MUSICAL INTERACTIONS IN GAMING

Interactive Qualifying Project Report completed in partial fulfillment
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ABSTRACT

This study examined the effectiveness of a video game prototype designed to embody an informal learning approach in a musical context. A survey method was used to test the validity of the prototype as an engaging and accessible informal learning task. The results of the survey suggest that the prototype kept players' interests and provided some accessibility to both musicians and non-musicians in terms of playability.

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Conclusions and Recommendations	……	Mark Foster
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TABLE OF CONTENTS

TABLE OF FIGURES

1 INTRODUCTION

Video games are essentially interactive tools for informal learning – players learn the rules of a game space through experimentation and intuition, and put invest time and effort in order to continue through the experience. Such an environment seems perfectly suited for teaching musicianship. Musical concepts can be difficult to learn without first mastering a musical instrument, but through the use of a virtual musical space, musical concepts can be taught and even put into practice by individuals who do not have experience with traditional musical instruments. The inspiration for this concept comes from Dr. Vincent Manzo's dissertation on teaching harmonic function recognition through interactive systems. Manzo writes: "[An accessible electronic musical instrument] could afford musicians who feel they lack the skills in determining chords and chord progressions greater opportunities to practice the skill and experience the harmonic result through performance" (Manzo 12). As an extension of this research, Dr. Manzo also plans on creating a video game designed to enhance musicianship – this concept was the inspiration for our project. Such a game would teach the player the basics of music theory, improvisation, and ear training – all while remaining engaging and interesting to the player. To further take advantage of the video game environment, players could potentially also be able to compose original music within the game and share that music with other players inside the game.

The scope of an entire game based on this concept is far too large for any small project group to tackle in three terms, so for our project, we decided to design and create a prototype of the opening section of such a game. Our IQP consisted of designing our game prototype, implementing it in the Unity game engine, creating a survey to evaluate the effectiveness of our prototype, and finally, sending our game prototype and survey to various test subjects. The

tutorial of a game is an extremely important, and can be very tricky to properly execute. Players must be taught the controls, mechanics, and rules of the game world in a way that keeps their interest and doesn't leave them with any misgivings on how certain mechanisms function. Our goal was to create a tutorial for the game that teaches the player the controls of the game and the absolute basics of music theory in an engaging and accessible way.

Those two adjectives were our key focus: "engaging" and "accessible". One of our most important goals was to keep the game interesting – so many educational games fail due to quickly losing the player's interest. Accessibility was also a key consideration – the target audience for a musical game like this is very broad, and is certainly not limited to just those who are experienced at music and video games. We needed to make sure the introduction to the game teaches the rules of the game world and the basics of music theory effectively without being too boring to advanced players.

The design of our prototype was informed by our background research. Over the course of our design process, we came to many conclusions regarding methods to keep player interest while properly teaching the game's controls. One of our primary focuses was to use very little text in our game, and keep the gameplay as uninterrupted as possible. The challenges that we initially designed started to feel much more like a music theory lesson than a game, so we were forced to take a step back and determine what factors of our design were contributing to that. By removing most NPCs and conversations, the player never loses control of their avatar for the entire duration of the prototype. Challenges in the game were also designed to be more active than passive, incorporating exploration elements to further motivate the player to complete them.

To determine the effectiveness of our prototype, we devised a survey that subjects would take upon completion of the game. In it, we polled our respondents' opinions on the difficulty

level of the game as a whole, the difficulty levels of each individual challenge, their thoughts on the control scheme, and finally, some subjective personal opinions on their enjoyment of the prototype. These survey responses are the core of our project – player testing and feedback are the only way to determine the effectiveness of teaching in a video game. All of our design and development was leading up to this survey, knowing it would be the sole indicator of our success or failure in this project. This report will detail our background research on tutorial design, the entire design and development process of our prototype, and the results of our survey.

The music video game prototype we developed and our survey will be available at http://users.wpi.edu/~mjfoster/IQP for the foreseeable future.

2 BACKGROUND

2.1 VIDEO GAMES AND TUTORIALS

One challenge faced by every video game is the challenge of creating an effective tutorial. Video games require instruction, in some form – there is always a layer of abstraction between the actions that the human player performs and the actions performed by the player's avatar in the virtual world, and if that abstraction is not understood by the player, playing the game will be a frustrating experience. As Ernest Adams states, "Put simply, your user interface must map the machine's controls to game-world activities, and somehow, somewhere, you're going to have to explain that mapping. And your interface almost certainly isn't as intuitive as you think it is" (Adams 3). The importance of a good tutorial to a game cannot be understated – as John Shafer (former lead designer for the *Civilization* game series) writes, "More players quit a game in the first hour than the rest of playtime combined. [The tutorial] needs to be *the* part of the game which stands out and shines. Unfortunately, the opposite is often the case" (Shafer 1). The quality of the opening section of a game, in which the player is introduced to the game's controls and mechanics, needs to explain so many things to the player and must do so in an engaging and intuitive way to keep the player's interest.

Back when video games lacked high visual fidelity, games were forced to explain themselves to players without words. While many games would still have text-based tutorials in the form of instruction manuals packaged with the game, many of the most iconic games from this early era of video gaming managed to explain themselves to the player without requiring them to read the instruction manual. One of the best examples of this sort of wordless instruction

comes from what is arguably the most iconic game of all time – Nintendo's *Super Mario Bros.* for the Nintendo Entertainment System.

2.2 *Super Mario Bros.*: Teaching through Level Design

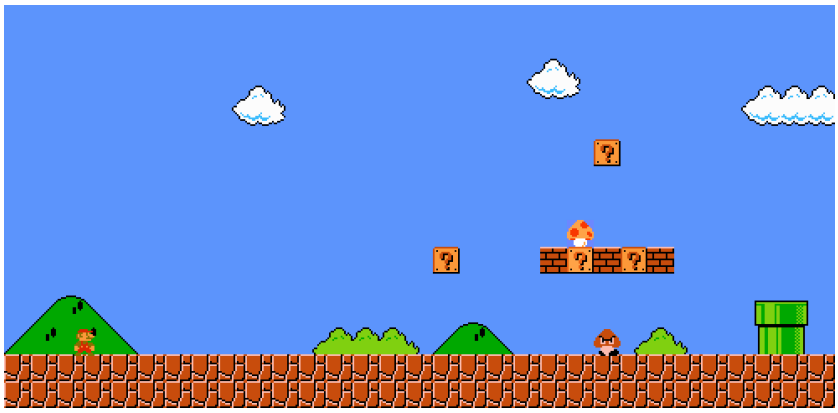

Figure 1 – the opening section of Super Mario Brothers' *first level*

Super Mario Bros. is a game belonging to the "platformer" genre. While other mediums may have genres that are characterized by their aesthetics or story, video game genres are characterized by their gameplay, and a platformer's gameplay consists of an avatar navigating a world by jumping on various platforms. The goal of the player is to make their way to the ending of the level by overcoming various obstacles by jumping. Early platformers took place in two-dimensional worlds – the player could move left and right by walking (or running), and jumping would move them vertically. This genre of gaming was extremely popular in the early era of console video gaming – mostly due to the overwhelming success of *Super Mario Bros*. However, *Super Mario Bros.*' success was no fluke – the game displayed many intelligent design decisions that gave it a level of quality that was nearly unmatched at the time.

