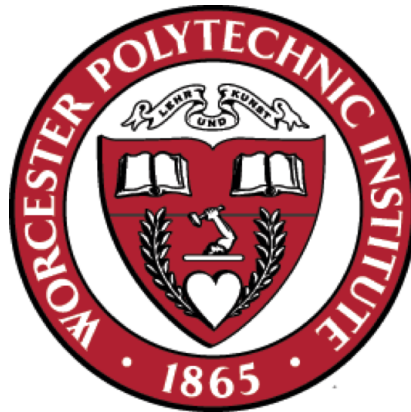

Interactive Music Systems: Tutorials for Digital Audio Workstations

Interactive Qualifying Project: E-Term 2015

By

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ABSTRACT

Interactive technologies exist to help non-musicians acquire musicianship skills using software-based instruments. These systems are accessible to non-musicians allowing them to create music, like playing chords and scales, with greater ease than traditional acoustic instruments. However, one component of modern composition, the use of Digital Audio Workstations (DAWs) to record musical ideas, still requires prior musicianship knowledge in order to operate. One goal of this project was to narrow the gap of accessibility of a DAW from being exclusive to musicians. This was accomplished through the development of an integrated tutorial game system based on a review of the literature on interactive music systems and DAWs. After developing the prototype, undergraduate students were surveyed for the purpose of feedback on the viability of our tool to facilitate DAW-based composition with accessibility. The data suggest that our prototype has such potential.

DEDICATION AND ACKNOWLEDGEMENTS

We would like to thank Professor Vincent J. Manzo for not only developing this project but for his guidance, support, and flexibility through the entirety of this extended term; there were a lot of good habits he helped us build both as a team and as individuals that we will carry on to future projects. We would also like to thank all of the student helpers at the writing center, who helped develop the writing style presented in this paper. Finally, we would like to thank all of the subjects who decided to participate in the study completed for donating their time.

AUTHOR'S DECLARATION

We declare that the work in this paper was carried out in accordance with the requirements of the Institute in accordance to the WPI Academic Integrity Policy. Research obtained from outside sources were properly cited and given credit. The project and follow-up study explained in this paper were both completed by the combined collaboration of the authors.

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INTRODUCTION

In recent years, music performance has been radically changed with the introduction of technology-based instruments. As a result, non-musicians can play and learn musicianship skills as well as perform using accessible, software-based musical instruments that are much easier to play than traditional acoustic instruments. However, these same accessible qualities have scarcely been applied to mechanisms of music composition and recording. As a result, Digital Audio Workstations (DAWs) and other common tools associated with music composition still possess a steep learning curve, and lack the immediate accessibility that tech-based music instruments possess. In short, the purpose of this project was to develop and test technology to help non-musicians learn the basics of musical composition.

Interactive music systems form a bridge between music and computer science to further the potentials of a musician. Interactive music systems can utilize innovative hardware and software to educate and enhance the capabilities of a user in respect to music. In short, interactive music systems are used to improve the musical society. This can range from creating new ways for music to be taught or learned, as well as connecting musician with fans. There is a wide scope of different types of technologies that are considered interactive music systems. This includes technologies such as: Musical Instrument Digital Interface (MIDI), different mobile applications also exist and serve this purpose, as well as Digital Audio Workstations (DAWs) which were the focus of this project. A DAW [1] is a music editing software for both musicians and non-musicians.

This project revolves around the creation of a tutorial for a DAW. In order to create an optimal prototype that may serve this purpose, there are two key components that must be considered and examined. The first component is to utilize the teaching style in which an average person retains the most knowledge while adequately stimulating the user. By finding and using this teaching style, the group will be more likely to create a final design that is optimized for any user,

regardless of skill or age. The second component of consideration when approaching such a task is that the final project must be similar to other commonly-used DAWs. A balance must be found between these two features; usability and simplicity sit on one end while the depth of features and versatility rest on the other. The goal is to create an engaging yet helpful tutorial-style game.

In short, three different areas were examined to help reach this goal: the different learning styles and how they may transfer to this project, the mechanic behind an integrated tutorial system, as well as the key features within DAWs until the intended balance was found.

BACKGROUND

There exists an abundance of accessible technologies to facilitate music performance, yet there are few resources to bring the same accessibility to digital audio workstations (DAWs) and other composition recording systems. By examining a transparent instance, a finer understanding can be attained.

Guitar! by Smule is a mobile application that allows users with varying prior musical experience to play and learn music. This is done using an intuitive and accessible software-based virtual guitar. In contrast, when observing a popular DAW such as Ableton Live, it is quickly noticed that it isn't intuitive. Although manuals and tutorials are available it is rather intimidating for someone without experience to use this DAW; it would take an abundant amount of time to familiarize themselves with the basics alone. Creating this bridge of accessibility for non-musicians between digitally playing and editing music is the end-goal. The plan to do this is to raise the level of accessibility for non-musicians of a DAW such that it may someday be on par with the level of accessibility of all other interactive music systems.

