Using Interactive Media As An Educational Alternative To Traditional Music Instruction

by
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Abstract

Video games are more popular now than they have ever been, and the video game industry is on the verge of hitting its Golden Age (Diver, 2015). In 2015 alone, the video game industry is predicted to reach $91 billion in sales revenue (Nunnely, 2015). Video games have become a key element in today's youth culture (Seel, 2001; Aarsand, 2007; Gee, 2007). With such a successful and culturally relevant medium at their disposal, pedagogues can use this form of entertainment as a gateway medium for educational instruction. This paper describes the progressive integration of technology in music education as well as the implications of using a non-traditional method of educational instruction through a video game. Focusing specifically on the instruction of music theory, several methods of instruction are examined. Past studies using video games as a medium to convey instruction are further examined. The development of an educational music theory video game is explored along with several development tools in its design. A randomized controlled trial was conducted in an undergraduate classroom where participants completed a series of activities using either the music theory video game prototype or a simulated method book application. The data suggests a significant improvement in each skill topic when using the video game and compares similarly to the simulated method book application.

Acknowledgements

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I would like to thank my wonderful girlfriend Robin for putting up with my irrational tantrums and for encouraging me to keep moving forward. I would not have done this without you and Zoey.

Introduction

Since the 1980s, technology has played a significant role in music education with the addition of computers, instructional software, and various digital technologies in the classroom. Where recordings and traditional instruments were once the only tools available to a music instructor, advancements in technology have begun to enhance traditional instructional methods and help blaze new pedagogical frontiers. Music notation software and virtual orchestras, for example, have allowed students to experiment with concepts such as modality, tempo changes, new instruments, and transposition with greater ease than traditional staff paper composition (Webster, 2002). The implementation of MIDI (Musical Instrument Digital Interface), a computer protocol for representing musical elements like pitch with numbers, and "loop-based" composition software have allowed students to easily create and manipulate music without a vast degree of formal training (Rudolph, 1997). Among the emerging technology-based tools that have influenced music education are immersive and interactive virtual environments, as evidenced in some video games like *Guitar Hero*® and *Rock Band*®, which blend real-life music making experiences with elements of virtual reality to create unique musical expressions in which performance is accessible for non-musicians.

Literature Review

Video Games in Education

"Stealth learning" is a teaching technique that educates a student while hiding behind a fun and entertaining game without any overt instruction. As video games have become a common part of

young culture and are so quickly to be engaged by young students, it can be used as the "sugar pill of learning" (Falstein, 2005; Warren 2009). While there have been many educational video games that have failed to be discreet with their instructions, there is still a strong history of educational video games that have succeeded in stealth education.

Educational video games have been noticed for their ability to engage and immerse students where a traditional classroom fails. In past studies, using video games as a means of education has not only been found to be a more preferred method of instruction among students, but it was found to show a significant increase on the post-test in the area of instruction. It was also shown that more children paid attention in class while using a video game tool than while not using it (Rosas et al., 2003). Similar studies have also found that video games can be used in a formal learning environment to learn about non-mathematical subjects such as geography. These studies showed statistically significant learning gains in students when learning about world continents and countries through a video game (Hakan et al., 2009).

The Federation of American Scientists has shown increasing support for educational video games. Because video games help players acquire sets of new knowledge and complex skills through gameplay, the FAS believe that video games can help strengthen the education system and better prepare our future workforce (FAS, 2006). With our current generation growing up in the age of video games and digital technology, education has a clear chance at making educational video games a working standard of instruction.

Educational Characteristics of Video Games

Overview

Using a video game for instruction has several factors that can allow students to feel more immersed in their environment. These factors include literary background, role-playing characters, visual and audible aids, and a relaxed, relevant medium (Foreman, 2004). Additionally, immediate feedback is a significant asset that can be utilized through such a method.

Presence

Presence is said to be a meditative state when playing a video game in which players have a sense of being in the virtual world and unable to discern between that and reality (Madigan, 2006). From compelling storyline to rich graphics, video games can provide a plethora of stimulation to your mind and senses. While a convincing and repeatable training atmosphere can be taken advantage of by the education system, these types of realistic simulations are used often in the military for training purposes. In these situations, users are equipped with head-mounted displays, wireless controls, and are often walking on an omnidirectional treadmill to ensure that players are having a more realistic experience. While this type of setup is not necessarily plausible for a classroom setting, the idea of immersing a student into a virtual world is a great concept for an educational environment.

Benefits

Research suggests that video games can motivate and interest learners (Dempsey et al., 1994; Jacobs & Dempsey, 1993; Lepper & Malone, 1987; Malone, 1980, 1983; Malone & Lepper, 1987; Malouf, 1988), increase retention rates (Dempsey et al., 1994; Jacobs & Dempsey, 1993;

Pierfy, 1977), and improve reasoning skills and higher order thinking (Mayland, 1990; Rieber, in press; Wood & Stewart, 1987; Hogle, 1996).

Educational games can be designed to have players master a certain skillset during gameplay. The FAS found that certain skills such as thinking, planning, learning, and technical skills that are needed for a strong workforce can be implemented in educational video games in such a way that mastery of the skills would be attained upon completing a video game (FAS, 2006). While these particular benefits come through stealth learning, there are other beneficial factors that occur with educational video games.

Immediate feedback is an important and easily overlooked aspect of gaming that has been shown to aid in learning. In a study at Rider University, researchers found that an immediate feedback system that allowed students to attempt a problem until it was correct promoted acquisition and the retention of test materials (Epstein et al., 2002). Another study found that, when compared to delayed feedback and no feedback, students in the immediate feedback group indicated superiority over both of the other two groups (Reddy, 1969). Using immediate feedback paired with a positive and encouraging environment, video games could provide an academic setting that students would receive positively.

Examples of Educational Video Games

The concept of having a bridge between video games and education has been around since the 1970s. Even early games such as *Lemonade Stand*® in 1979 taught real-world skills and lessons

about business and economics. While the game itself seems to have a trivial appearance, the critical thinking that goes into decision making and planning is all but trivial.

One of the most well known video games of all time is *Tetris*®. Developed in 1984, the goal of the game is to arrange the falling geometric block patterns in complete rows to gain a high score. The patterns of the geometric shapes are randomly picked and often need to be rotated properly to complete a row. While *Tetris*® has been named the second greatest game of all time (IGN, 2007), *Tetris*® has also been found to have some real-world benefits. Studies show that students who played *Tetris*® improved performance on tasks associated with spatial visualization and two-dimensional mental rotation (Okagaki and Frensch, 1994; De Lisi and Wolford, 2002).

In the early 2000's, researchers began designing more robust educational video games that would apply direct research and engage students in real-world studies in unique ways. *Immune Attack*, for example, is a first-person serious game that teaches complex biology and immunology to students through a video game. It is funded by the National Science Foundation and jointly developed by the FAS, the University of Southern California, Brown University, and Escape Hatch Entertainment. In *Immune Attack*, players interact with objects to train the body's immune system how to function properly to prevent it from dying. As the game progresses, more biological threats and pathogens attack the body and the player must identify the threat and teach the body to handle it accordingly (FAS, n.d.). While players use strategies and critical thinking that is present in other video games, they are learning more about biology and putting their theories into practice in a relevant and fun way.

Traditional Music Instruction

In traditional music education, pedagogues will use textbook approaches to teach common concepts of music such as intervals, scales, and arpeggios. Students will often be taught how to formally sight-read sheet music, learn to play an instrument using proper physical form, and understand other key concepts that will have direct transference into music performance and appreciation. While some of these concepts are covered in more non-traditional approaches such as the Suzuki method, a more traditional method of music education will better prepare a student who is planning to pursue music theory professionally. However, non-traditional methods of music instruction tend to pique students' interests and actively engage them more than traditional approaches (Beatty, 1989). Therefore, a non-traditional method could be more advantageous for students not pursuing a career in music.

Non-Traditional Methods of Music Instruction

The Suzuki Method

Using non-traditional instructional methods, such as through video games, is certainly not a new idea. Over 50 years ago, Shinichi Suzuki developed his ideas and philosophy of teaching into an instructional method for teaching classical violin. Rather than focus on traditional instruction methods of sheet music and theory to develop technically proficient performers, Suzuki wanted to nurture his students and help further their educational experience and knowledge of music. Suzuki believed that all students possess the ability to become excellent performers when given a nurturing and positive learning environment. The method of instruction involves intense repetition to develop a natural connection to what is being administered. He compared this method to how a child can naturally learn a parent's native language with ease and often referred to his method as a "Mother Tongue" method of pedagogy.

The results of the Suzuki method are highly praised, yet often criticized for a variety of reasons. While students are able to perform very complex works with excellence, their knowledge of music theory is limited. They are able to obtain excellence through repetition and familiarity of the same works repeated often until mastery is attained. While this is an excellent method of improving performance skills, it becomes very difficult for a Suzuki student to perform works that were not rehearsed while a more traditionally instructed student would be able to perform an unfamiliar work easier due to a stronger understanding of theoretical concepts of performance that are absent in the Suzuki method. This often poses more of a philosophical question of what skills comprise a trained musician. However, the main philosophy of the Suzuki method is not to transform students into professional musicians, but rather allow any student the ability to perform music and increase their enjoyment and appreciation of music (Barber, 2001).

Kodály method

Zoltán Kodály introduced a new approach to music instruction in 1925 in an attempt to improve the music education system in Hungary. While he did not develop the method as it is known today, his early approaches to music instruction formed the basis that his apprentices developed further into the Kodály method. Kodály believed that children should be taught materials that expanded on their inherent abilities and incorporated traditional folk songs into his lessons to provide a sense of familiarity in the materials.

The Kodály method teaches rhythmic patterns orally where the teacher will sing a rhythmic pattern and the student will be asked to repeat the given pattern. Students are introduced to music

concepts through listening, singing, and moving while also creating a fun and positive environment. Kodály also emphasized the use of clapping when teaching using rhythmic syllables. When teaching such concepts as quarter notes, a Kodály teacher will clap on the downbeats and say words to help clearly count each beat. For example, when working with quarter notes, one would clap on each downbeat and say the word "Ta" with each clap. Non-metric note counting is also sometimes included in the Kodály method. With non-metric counting, students would count upward for every note not played. For example, a whole note would have the student count "1" and clap on the first beat and then count "…2, 3, 4" before repeating the process. Half notes would be counted as "1" while clapping on the first beat and counting "2" during the rest then "1" while clapping on the third beat and counting "2" again for the remaining rest.

Solfege is strongly integrated in the Kodály method while singing. Adopting the ideas of John Curwen, Kodály added solfege hand signals into his approach. These hand signals represent the common syllables of solfege "do", "re", "mi", "fa", "sol", "la", and "ti". The hand signals include upward and downward movements to help enable students to see height and depth of pitch.

The results associated with classes that use the Kodály method often find that students' singing improves each week, especially in pitch. Other skills such as rhythmic patterns, music literacy, and performance are said to improve significantly from year to year. Other studies have shown that not only does the Kodály method improve excellence in music theory, but also improves perceptual functioning, promotes intellectual development, positively affects concept formation and motor skills, and improves other curricular skills such as reading (Devries, 2001).

Video Games in Music Instruction

With the exception of games like *Guitar Hero*® and *Rock Band*®, sound interaction is usually absent from commercial video games. However, rhythmic video games such as *Samba de Amigo* where players must reproduce a given sequence in sync with a soundtrack are quite successful in other countries. *Rhythm Breaker*, also part of the Jam-o-drum project, offers what amounts to a competitive multi-player *Tetris*® styled syncopation game in which players have to follow imposed temporal patterns (Denis and Jouvelot, 2004).

Duration, pitch, tone color, dynamics and structure were the five elements of music identified as essential for musical development (Russell-Bowie, 2009). In theory, a similar video game method that focused more on these elements of music theory should also help develop distinct and transferable music skills. Ranging from early instruction of notes, intervals, and scales, players could receive Suzuki-styled instruction involving repetition, familiarity, and positive encouragement. As skill progresses, more advanced topics can be adaptively introduced such as progressions and collaborative performance. While there is still some trial and error that will inevitably occur as to what methods of teaching are received better, the concept of surrounding a student in a positive and encouraging environment seems to prevail. If video game development can close the gap between entertainment and music education, there are certainly a number of factors that will appeal to a young student audience and promote a positive learning environment. Green (2006) suggests that, in order for students to develop the ability to critically respond to music, they must be intimately familiar with the style of music first. She also found that using informal music learning in the music curriculum was extremely engaging and

beneficial for the students involved. Therefore, the potential of interactive music video games as informal tools for music education should be considered.