Super Mario Bros. doesn't start off with a sprawling paragraph of text explaining the controls or backstory. Instead, the player is immediately immersed into the gaming experience and is forced to learn the controls and game mechanics intuitively. Upon hitting the start button,

the player is instantly presented with the opening of the game (see Figure 1). One of the first subtle hints given to the player is the position of Mario on the screen. Mario begins the game standing closer to the left edge of the screen while facing right. This heavily suggests to the player that, in order to progress, they must move to the right. As they move right, they encounter the game's first enemy – a walking mushroom with angry eyebrows, walking directly toward the player. The Goombas were designed so that any interaction with them will clue the player in on their intentions. If the player runs into the Goomba, he'll see Mario die and realize that creatures like that are enemies and need to be defeated or avoided; if the player lands on top of the Goomba, they'll see Mario squish it and gain 100 points, indicating that squishing creatures like this is beneficial to them (Anthropy 3). Using only visual cues and clever design, even this first screen alone manages to teach some of the game's most essential mechanics to the player.

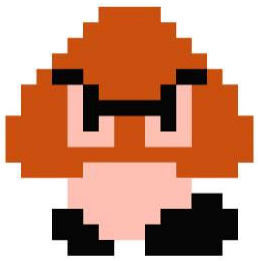

Figure 2 – A Goomba enemy from Super Mario Bros.

Super Mario Bros. further teaches the player about power-ups in a very cleverly designed section of the opening level. The very first power-up in the game is almost impossible to avoid – the first Mushroom, when hit out of its box, will move to the right, bounce off of a pipe, and head straight for Mario, who would have a hard time jumping over it with a line of blocks overhead. The point value and the increase in Mario's size make it very clear that this Mushroom is a helpful object. Finally, after a few more Goombas, Mario encounters a pipe that's taller than any other obstacle he's had to surmount thus far (Figure 3). This ensures that the

player can't move on in the game without first discovering that Mario jumps higher when the A button is held down rather than just quickly tapped – a skill that is absolutely essential to know to complete the game. All of these things are taught to the player in the first two screen-lengths of the level without any explicit "telling" of information.

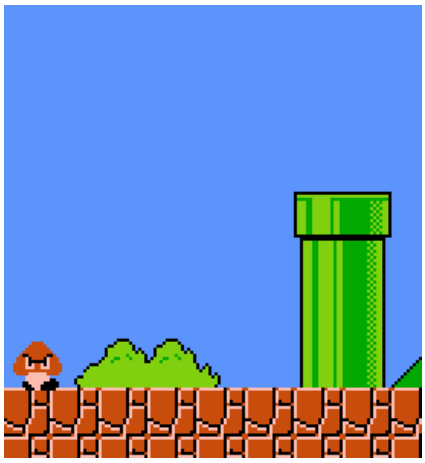

Figure 3 – This pipe cannot be passed unless the player holds the jump button to jump higher.

These sorts of teaching strategies are not only presented by *Super Mario Bros.* – these techniques have been employed by many well-designed video games. James Paul Gee, in his book What Video Games Have to Teach Us About Learning and Literacy, lists 36 learning principles exhibited by games with effective informal learning. These 36 principles, along with the entire book, have become seminal works in the field of interactive learning. *Super Mario Bros.* has already illustrated a few of these principles – such as the discovery principle, which Gee describes as keeping overt telling to a "well-thought-out minimum, allowing ample opportunities for the learner to experiment and make discoveries" (Gee 207). The tall pipe in *Mario*'s first level is an excellent example of the incremental principle – by putting this obstacle so early in the game, the game ensures that players don't get the wrong idea of how jumping works (Gee 207). This challenge ensures that the basic skills the player learns are correct and will aid them in later trials – something that an effective tutorial absolutely must do.

2.3 *MEGA MAN 3*: TEACHING THROUGH LEVEL DESIGN

While Gee presents many learning principles in his work, one of the more important ones relating to interactive tutorials is the idea of psychological moratorium – which is, as Gee puts it, a space in which learners can take risks where consequences are lowered (Gee 207). This principle, along with the principle of incremental learning, is masterfully demonstrated by the *Mega Man* series of video games. While *Super Mario Bros.'* first level is a shining example of a game that teaches a player all of its primary controls right away, the Mega Man series spreads its teaching tools about all of its levels. Mega Man's primary method of teaching a player is by creating layers of psychological moratorium – in other words, a player is introduced to obstacles and puzzles in a safe environment, where if they fail, they can just try again without consequence. Then, the game gives a player a similar puzzle that's a bit more difficult, but there's still no in game consequence. Once the player has had time to practice and perfect the strategy for this obstacle, they are given an even more formidable iteration of that puzzle with actual in-game consequences for failure, such as taking damage or even losing a life. This method of teaching is compelling, non-frustrating, and effective, and *Mega Man* uses it often in its design.

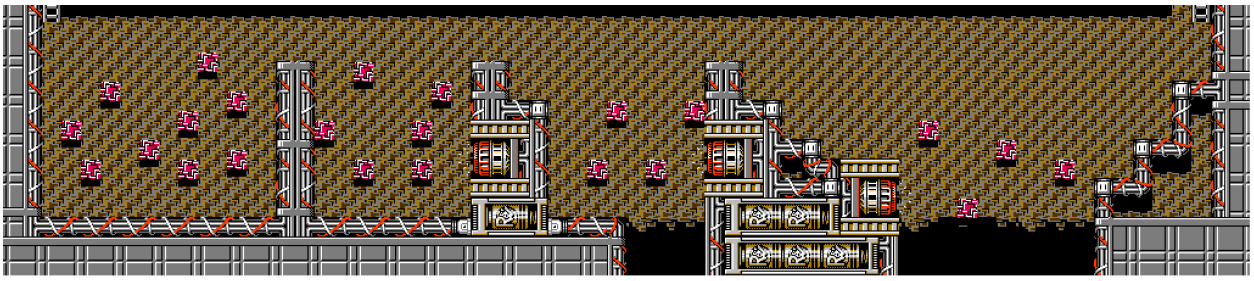

Figure 4 – The "disappearing block" section of the Magnet Man level in Mega Man 3. *While all of the red blocks appear stationary in this image, they actually fade in and out of existence in a complicated pattern.*

One of the best examples of this teaching methodology can be found in *Mega Man*'s "disappearing block" puzzles. Blocks appear and disappear in a pattern, and players must time

and aim their jumps properly without seeing where the next block will appear. One of the earliest examples of this puzzle occurs in *Mega Man 3* in Magnet Man's stage. There are four different block patterns at one spot in the stage, and they each improve on the other in subtle, but important ways. The first one takes place over solid ground. The second one also takes place over solid ground, but this time there's a magnet pulling the player to the right, forcing a player to rethink their tactics from the previous pattern to adjust for the pull. The third pattern is much like the first, but takes place over an open pit, giving failure some severe consequences. The fourth pattern is much longer than the others and reintroduces the magnet, resulting in an extreme challenge. However, the game didn't just throw the final challenge at the player with no warning. It gave the player the opportunity to practice and master the puzzle, which removes a great deal of the frustration that would otherwise surround such a difficult obstacle. By incrementally increasing the difficulty of challenges and severity of consequences, the *Mega Man* series of games keeps players on the edge of their regime of competence without ever feeling impossible, resulting in an extremely rewarding and engaging experience – all without saying a single word to the player.