Many areas of research were scrutinized to obtain a versatile idea of what our project is as well as formulate a hypothetical resolution, which in turn became a practical and applied prototype. The first area of research to be considered is the understanding of Digital Audio Workstations, also known as DAWs. DAWs exist for a variety of platforms, all of which serve different purposes as well as have separate strength and weaknesses to meet their respective objective. By inspecting different DAWs, in regards to their purpose, strengths, and flaws, a DAW was created that would serve the study's purpose of tending to the needs of non-musicians. This deemed necessary to creating our final design of creating a tutorial game. The next area of research intertwined to this endeavor was learning styles. In order to scope learning styles in a manner that would be applicable to the project, the concept of transferability was applied.

Transferability, in short, is the application of similar studies and their results to our project; this was utilized to form our hypothesis along with our perceived results. The reason as to why this concept was applied is simply because there are very few comparative studies completed comparing different tutorial methods and their results. In order to design an optimal tutorial, a thorough knowledge of tutorial design was necessary. Although it is not ideal, it proved to be quite serviceable. The final area of research conducted was the mechanics of an integrated tutorial system. In general, games tend to be the best example of this since they can be complex but are relatively intuitive and don't require the user to read an instruction manual in order to play; this makes games both complex yet extremely accessible to most people. As mentioned previously, DAWs may be complex but fail to maintain accessibility towards non-musicians. An old classic, Super Mario Brothers, mastered the mechanics behind an integrated tutorial system. By analyzing each ingredient in this system, a recipe to serve the study's specific need was developed.

2.1 Current Digital Audio Workstations

Many DAWs commonly used by professionals were analyzed for their availability of features and interactive elements that might aid composition, particularly for non-musicians. This was because of the simple fact that intuitive learning and complexity stand on opposite sides of a seesaw. Intuitive learning directly correlates with the accessibility of any given software. That being said, there are many DAWs available and we used this to find balance between accessibility for non-musicians while maintaining complexity for the more experienced users. Overall, this serves our overarching purpose of increasing the accessibility for non-musicians.

The group began to attack this problem by conducting background research to familiarize themselves with DAWs as well as the key features that must be accentuated in a tutorial for someone who is a non-musician. The research began by examining DAWs that were found to be the most popular and most frequently used[3].

2.1.1 Garage Band

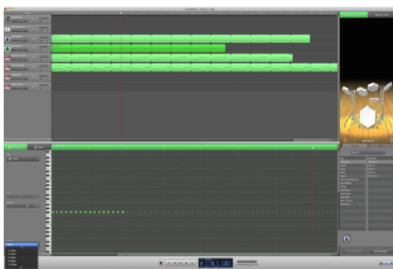


FIGURE 2.1. Garage Band [5].

The first DAW examined by the group as a whole was Garage Band. Garage Band is arguably one of the most standard DAWs for beginners. It is a software available on all Mac Operating Systems that maintains a level of simplicity while offering a lot of depth as well. A user can use Garage Band to compose music by using multiple instruments and tracks to create their masterpiece.

The most basic tutorial covers creating the soundtrack for a single instrument and looping different beats within a track. Further tutorials detail how to

manipulate that single track with equalization and other effects. Another key feature of Garage Band was that it is easy for the user to single out a track so that only that track is audible. This is essential when making sure the levels are correct. A component of Garage Band that makes it particularly useful for more advanced musicians is the ability to produce their own music using a physical MIDI keyboard. Otherwise, an onscreen keyboard is provided and the user can use their computer keyboard to simulate piano notes and be able to move through different octaves by pressing X or Z.

2.1.2 Groovy Music

In contrast to Garage Band, Groovy music is an exemplary DAW that sacrifices depth for simplicity. Right off the bat, we noticed its colorful design made it especially appealing to a younger demographic while limiting the amount of functionality lost. It manages to teach the basics of working with DAWs in a visually appealing and easy-to-learn way. This DAW demonstrated how we can use visual appeal to enhance the simplicity of our designed DAW.



FIGURE 2.2. Groovy Music [2].

2.1.3 Sugar Pucks



FIGURE 2.3. Sugar Pucks [8].

Sugar Pucks, a musical game created by WPI students, was also researched for features necessary in creating our tutorial game. Similar to Groovy Music, the interface is simple and appealing. In turn, the functionality awarded to the user is more limited than the average DAW. Rather than being able to create multiple tracks, the user makes a single track with different notes of equal lengths. The user is also unable to manipulate the single track in any way, however, the tempo of the composition can be adjusted. A preliminary idea when examining this was that this could potentially serve as the first level of our tutorial game where we would familiarize the beginner with creating a single track before advancing to the next level and dealing with multiple tracks. Future levels would then just manipulate a single track, including the utilization of looping or the application of effects. A method of testing would then need to be implemented to ensure that the user has acquired the intended knowledge.

2.1.4 Ableton Live

Leaping back into the more complex yet popular DAWs utilized, Ableton Live was analyzed. Ableton helps create music quickly by allowing users to create beats, drums, tracks, and effects.

It is very popular because it has Windows and MacOS versions. As with other DAWs, users can loop tracks. Users can add their vocals and apply effects to tracks such as equalization, cut, paste, delay, and publish options. Most notably, Ableton Live offers a workspace that is far more comprehensive than most DAWs.

The tracks, as displayed in the figure 2.4, are set in a vertical fashion that can store multiple instruments. This allows users to keep associated instruments together in one place and apply effects and equalization all at once. This saves time and keeps the workspace organized for the user. The layout is designed to be incredibly comprehensive and has great depth. However, when the simplicity is examined it is quickly noticed that the interface is rather intimidating, especially to a beginner.



