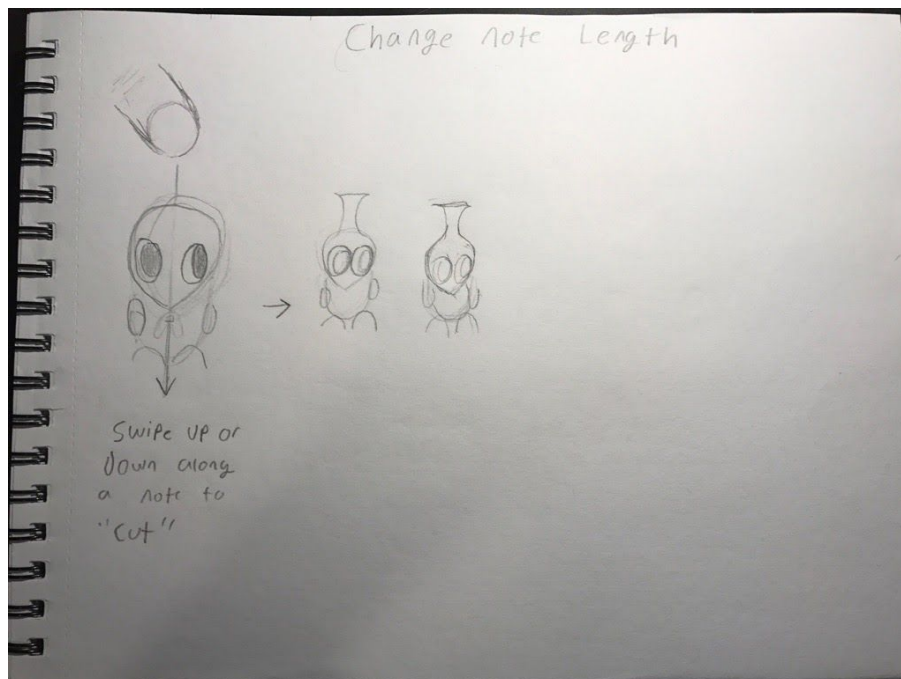


Fig 23: Initial Subdivision Concept

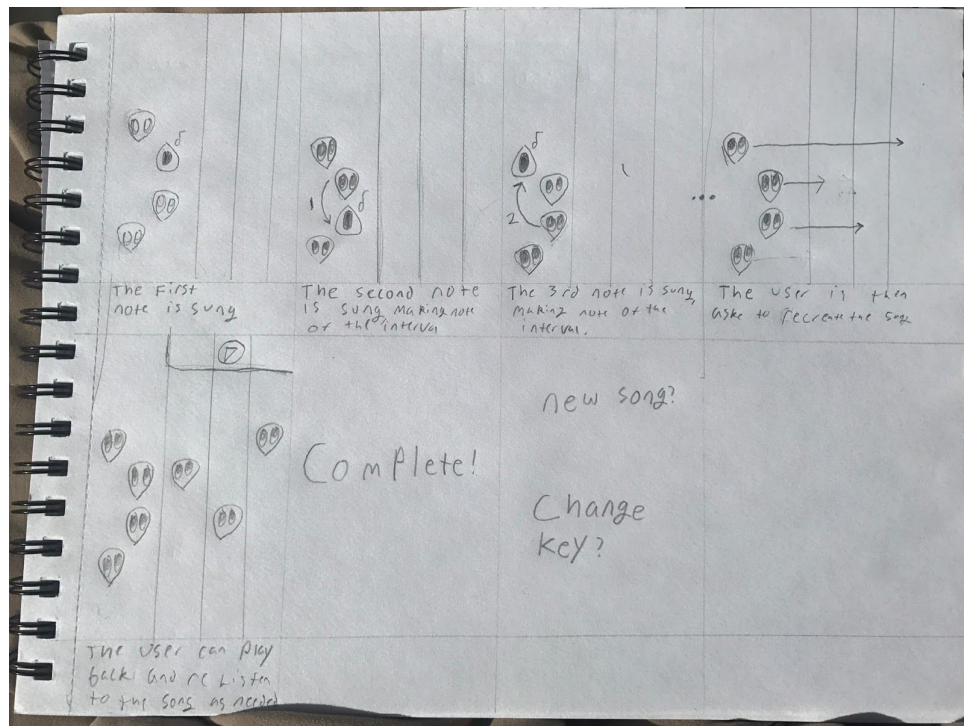


Fig 24: Initial Extended Melody Lesson

Appendix III

Additional Scenes And Voice Overs

4th

“In general, We call a group of beats a mesure. The most common measure is made up of 4 notes, which we call quarter notes. To tell where we are in the mesure, we count the notes. 1, 2, 3, 4.”