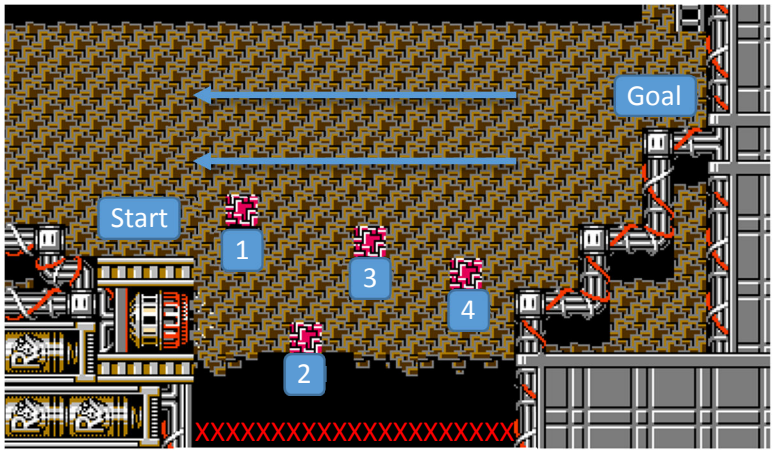

Figure 5 – The final "disappearing block" puzzle in Magnet Man's stage. There is a constant force dragging the player to the left, and if he falls, it means that he loses a life and must attempt the entire section again.

Games such as *Super Mario Brothers* and *Mega Man* are known as classics of video gaming – and not just because they were the first games that many people played. While their graphics and hardware are now vastly outdated, these games stand the test of time due to the sheer brilliance of their instructional design. Even in their comparatively ancient time, these games showed the gaming industry how effective teaching through embodied experience could be.

2.4 TUTORIALS IN THE MODERN ERA

All of the examples given so far are from a very early era of video gaming – an era where this sort of wordless instructional design is made easier due to controls and controllers in that era being far simpler than they are now. Players could be expected to try every button and combination of buttons on their controllers, so overly explicit instruction was not necessary. As games and controllers become more and more complicated, many games began abandoning the practice of teaching through experience and level design and instead focused on explaining each mechanic to the player through text. While this is a method that is capable of presenting a great deal of information to a player in a short time, it is less intuitive than teaching through letting a player figure things out on their own. Relying on long-winded explanations to explain controls and game mechanics doesn't take advantage of the interactive nature of video games. Letting the player experiment in an engaging and forgiving environment and make conclusions based on their own trial and error is a uniquely interactive and extremely effective method of teaching.

To illustrate the importance of keeping the tutorial an interactive experience, look at the differences between the tutorials of *Starfox Adventures* for the Nintendo Gamecube, and *The Legend of Zelda: Ocarina of Time* for the Nintendo 64. Both games are of the same genre –

three-dimensional, third-person adventure game – and the games even feature very similar control schemes. However, their opening tutorials are remarkably different. In *Starfox*, almost every single control is explained to the player through on-screen text. In Figure 7, as soon as the player approaches this caged bird, he interrupts the gameplay just to tell the player to look at an on-screen prompt. A similar event occurs whenever the player has to press a new button on the controller. *Ocarina of Time* takes a far different teaching approach in its opening section. Instead of explaining every single button's function to the player one at a time, it instead uses a sort of "tutorial sandbox" – a large area with sections designed to get the player to practice using the game's controls. The area contains many non-player characters which the player can choose to talk to, and many of these characters will explain some of the more complicated mechanics in more detail. The opening section of *Ocarina of Time* is essentially a playground – there are plenty of areas strewn about that will test players' skills at navigating the game world and performing more complex tasks, such as combat or camera control. *Ocarina of Time* is lauded by many as one of the greatest games ever created, while *Starfox Adventures* is seen as a blemish on the otherwise excellent *Starfox* franchise. While both games have very similar controls and gameplay design, *Ocarina* presents these mechanics to the player in a much more interesting and intuitive way, and has managed to remain a timeless example of effective tutorial design in a three-dimensional game.

Figure 6 – Ocarina of Time*'s opening area, Kokiri Forest, is a safe area where the player can experiment with the game's controls and get a grasp on the mechanics.*

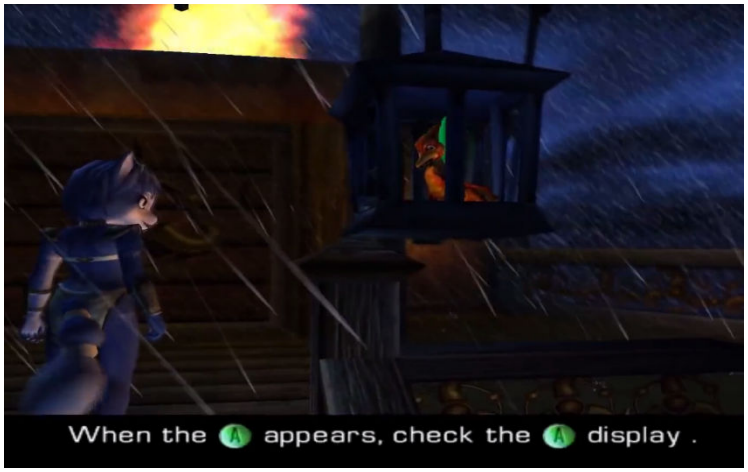

Figure 7 – Starfox Adventures' *tutorial is littered with gameplay interrupting cutscenes that explain every control and mechanic to the player.*

However, teaching strictly without text can only be effective for so long. As controls and controllers become more complicated, players cannot be expected to try every combination of buttons on their own just to find which ones perform essential actions (this is especially true if the player is using an input device with a large number of buttons, such as a computer keyboard). Clearly, tutorials needed to become a bit more complicated to keep up. Some tutorials take this idea too far, and explain single button to the player through mountains of text (such as *Starfox Adventures*). These sorts of tutorials leave nothing to be figured out by the player, and while

they could arguably be called a more thorough lesson, they are hardly engaging and barely interactive.

Some modern tutorials try to find an equilibrium between intuitive, wordless teaching and explaining complex controls by using descriptive images that will guide the player to the proper buttons. For example, the tutorial of *Kirby's Epic Yarn*, a game for the Nintendo Wii, is split up into various small segments, each one designed to introduce a new mechanic or control to the player, and give them a small obstacle that must be overcome by using that mechanic. To explain which button to use in each section, the game simply shows a picture of that button on the controller alongside a small image that shows what that button will do. This is an effective way to get the player to press that button, and then observe what happens and make conclusions based on that observation. Having a small area in which the player can immediately practice this new ability only adds to the effectiveness of this tutorial method.

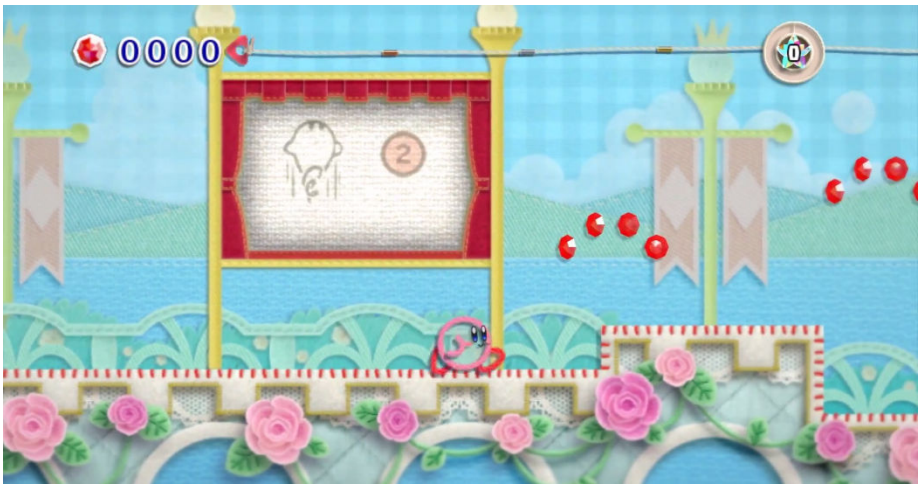

Figure 8 – the beginning of Kirby's Epic Yarn*'s tutorial. The game introduces the jump button ("2") using the image shown here, and then presents the player with a raised surface that they must jump over to proceed.*

A common thread through many of these points is the importance of keeping gameplay non-interrupted. Taking control away from the player and forcing them to listen to explanations of controls and gameplay mechanics that they may have already figured out is a surefire way to

lose a player's interest. Another tutorial sin is locking out player choice (such as disabling controls or mechanics) just to force the player into performing one particular action. Locking the player into one action and one action only is no better than removing control from them altogether.