FIGURE 2.4. Ableton Live [4].

2.1.5 Analysis

Four DAWs were observed, two of which were much simpler while the other two provided far more features. After researching these DAWs, it was evident that an intentional balance between these two opposing factors would need to be developed. Based on the focus of targeting non-musicians, it was concluded that the DAW must have the basic functional features but would be rather simple in layout. The essential feature that should be present in the DAW include: the play/pause button, the single out/mute buttons, adding/removing notes from a single track, adding/removing multiple tracks, as well as equalizing/manipulating/looping a track.

2.2 Learning Styles and Transferability

Different learning styles were perused along with correlating retention rates and stimulation in various articles and comparative studies. Their applicability to our project was also noted. By selecting a learning style that is both high in retention rate and stimulation, the level of accessibility was optimized for any user, specifically non-musicians.

The many differences between the various teaching styles result in diverse retention rates as well as differing levels of user interest. DAWs, like all programs, require some form of educational process. This is typically done through manuals, video tutorials, or any other static learning method in which the user is not engaged. Naturally, the human mind works more efficiently when it is stimulated. There are a few positive and negative factors about static learning methods that were considered when approaching such a task. The main positive factor of static teaching methods is that they apply to a myriad of users. In the context of DAWs, companies tend to make a single video tutorial or written manual as a reference for the user. A critical downfall to using

static methods, however, is that the tutorial may not stimulate the potential interest of the user as well as other teaching methods; this may result in the user retaining less information. The group theorized that an optimal tutorial would utilize static methods, but simultaneously draw from other methods in order to make it enjoyable and stimulating for a typical non-musician user. The group conducted background research on learning styles and retention rate, in order to validate this theory. These studies did not have to relate to DAWs; as long as it touched upon teaching style, particularly static methods, it was applicable to our project.

2.2.1 Enjoyment and Retention Rate

An article published in the magazine *Science* attempted to discern whether video games could be an alternative avenue for science, technology, engineering, and math (STEM) education[9]. The author, Merrilea J. Mayo, hypothesized that because video games are a far more accessible medium than other traditional forms of education, they could be used to reach a broader audience. The main opposition to this pedagogical approach is the idea that games with inherent academic learning are far less desirable to players than non-academic games. Mayo posited that this could not be the case as websites like whyville.net that host a cornucopia of math and science based games is voluntarily frequented by over four million children. She also proposed that the vast majority of education-oriented games lack two essential components: quality and sustainability. These games tend to be low-budget and poorly produced, those that break away from this stereotype do not have the proper know-how to bring the game successfully to market. This creates an awkward disconnect for the finished products; they either offer a subpar experience or fail to reach a larger audience due to inferior advertising. In both scenarios, the game is unsuccessful in propagating STEM education. To remedy this, education games must have an acceptable level of quality and be promoted more convincingly. If this is the case, Mayo is convinced that education games certainly have their place in an academic setting. This article suggests that there is a direct correlation between enjoyment and retention rate. This is applicable to the tutorial game such that the tutorial designed should be enjoyable, maximizing the retention rate of the information presented to the user.

2.2.2 Traditional Learning Styles' Effectiveness

In an article from *American Public Media*, Emily Hanford wrote about the ineffectiveness of the traditional lecture-based teaching style[7]. Hanford explained that students tend not to retain much information that is taught to them through lecturing. When given the opportunity to collaboratively learn, students recollected far more of the material later on. Requiring direct interactions from students resulted in the retention of information being typically higher according to the article. A traditional tutorial for a DAW is usually a walkthrough of the basic steps with text and pictures to guide them or a video explaining serving the same purpose. Both of these are comparable to traditional lectures demanding the student to start off with far

more motivation than something more interactive would. With this in mind, a tutorial with an interactive non-player character would prove to be vital to our success.

2.2.3 Static Versus Interactive Learning Styles

One study compared individual learning with cooperative learning and gave the subjects two tests to be taken. Cooperative learning is defined as “the instructional use of small groups so that students work together to maximize their own and each other’s learning”[10]. This is applicable to the tutorial because it implies that a way to optimize user learning would be to create a virtual teacher character, in order to mimic cooperative learning as much as feasibly possible. The results were inconclusive in regards to the retention rates of the students varying with the two learning styles; however, the study suggested that cooperative learning resulted in increased motivation and participation in the content. DAW tutorials are not complex indicating that the retention rate across different teaching styles should not vary much. The effect of cooperative learning on retention rate may be minimal, but the marked improvement in user satisfaction and motivation will be of great significance in the creation of the tutorial. This is especially noteworthy considering one of the main focuses of the project is keeping the user stimulated.

2.2.4 Analysis

These articles and studies suggest that dynamic or interactive learning styles result in greater engagement and engagement of the user will result in greater retention of relevant knowledge. Our primary goal for this tutorial, as with all tutorials, is to portray the necessary information to the user for them to be able to learn. A side objective for this tutorial, however, would be the engagement of the user. By creating a dynamic tutorial such as a tutorial game, these two goals are delivered simultaneously.

2.3 Integrated Tutorial System Example

For the sake of the study’s design process, an integrated tutorial system was taken into account. This schema offered a more intuitive approach to engaging non-musicians and providing them with a base-line of expected accessibility.