Methodology

The intention of the thesis is to research the underlying question of how an interactive game that provides instruction on music theory and musical concepts will perform in comparison to a more traditional method of music instruction such as a music method book. The goal of the thesis is to design an interactive educational quest-based game that will introduce rudimentary musical concepts and music theory principles in an interactive environment. The intention of this educational tool is to administer music instruction through a more relevant medium that will allow untrained students to understand, perform, and compose music. In order to compare the effectiveness of this tool, a study was conducted comparing the interactive video game to another application that simulates a method book.

Before Heaven

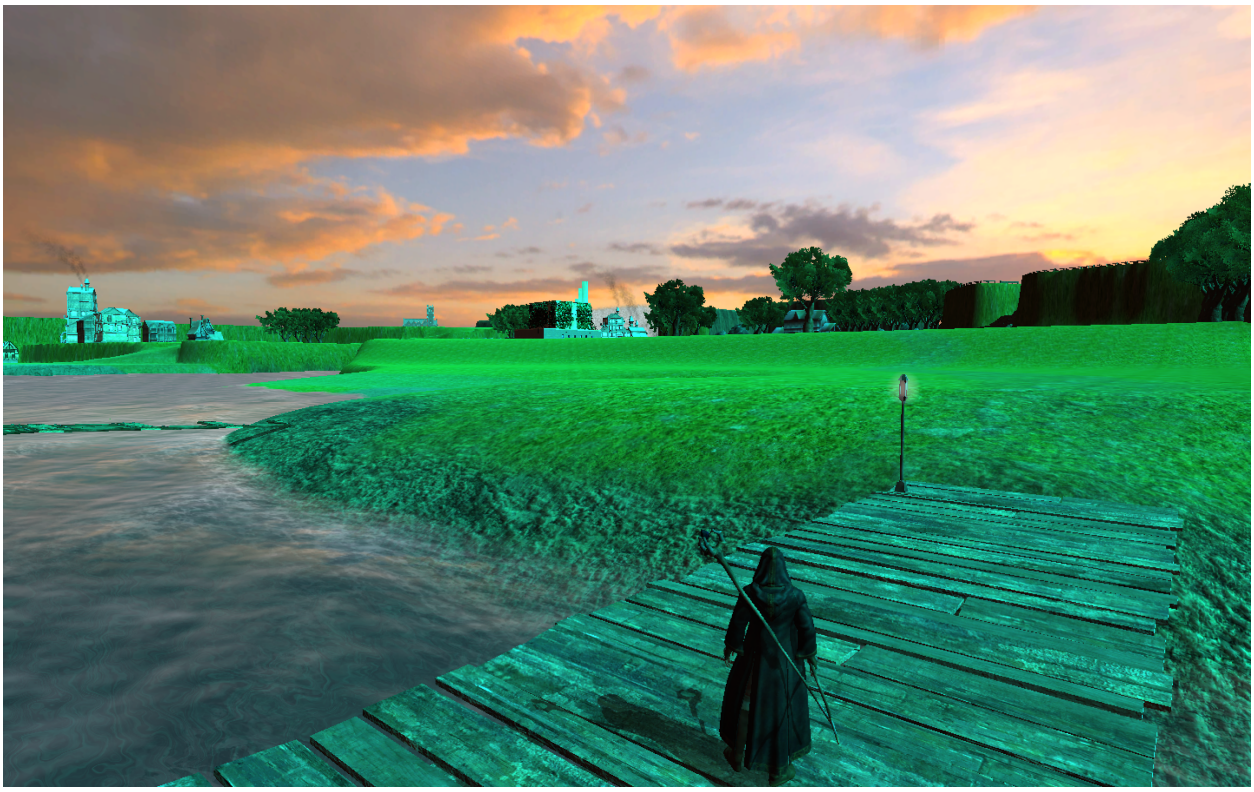

Figure 1. A screenshot of Before Heaven level, Ionia.

Overview

Before Heaven is an interactive role-playing video game that teaches the concepts of music theory. *Before Heaven* was developed to be an independent video game project that could effectively teach music theory through a relevant, enjoyable method as both a standalone game and as a teaching aid. In *Before Heaven*, the player travels across several provinces to compete in musical tournaments where the winning group of musicians acquires political power. As the game progresses, the player can obtain new instruments, compose their own music, and learn concepts of music theory.

Development

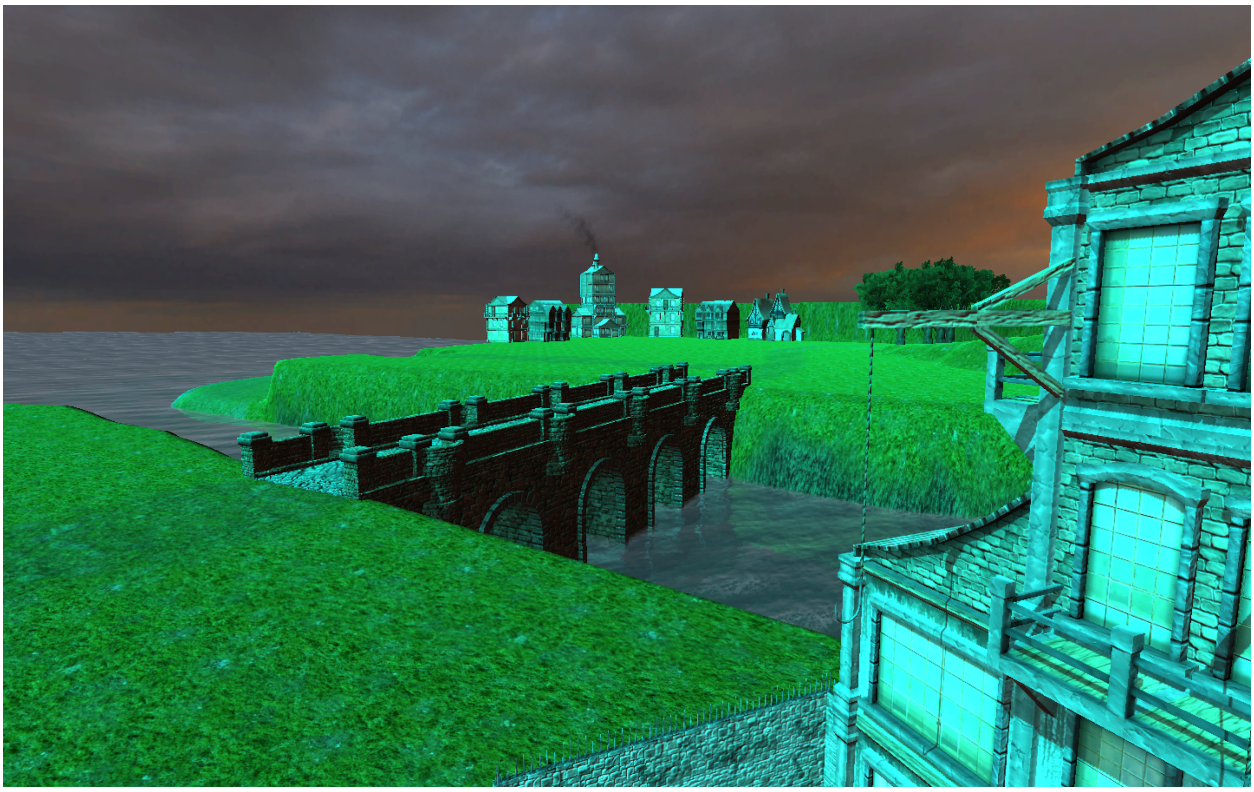

Figure 2. Cutscene of Ionia when first landing ashore

Before Heaven was built using the Unity3D engine and was written almost entirely using the C# programming language. In addition to the creation tools found in Unity, several custom toolkits and classes were also developed to improve with various aspects of development such as production flow and audio performance. These toolkits were designed for the specific needs of *Before Heaven* that would not typically be implemented using traditional development techniques. While most of the assets were designed by the Unity Asset Store community, the aesthetics and scenery design of each province follows its own specific theme according to the genre or musical style of that province. Additionally, the characters and props are styled in a combination of steampunk and cyberpunk.

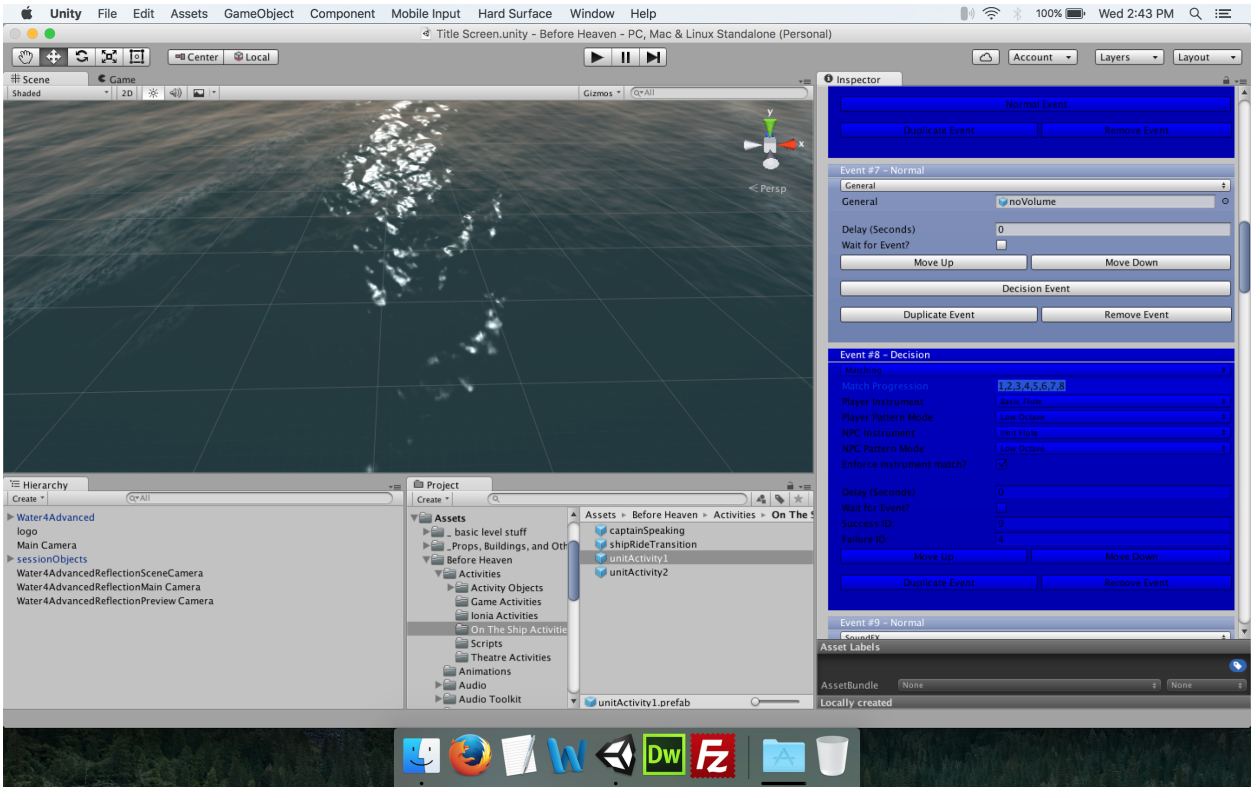

Figure 3. Activity manager designing a matching game activity in the inspector window

The technical features of *Before Heaven* were specifically designed for the game and allow a modular approach in development. The interactivity controller and activity manager were created as a development tool to not only speed up the production process, but also to allow non-programmers and educators to create their own activities in *Before Heaven* without having to write any code themselves. By dropping the activity manager script on an object, a menu appears that allows users to create "Event Blocks" that will execute in numerical order according to their event identification number. In addition to simple execution, these event blocks can have special attributes such as delay, where the event block will be delayed by a specific number of seconds; wait for previous, where the event block will wait for the previous event block to finish before it executes; and decision blocks, where the event will continue to run until it receives a success or failure message from the event object itself. The types of event blocks available for the user

include:

- Dialog Object - allows users to drag in premade dialog objects that will launch when executed. These objects can be used as both a standard event block and a decision block.
- Animation Object - triggers an animation sequence or cutscene. These objects can be used as both a standard event block and a decision block.
- Focus Camera - accepts a game object as a parameter and will transition the camera to the three-dimensional coordinates of the provided object.
- Money Object - allows users to award money to the player.
- Sound FX Object - allows a dropdown menu of available sound effects to play on execution.
- Matching Game - allows the user to utilize the matching activity found in the game by specifying the desired notes to be played and the instruments that the NPC and player will use as well as the note performance mode. These objects can only be used as a decision block.
- Item Object - displays and rotates an object in front of the user as well as adds it to their inventory
- Sight-reader - allows the user to utilize the sight-reading activity found in the game by specifying the desired composition and accompaniment track to be played as well as the score ranges that determine a success or failure. These objects can only be used as a decision block.
- Composition - deploys the composition editor activity found in the game. These objects can only be used as a standard event block.