2.5 EDUCATIONAL GAMES

It is clear games have many tools and techniques to facilitate remarkably engaging learning – yet games remain primarily a commercial product for entertainment purposes, and not a learning tool for schools and classrooms. With all of these effective tutorials showing off the immense teaching power video games have, why are games not a staple of education? Henry Jenkins has a hypothesis: "Within the games industry, 'edutainment' has become a bad word, suggesting an earnest aesthetic, derivative gameplay, and poor production values. Common wisdom is that educational games fail both commercially and creatively" (Jenkins "From Serious Games…" 1). A primary reason for the failure of "edutainment" games is that they tend to treat video games as replacement for "skill and drill" exercises. By wrapping up these boring tasks into a framework that resembles a video game, the designers of these games seem to believe that their menial content will magically become engaging to users. Of course, this is not the case – video games remain a commercially focused medium, and very few classrooms successfully use them as teaching tools.

This is not to say that video games are incapable of functioning as classroom aids. It is clear that video games can provide extremely effective teaching, but any game that wants to teach something to its players must be meticulously designed to do so – if tasks are boring outside of an interactive medium, they will not instantly become exciting when inside one. As

Henry Jenkins writes, "The fantasy is that one can just plant kids in front of a black box and have them 'learn' as if learning involved nothing more than absorbing content. Those who fear that games may turn normal youth into psycho killers similarly hope that games might transform them into historians, scientists, engineers, and tycoons. […] Putting the emphasis on the program to deliver content has often led to highly rigid and pre-structured play experiences, carefully regulated to conform to various state and national curricular blueprints, with little chance for emergent play or creative expression by the players" (Jenkins "You Can't Bring…" 3). Games are not automatically engaging – they only become that way as a result of careful design and thorough testing.

2.6 Level Design and Testing

There is only one way to determine the effectiveness of a video game – testing it. There's no algorithm for testing the quality of a game tutorial – it can only be evaluated through letting others experience it and provide feedback. As Joel Burgess, senior level designer for Bethesda Game Studios, puts it, "As early and as often as possible, get people in front of the level and watch them play it. […] The unfiltered feedback you get from players will always be the best guiding light, and will often help you win internal arguments you had already been having" (Seifert 2). Many playtesting sessions are informal, in order to make the tester comfortable enough to give frank, honest opinions.

One of the most important pieces of feedback a tester can give simply *how* they progress through a level. Level design is a subjective art – what may be obvious to some may be less obvious to others. Understanding how players perceive and react to cues and obstacles in a level is the most essential piece of information needed when designing a game area. It is extremely

important to know how someone would progress through an area they have never seen before – and that is a state of mind that the level designer could never have. As Jim Brown, lead level designer for Epic Games, states, "[Level designers] sometimes build a level assuming that the player will proceed through it in the same manner that the [level designer] who built it will get through it. Just because you've played it 500 times doesn't mean the end user has, and they will be facing backwards at the wrong moment, hit triggers out of order, go the wrong way, and break your level in every way imaginable" (Seifert 1). Letting players roam about a level while letting them act based on their own intuition is the best way to determine the flaws in a level design.

One problem that many three-dimensional level designs face is the issue of level flow. Players must be able to understand the primary path through the level, and encounter all of the events and challenges in the intended order. However, if a level is too linear and directs the player onto the prescribed path too strictly, it will feel stifling to the player. A careful balance between directing the player and giving them a feeling of freedom must be struck when designing levels, especially three-dimensional ones.

There are many techniques that level designers can employ to create levels that feel open and free while still directing the player along the right path. Two of the most important of these tools are sightlines and lighting. The Fullbright Company's co-founder, Steve Gaynor, has this to say on the topic: "For instance, if you enter a space and you can see two doors on the far wall, is one more important than the other? Is the player supposed to enter one first? Maybe set up a sight blocker so they only see one door first, and can't see the second one until they've reached the first one, and so in all likelihood will go in there first instead of skipping it […] Also, if the lighting is too even, nothing is prioritized. Look at how you can throw spotlights and shadows around to highlight important things, so the player can get a lay of the land on first glance"

(Seifert 1). When designing a three-dimensional game area, careful attention must be paid to the order in which a player's attention is drawn to each object.

3 METHODOLOGY

We created a prototype of an introductory area for a musical video game in the Unity game engine. Following that, we prepared a survey to get the reactions of players and gauge the effectiveness of the prototype. Our design decisions were made to emphasize tutorial techniques we observed in existing video games. After we completed the prototype, we sent it out in conjunction with the survey by email. The survey was sent to college students, many of whom had some musical background and/or experience playing games.

For this methodology section, we will be presenting our design document – a document that describes the design of our game and the details of how to implement that design. We updated this document as we modified our design, and this final version represents the design of the final version of the demonstration we created. The differences between the original design document and the final prototype will be noted. Following this, we will discuss the thought processes behind the creation of our survey.

3.1 INTRODUCTION

The goal of this document is to describe and detail the implementation plan of our music-game demonstration. In this section, players will be familiarizing themselves with the controls of the game, and learning some of the basic musical concepts that they would be using throughout a completed version of this game.

3.1.1 Goals

This opening section of the game has these primary goals:

- Teach the player the controls of the game in a non-frustrating way.
- Establish the musical atmosphere of the game world.

- Make sure the game is engaging, and doesn't just feel like a music theory lesson.

This opening section should prepare the player for the later sections of the game, while also teaching them some of the absolute basics of music theory.

3.1.2 Activities Overview

The entire game is split up into various discrete activities. These activities each have a specific purpose, and usually try to advance the player's understanding of music in some way. The activities in this opening section of the game are as follows:

- Ascending the Cliff
- The Chord Bridge
- The Rhythm Bridge

The original design document planned to feature these six activities:

- The Wagon Ride
- The Old Man Game
- Basic Notation Reading
- Chord Introduction
- Note Pattern Introduction
- Crossing the Bridge

We decided on our three activities as minimal yet effective replacements for the above activities.

3.2 Basic Interaction

Figure 9 – an illustration of our control scheme. See legend below for an explanation of coloring.

: *Instrument Actions*

Play the note, chord, or pattern associated with that number in the scale (see section 3.2.1)

: *Movement*

Moving forward, backward, left, or right based on the current angle of the camera.

: *Utility* Keys

The functions for the Q and E keys were initially to interact with nearby objects or people, but they were removed in favor of automatic interaction when the player is close. This decision was made to keep the controls from becoming too complicated – removing a "talk to NPCs" button meant that there would be one less control to explain to the player. The 9 and 0 keys are to change between note and chord mode for music playing.

Mouse: Camera Control

Moving the mouse rotates the camera around the player in that direction, giving the game a standard 3rd person camera setup.

3.2.1 Musical Actions

There are two modes of making sounds with the instrument: Note Mode and Chord Mode. Initially, there was also Pattern Mode, but that was taken out for this prototype, to avoid confusing players.