To do this, an old classic was observed, Super Mario Brothers. Super Mario Brothers has some of the best examples of well-designed learning curves without blocks of texts or a manual for the user to read. Right off the bat, the opening screen tells the user a lot; unlike typical gameplay where Mario is in the center of the screen he is off to the left facing the right with a bunch of blank space to his right.

2.3.1 Opening Screen/Layout Design

This opening screen allows the user to get accustomed and familiar with the controls. Along with this, the opening screen suggests the direction the user is going to go for the whole game, in the right direction. The opening screen shows the player's score, the number of coins they've collected, the level, and the time; all of which are self-explanatory.

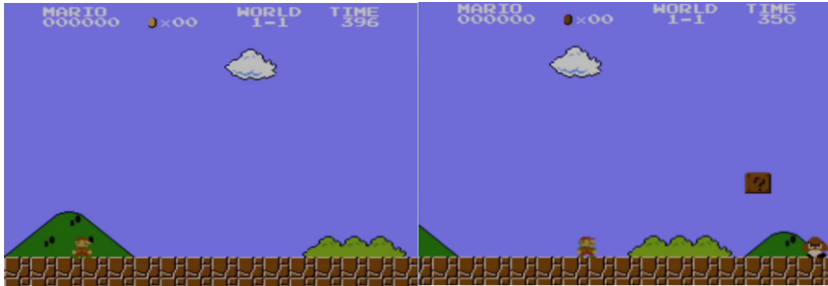


FIGURE 2.5. Opening Screen/Layout Design [6].

2.3.2 Lesson 1: Angry Mushroom

As the player moves right the first two things he encounters are a static box with a question mark and an angry mushroom heading towards him. The question mark box suggests that it is something good as it is static where as the distinct features on the angry mushroom coupled with the fact that it is moving in the opposite direction and to the left suggest that it should be avoided. If the player doesn't avoid the angry mushroom nothing big is lost and a valuable lesson is learned and ensured, the angry mushroom is an enemy and you have a limited number of lives. Along with this, the user starts at the beginning of the level once again. This utilizes a short iteration cycle suggesting and is a valuable tool in a game that teaches the user through some sort of punishment.



FIGURE 2.6. Lesson 1: Angry Mushroom [6].

2.3.3 Lesson 2: Question Mark Box

When the user attempts to dodge the mushroom by jumping the probability of him accidentally hitting the question mark box is incredibly high. The design behind this is to direct the user to the best of their ability to discover the purpose of the question mark box, as a reward system that helps the user.



FIGURE 2.7. Lesson 2: Question Mark Box [6].

2.3.4 Lesson 3: Size Mushroom

The next question mark the player hits releases a different looking mushroom. This new mushroom doesn't appear a threat as it moves in the same direction as the player, to the right. If the player decides the mushroom is bad and should be avoided, they are still put in a position where the possibility for collision with the mushroom is incredibly high for someone new to the game. This part is designed such that even when the player tries to jump over the mushroom, they hit a block causing them to hit the mushroom.

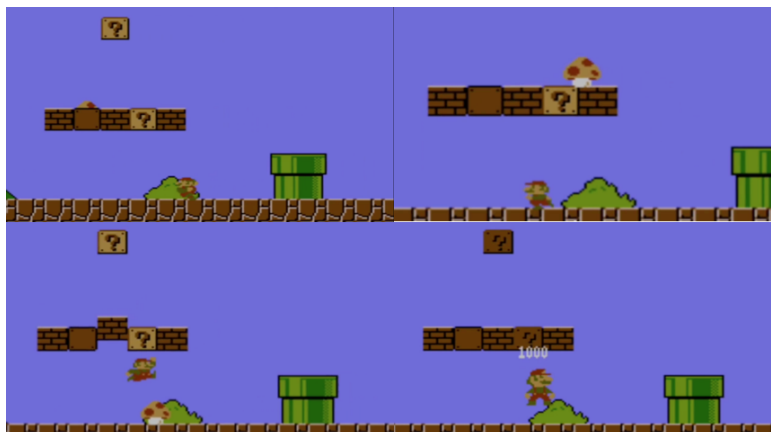


FIGURE 2.8. Lesson 3: Size Mushroom [6].

2.3.5 Recap/Summary

In a couple minutes of game play, the player has learned a lot within this game. The player has learned that the objective of the game is to move right, that angry mushrooms are bad, the player has a set number of lives, how to jump, the question mark boxes are good, and that the orange mushrooms are good and give some sort of power up. All of this is achieved without a single text box. The design behind this level is extremely brilliant in integrating a disguised tutorial for the user to be acquainted with the game.

2.3.6 Analysis

The take away from all this was that the most optimal tutorial allows the user to make the connection themselves, with minimal aid. Our tutorial would have little to no text such that the users may make the connections themselves.

METHODOLOGY

Digital Audio Workstations and commonly used recording composition software require a steep learning curve in order to be operated when compared to the abundance of performance systems accessible to non-musicians. In this light, one objective of this project was to increase the accessibility of DAWs by implementing some of the commonly used accessibility features found in music performance technology. This objective was fulfilled by the integration of an in-game tutorial which assists the user to discover the desired controls and functions by providing hints that prompt them in a specific direction. This tactic urges the user to actively develop the necessary mental connections and make the controls second nature while also stimulating their interest.