Fig 25: Quarter Note Scene

8th

“We can cut each of these notes in half to make 8th notes. The notes that are in the same place as the quarter notes are counted and these off notes are noted with an and.”



Fig 26: Eighth Note Scene

16th

“We can cut 8th notes in half again to make 16th notes The notes that are in the same place as the quarter notes and 8th notes are counted the same and these off notes are noted with an e and an a.”



Fig 27: Sixteenth Note Scene

Syncopation

“In general, syncopation happens when we accenting or emphasize the off beats in a song. For example, if we have a song with a pulse of 1 & 2 & 3 & 4 &, we can play on the 1 and the a to create a syncopated beat.

Press play again to listen to the syncopated beat, then, try moving the 2nd sugar puck around, and listen to how the beat changes. Can you hear the difference between the pulse 1 & 2 and 1 a 2?”

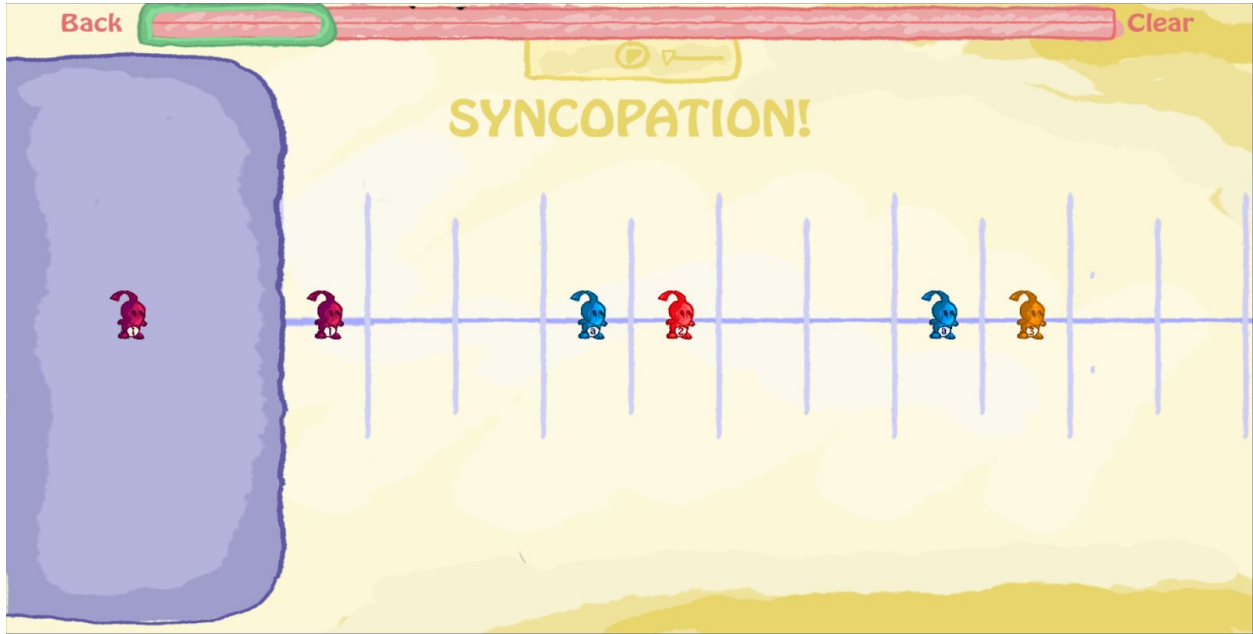


Fig 28: Syncopation Scene

Polyrhythms

“A polyrhythm is when two (or more) different rhythms are being played at once. Typically each voice is counting at the same tempo but to different numbers before repeating. To make this even more complex, the voices usually only speak out loud, or emphasize the first beat in the sequence.

A polyrhythm is set in the format of A:B where one voice counts to A before repeating and the other counts to B before repeating. This creates a mismatched effect.

Press play again to first hear each voice counting all of their numbers, then only speaking the first number of each sequence”

Back Clear

POLYRHYTHMS! 3:4

Back Clear

POLYRHYTHMS! 2:3



Fig 29: 2:3, 3:4, 4:5 Polyrhythms Scene

Key

“A key is a group of notes chosen around a central note. When you choose a key, you're asking for a set of properties that lets a song create a particular type of imagery and emotional reaction. For example Major keys tend to feel happy, while minor keys tend to feel sad.