Note Mode: Upon pressing one of the number keys (1-8), the player will play that scale degree in the current key. The player does not get to decide what key he will be playing in, as the game decides that based on the current situation. For this prototype, the player is restricted to the key of C.

Chord Mode: Upon pressing one of the number keys (1-8), the player will play the triad built from that scale degree. For example, if the game puts the player in the key of C, pressing "1" will play a C major chord (C, E, G). Pressing "3" will play an E minor chord (E, G, B). The chord may not necessary be in first position – the inversion of the chord will be chosen at random. This keeps the chord from becoming irritating if the player has to play it multiple times in succession.

3.2.2 Musically Triggered Actions

One idea that did not make it into this prototype was the ability to perform certain actions anywhere in the world by playing a series of chords. These actions would be helpful for the player to navigate the world or interact with people. For example, playing the cadence V-I would allow the player to run faster, or playing the cadence ii-V-I would give the player a much higher jump. An expanded version of this game might use some of these ideas, but there wasn't room in the prototype to both teach the player and effectively use these actions.

3.3 PLAYER CHARACTER

3.3.1 Appearance

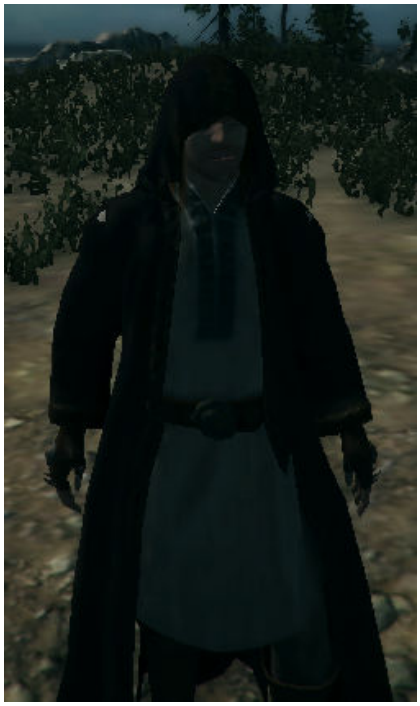

Figure 10 – the player character's appearance (will likely change for complete game).

3.3.2 Actions

The player can move their character and play an instrument. Other forms of interaction have been disabled for this prototype, in order to not distract the player. The ability to jump using the spacebar was present in our initial design, but was taken out for our final iteration. There were multiple reasons for this – the most important of which being that jumping didn't seem to serve a purpose in our game. In fact, it seemed to just be a distraction – players would be confronted with an obstacle that could only be overcome by playing music, and they would just try jumping over or around it instead. In the end, we decided that the game would be more straightforward and less frustrating if jumping was removed entirely.

3.3.3 Customization

In a future version of this game, customization of the character's appearance will likely be included. For this prototype, we chose not to include this feature. Implementing quality character customization is a very complex task, and it would have little to no effect on the effectiveness of our tutorial, which is what our project is all about.

3.4 Activities Overview

This is a general overview of each activity. For more precise detail, see Section 3.6.

3.4.1 Ascending the Cliff

The game begins with the player in an open field. They encounter an old man, who tells them that the number keys can be used to play notes. NPC's dialogue appears in a small box above their head that shows up whenever the player is close to them (see Figure 11).

Figure 11 – One of two speaking NPCs.

After that, the player comes upon a cliff with four groups of dots, each below a long, thin rock. By pressing each number key equal to that number of dots (1, 3, 5, 7), the corresponding rock extends from the cliff. Once all four rocks are extended, a small jingle plays, indicating that the player has completed the activity and is able to proceed up the cliff via the rocks.

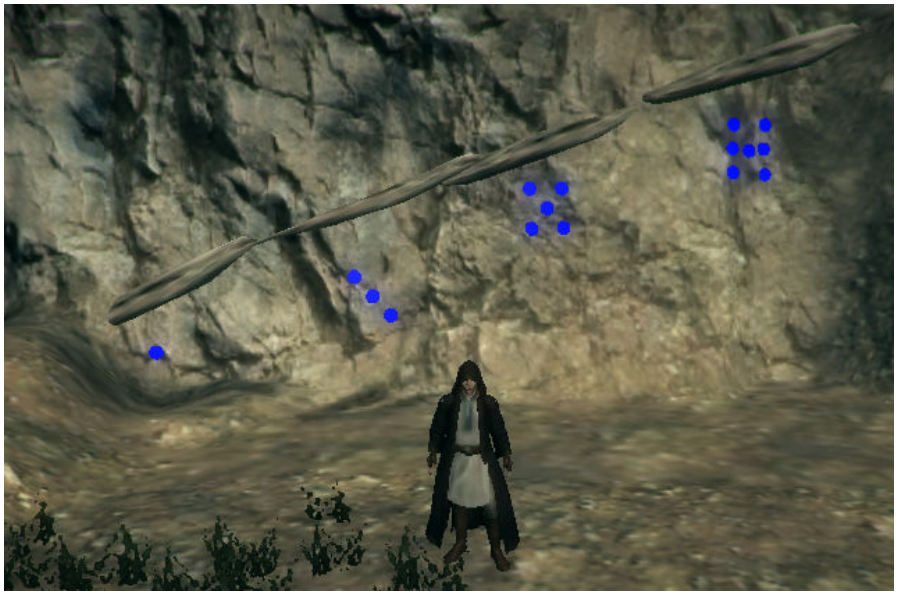

Figure 12 – the initial state of the first activity.

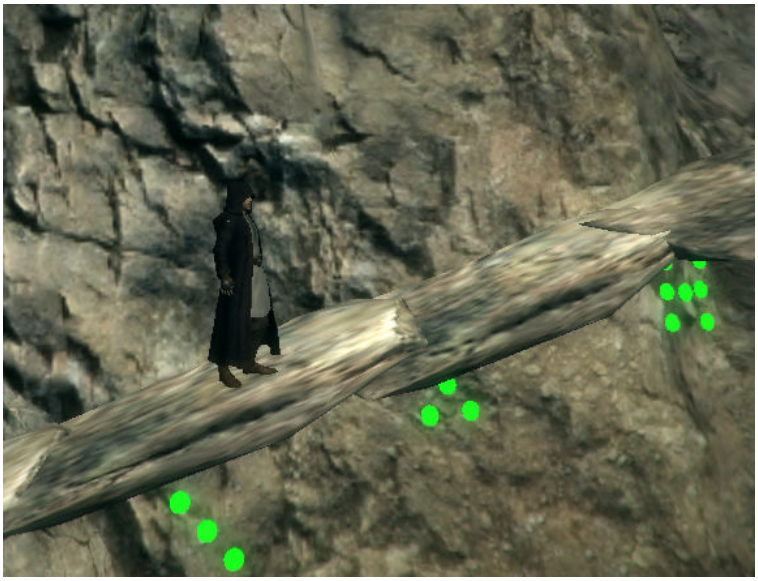

Figure 13 – The first activity after the player has played the 1, 3, 5, 7 notes.

3.4.2 The Chord Bridge

After continuing along the path for a short time, the player comes upon a broken bridge next to a pile of planks. The groups of dots are present again on the pieces of the bridge, indicating the notes to play. This time, there are three groups of dots per missing bridge piece, and all three notes must be held down at the same time to play a chord. Doing so will bring three planks from the pile to the bridge, allowing passage to the next part of the bridge.

Figure 14 – the initial state of the second activity.

Figure 15 – After the player has fixed and crossed one piece of the bridge, and is holding down the 4 and 6 keys on the second section.