The way this was approached was through an in-game NPC who challenges the player to learn a certain feature and then prompt them to expand on what has been already learned and progress. The NPC continues to do this with each feature we expect the user to learn until the desired features have been taught. After this is done, the user should be able to reliably use and understand every aspect of the DAW with little to no guidance.

In order to analyze the efficiency of our design, users were facilitated to test our tutorial game and subsequently take a feedback survey. As mentioned previously, the design of the project was meant to cater to the needs of non-musicians. It was designed this way due to the fact that music and technology have developed together in such a way that DAWs are not very accessible to those who are not musicians. That being said, naturally the testing and study completed was geared towards non-musicians. Due to this fact, the study was designed to include and test exclusively users who were non-musicians, in order to most accurately simulate experiences that users will have in the real world. The study conducted had a relatively small population of 15 subjects. For the purposes of this study, this smaller sample size was sufficient. Further studies, however,

should ensue a larger population to normalize data and reveal outliers or design flaws.

3.1 Hypothesis

Upon completing their research, the group came to the conclusion that users who are engaged with an in-game tutorial that utilizes active teaching will ultimately retain more information than users who rely on more traditional static methods of learning, such as video or written tutorials. The purpose of applying this style of teaching to DAWs is to allow DAWs to be more accessible and understandable by non-musicians. This study was designed to gauge the future implications of developing such a prototype based off the feedback collected in the survey. The data found in the survey allowed the group to see to what extent the users feel that they learned valuable information from the tutorial. A more in-depth study should include the same DAW interface was designed, with a tutorial manual to replace the tutorial game design.

3.2 Creating the DAW Tutorial Game

3.2.1 Developer Environment

The first design choice that was addressed during the planning for this project was in what development environment the tutorial should be created in. The initial choice was to create the project in Unity 3D, as to allow future groups to build on this project and progress with it. The group ultimately chose not to use Unity 3D due to time constraints. Using GameMaker Studio proved to be much more efficient, and allowed the group to create a much more robust tutorial given the limited timeframe they were given. Although it sacrificed continuity between this project and other pre-existing projects, This project should still be able to serve as a basis for a wide range of future applications.

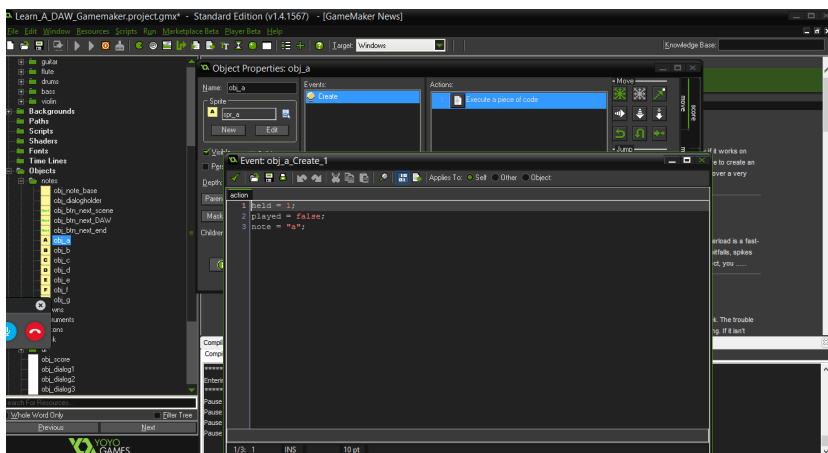


FIGURE 3.1. GameMaker Studio Developer Environment.

As opposed to creating an incredibly in-depth and complex DAW, the group decided to create a simpler tutorial that focuses on teaching non-musicians the basic and common elements found in many DAWs. Implementing more features than what was necessary to accomplish this goal would serve little purpose in determining the effectiveness of the tutorial, and may confuse the users.

3.2.2 DAW Design

After determining the developer environment, the next task was the creation of the actual DAW. The main elements, as shown in figure 3.2 below, that make up the DAW are: the add and remove track buttons; the play, pause, and stop buttons; the draggable instrument buttons; and the draggable note buttons. The add track button adds a track at the bottom of the stack of tracks while the remove track button does the opposite. The play, pause, and stop buttons allow manipulation of the DAW's tempo bar. The draggable instrument and note buttons can be used to manipulate what a track plays.

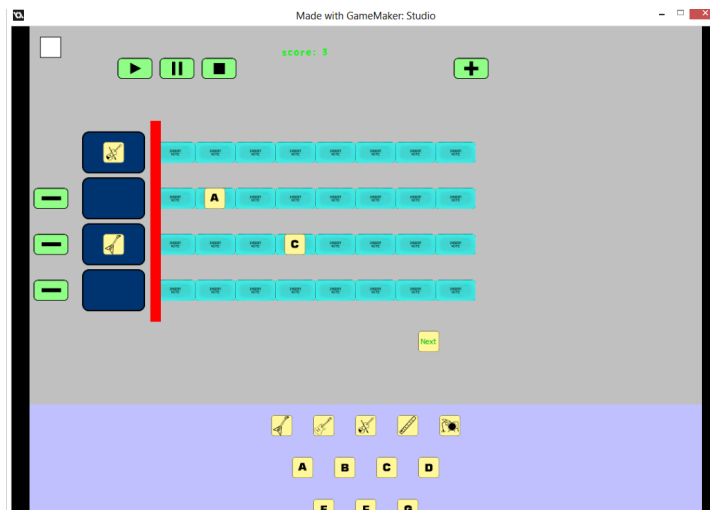


FIGURE 3.2. DAW Layout Design.