Every key of the same type -all major keys, or all minor keys, and some more specialized keys- sound nearly identical when heard alone, as each note in the scale serves the same tonal quality. Because of this, a song can be "transposed" or moved to other keys, and it will still be recognizable.

To create a Major Key, you take the Tonic, or home note of the song, and you choose pucks in the following fashion: 2 pucks above that, 2 pucks above that, 1 puck above, 2 pucks above, 2 pucks above, 2 pucks above, and back to the original note. That's just what the Key button does.

Try this now. First, press the key button, next, click any sugar puck you want, and finally click the Twinkle button. Press play again and listen to the song. See if you

recognize it, then, click the key button again, choose another key, and click twinkle again.
See if you can hear the similarities between major keys”

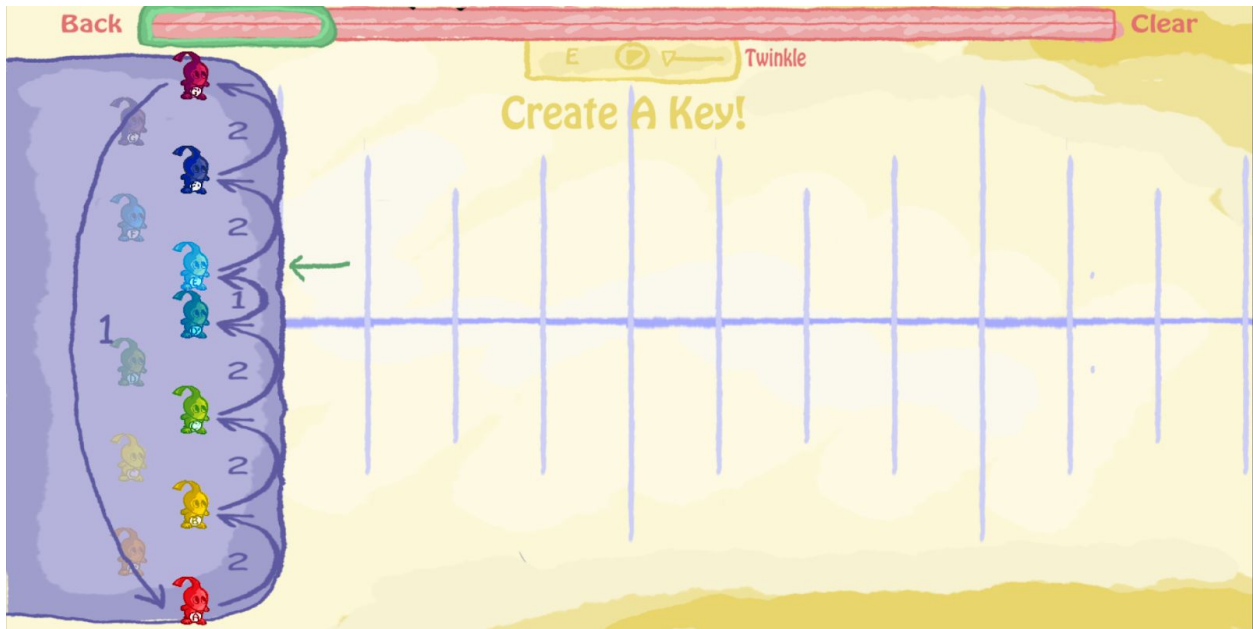


Fig 30: Key Selection Scene

Chord:

“First, choose a key.

To create a basic chord, or a group of notes played at the same time, choose a note in the key and drag it onto the grid. Look at the note the arrow is pointing to. Does it say the next note should be 4 pucks away? You're making a major chord.

Does it say the next note should be 3 pucks away? You're making a minor key.

Drag that puck overtop of the last one. Do you see the next note the arrow is pointed to?

For major and minor chords it will always be 7 pucks away from the original note.”