3.4.3 The Rhythm Bridge

The final activity the player encounters is a more difficult broken bridge. However, they are given Chord Mode so that they only need to press one key instead of three. The goal of the activity is to play the proper chord on the downbeat of the measure, so that a group of floating planks will land and fix a piece of the bridge. An audio click track is playing, so that the player can hear when the correct timing is to play the chord. The colors of the squares on the bridge pieces correspond to colored music notes that emit from the player upon playing a certain chord.

These colored bridge squares are a complicated piece of visual feedback. On every downbeat, the squares will briefly pulse – increasing in size slightly. The outline of the squares indicates a player's success or failure upon playing a chord. Take, for example, the first square – the cyan square. Cyan corresponds with the "2", or "II" note/chord in the game. If the player plays the II chord at the wrong time, the outline will turn red. Seeing the square change color at all should clue the player into the fact that this chord has something to do with solving the puzzle, and the red color should hopefully indicate that they are still doing something incorrectly and haven't quite solved the challenge just yet. If the player combines these two pieces of visual feedback and plays the II chord on the downbeat of the measure, the outline lights up white and the planks move into place, allowing passage across the chasm.

Figure 16 – the initial state of the final activity.

Figure 17 – the final activity completed.

3.4.4 Previous Activities

The Wagon Ride: This was an introduction to the basic music controls. The player would not be able to walk around during this activity, so they could focus only on the musical controls.

The Old Man's Game: An old man would give you an instrument during the wagon ride and teach you how to use it. After the wagon ride, he would be available to repeat what he taught you on the wagon.

Chord Introduction: In this activity, the player will be arranging "frogs" (or some other kind of friendly creature) by playing chords, in order to cross a pond.

Basic Notation Reading: The player meets a guitarist and bassist who are looking for help playing a song. The player helps them out by playing sheet music for a third part.

Note Pattern Introduction: The musicians introduce pattern mode to the player, and have the player perform their song with that mode.

The Broken Bridge: The player encounters a broken bridge on the way to town. Frogs (or another kind of creature) help out again. By playing music notes, the frogs will jump up and push planks into place, but a mistake will knock the planks down.

These activities were replaced with the current ones to streamline the game and focus on the content we felt was the most important. To make our game prototype more engaging, we set up our activities in a way that the player should determine what to do by observing their environment, rather than reading dialogue that tells them how to proceed. The beginning activities of our current prototype and the planned activities have the same basic rules: the player must play a sequence of notes to continue. The current prototype allows the player to discover the steps necessary, but the earlier idea would just force the player into following instructions.

Having a smaller set of 'lessons' to teach allows us to focus on making those complete instead of trying to briefly go over a greater range of ideas. Instead of trying to hint at everything, we made sure the player would understand just a few ideas by the end of the prototype. Specifically, we wanted to teach the number-key based music controls for both note mode and chord mode.

We decided to skip teaching a discrete musical notation in favor of our environment based clues. We were considering using traditional music notation or perhaps a simplified notation, but decided against it to keep the game simple and accessible to non-musicians.

3.5 Additional Musical Interactions

We had a few ideas for minor activities that the player could discover while walking around the game. These would not be necessary for progression, but would add to the immersion

and engagement of the player. Having these hidden activities in the game world could give the player a greater sense of wonder and discovery when they find them. They aren't present in our prototype but we feel that they would be an excellent feature for a full version of this game.

3.5.1 Birds in a Tree

The player can come upon a tree with many birds in it. They may notice the birdcalls and try playing along with the birds. The birds may give a small prize for playing their song correctly. Other trees house woodpeckers, whose rhythms must be matched with a percussion instrument to get a prize.

3.5.2 Songs Hidden in Level Architecture

By standing in certain places and looking at the world, the notation for a song may suggest itself. Ideas for places to hide songs: carved into rocks and trees, arrangements of rocks or other environment props, arrangement of buildings seen from above. Playing these songs can trigger unlocking new areas or other benefits. Our current activities in the prototype are very obvious about what notes to play, but these hidden songs would be much more subtle.

3.5.3 NPC Humming/Whistling

Regular NPC's may whistle or hum as they walk around. The player can try matching their song. If they are successful, the NPC could tell them the some information about the song. This could be also be a clever way to introduce the player to the lore of the game world.

3.6 Activity Scripts

3.6.1 Ascending the Cliff Script

When the game loads, the player is in an open field. An image of the movement controls is overlaid onto the screen, giving the player a clue of how to move around the world. The player

encounters an old man who tells the player how to play notes (via the number keys). Immediately afterwards they find themselves in front of a cliff with a rock path upwards, but the rocks are stuck deep into the cliff. Under each rock is a group of dots: first one dot, then three, then five, then seven. When the player presses the corresponding number key and plays that note (1, 3, 5, and 7), the rock above that numbered group of dots extends from the cliff. Once all four have been pushed out, the player is able to walk up them to the next area.

3.6.2 The Chord Bridge Script

After walking up the cliff area and through a short path, the player encounters a broken bridge. Next to the bridge is a pile of planks, with a slight blue glow. On each bridge piece, the groups of dots hint at another note to play. However, this time there are three groups of dots on each bridge piece. Playing one of those notes will cause a plank from the pile to hover over the missing bridge, but once all three are held at once – a chord – the planks move down to fix the bridge. The first broken section requires the 1-3-5 notes, the second requires 4-6-8, and the third needs 2-5-7. Once completed, the player can cross over the bridge to the next activity.

3.6.3 The Rhythm Bridge Script

This final activity is similar in appearance to the previous, but requires switching to Chord Mode. An old man is present at this beginning of this broken bridge, informing the player how to change modes. With this mode, each press of a number key plays an entire chord, rather than a single note. On the pieces of the broken bridge, instead of groups of dots, there is a single colored square each. These colored squares correspond to the colored music note effects that emit from the player whenever they play a note, giving a hint to the player as to what note to play. The goal of this activity is to play the correct chord with the correct timing – a click track is

playing in the background, and the planks hover over the bridge and shift side to side with every fourth beat. Doing so causes the planks to move down and provide a path to the next part.

3.7 SURVEY

After completing our demo, players were asked to take our brief survey. The purpose of this survey was to gather thoughts from the participants in a few concise questions. While the optimal form of playtesting may be a direct observation of players, our circumstances did not allow for this, so we settled on having our players take a survey. This better fit our needs because it allowed us to reach a larger audience in a shorter amount of time. Our goal was to create a survey that allowed us to get the most information from the participants while still being a reasonable length. We attempted to make our survey as informative as possible without becoming annoyingly long to our players. When beginning to design the survey, we decided upon a few specific pieces of information that we really wanted to learn as a result of the survey. We designed our questions around these specific goals.

One of our primary goals of this project was to create a tutorial for a musical video game that is accessible to all players, regardless of prior musical ability or video game proficiency. We wanted to be able to compare the responses of the survey between musicians and non-musicians, and gamers and non-gamers. Therefore, our first question asked the tester if they had a musical background (for this survey, we defined a "musical background" as having played an instrument for five or more years), and our second question asked the tester to rate their proficiency at video games. To see if we achieved this goal, we split our results along these categories and looked to see if there were any significant differences in results.

Another key piece of information we wished to glean from the survey was validity of our tutorial as an effective pedagogical tool while not being too confusing or complicated. To determine if we succeeded, we asked our testers to rate the game's difficulty in a variety of ways. First, we asked testers to rate the overall difficulty of the demo on a scale of one to five. After that, we asked them to rate the difficulty of each individual activity on a similar scale. These questions allow us to gauge the challenge level of each aspect of our demo, and can help us understand testers' general impressions of difficulty and allow us to pinpoint especially troubling sections.