Since the physical continuity of this project was sacrificed and shifted to the conceptual continuity it was a lot more practical to make a simple DAW that could be used for analysis of testing the tutorial game. The entire project design is based towards the accessibility of DAWs specifically for non-musicians; this means that the more complex features would deem to be unnecessary for our tutorial game design and follow-up study.

3.2.3 Tutorial Design

After finishing the design of the interface, the group began to create the activity of the game itself. The tutorial begins with an advisor NPC interacting with the player for help in completing

a musical track (due to the NPC being injured) as shown in figure 3.3. The player is then led to the DAW scene where they are guided through the features within the interface while also gaining points for every learned feature. When a preset number of points have been met, they are prompted to a congratulations screen and are informed that they have completed the tutorial game. The only way for the player to complete the tutorial game is by mastering all the desired features.



FIGURE 3.3. Game NPC Interaction.

In figure 3.3A, the NPC says "Hey! Welcome to our little recording Studio.". Once the player hits the "Next" button, as shown in figure 3.3B, the NPC says "As you can probably tell, I messed up my arm pretty bad.". A final push on the "Next" button will, as shown in figure 3.3C, prompt the NPC to say "I was hoping you might help me finish up this track I have been working on!" A final press on the "Next" button will open the DAW interface shown in the previous section.

3.3 Prototype Testing

After designing the interface and interaction between the tutorial and the user, the final component of the methodology was the testing of the design in order to analyze the strengths and weaknesses of the tutorial. This was accomplished by having the users, non-musician college-level students, complete a survey following their completion of the tutorial game prototype. An email was sent to the WPI mailing list with instructions on testing the game and taking the post-tutorial survey. The email is shown in appendix A. The feedback survey, shown in appendix B, has 8 questions on a rate-scale basis. This served to provide a general and more quantitative idea of both the strengths and weaknesses of the design. Further studies could include comparative studies analyzing the differences between the tutorial design with static tutorial methods. The feedback survey was designed to assess how the design stimulates the user's interest, their depth of knowledge after completing our tutorial, as well as their retention, in this case perceived retention rate. A further study could include testing the retention rate of the users after any specific time away from the interface.

DATA AND ANALYSIS

There were many areas of success in the prototype design that were highlighted by the results of the study conducted. Although error will unavoidably exist in nearly all studies, this study still served its purpose to test the flaws and strengths of the tutorial, and to serve as a helpful example to future studies that may be similar to this one. The study proved that features of the DAW that were highlighted in the tutorial were much more readily understood and internalized by the users as opposed to features that were not. An area of interest in this study was found in the fact that the feedback surveys indicated that subjects didn't find the tutorial design to be informational. Although it may seem like a failure, this actually helps to prove that the tutorial was a success. The prototype was designed to be a tutorial game, a teaching method in disguise. Overall, the subjects understood most of the concepts within the design without feeling as though they were learning; this suggests that the tutorial was successful in causing the users to teach themselves as opposed to being fed information.

4.1 Data

| Q1: Informational | Q2: Engagement | Q3: Adding/Removing Notes | Q4: Adding/Removing Tracks | Q5: Looping | Q6: Equalizers/Manipulations | Q7: Playing/Pausing | Q8: Singling Out/Muting |
|-------------------|----------------|---------------------------|----------------------------|-------------|------------------------------|---------------------|-------------------------|
| 3 | 2 | 2 | 3 | 1 | 1 | 4 | 1 |
| 2 | 1 | 5 | 5 | 5 | 1 | 3 | 1 |
| 1 | 3 | 3 | 5 | 4 | 1 | 5 | 1 |
| 4 | 3 | 4 | 4 | 5 | 4 | 4 | 5 |
| 2 | 3 | 5 | 5 | 5 | 5 | 5 | 5 |
| 2 | 2 | 4 | 4 | 2 | 3 | 5 | 3 |
| 2 | 1 | 4 | 4 | 4 | 4 | 3 | 4 |
| 3 | 4 | 5 | 5 | 4 | 1 | 1 | 1 |
| 5 | 5 | 5 | 5 | 4 | 3 | 5 | 5 |
| 4 | 4 | 5 | 5 | 3 | 3 | 5 | 4 |
| 5 | 5 | 4 | 5 | 5 | 4 | 5 | 5 |
| 3 | 2 | 3 | 2 | 3 | 4 | 2 | 3 |
| 5 | 3 | 4 | 5 | 4 | 4 | 5 | 5 |
| 3 | 5 | 4 | 5 | 5 | 5 | 5 | 5 |
| 3 | 2 | 5 | 5 | 5 | 1 | 5 | 1 |

FIGURE 4.1. Raw Data.