- General - these blocks allow users to drag and drop their own game objects into the activity manager for execution. These event blocks are instantiated and parented under the activity manager and can be used as standard event blocks and decision blocks. When used as a decision block, the activity manager can accept several commands to navigate through the activity manager such as “success”, “failure”, or “go to event ID”.
- Exit - these events exit the activity manager prematurely instead of when the activity manager reaches the last activity

Figure 4. The chord progression assistant activity in the theatre

The interactivity controller is a script that is assigned to the player that will interact with NPCs when the player enters a collision trigger. These collision triggers vary in shape, size, and number depending on the NPC and can be created using Unity 3D’s standard editor. Each NPC is given an interaction script that can be loaded with the activity managers for that particular

character in the order that they are to be launched. The interactivity controller is designed for two types of interactions: NPCs and AutoNPCs. When a player walks into the collision area of a character with the tag NPC, the activity manager does not launch until the player presses the action button. When a player walks into the collision area of a character with the tag AutoNPC, the activity manager launches automatically. NPCs are used more often and are used when the player interacts with other characters around the village who may have quests or trades for the player. AutoNPCs are most often used to trigger cutscenes or activities that are needed to be executed at a specific moment in the level. The interactivity controller also handles the rules of interaction such as prohibiting interaction while performing or while interacting with another character.

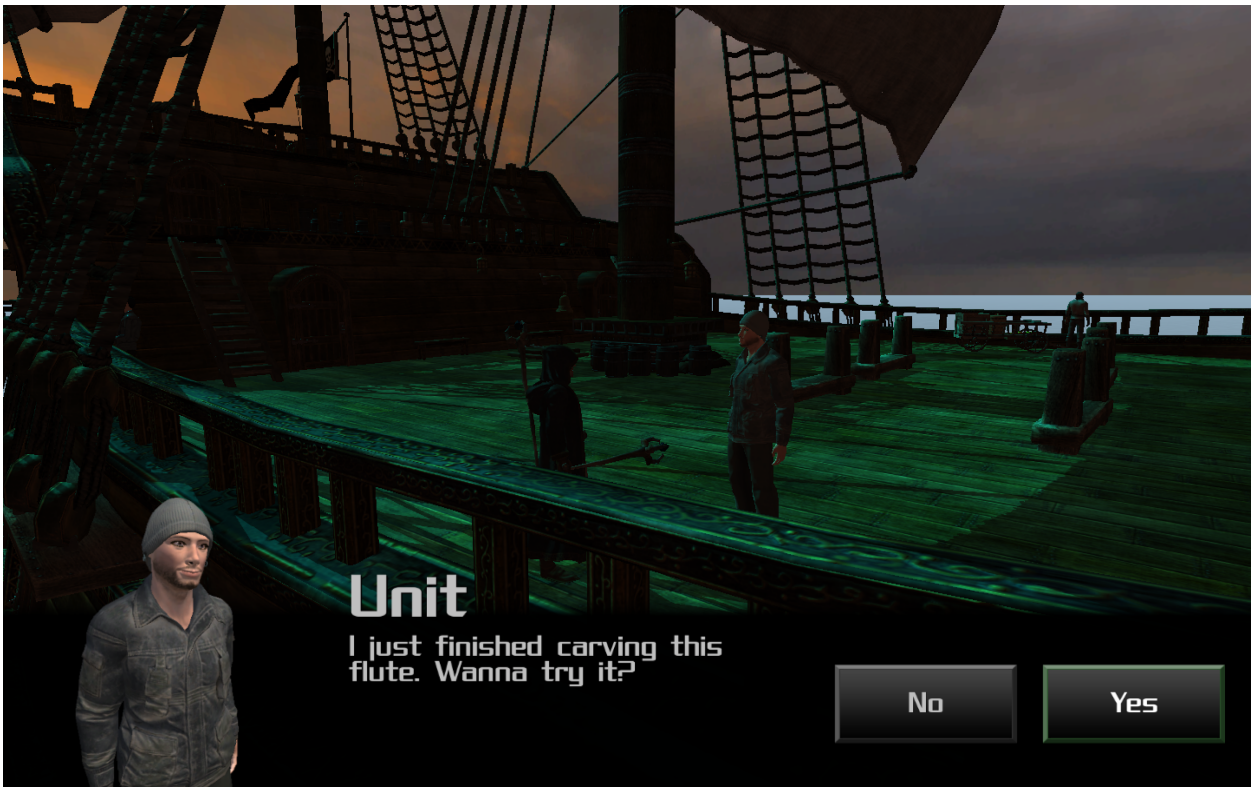

Figure 5. Conversation between the main character and Unit in the first activity

It was important that the audio system of *Before Heaven* was designed to be completely modular, reliable, and precise due to the extreme precision that is involved in music. Timing needed to be sample-accurate and consistent regardless of the user's computer hardware. This was particularly true when performing rhythmic patterns or when syncing with an interactive activity such as the sight-reading activity. Additionally, it was essential that the audio system could both perform each note in its entirety without being terminated until it is completely faded and be triggered as an individual note from a specific instrument at any given moment. The strategy involved in developing this system was to have sets of notes for a low octave, high octave, pattern mode, and chord mode for each instrument that contained an audio clip for each note. There are 8 note buttons and 4 mode selectors that can be mapped to any input device and are used to perform the currently selected instrument. When a user presses a note button, the desired note of the selected instrument and mode will sound. If the user holds down a note button, the note will sustain for an extended period of time or until it is released. Many instruments contain alternate sets of each note to further enhance the performance and to prevent monotony when performing the same note numerous times. Currently, the user only has the ability to perform in the C major scale.

Figure 6. A note matching activity aboard the ship

With the exception of the background music, most of the audio in *Before Heaven* is generated from a series of values triggering individual audio files as opposed to being recorded as a single audio file. When the game performs a composition, for example, it is not playing back one file of the entire composition, but rather is playing back many audio files of single notes in sequence according to the data that it is given. There are a number of methods written that will parse through a line of data and perform the correct sound. For example, if the developer wanted to perform the scale, but sustain note 6 until the end, they would send the function a message such as:

Index, Note Number, Start Time, End Time, Instrument, Pattern Mode, Key

0, 1, 0, 1000, flute, 0, C;

1, 2, 1000, 2000, flute, 0, C;

2, 3, 2000, 3000, flute, 0, C;

3, 4, 3000, 4000, flute, 0, C;

4, 5, 4000, 5000, flute, 0, C;

5, 6, 5000, 8000, flute, 0, C;

6, 7, 6000, 7000, flute, 0, C;

7, 8, 7000, 8000, flute, 0, C;

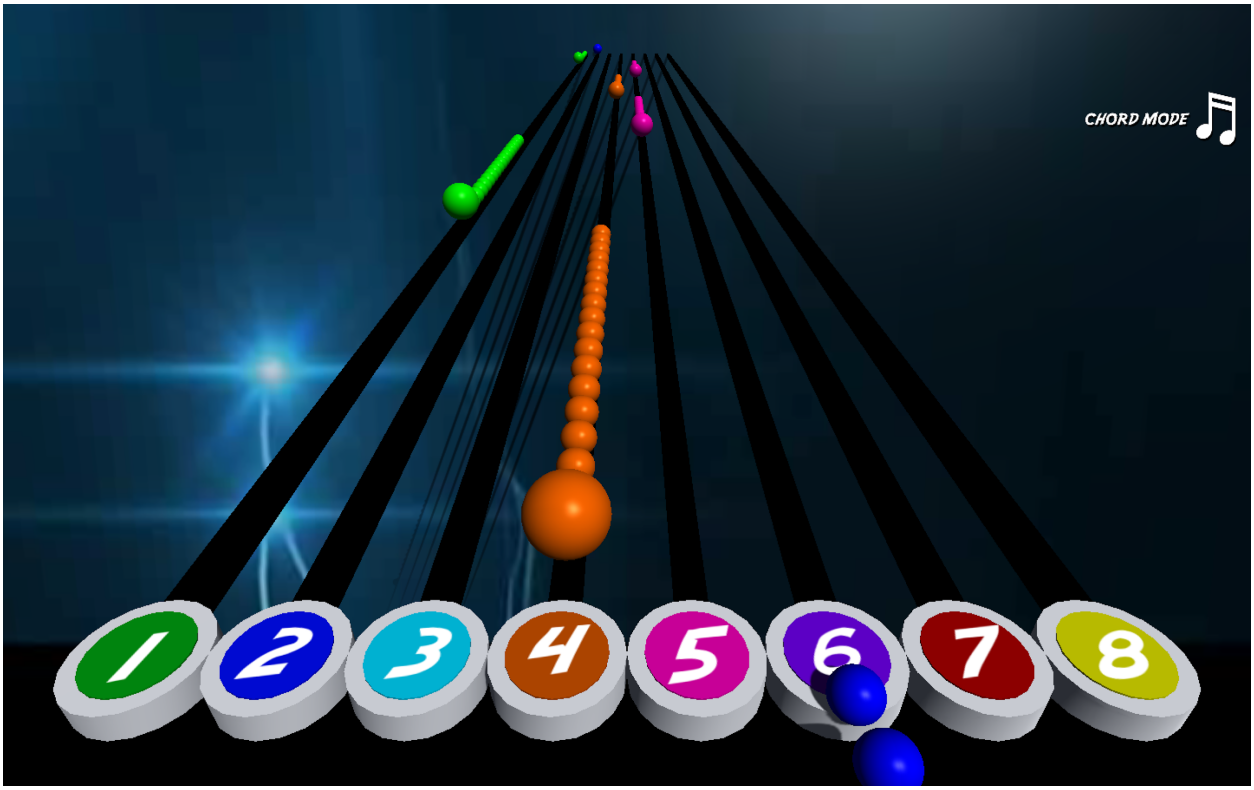

Figure 7. The chord progression sight-reading activity in the theatre

When parsing, the function would cycle through the lines in order according to the first element. It would then send a message to a function requesting to switch the current instrument to the flute object using the low octave in the key of C. Lastly, it would delay the performance of the note until the master clock had reached the appropriate time in milliseconds and then perform

each note for the difference in milliseconds between the start time and end time. Additionally, the same function can be called with fewer parameters in the event that one wants to perform a particular sound without specifying a change in instruments or a note duration. With this audio system, it is also possible to group instruments and patterns together and perform them at the same time. For example, if one wanted to perform with a harpsichord in chord mode and synthesizer strings playing in pattern mode at the same time, the system can be configured to trigger those notes simultaneously using instrument groups.

Figure 8. The login/title screen of Before Heaven

The last major custom component of *Before Heaven* is the object synchronization system. This system connects to a MySQL database through PHP and frequently sends and retrieves data to and from the game in real-time. During the study, participants entered a participant code that

covertly generated a user account and logged them into the server automatically in order to track their progress during the study. However, when a user opens the standard version of the *Before Heaven* application, they are prompted for a username and password. This information is encrypted using MD5 encryption and sent along with a security key through POST to a PHP file on a central server. The PHP file receives the information and compares the MD5 hash to the server's security hash to verify its authenticity. If the information is incorrect or the hash is not verified, the user is presented with an incorrect credentials error. Once successfully authenticated, a progress bar appears and the game simultaneously retrieves the player's saved progress information and loads the level from where the player left off.