We also wanted to gauge players' perceptions about the control scheme. If the controls were awkward or uncomfortable, that would greatly increase the challenge of the game in a very frustrating way for the player. We asked testers to rate the control scheme, and give any comments they had on it. We also asked players if they would have preferred to use a different controller than a keyboard and mouse (such as a gamepad or a more specialized music-focused instrument, like a *Rockband* guitar) to play the game. While our project wasn't focused on the hardware aspect of game development, we decided this would be a good question to ask to help inform future groups that may work on this game with more of a human-computer interaction focus.

Finally, one of the most important pieces of data we hoped to draw from our survey results was whether or not our demo was engaging. We wanted to know if our players were enjoying themselves – which was our primary goal. The way we decided to determine this was to ask the tester if they would play a full-fledged game based on our demonstration tutorial. If they answered yes, then clearly we have caught their attention and interest enough for them to want more. Lastly, we asked testers to tell us their favorite and least favorite parts of the demo. This

final question was a way for us to hear some of the testers' thoughts in a more subjective, open-ended manner.

4 RESULTS AND DISCUSSION

Using the responses we received through our survey, we were able to determine the strengths and weaknesses of the prototype we developed. Taking into account the players' skill at video games as well as their musical background, we asked them questions about the difficulty of the individual challenges as well as the overall difficulty of the demo. We also asked for some feedback on the control scheme of the demo, along with whether or not this game would be better suited for a different controller.

4.1 PLAYERS' BACKGROUND

The first question of our survey asked subjects if they had any musical background. We defined having a musical background as having played an instrument for more than five years. This question was of fairly high importance to us because we need to know what kind of background the players have. 67% of our subjects replied "yes" to this question. We also asked how proficient the players felt they were at playing video games. We gave them a scale from one to five, with five being very proficient. The average of our results was 3.67.

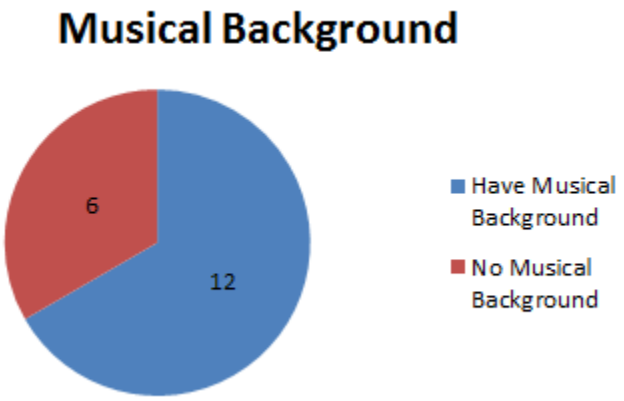

Figure 18 – the results of the question "Are you proficient on one or more musical instruments that you have played for over five years?"

4.2 Demo Completion

The next section of the survey asked if participants actually completed the demo. We then asked those that did complete the demo how difficult they thought the demo was overall. Out of all the responses we got back, we found that 77% completed the entire demo. Those who did not complete the demo were most often stopped by issues in the second and third challenges. For the next question – how difficult participants found the demo to be overall, on a scale of one to five, five being extremely difficult – we only accepted responses from participants who said they completed the demo. The average of all the responses we received was 2.21 (again, with five being the most difficult). The difficulty of the demo and the number of people who completed it reflect well on how we accomplished our goals in developing these activities.

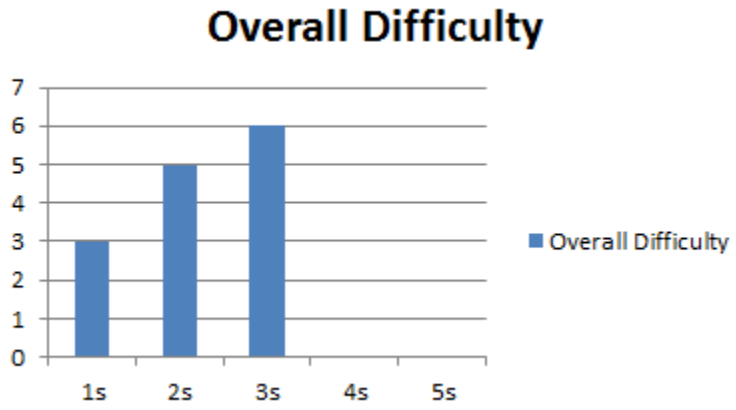

Figure 19 – the results of the question "Rate the difficuly of the demo."

4.3 Activity Difficulties

Our survey then proceeded to ask for details on how difficult the participants found the individual challenges. These were rated on a scale of one to five, with five being the most difficult. The results from these questions are directly related to how well we did in creating the challenges. The first challenge received an average rating of 1.94. The second challenge

received a rating of 1.89. The third challenge added another gameplay element, as well as incorporating the mechanics from the first two parts. The average rating on the third challenge was 3.44.

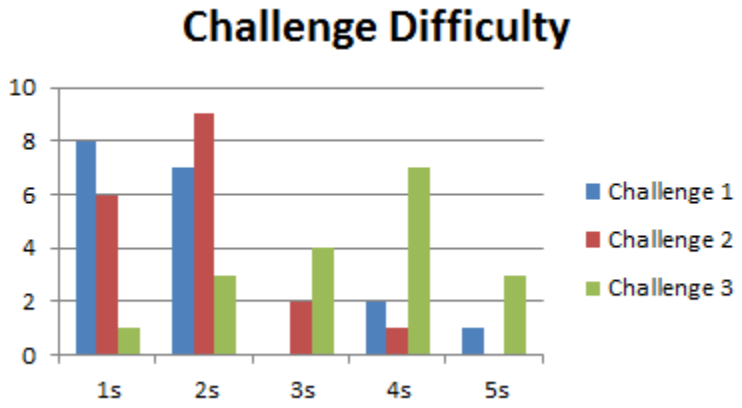

Figure 20 – the results of the question "How difficult was it to infer the steps necessary to complete the activity shown in the picture above?" asked for each of the three activities.

4.4 Control Scheme

The last section of the survey asked how participants felt about the current control scheme of keyboard and mouse. Because this game is focused around music, we wanted to get opinions on whether or not people felt this game would benefit from having a dedicated, more musically-focused controller. The first question we posed to the participants along these lines was for them to rate the ease of use of the keyboard and mouse control scheme. We had an average response in this part of 2.67. We had also asked about the type of controller people felt would be better suited to this game. The results of that question will be discussed later in this report.

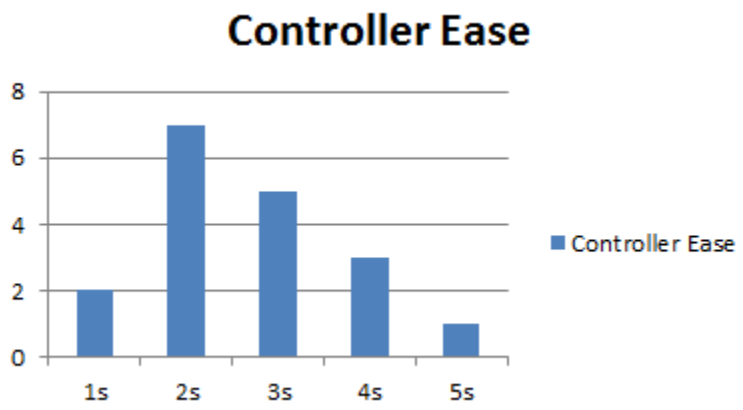

Figure 21 – the results of the question "Rate the ease of use of the control scheme."