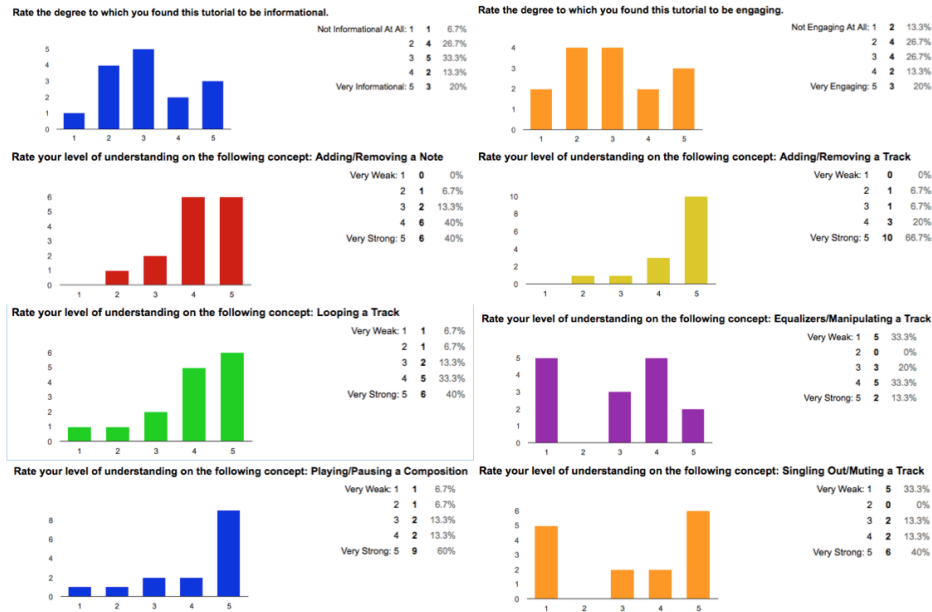


FIGURE 4.2. Graphed Results.

Figure 4.1 shows all of the raw data collected, to maintain anonymity, the time stamps the subjects chose to take the survey were removed. The data below demonstrates on a rate-scale basis on how the subjects felt in regards to the respective topics after completing the tutorial game. A rating of 1 means that they very strongly disagree while a rating of 5 means that they very strongly agree.

Figure 4.2 graphs each question shown in appendix B along with the respective results grouped in a bar graph. This made the results much easier to analyze as well as helped separate the strengths and weaknesses in our design as well as identify flaws and errors within the study.

4.2 Analysis

Upon analyzing the results, flaws within the study soon became apparent. The results of question 4 and question 7 can serve as good examples of said flaws. Question 4 asks the users to rate their level of understanding of adding and removing a track while question 7 asks the user to rate their level of understanding on how to play or pause a composition. Both of these questions should result in all or most of the subjects inputting a 5 (very strong) in the feedback survey. All subjects were expected to very strongly understand how to play and pause a composition because the play/pause buttons were placed where they could be easily seen by the user, and they were explicitly mentioned and focused on in the tutorial. Similarly, all the subjects should very strongly understand how to add and remove tracks is because there are distinct plus and minus signs, and the first tip the user encounters when opening the DAW explains how to add and

remove a track. Keeping this fact in mind along with the fact that all test subjects were college level non-musicians, figure 4.2 demonstrates how only 66.7% and 60% of the subjects inputted a rating level of 5 (very strong) for questions 4 and 7, respectively. These flaws will be explained in greater depth in section 5.

Noting that figure 4.2 may not accurately depict an exact ranking of the design, there are a few things to take away from these results. Overall, by analyzing the trends, an understanding of the strengths and weaknesses in the prototype design can be obtained. The trend for questions 1, which inquires about the design being informational, a relatively decent amount of people inputted a ranking of 1, being not informational at all, to 3, being neutral. At first glance, this may seem like a negative flaw in the design but this tutorial game is designed to be an integrated-style game. This is comparable to completing the Mario Super Bros integrated tutorial mentioned in section 2.3. Although the user may not feel like the Super Mario Brothers tutorial helped them gain knowledge, they learn a significant amount about the game. Similarly, that could be the implied result of the feedback given in regards to question 1 which is demonstrated in figure 4.2.

Referring to figure 4.2 in regards of question 2, there's a great deal to be said. Question 2 asks the user to rate the degree in which they found the tutorial to be engaging. Stimulus is an intriguing mechanism within humans. Stimulus and engagement are very heavily influenced and often times initiated by the users' interest level. A subject who has no interest to learn a DAW may not find the prototype design as engaging as someone who does. Looking back to section 2.2, it was emphasized that many studies suggest a direct correlation between engagement and retention. Knowing this, it became obvious that analyzing the retention rate of the subject would deem significant by examining the raw data shown in figure 4.1, on an individual basis.

The final take away from figure 4.2 are the strengths and weaknesses in our design. By examining the overall positive trends in the graphs corresponding to questions 3, 4, 5, and 7, it was reassuring to know that those are concepts portrayed strongly in the design. However, the trend shown in the graphs representing the results for questions 6 and 8, which tended towards the lower end of the rate-scale system, suggested that the design may not have optimally showed the users how to manipulate or mute a track.

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this project was to design a prototype that would yield practical application and be applicable to the Before Heaven game rather than designing a prototype with conceptual continuity. Although the weren't capable of producing such a prototype, there is a collection of conceptual ideas to take away from this project as a whole. This includes the implications suggested by the results of the study, design changes for conducting future studies to yield results with minimal range of error, and the future applications of creating a novel tutorial.