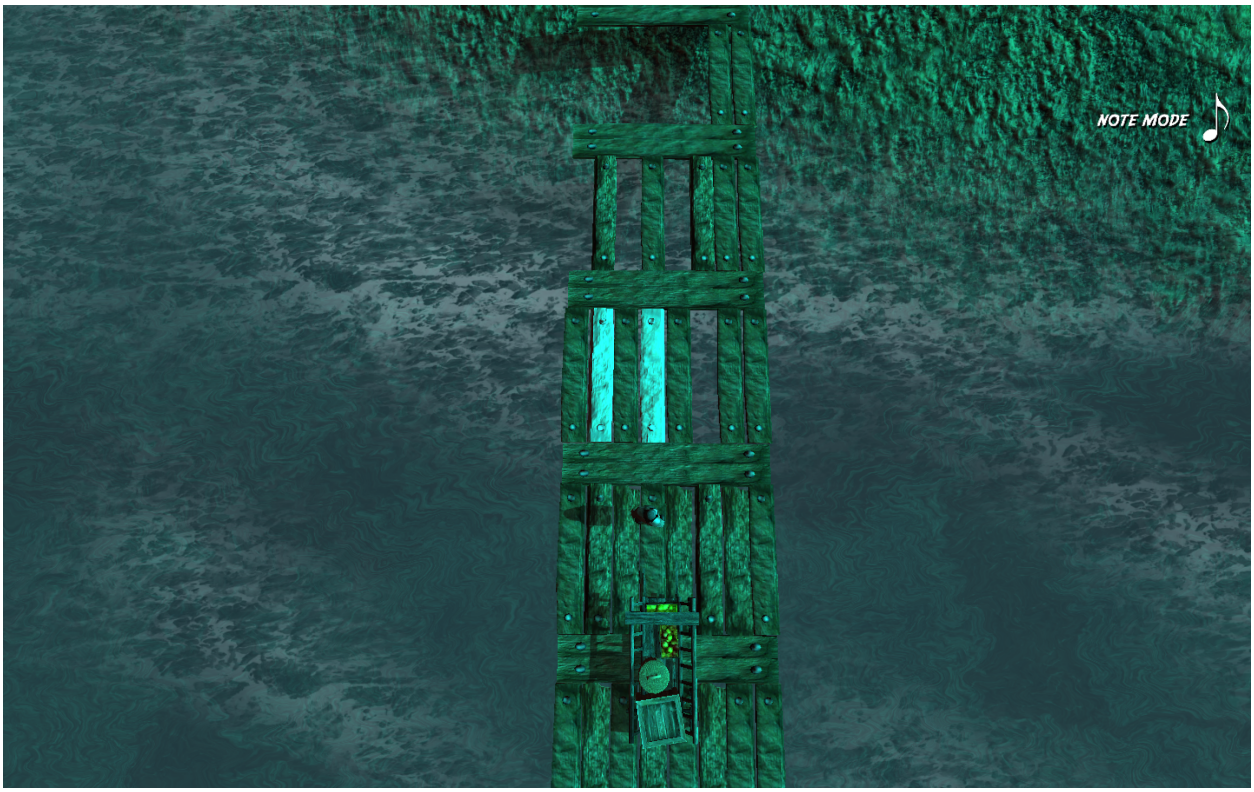

Figure 9. Player performing the missing notes of the chord to fill in the planks in the second activity

The method of synchronization works by storing data for every object that can interact with the player or change during gameplay. The server stores three values per object for every user: object ID, scene ID, and progress state. The object ID is the unique identification number of that object in that particular scene. The scene ID is the unique identification number of the scene that the object is found in. Multiple objects can have the same object ID, if they are in different scenes, and multiple objects can have the same scene ID, if they have different object IDs. The progress state value indicates to the code of that object what state the object should be in. Each synchronized object has a script attached to it that will instruct the object to transform into the correct state when the progress state is changed. If a saved progress record does not exist in the server for a particular player, the default progress state is 0. For example, the broken dock that gets repaired in the study has a progress state of 0, but once the player repairs the dock, the activity manager has a progress state event to change the value to 1. Should the player revisit that level or restart the application, the dock will remain repaired because it will load the progress state as 1 after it retrieves the server information. This method is particularly useful when a player may be using different computers or cannot save to a specific computer such as in a computer lab. This is also useful when a developer is using the activity manager to design assignments for a class and would like to check on the progress of each student.

Experimental Study

On September 23, 2015, and November 18, 2015, two undergraduate music classes from Worcester Polytechnic Institute were asked to participate in a randomized controlled trial to test the effectiveness of technology in music education. Between the two sessions, a total of 44

students were split into two even groups of 22 based on the number of their computer workstation. Each student was given a participant identification number that was derived from a combination of their workstation number and the day of the month that they were born. For example, if you were at the computer workstation #14 and were born on June 4, 1993, your identification number would be 14-04. Participants with computer workstations numbered 1-13 were assigned as Group A and participants with computer workstations numbered 14-25 were assigned as Group B. Computer workstations #11 and #9 were not functioning properly and were not used. Participants in Group A would receive an application that imitated the style of instruction found in a music method book and were asked to follow the instructions and complete all of the activities. Participants in Group B would receive a demo of *Before Heaven*, an interactive music theory video game, and were asked to complete the first few activities.

Each of the students from both groups were given a folder on their desktop that contained a set of instructions, a link to the pretest, an application, and a link to the posttest, numbered from 1-4 respectively. I read the following instructions aloud to the class:

> Welcome! You are invited to take part in this study to research the effectiveness of technology in music instruction. Results will be used to compare one method of instruction against another. This study will take approximately 20 minutes and requires no prior knowledge or skill in music theory. Participation is completely optional and you may stop at any time, if you become uncomfortable with continuing in the study. We do not ask, publish, or store any personal information from you and all results are kept confidential. These instructions can also be found in your group folder.
>
> The survey will ask for a participation code, this is your computer number and your day of birth. If I was born on the 4th of December and sitting at computer 25, my participation code would be 25-04.

You may now put on your headphones and locate the folder for your group and complete the tasks in order starting with "1. Instructions". Please do not forget to take the post-test after you are finished with the activities.

(See Appendix A)

Pretest

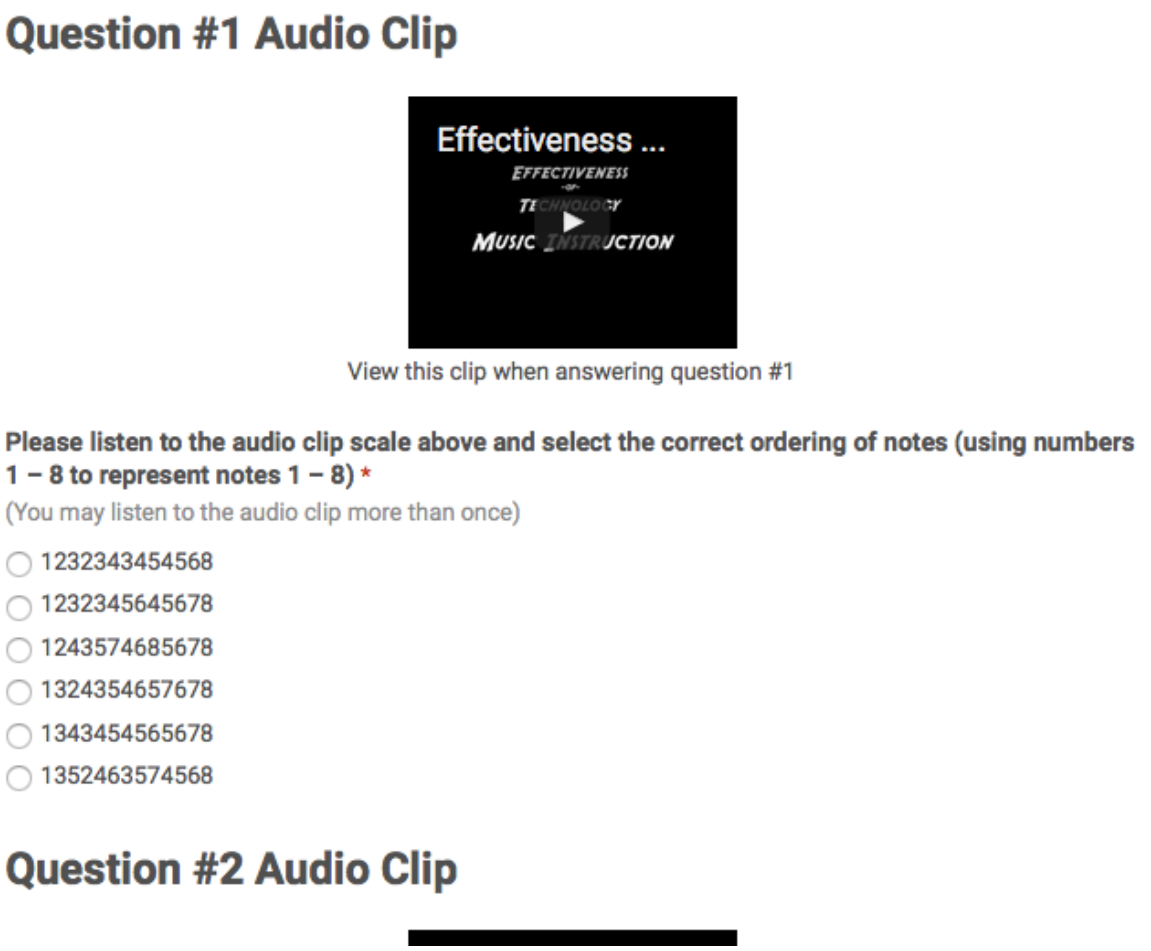

Figure 10. A screenshot of the Google form Pretest

Both groups of students were given the same pretest that assessed their prior knowledge of music as well as skills such as chord and progression identification. The posttest consisted of the same questions as the pretest and included three self-assessment questions regarding how well they

thought their skills have improved and how likely they were to use the instruction application outside of the classroom. There were two qualifying questions on the pretest that were not included in the posttest that were there to ensure that the prior skill balance of the groups was even:

1) Are you proficient in performing on one or more instruments that you have played for more than 3 years?
2) Are you proficient in fundamental music theory skills including melodic dictation, oral chord recognition, and simple harmonic analysis?

While both groups of participants were given the same pretest and posttest, the instructions and application were different. The instructions contained an overview of basic controls pertaining to the application of their group. For full pretest and questions, see Appendix F.

- **Group A Instructions**
  Follow the instructions on each screen carefully and when you are finished with a section, click the Next arrow to continue. The program will notify you when you have completed all activities.

  To begin, examine the keys labeled 1-8 on the graphic keyboard and find the corresponding keys on the MIDI keyboard connected to your computer.

  Controls
  Use the MIDI Keyboard to play notes and chords

  Game Objectives
  Follow the instructions on the screen carefully

(See Appendix B)

- **Group B Instructions**
  When successfully opened, you will see an ocean scene with the words “Before Heaven” on the screen. Please complete all three activities. The controls and objectives are listed below. The game will tell you when you have completed all activities.