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The three main focuses of this project were to make a prototype that would be engaging, accessible and complete. We aimed to design tasks that flowed along a proper difficulty curve, making sure the player remained interested in completing them. We wanted to teach them without them feeling like they were playing an educational game. The accessible requirement was fulfilled by the difficulty of the challenges we posed to the participants. We wanted to make it so even people with no musical background would be able to figure out the puzzles and learn from them. The last main focus we had was to make the demo complete. The way we wanted to achieve this goal was through the third and final challenge. We designed this challenge to incorporate the aspects from the previous two challenges, meaning that if the player could overcome this final challenge, they must have a basic grasp on the mechanics presented in all three activities. We will take a closer look at our success or failure in each of these aspects.

5.1.1 Engaging the Player

A video game is only effective for as long as it holds its players' interests, and if we failed to do that even for a short prototype, the whole idea could be considered a failure. Thankfully, the results of our survey suggest that we created a demonstration that was very engaging to players. The difficulty ratings for each activity demonstrated that the participants found the challenges to be appropriately scaled for the level of difficulty we were aiming for, preventing them from becoming too bored or too overwhelmed. One of the final questions that were on the survey was asking the players if they would be interested in playing a full version of this game. These responses were quite positive, with more than 83% of the participants saying that they

would like to play a full version of this game. This is a very strong indicator of success to us – more players quit playing a game in the first hour than the entire rest of gameplay time combined, so by having so many participants say that they would want to continue playing after completing our demonstration, we firmly believe we created an interactive experience that captured players' attentions and interests. We also asked the participants to list their favorite parts of the demo. Many people responded by saying they really enjoyed the puzzle aspects and how they were able to progress and learn about music fundamentals – and not a single subject mentioned feeling bored or feeling like they were simply playing through a music class. As one person stated, "the second part was the best because I got what was going on and it got me all excited". There were multiple responses similar to this which allows us to conclude that we did a good job in creating engaging tasks that can hold the attention of the players.

5.1.2 Accessibility

We wanted to develop this demo so it would be equally appealing to gamers as well as musicians. To identify how our participants classified themselves, we had asked them if they were musically proficient as well as asked them for their video gaming proficiency. While the responses about musical proficiency were fairly split with 67% saying they were musically inclined, most of our responses stated that they would consider themselves to be at least average at video games. We only had 5.56% of our responses say that they were not experienced with video games. By looking at this small selection, we can see that they did enjoy the game and found it to be a unique experience. The biggest issue that this group had with the game was the control scheme. This issue received multiple different responses from the entire field of participants. Some liked using keyboard and mouse and thought that the controls worked well. Others, including those that were not experienced in video games, felt that the game would be

better suited for a gamepad controller. There were also quite a few responses saying that they would have liked a piano controller to press the notes and have the keyboard only for moving. Based on the wide range of responses, we feel that the game was fairly accessible to gamers and musicians; however, we would have liked to get more responses from those who were new to video games.

5.1.3 Completeness

The final section we want to discuss about our findings is how well the players grasped the ideas that were presented to them in the challenges. To find the answers to this we mainly focused on the results from the third challenge. We did this because the third challenge was designed to act as a final test for the players by incorporating the skills they have picked up along the way. The average difficulty rating that we received for the third trial is much higher than the average for the first two, meaning the players found it more difficult to complete this task. There are a few factors that most likely contributed to this higher score. One was giving the players a new playing mode called "chord mode" as a reward for beating the second challenge. After we had given the players this new mode we asked them to use it right away in the third challenge with little time to get used to it or to experiment. This may have given some players trouble and a few of the players commented on it in the survey. Another issue might have been that on top of including skills from the first two challenges, we had attempted to teach the players a new skill. This new skill was an attempt to include rhythm into the game by having the player press the chord at the right time to proceed. While we didn't receive any comments on this in particular, it is something that might have given testers some trouble. Overall, the players enjoyed the experience and seemed to really get the feel for the mechanics of the game. One tester wrote, "My favorite part was playing the notes in time with the chord. Least favorite was

the end! Wish it kept going!" This indicated to us that we did a fairly good job at teaching the mechanics and making the demo an enjoyable experience.

5.2 RECOMMENDATIONS

A completed version of this game would expand on the content in this demo. The activities we chose to develop all allow the player to look around and figure out the situation. We recommend focusing on those kinds of interactions for teaching the player how to play music. When it comes to introducing players to new ideas, simple puzzles are far more engaging than explicit explanation. Combining puzzles into the level architecture worked very well for us – solving the puzzle gave the player a new area to explore, and that was more than enough reward to keep them extremely engaged and interested. We think that this system of rewarding the player is more elegant and effective than rewarding them with some sort of in-game "points" or currency, whose value is less understood by the player.

This game idea certainly merits further studies. One study that we feel could be performed is an exploration on control schemes for this style of game. We had a significant portion of testers express some concerns on the control layout of our demo, and we feel like the game could potentially be accessible to a wider audience if an alternate control device was used. A future project group could potentially test alterative input devices (such as gamepads or even *Rockband*-styled instrument controllers) for their effectiveness. Another study could potentially take a look at other ways to engage players aside from gameplay – such as narrative, aesthetics, or sound design. While our project focused entirely on designing and implementing engaging gameplay for a music game, there are many other components to a good video game, and each has enough depth to make for a worthwhile study.

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APPENDIX A: SURVEY

INFORMATION

Before taking the survey, we'd like to make sure you understand and consent to the following: - The intent of this survey is to collect information for an IQP that will be published online when complete. - The topic of our research is the effectiveness of an interactive demo for teaching the basic mechanics of a music theory game. - The only things we are asking of you are to download and install the Unity Web Player (if it is not already installed), play our game demo, and answer some questions about it. - The game and the survey will not collect any personal information about you. Participants will remain anonymous. - This activity is entirely voluntary - you may stop playing the game or stop answering questions at any time.

Do you understand and agree to the previous statements? *

- ☐ Yes
- ☐ No

Are you proficient on one or more musical instruments that you have played for over five years? *

- ☐ Yes
- ☐ No

How proficient do you feel you are at video games? *

	1	2	3	4	5	
Beginner	☐	☐	☐	☐	☐	Advanced

Did you complete the demo? *

- ☐ Yes
- ☐ No

Rate the difficulty of the demo. *

	1	2	3	4	5	
Easy	☐	☐	◉	☐	☐	Very difficult

ACTIVITIES

SCALING THE CLIFF

How difficult was it to infer the steps necessary to complete the activity shown in the picture above? *

	1	2	3	4	5	
Not difficult	☐	☐	☐	☐	☐	Very difficult

CROSSING THE BRIDGE

How difficult was it to infer the steps necessary to complete the activity shown in the picture above? *

	1	2	3	4	5	
Not difficult	☐	☐	☐	☐	☐	Very difficult

FINAL CHALLENGE

How difficult was it to infer the steps necessary to complete the activity shown in the picture above? *

	1	2	3	4	5	
Not difficult	☐	☐	☐	☐	☐	Very difficult

Rate the ease of use of the control scheme. *

	1	2	3	4	5	
Easy to use	☐	☐	☐	☐	☐	Difficult to use

What aspects, if any, did you feel were missing from the control scheme? *

Do you feel this game would be better suited to a different kind of controller? If so, what kind of controller would you have liked to use? (For example: joystick controller, Rockband-style instrument, etc.)

Would you play a full version of this game? *

In other words, if this demo was fleshed out into a full length game, would you be interested in playing it?

 Yes

 No

What was your favorite part of the demo? What was your least favorite part? *