5.1 Continuity

Before proceeding further, it is necessary to reiterate the concept of continuity as it is meant in this paper. Continuity is the progression of an idea or project, to advance and develop. This project is the continuity of a much broader topic, the advancements of integrate music systems and specifically the development of the accessibility of DAWs towards non-musicians. There is much to take away from this design and study that help further the cause of expanding the accessibility of DAWs to less experienced users.

5.2 Study Implications

As mentioned in section 4.2, there were certain features within the DAW that were more apparent than others. The features that weren't as apparent also weren't part of the guided steps within the game. This implies that there is a direct correlation between guiding the user to complete an action with the desired feature being taught as the process of the using the feature allows them to better understand it as well as increase the retention rate. The results in this study demonstrated that users didn't seem to find the tutorial game to be informational and yet a

decent amount of features were strongly understood by the users. This suggests that a disguised tutorial game can be used as a successful teaching method.

5.3 Future Studies

One of the most important variables that future studies should alter is the number of participants in the study. As mentioned in section 4.1, there were unsubstantiated yet obvious outliers. This was shown in questions 4 and 7, which were control questions so to speak, designed to analyze the viability of the test's results. These were questions in which all or most people should have rated a 5 but only about 65% of the subjects did so. Designing a study with a much greater number of participants will make those outliers a lot more apparent and will also make it such that their footprint on the results is less heavy. In essence, a greater number of participants will help normalize the data, reduce the impact of outliers, and make the trends used to identify strengths and weaknesses more apparent.

Another method of improving this study would be taking this study and expanding it to become a comparative study rather than a one-sided study. Designing an experiment with two groups and comparing the results, side by side, to determine pros and cons of each method, would potentially yield far more accurate results. The methods would consist of a traditional video or manual tutorial being compared to an integrated tutorial game. To minimize error in such a study, the feedback survey should be identical and DAW interface should be similar, if not identical.

A key variable that can also drastically change the results of such a study is the type of subjects used in the study. Rather than using random subjects or subjects picked by randomly set parameters such as age, the subjects should be picked by the intended application. The group made the mistake of simply picking college-level non-musicians. In the best case scenario, subjects should be picked based off of two factors, experience level and interest level. The target audience of this study is non-musicians that are interested enough to want to learn how to use a DAW but are intimidated by its complexity as well. This study had users give feedback which indicated that they did not feel engaged, that may be due to the fact that learning how to use a DAW may not have been interesting to them to begin with.

5.4 Future Applications

The applications of such a design are endless and expand beyond music. Overall, in all forms of art, technology can be used to help broaden the scope of users. The improvement of the accessibility of DAWs is only the beginning, This teaching method can be used in simulation games to help students learn instruments or even medical procedures such as CPR. Overall, the integrated tutorial game is a very significant and versatile tool which, when applied correctly, can yield unforeseen benefits.

APPENDIX



APPENDIX A

The next page contains the email that was sent to the WPI mailing list such that we may have users to both test our design and provide feedback for analysis.

Hello Students!

For our IQP we've designed a tutorial game for a digital audio workspace. We are at the stage of testing our design and prototype, which is where you all come in! All we would like for you to do is go through our tutorial game and answer a few questions at the end. This shouldn't take any longer than 10-15 minutes. Also, know that you will remain 100% anonymous. Your participation is much appreciated! Details on how to participate are listed below. Thanks again!

To participate:

1) Click on the following link to play our tutorial game.

<https://drive.google.com/file/d/0B8jJ7RQ27bNvRTB1SXkwUi1BMWs/view?usp=sharing>

2) Once you've done that click on this next link to participate in the survey and give us your feedback!

<http://goo.gl/forms/9dpz7r4Osw>

Thanks,
Mina Micheal
Stephen Long
Sam Wallach
Samm Conley
William Nguyen

APPENDIX



APPENDIX B

The next page contains the tutorial survey that the testers completed to provide us with feedback on our design for analysis.

Tutorial Feedback Survey

* Required

1. **Rate the degree to which you found this tutorial to be informational. ***

1 = Not Informational At All. 2 = A Bit Informational. 3 = Somewhat Informational. 4 = Informational. 5 = Very Informational.

Mark only one oval.

| | | | | | | |
|--------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|--------------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Not Informational At All | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Informational |

2. **Rate the degree to which you found this tutorial to be engaging. ***

1 = Not Engaging At All. 2 = A Bit Engaging . 3 = Somewhat Engaging. 4 = Engaging. 5 = Very Engaging.

Mark only one oval.

| | | | | | | |
|---------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|---------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Not Engaging At All | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Engaging |

3. **Rate your level of understanding on the following concept: Adding/Removing a Note ***

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.

Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

4. **Rate your level of understanding on the following concept: Adding/Removing a Track ***

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.

Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

5. Rate your level of understanding on the following concept: Looping a Track *

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.
Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

6. Rate your level of understanding on the following concept: Equalizers/Manipulating a Track *

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.
Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

7. Rate your level of understanding on the following concept: Playing/Pausing a Composition *

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.
Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

8. Rate your level of understanding on the following concept: Singling Out/Muting a Track *

1 = Very Weak. 2 = Weak. 3 = Neutral. 4 = Strong. 5 = Very Strong.
Mark only one oval.

| | | | | | | |
|-----------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------|
| | 1 | 2 | 3 | 4 | 5 | |
| Very Weak | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Very Strong |

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