  Controls

Movement/Walking: Arrow keys
Action Button/Talk to People: D key
Play notes/chords: 1-8 number keys
Use chord mode: 9
Use note mode: 0

Game Objectives
Activity #1: Talk to Unit and complete activity #1 (the ship will start moving shortly afterward)
--land in Ionia--
Activity #2: Walk onto shore and complete activity #2
Activity #3: Walk into movie theatre, talk to Cicero, and complete activity #3

(See Appendix C)

Intervention

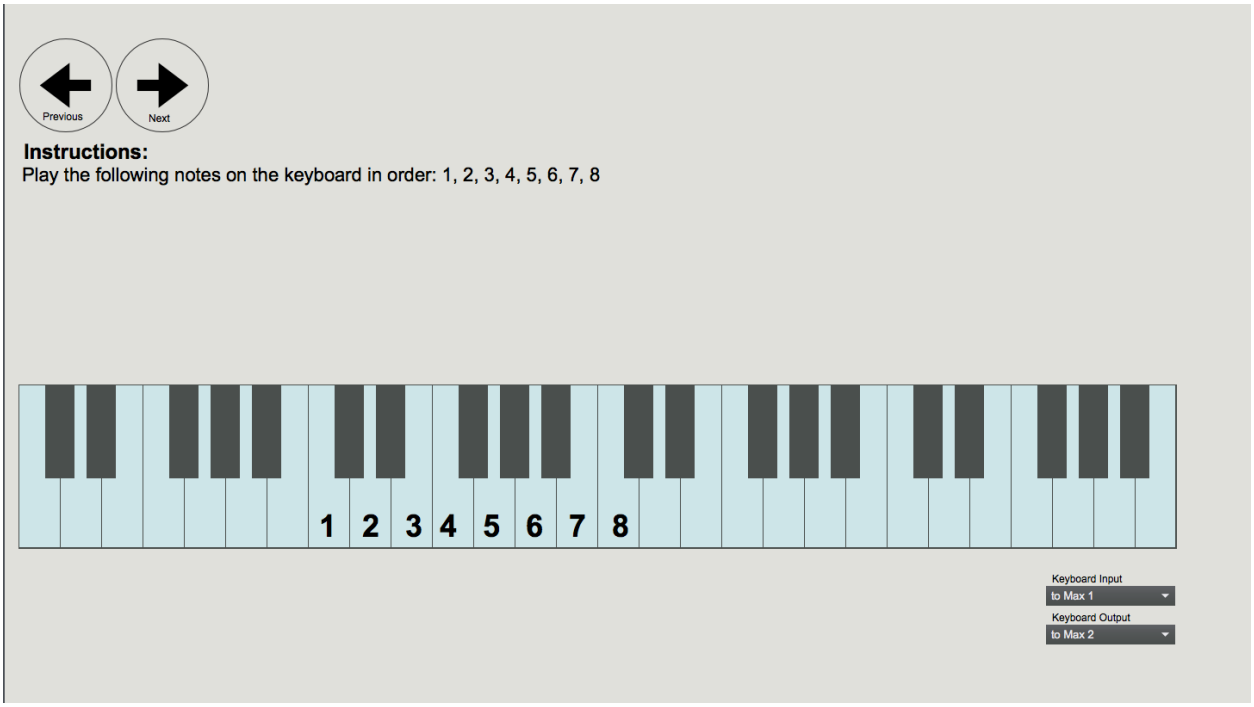

Figure 11. A screenshot of Group A's application

Group A's application was developed using Cycling 74's Max/MSP and displays 25 individual sets of instruction. The participant has a visual display of a keyboard representing the MIDI keyboard that is in front of them with the notes of the scale numbered from 1-8. When a note is

played on the MIDI keyboard, the key on the Max/MSP patch changes color. The user goes through each activity as they would using a standard method book. While the activities of the Max/MSP application assign the same musical activities as the *Before Heaven* game, there are features that are not present in Group A's application such as immediate feedback for incorrect answers or a playback of the notes that are to be performed.

Group A's activities are intended to simulate a self-directed study similar to a musical method book. The activities found in Group A's application are mostly sequences of notes or chords that the participant must perform. For example, the first activity is shown in Figure 11. Like a method book, there is no method implemented to determine whether or not the user performed it correctly, how many tries the user attempted, or whether or not they even performed it at all. For a full list of activities, see Appendix D.

Figure 12. A screenshot of Group B's application

Group B's application was a condensed version of *Before Heaven* designed specifically for this trial. Once opened, the user is prompted for their participation code before beginning the game. The video game starts out with an animated cutscene of the ocean and quickly focuses on a sailing ship carrying a series of characters including the main character. Once the sequence has ended, the player is free to walk around the main deck of the ship. There is only one character on the main deck that the player can interact with, Unit. In addition to setting the scene of the story, Unit mentions music and the tournament that is coming up in the nearby village of Ionia. He asks if the player knows how to play music and asks the player to try out a flute he had recently made. He then introduces a few activities where he will perform an exercise such as playing the C major scale using numbers 1-8 and asks the player to repeat what he has just played. With each successful repetition, a success sound is triggered and Unit plays a new exercise. When the player finishes an exercise and fails to perform the exercise correctly, Unit will perform the exercise again and ask the player to try again until it is correct. The game will wait for the player to finish attempting the exercise and does not correct the player immediately upon performing an incorrect note. Upon completing all of his exercises, Unit awards the flute to the player as a gift and notifies him that the stop for Ionia is next. The completion of the first activity triggers the background music to stop looping. Once the final loop of the background music has finished, the Captain - not actually seen in the video game - notifies the ship that they are approaching Ionia. As Ionia comes into view, the camera switches to a cutscene that quickly flies through some of the sights of Ionia such as the village center, the waterfall, and the arena. Upon finishing the cutscene, the camera then refocuses on the main character who is now standing on the dock of Ionia with the ship docked behind him.

While walking onto land, Petom, a man who also came off of the ship, is standing on the other dock with his wagon cart and yells over to the player for help. He explains that the planks in the dock are missing and he can't pull his cart onto land without them. He asks if the player can help him by perhaps playing the number of each plank that is missing. These missing planks are arranged so that the player plays the intervals of the 1, 2, and 3 chords. If the player attempts to play incorrect notes simultaneously with the correct notes or just tries to press every note at the same time, the activity will not proceed. While playing through each of the different grouping of notes, Petom explains that the groupings of planks are actually the notes that make up chords. He then explains that the player can switch between single note mode and chord mode by pressing the 0 and 9 keys. Once the player fills in all of the planks of the dock, Petom thanks you and directs you to the location of the theatre just up the path road. The player, once again, is free to move about the map and eventually walks into the theatre.

Once inside, there are a few theatre employees standing around the room with the main theatre door located directly in front of the player. Upon entering the main theatre, the camera focuses on Cicero sitting in the back row critiquing the film on screen. Commenting about passion and suspense, Cicero performs a scale. He then performs the scale again, but does not play the last note, the resolve, thus creating musical tension. He stresses the importance of both the resolve and musical tension before playing the scale again with a delayed resolve to build suspense. The player is then asked to perform the scale on his flute. Once completed, Cicero begins to explain how chords progress into one another and how just like the resolve of 8 from 7 is important, so is the progression of some chords into other chords. The player is then free to perform in chord mode with a chord indicator at the bottom of the screen.

The chord indicator is built from a set of rules that show which chords flow better based on the previous note performed. Chords are visually illuminated to 25%, 50%, 75, % and 100% intensity based on the relevant flow from the prior chord performed. After the player has performed 10 chords, they have the option to continue in the activity. Cicero then suggests that the player attempt to play a series of chord progressions over a film to help liven the film's soundtrack. With the camera fixated on the screen, 8 vertical lines appear with a circular base numbered from 1 through 8. As colored spheres float down the numbered lines, players must play the chord as the spheres collide with the base in a Guitar Hero type of gameplay. After playing through various exercises of chord progressions, the screen tells informs the player that the activities are complete. For a list of all activities and dialog, see Appendix E.

Posttest

After both groups run the application section, the final component is the posttest also using a Google form. While featuring the same skill questions as the pretest without the two prior skill assessment questions, the posttest includes a three-question assessment of the study at the end. The assessment questions ask the participant to rate the degree to which they agree with the following statements on a 1 (Strongly Disagree) to 6 (Strongly Agree) scale:

- "My knowledge of scales improved"
- "My knowledge of chords improved"
- "I enjoyed using the method of instruction and would likely use it outside of the classroom"

For the full posttest and questions, see Appendix G.

Results

The responses of the pretest and posttest were collected through a Google Forms page that was included in both group folders. The two assessment questions from the pretest were asked to ensure a balance of prior knowledge and experience between the two groups. While there are no prior physical requirements for either of the two intervention applications that would benefit a participant from either group, the first question is to generally gauge a participant's interest and experience in music prior to the study. Out of the 44 responses, 13 participants from Group A (Control) and 19 participants from Group B (Experimental) answered that they have some prior knowledge of music theory and have played an instrument for more than 3 years. Both groups had one participant each that did not finish the study and did not complete the posttest. The following table shows the average responses of both groups for the two assessment questions on the pretest. While there were some participants that had played an instrument for more than 3 years who had no prior music theory, there were no participants who had prior music theory that did not play an instrument for more than 3 years.

N=42	**Played for 3+ years?**	**Prior music theory?**
Group A (Control)	0.619	0.381
Group B (Experimental)	0.905	0.571

Table 1. These averages originate from the two assessment questions of the pretest on a binary scale

The following tables and charts show the averages of both groups based on the number of correct answers on both the pretest and posttest. Despite the experimental group's responses of having prior knowledge and instrument skill being higher than the control group's responses, the control group answered 0.238 more correct answers on the pretest than the experimental group. After the intervention, the control group's number of correct answers increased by +1.286 more correct answers, while the experimental group's number of correct answers increased by +1.096 more correct answers.

N=42	**Pretest Avg.**	**Posttest Avg.**	**Difference**	**Standard Deviation**
Control	6.523	7.810	+1.286	1.848
Experimental	6.285	7.381	+1.096	1.786

Table 2. These averages are out of a possible 9 correct answer total

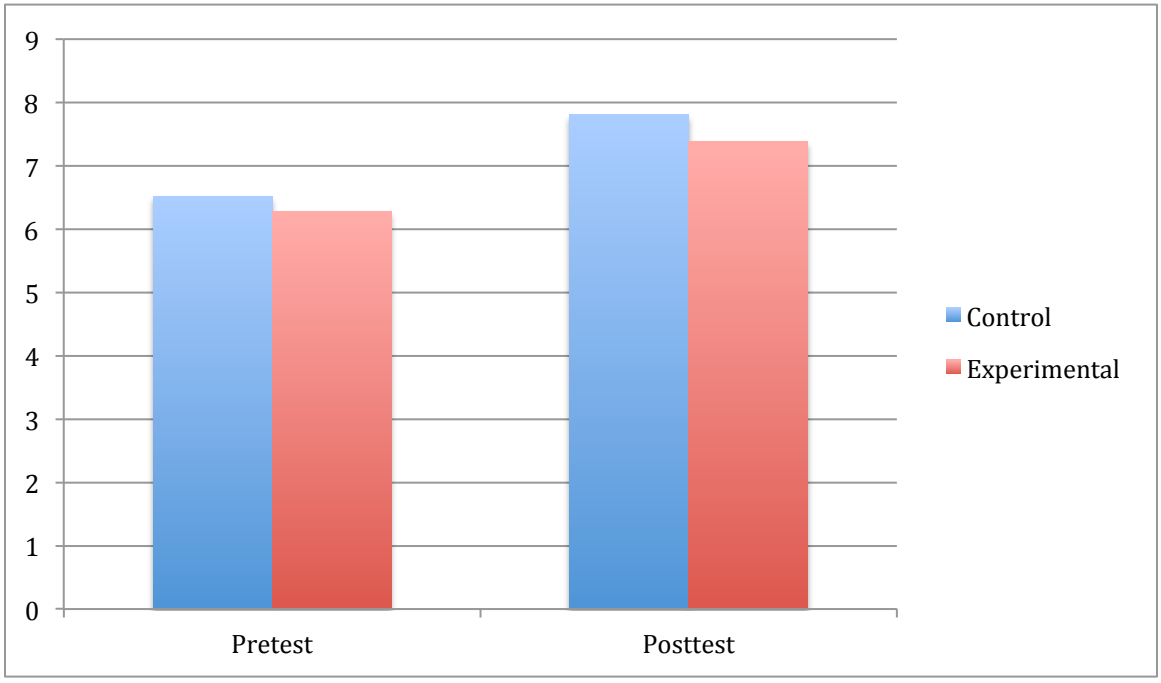

Figure 13. Overall results of pretest and posttest from both groups out of a maximum score of 9