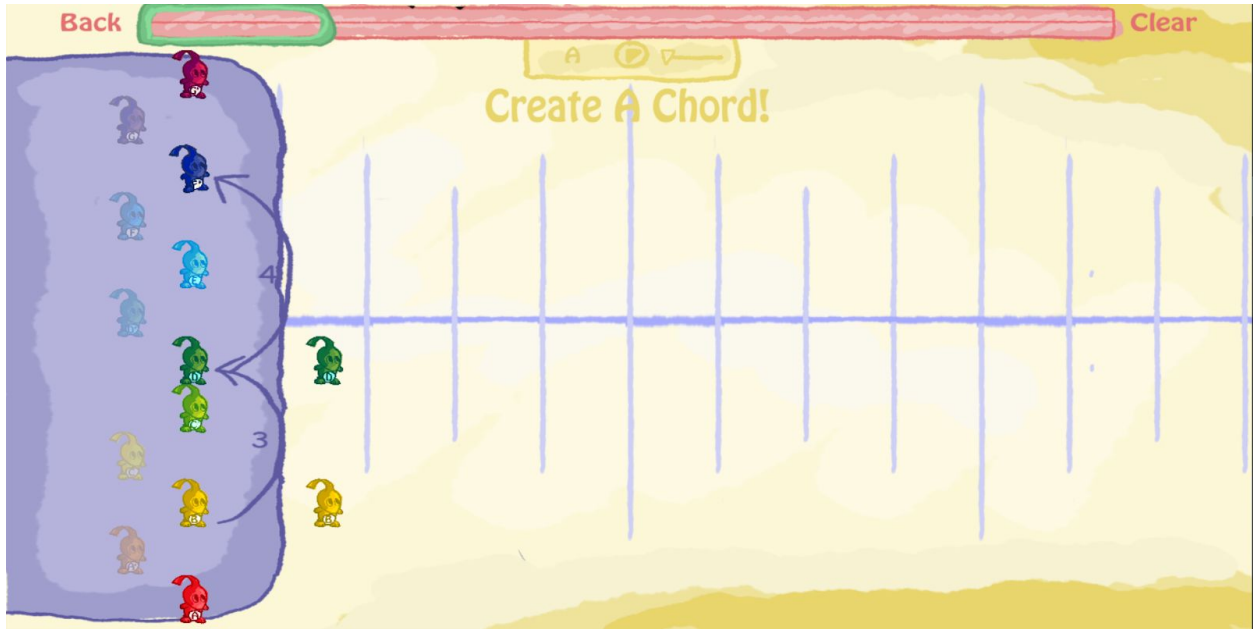


Fig 31: Chord Creation Scene

Appendix IV

Multiple Intelligences in Music

The natural intelligence includes the ability for a person to make distinctions between organisms and entities in the natural world. In a musical setting, this includes identifying differences and similarities between cultures through rhythms, melodies, and chord structures.

Musical intelligence is developed through musical training and education, allowing an individual to identify pitches, dynamics, tones, timbres, and other musical qualities.

Logical-mathematical intelligence allows a person to understand and work with numbers, as well as perform inductive and deductive reasoning. As previously mentioned, music plays a profound role in the development of mathematical and logical processing skills in young students.

Existential intelligence is the ability of a person to understand and contemplate the deep questions and issues of humanity and human existence. The arts frequently attempt to understand

human nature by posing and answering existential questions. Famously, Samuel Beckett's *Waiting for Godot* both presented and challenged such issues. Lawrence E. Harvey claimed "Chronometric time has been replaced by existential time...a central image is acted out by Pozzo, the image of the course of a day, figuring, as it so often has, the course of a man's life." in his article "Art and the Existential in en Attendant Godot." [49] Through music too, composers aim to understand the human condition not in French, but in melody.

Interpersonal intelligence connects one person to another through mutual understanding, verbal communication, and nonverbal communication. Explained above, performance in an ensemble setting engages this intelligence. The conductor uses verbal and visual cues in music, a performer may listen and read music for cues, and several types of nonverbal communication are present throughout performers.

Bodily-kinesthetic intelligence is a measure of motor skills. Through practice and training, musicians develop such skills to transform a written piece into live performance. Each stroke of a piano key, plucking of a string, or positioning of a trombone slide challenges and grows this form of intelligence.

Linguistic intelligence is used to explain emotions and abstract thought. This type of intelligence is especially present in the language of music. Stephen Klepner, a music professor at Castleton University explained that music "is a way for people to take abstract concepts in their head and create something that's in the real world with that. And that allows you to show emotion in a way that words can't." [Appendix I]

Intrapersonal intelligence allows a person to understand their own self. In the same manner as linguistic intelligence, music allows a person to express their own persona to other people. In the same interview with Stephen Klepner he states "if you can figure out how to get your feelings across in something, it can help people, especially in a time of stress." [Appendix I]

The final intelligence, spatial intelligence, allows a person to think in three dimensions. In the orchestra setting, the position of other instruments and sounds relative to themselves. Listening to other instruments at different positions allows a musician to interpolate music, rhythm, intonation, and other practices fundamental to the performance of music. On a more technical side, the space in which the music is performed can play a profound role in the

reception by an audience. For example, acoustical engineers design music halls to reflect sound in a particular manner. The positioning of marching members on a football field also influences the way sound interacts with the audience.