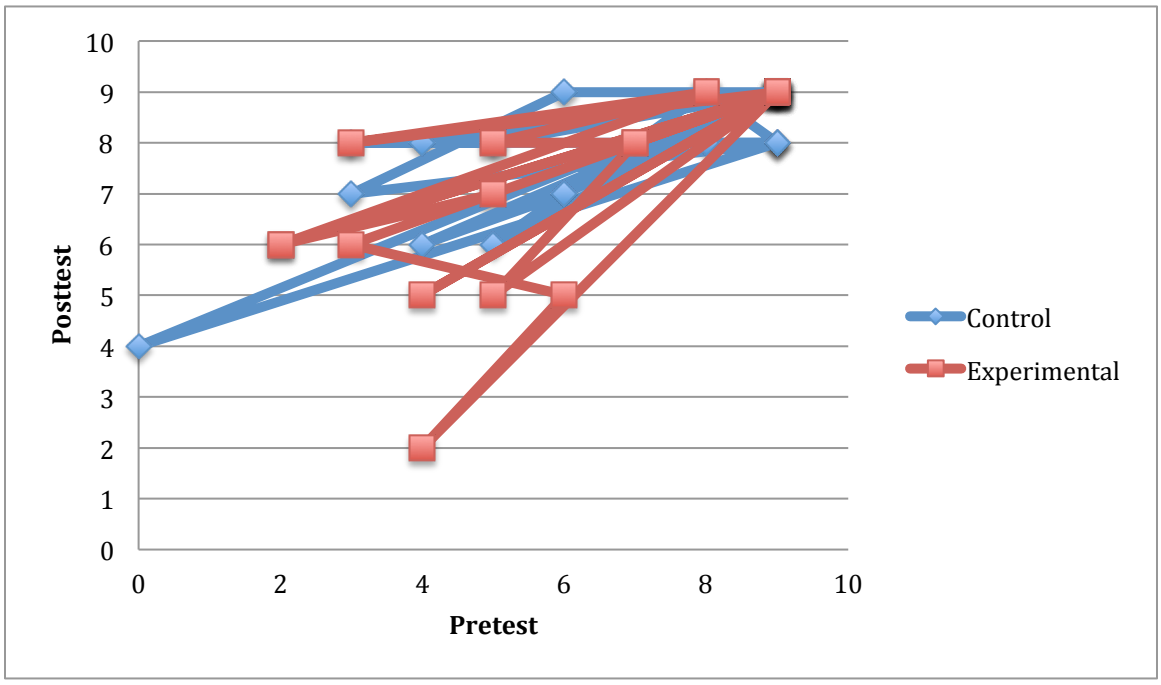

Figure 14. Plot of test scores using the pretest as X and posttest as Y

Of the 9 questions that were featured on the pretest and posttest, each reflected 1 of the 3 main topics that were covered in the intervention applications: interval recognition, chord knowledge, and progression identification. Consisting of 3 questions each, these sections featured recorded samples and a multiple choice question to identify each of the samples that were played.

Pretest

N=42	Interval Recognition	Chord Knowledge	Progression Identification
Control	0.794	0.635	0.746
Experimental	0.762	0.587	0.746

Table 3. These values are based on the total average of all 3 questions of each section with a maximum average of 1

Posttest

N=42	Interval Recognition	Chord Knowledge	Progression Identification
Control	0.810	0.92	0.873
Experimental	0.810	0.778	0.873

Table 4. These values are based on the total average of all 3 questions of each section with a maximum average of 1

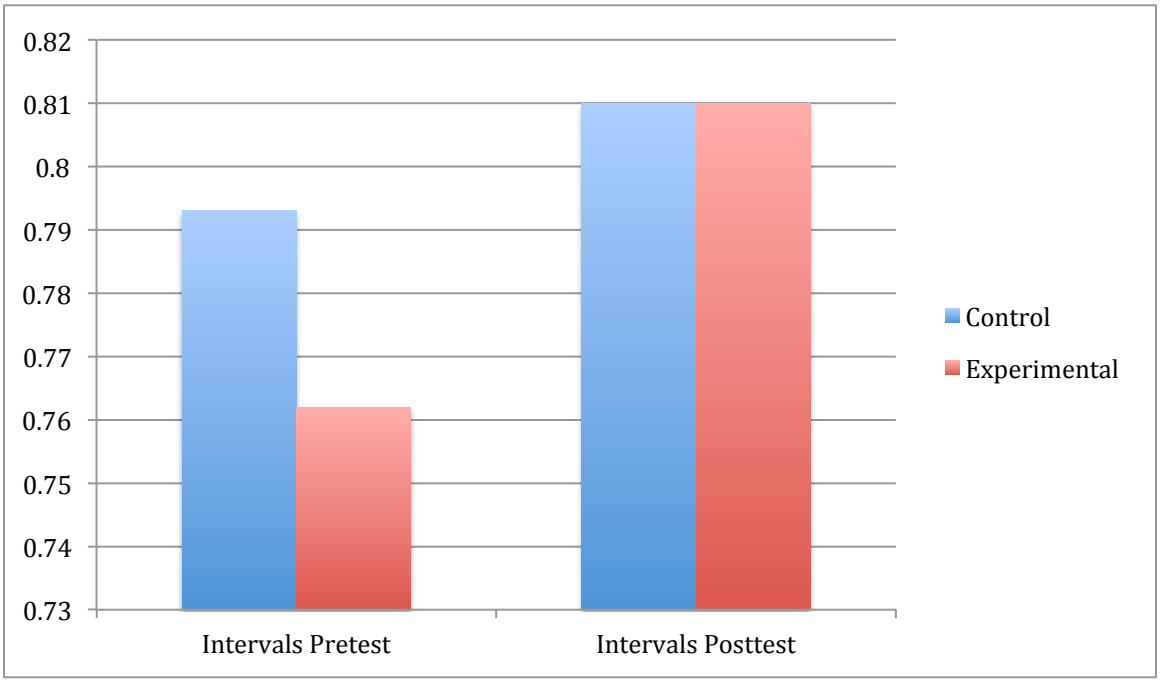

Figure 15. Illustrates the results of the 3 questions focused on interval recognition

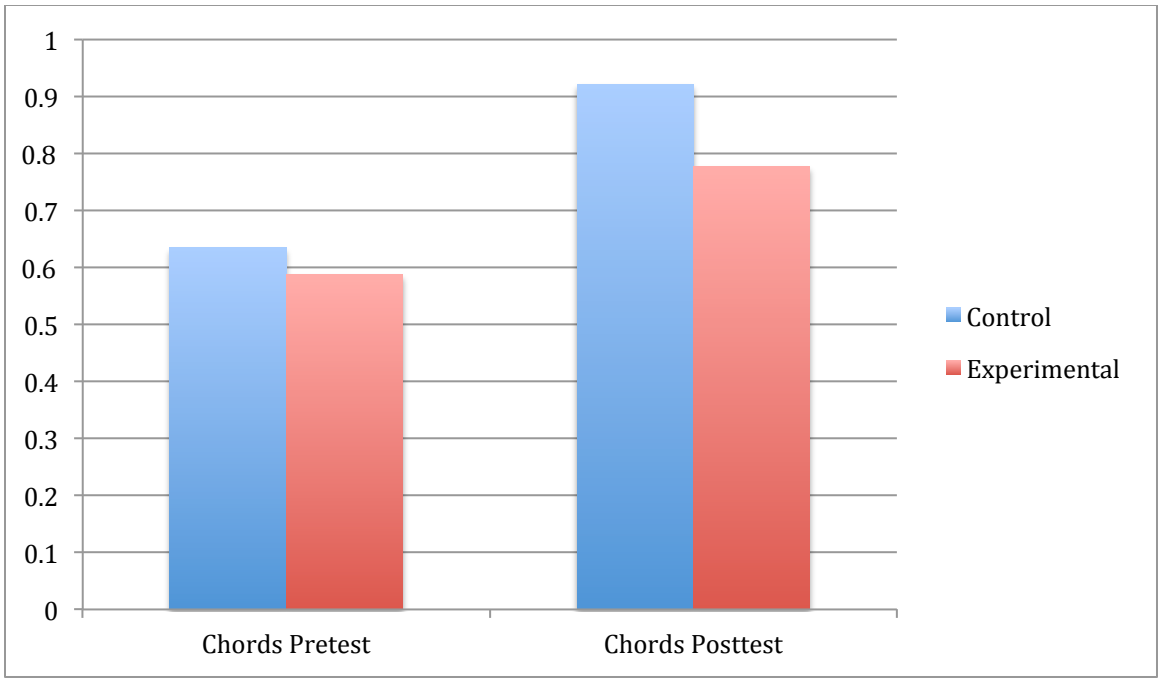

Figure 16. Illustrates the results of the 3 questions focused on chord knowledge

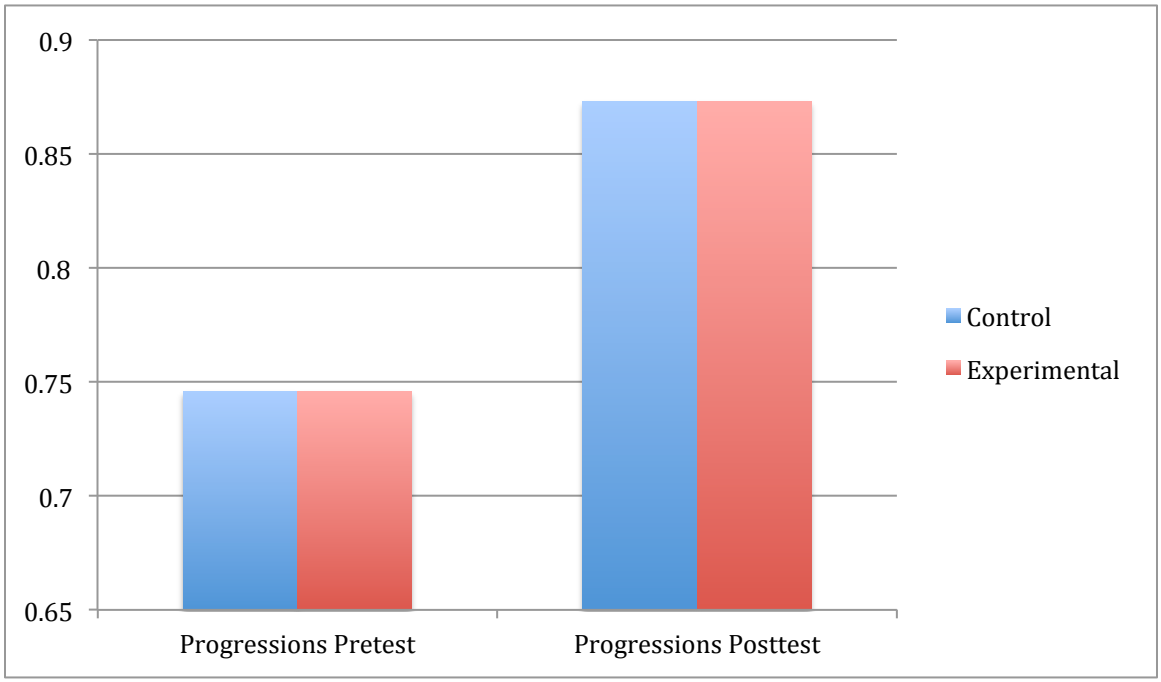

Figure 17. Illustrates the results of the 3 questions focused on chord progression identification

As you can see from these three charts, both groups have improved significantly in all sections. The data suggests that the experimental group shows greater improvement in interval recognition and than the control group, the control group shows greater improvement in chord knowledge than the experimental group, and both groups improved the same amount in progression identification.

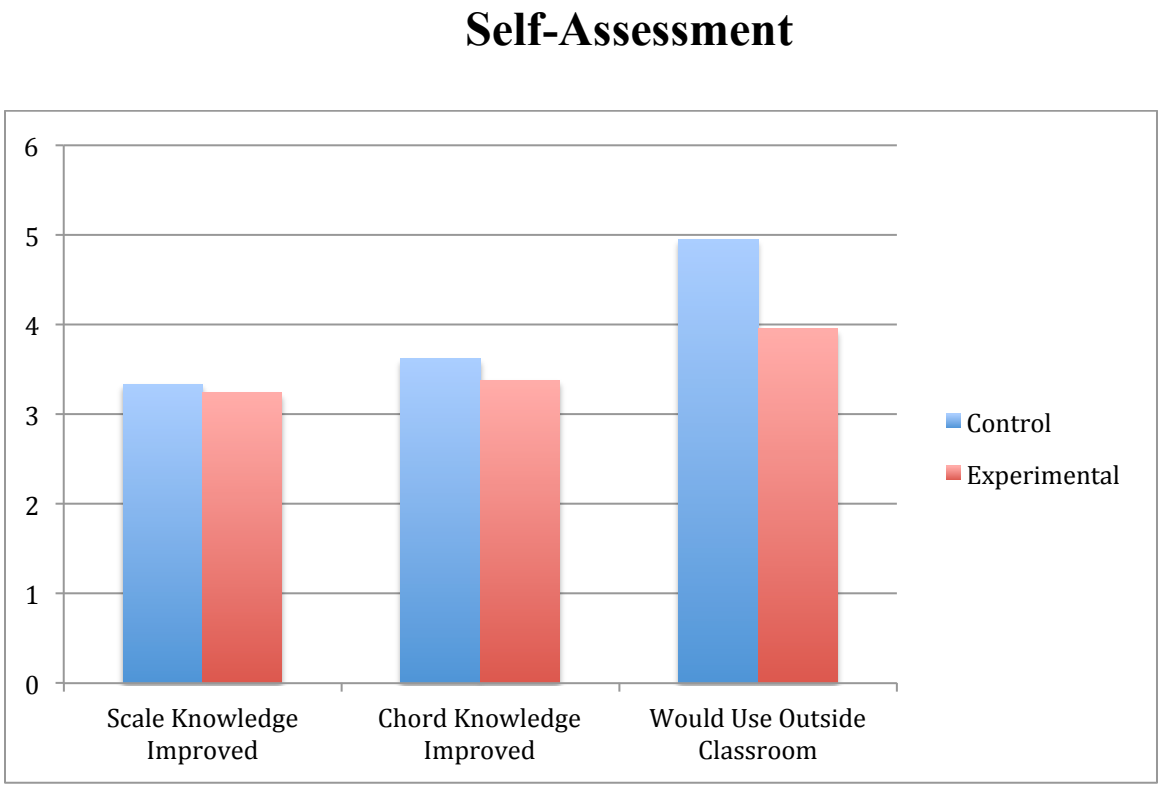

Figure 18. Shows the participant responses of the self-assessment questions of the posttest

Both groups of students were asked to assess their skills based on their prior knowledge after using the intervention application and rate on a scale from 1 to 6 how they thought they improved in various areas. They were also asked to rate their enjoyment of their respective

intervention application and whether or not they would use it outside the classroom setting. The data suggests that the control group has a higher average than the experimental group in all three areas.

Discussion

The results of this study suggest and highlight some interesting ideas regarding the use of a video game as an alternative educational tool. While the appeal of a video game may certainly be higher than that of a traditional music method book, the educational value must be comparable in lieu of it. The claimed instrument skill and prior knowledge of music theory was higher in the experimental group (Group B) than it was in the control group (Group A). However, the experimental group averaged a significantly lower score in each area than the control group averaged. While this data suggests contradiction, there are certainly some factors that could influence this outcome. The self-assessment claims of the first set of data were not intended to be a metric for prediction as to what the data would later suggest. These claims are reliant solely on what the participant considers experience and prior training and is not a standardized method for evaluation. The intention of this self-assessment was to 1) gain a stronger background on the population of the study 2) confirm that there was some indication of prior knowledge other than just the pretest itself.

The pretest showed that there is a general balance of prior knowledge between both the control group and the experimental group. The control group had 8 students that answered every question correctly on the pretest, while the experimental group has 7 students. Additionally, both groups scored approximately the same score with the control group scoring slightly higher with

an average of 6.5 correct answers and the experimental group scoring an average of 6.3 correct answers out of a possible 9 correct answers. The posttest results showed a similar improvement in the experimental group as the control group. It is also important to note that the experimental group maintained or improved in every question on the posttest while the control group showed a decrease on some of the questions on the posttest.

Each of three music concepts that are covered in the intervention applications is tested on the pretest and posttest with three questions per concept. These three sections can be categorized as interval recognition, chord knowledge, and progression identification. Of these three categories, the posttest shows a higher improvement in the experimental group for the interval recognition section while the control group scored higher in the chord knowledge area. Both groups scored and increased the same amount in progression identification. We find these results interesting because this data directly reflects the strategies of both intervention methods. The immediate feedback that is implemented in *Before Heaven* provides a simulated tutor that is accessible to any student at their convenience by providing playback of notes, immediate feedback, and adaptable gameplay. A method book, while providing the student with an effective means of instructions, does not provide key concepts such as immediate feedback or playback that have been known to be effective in various fields of instruction (Reddy, 1969). This is reflective in the data of interval recognition. While the data suggests that the control group's intervention showed greater improvement in chord knowledge than the experimental group's intervention, this not a negative indication of the effectiveness of the method of instruction. The technical knowledge of chords that is presented in the control group's intervention does not require the same effort in experimental group's intervention due to the chord mode that simplifies the chord performance process. While the actual physical performance of the notes is still required for the control group,

the chord mode found in experimental group's intervention, *Before Heaven*, has negated the physical mastery of this concept thus indicating possible cause to the control group's greater improvement. While it may not have been as effective as control group's method of instruction, *Before Heaven's* concept of chord mode resulted in a positive increase in the identification of the chord progressions for the experimental group. The score improvement in the experimental group can be attributed to the effectiveness of the interactive video game method and the data suggests that it can be used as a suitable alternative to aid music instruction.

The posttest consisted of three self-assessment questions that asked participants to indicate how well they believe their skills have improved from using their assigned method and to indicate their enjoyment of the method and likelihood that they would use their method outside of the classroom. The first two questions asked participants to rate how well they agree with the following statements "My knowledge of scales improved" and "My knowledge of chords improved" while the last statement focused on the enjoyment of the method, "I enjoyed using the method of instruction and would likely use it outside of the classroom". Each question was rated on a scale from 1 to 6 ranging from "Strongly Disagree" to "Strongly Agree" respectively. A scale of 6 was used to ensure that a quantitative perspective was recorded rather than a neutral answer of 3 on a scale of 5. For both of the skill-based assessments, the control group's responses were higher than experimental group's responses even though the data suggests that experimental group improved about as much as the control group. This data could reinforce the idea of stealth learning and gives validation to the concealment of an effective instruction in a relevant medium. The control group's indication of enjoyment of the method and likelihood to use it outside of the classroom was approximately 1 degree higher than experimental group's indication. While it may be surprising to see a low response for a video game when rating the

level of enjoyment, the indication could be based on other factors or expectations affiliated with video games that are unaffiliated with the main focus of the instructional method such as stunning graphics or intense combat. While having the features implemented in *Before Heaven* may add to the enjoyment of the game, it would certainly take the focus away from the pedagogical aspects of the project, which are the main focus.

Conclusion

This study was conducted to explore the effectiveness of a video game as an alternative to a more traditional method of instruction. The main empirical findings of the study show that the experimental group using the video game, *Before Heaven*, improved about as much as the control group using the method book application. Additionally, this data reflects not just improvement, but improvement in the areas that *Before Heaven* specifically targets such as interval and progression identification. *Before Heaven* has a "chord mode" that allows players to perform a chord by pressing just the chord number rather the various notes of a chord such as 1, 3, and 5 of the 1 chord. Because the experimental group showed great improvement in every other section, the experimental group's reliance on "chord mode" could be a factor in their overall minimal improvement in chord knowledge. This reflection in the data of the removal of chord knowledge when using "chord mode" further demonstrates the necessity for a fine-tuned pedagogical perspective when developing an educational video game.

While *Before Heaven* is certainly not the first stealth pedagogical video game, its effectiveness can be a good example of how video games can be used as an instructional tool that can aid

learning. While the prototype of *Before Heaven* was stable enough to be used in a study, there are several stages of improvements that will be developed such as stronger animations and graphical coherence, more user testing on educational effectiveness, and extended controls in performance. The development toolkit used to make activities is functional and can be modular for other pedagogical areas, however, the intention of the toolkit shall remain as a tool for developers of *Before Heaven* or possibly as a sandbox development tool that is not released with any content from *Before Heaven*. This would allow teachers to develop activities using the same methods of *Before Heaven* for generating music and activities, but would not limit them to or interfere with any development in *Before Heaven*.

Other areas of research that can be explored include the positive and negative effects of storyline, aesthetics, and sound in the effectiveness of a pedagogical video game. While *Before Heaven* was designed in a similar graphical style as many role playing video games, perhaps having a cell-shaded cartoon-looking aesthetic such as in the Legend of Zelda: Wind Waker may prevent users from taking the game seriously and negatively affect the educational intentions of the game. Does having a narrative affect the user's ability to focus on non-narrative, educational instruction? Ultimately, if using video games as an instructional method is the current direction of many educational programs, more research and development must take place to make it effective.

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Appendix A

Instructor Instructions

Make sure that group folders are available on all computers Split groups evenly on random metric (i.e. if there are 20 computers, 1-10 are group A, 11-20 are group B)

Read the following statement (also found in each group folder):

Welcome! You are invited to take part in this study to research the effectiveness of technology in music instruction. Results will be used to compare one method of instruction against another. This study will take approximately 20 minutes and requires no prior knowledge or skill in music theory. Participation is completely optional and you may stop at any time, if you become uncomfortable with continuing in the study. We do not ask, publish, or store any personal information from you and all results are kept confidential. These instructions can also be found in your group folder.

The survey will ask for a participation code, this is your computer number and your day of birth. I was born on the 4th of December and sitting at computer 25. My participation code would be 25-04.

You may now put on your headphones and locate the folder for your group and complete the tasks in order starting with “1. Instructions”. Please do not forget to take the post-test after you are finished with the activities.

Appendix B

Group A Instructions

Instructions

Welcome! You are invited to take part in this study to research the effectiveness of technology in music instruction. Results will be used to compare one method of instruction against another. This study will take approximately 20 minutes and requires no prior knowledge or skill in music theory. Participation is completely optional and you may stop at any time if you become uncomfortable with continuing in the study. We do not ask, publish, or store any personal information from you and all results are kept confidential.

If you have not done so, please complete the pre-test survey for Group A before continuing. Please put on your headphones and open the application named "Group A" on your computer. When successfully opened, you will see a musical keyboard on the screen. Follow the instructions on each screen carefully and when you are finished with a section, click the Next arrow to continue. The program will notify you when you have completed all activities.

To begin, examine the keys labeled 1-8 on the graphic keyboard and find the corresponding keys on the MIDI keyboard connected to your computer.

Controls

Use the MIDI Keyboard to play notes and chords

Objectives

Follow the instructions on the screen carefully

Appendix C

Group B Instructions

Instructions

Welcome! You are invited to take part in this study to research the effectiveness of technology in music instruction. Results will be used to compare one method of instruction against another. This study will take approximately 20 minutes and requires no prior knowledge or skill in music theory. Participation is completely optional and you may stop at any time if you become uncomfortable with continuing in the study. We do not ask, publish, or store any personal information from you and all results are kept confidential.

If you have not done so, please complete the pre-test survey for Group B before continuing. Please put on your headphones and open the application named "Group B" on your computer. When successfully opened, you will see an ocean scene with the words *Before Heaven* on the screen. Please complete all three activities. The controls and objectives are listed below. The game will tell you when you have completed all activities.

Controls

Movement/Walking: Arrow keys

Action Button/Talk to People: D key

Play notes/chords: 1-8 number keys

Use chord mode: 9

Use low octave note: - (minus key next to 0)

Use high octave note: =

Game Objectives

Activity #1: Talk to Unit and complete activity #1

--land in Ionia—

Activity #2: Walk onto shore and complete activity #2

Activity #3: Walk into movie theatre, talk to Cicero, and complete activity #3

Appendix D

Group A Activity Overview

Welcome to this lesson. To begin, examine the keys labeled 1-8 on the graphic keyboard and find the corresponding keys on the MIDI keyboard connected to your computer.

Play the following notes on the keyboard in order: 1, 2, 3, 4, 5, 6, 7, 8

Play the following notes on the keyboard in order: 1, 3, 5, 3, 1

Play the following notes on the keyboard in order: 1, 5, 8, 5, 3, 1

Play the following notes on the keyboard in order: 1, 3, 2, 4, 3, 5, 4, 6, 5, 7, 6, 7, 8

Play the following notes on the keyboard in order: 8, 7, 6, 5, 4, 3, 2, 1

Play the following notes on the keyboard all at the same time to make a chord: 1, 3, 5

Play the following notes on the keyboard all at the same time: 2, 4, 6

Play the following notes on the keyboard all at the same time: 3, 5, 7

Play the following notes on the keyboard all at the same time: 2, 4, 6

Play the following notes on the keyboard all at the same time: 1, 3, 5

Play the following notes on the keyboard in order: 1, 3, 5, 3, 1

Play the following notes on the keyboard in order: 2, 4, 6, 2, 4

Play the following chord on the keyboard: 1

Play the following chord on the keyboard: 2

Play the following notes on the keyboard in order and notice the tension when not finishing the scale: 1, 2, 3, 4, 5, 6, 7

Play the following notes on the keyboard in order and notice the tension resolve when finishing with 8: 1, 2, 3, 4, 5, 6, 7, 8

Play this common 4-chord pattern: 1, 5, 6, 4

Play this common 4-chord pattern: 1, 2, 3, 5

Play this common 4-chord pattern: 1, 4, 5, 4

Play this common 4-chord pattern: 1, 6, 4, 5

Play this common 4-chord pattern: 1, 3, 1, 3

Play this common 4-chord pattern: 6, 3, 6, 3

Play this common 4-chord pattern: 1, 3, 1, 3

Play this common 4-chord pattern: 6, 3, 4, 5, 1 (hold)

You are finished! Thank you for participating!

Appendix E

Group B Activity Overview

Activity #1 – Ship Ride (Reading and Listening)

You are on a large ship sailing into the port in the Ionian province, ***Unit*** sits with flute and asks you if you want to learn to play. He hands you a flute and asks you to repeat after him. Repeat what he plays to win the **flute**:

Ship ride dialog:

Unit dialog:

1. Hey, you look really familiar.
2. Are you from Ionia? I live here, but I'm headed way up to Dorian woods for a few days on business.
3. Ionia is a great little town if you're staying here, especially with the tournament coming up; lot's of new groups and acts coming through.
4. Are you also a Summoner? You look like one.
5. I just finished carving this. Wanna try it?

If no:

6. Ok, no worries.

If yes:

7. Ok, great. Repeat what I play on mine.

Unit plays the following--you must repeat after each line:

1, 2, 3, 4, 5, 6, 7, 8

1, 3, 5, 3, 1

1, 5, 8, 5, 3, 1

1, 3, 2, 4, 3, 5, 4, 6, 5, 7, 6, 7, 8

8, 7, 6, 5, 4, 3, 2, 1

If plays any exercise incorrectly,

That didn't sound quite right. Want to try it again?

8. Hey! Not bad! I hope that flute worked ok for you.
9. It's just a prototype, why don't you just keep it.

Receive flute in inventory

10. I have some of my other instruments for sale at the shop in town if you're staying in Tonic.
11. You should check them out. Tell the shopkeeper that Unit sent you.

Display "Unlocked Scale Mode"

Activity #2 – Bridgeman (Performance)

Unlock chord mode and pattern mode. Bridgeman, Petom, can't get his wagon/cart across the bridge. Play chords and notes to drop planks across the broken planks on the bridge.

You stay stationary with a top-down view over the bridge, as you hold down the number of the missing plank, his wagon moves forward a little.

Activity dialog:

Petom:

1. Some of the planks are out and I can't get my cart over this bridge.
2. Can you help?

Play the scale one note at a time to allow him to cross the bridge

3. That's it! I knew you could summon some help!
4. Ok, lots of missing planks ahead!
5. Now, I think now you need to play some chords.
6. Play the right notes all at once as a group.

Play chords 1, 2, 3, 2, 1

Planks groups notes to be played simultaneously:

1,3,5

2,4,6

3,5,7

2,4,6

1,3,5

Display “Unlocked Chord Mode”

7. Those chords did the trick! We’re almost across the bridge!

8. Now, instead of holding down each note in the chord, you can just play the chord root

9. Try switching between both scale mode and chord mode by pressing *9* and *0*

10. Ok, just a few more planks. This bridge is starting to scare me a little.

11. Play some single notes again, and help me outta here!

Switch to scale mode/single notes--if they’re not playing in scale mode display:

Play single notes not groups of notes!

1, 3, 5, 3, 1,

2, 4, 6, 4, 2,

Switch to chord mode--play chords not single notes!

1, 2

Display “Unlocked Pattern Mode”

12. You did it! We’re over the bridge

13. Hey, that was a nice way to break up the notes of the chord into a pattern!

14. Try switching between Scale Mode with *9*, Chord Mode with *0,* and Pattern Mode with -

15. You sound great!

16. Ya know, the creatures in this land are always singing! It can be rewarding to interact with them you when hear ‘em.

17. I don’t have much money myself, but take this as a thank you for all your help: *Receive 50 coins.*

18. I hear they’re preparing to show a new picture at the theatre

He walks away

Activity #3 – Film Score & intensity indicator (Reading)

After activity #2, go to the film house. The ***Film Director*** *Cicero* of the Indie Film asks you to compose a score for his short film in the studio – earn a **string orchestra instrument**.

Activity Dialog

Cicero:

1. Finally a fellow connoisseur of fine spirit has arrived! Can you believe how dull this film is?!
2. The acting is decent, perhaps mediocre at best, but the spirit is so derivative, and such a disappointment. There's no tension!
3. Listen to this:

Plays scale

4. Now listen to this:

Plays scale all but last tonic, retries and still remains on 7

5. Can you hear how the scale is begging to be resolved? It needs to resolve back to the beginning!

Plays scale, hangs on 7 for a second, and then resolves to 8.

6. There's tension when we expect for the scale to resolve and it doesn't resolve! That tension creates the drama!
7. Play the scale for me.

Asks you to play the scale, repeats scale if player plays incorrectly

First part completed

8. Am I boring you with this?

If Yes:

9. It's truly shame you never learned to think abstractly. Maybe there's a ball somewhere that you can bounce.

If No:

10. Fabulous! The tension doesn't stop with notes in the scale.

11. You know that chords are made from the notes of the scale, and each note in the chord wants to resolve somewhere! Talk about tension!

12. In the same way that note 7 in the scale wants to go back to note 1, the 5 chord contains note 7, and wants to resolve to a chord that has note 1 in it, like the 1 chord.

Play sub activity where numbers 1 – 7 appear on the screen representing chord functions. For each chord you play, the chord number you play lights up in one color, and the other numbers light up in another color with varying intensities or heights.

Prompt user to switch to chord mode

- 1 chord – all other chords light up full
- 2 chord – 5 and 7 light up full, all others light up ¼
- 3 chord – 1, 4, 6 light up 1/2, all others light up ¼
- 4 chord – 1, 5, 7 light full, all others ¼
- 5 chord – 1 full, 6 ¾, all others ¼
- 6 chord – 2, 4 full, 1 ¾, all others ¼
- 7 chord - 1 light up full, all others light up ¼

Tinker with chords until they hit continue (after at least 10 chords played)

13. Play these common 4-chord patterns

Cinema screen shows--

Progression:

1 5 6 4

Plays click track in background, and shows note reader display. Each chord progression plays for 4 repetition then switches to the next progression

1 5 4 5

1 2 3 5

1 4 5 4

1 6 4 5

13. Did you hear how the 5 chord needs to resolve to the 1 chord? But, oh how intense it is when the chords do not resolve to where we suppose they will!

14. We avoid resolution to increase the drama!!

15. Want to know my little secret when it comes to film spirit?

16. It's often overlooked, but I swear to you that the 3 chord is magical!

17. Now, let's see what you can do to liven up this dead film:

Camera fixes on film in background and shows

Progression:

1 3 1 3

as title, plays click track in background, and shows note reader display. Each chord progression plays for 2 repetition then switches to the next progression

6 3 6 3

1 3 1 3

6 3 4 5

1 (sustained)

If Fail:

18. Ahh! That was not the drama I was looking for! Darkness! Darkness!!!

If Succeed:

19. Ahh!! Beautiful sadness!! Did you hear how the 3 chord sits in its own harmonic space? It needs no overt motion, only complacency!!

20. Beauty!! The film shall be a success!! Please, take this as a reward!

Presents you with *string instrument*

It was a gift from a very skilled summoner. I'm told it's not like ordinary instruments, but I could never get it to do anything special.

I guess I should've spent some time practicing it! Ha ha ha

"All Activities Completed"

Appendix F

Effectiveness of Technology in Music Instruction Pre-Test

Please read the questions carefully and answer all questions completely

* Required

Please enter your participant number below *

[input text box]

(This is your computer number and your day of birthday i.e. 21-04)

Question #1

Are you proficient in performing on one or more instruments that you have played for more than 3 years? *

- Yes
- No

Question #2

Are you proficient in fundamental music theory skills including melodic dictation, oral chord recognition, and simple harmonic analysis? *

- Yes
- No

Question #3 Audio Clip

View this clip when answering question #1

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1232343454568
- 1232345645678
- 1243574685678
- 1324354657678

- 1343454565678
- 1352463574568

Question #4 Audio Clip

View this clip when answering question #2

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1232343454565678
- 1234234534565678
- 1243574685674678
- 1324535465678678
- 1345345645675678
- 1352346345745678

Question #5 Audio Clip

View this clip when answering question #3

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1234321234
- 1235321235
- 1258641356
- 1368641468
- 1358531358
- 1358641468

Question #6

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 3 chord is made from combining which scale notes?

- 1 3 5
- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8
- 5 7 2
- 6 4 2

Question #7

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 4 chord is made from combining which scale notes?

- 1 3 5
- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8
- 5 7 2
- 6 4 2

Question #8

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 2 chord is made from combining which scale notes?

- 1 3 5

- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8
- 5 7 2
- 6 4 2

Question #9 Audio Clip

View this clip when answering question #7

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4
- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Question #10 Audio Clip

View this clip when answering question #8

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4
- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Question #11 Audio Clip

View this clip when answering question #9

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4
- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Appendix G

Effectiveness of Technology in Music Instruction Post-Test

Please read the questions carefully and answer all questions completely

* Required

Please enter your participant number below *

[input text box]

(This is your computer number and your day of birthday i.e. 21-04)

Question #1 Audio Clip

View this clip when answering question #1

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1232343454568
- 1232345645678
- 1243574685678
- 1324354657678
- 1343454565678
- 1352463574568

Question #2 Audio Clip

View this clip when answering question #2

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1232343454565678
- 1234234534565678

- 1243574685674678
- 1324535465678678
- 1345345645675678
- 1352346345745678

Question #3 Audio Clip

View this clip when answering question #3

Please listen to the audio clip scale above and select the correct ordering of notes (using numbers 1 – 8 to represent notes 1 – 8) *

(You may listen to the audio clip more than once)

- 1234321234
- 1235321235
- 1258641356
- 1368641468
- 1358531358
- 1358641468

Question #4

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 3 chord is made from combining which scale notes?

- 1 3 5
- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8
- 5 7 2

- 6 4 2

Question #5

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 4 chord is made from combining which scale notes?

- 1 3 5
- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8
- 5 7 2
- 6 4 2

Question #6

Please select the correct notes comprising the chord below (using numbers 1 – 8 to represent scale degrees 1 – 8) *

The 2 chord is made from combining which scale notes?

- 1 3 5
- 1 4 5
- 2 4 6
- 2 4 8
- 3 5 7
- 3 4 5
- 4 5 7
- 4 6 8

- 5 7 2
- 6 4 2

Question #7 Audio Clip

View this clip when answering question #7

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4
- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Question #8 Audio Clip

View this clip when answering question #8

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4

- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Question #9 Audio Clip

View this clip when answering question #9

Please listen to the audio clip above and select the correct ordering of chords (using numbers 1 – 8 to represent chord functions 1 – 8) *

(You may listen to the audio clip more than once)

- 1 2 3 4
- 1 2 3 5
- 1 3 4 5
- 1 3 5 6
- 1 3 4 5
- 1 4 6 5
- 1 4 5 4
- 1 5 4 5
- 1 5 6 4
- 1 6 4 5
- 1 6 5 4

Question #10

Please rate the degree to which you agree with the following statement: *

"My knowledge of scales improved"

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Question #11

Please rate the degree to which you agree with the following statement: *

"My knowledge of chords improved"

1 2 3 4 5 6

Strongly Disagree Strongly Agree

Question #12

Please rate the degree to which you agree with the following statement: *

"I enjoyed using the method of instruction and would likely use it outside of the classroom"

1 2 3 4 5 6

Strongly Disagree Strongly Agree