

The Crafter's Ear Evaluating an Aural Theory Simulation in Minecraft

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Abstract: While music educators throughout history have sought to develop effective training methods for their students, little innovation has been developed beyond “drill and practice” methods for aural music theory skills. In order to “show” what the musician already aurally perceives, a virtual simulation was developed for music educators to use with their 10- to 13-year-old beginning music students. The sandbox game Minecraft was chosen as the platform due to its ability to construct “redstone-powered,” musical note blocks. “Primitives” (single or multi-part objects) were provided for pitch identification and use as a template for constructing personal, interactive aural theory aids not dependent upon formal music notation or playing/singing ability. This usability study sought to evaluate the navigation and effectiveness of virtual content design and user satisfaction of the aural music theory simulation. Three iterations were conducted with thirteen participants. In the form of a PDF were also requested. This study discusses virtual world usability methods, evaluation instruments, participant data, design implications in a 3D-Virtual World (3D-VW) environment, simulation modifications, and platform preferences. The Crafter's Ear tells a story of successful and unsuccessful adaptations of a 3D-VW usability study. Data supports the simulation's potential as well as need for re-evaluation of the primary platform used for development. The researcher anticipates the results of this study will support a growing need to identify and improve upon best practices for 3D-VW simulation usability studies in the future.

Introduction

Aural music theory training has been an important musical discipline stemming as far back as 900 CE with Guido's development of the hexachord system and solmization symbols (Reizenweaver, 2012). Throughout history, music educators have sought effective training methods for their students. Karpinski (2000) stated that “learning to hear and read music with understanding and facility is arguably the most important goal we set for our students.”

Musical ability and theoretical aptitude in music students are not always at the same proficiency level. Individual music students often have pre-existing musical awareness without being able to articulate the theoretical framework (notated or sung) of the music. Musumeci (2000) suggests the “transition from figural to formal will consist simply in

putting names to what is already known and that the job of the teacher is not to teach, but to show.” While the majority of theoretical and aural skill training currently occurs at the college level, a strong case can be made for introducing music theory and aural skills at the beginning of musical development. A study done by Skoe and Kraus (2012) showed correlation between adult long-term brain neuroplasticity and music training at an early age. Other studies have also shown positive, experience-dependent plasticity in the brain due to early exposure to music lessons such as Schneider et al., 2002; Musacchia et al., 2007; Patel and Iversen, 2007; Parbery-Clark et al., 2009, 2012; Zendel and Alain, 2012. Additionally, for students pursuing music at a professional level, passing entrance theory and aural skills tests are prerequisites for entering the majority of college music programs. Early exposure to these skills will not only have a positive effect on these types of assessments, but provide long-term benefits of increased musicianship, musical ability, and improved cognitive function (Burunat, Brattico, Hartmann, Vuust, Särkämö, & Toiviainen, 2018).

Drill and Practice Methods

Current methodology for aural skills training involving face-to-face, as well as Computer-Assisted Instruction (CAI), relies primarily upon “drill and practice” methods that do little to solve the issue of “showing” the meaning to the pre-existing aural awareness of the music student. Drawing upon the idea of “showing” what the musician already knows, the researcher postulated that developing a virtual simulation for music educators, coupled with metacognitive concepts for optimal instruction and retention, would improve upon current methodologies.

Minecraft and Music

Minecraft is a virtual sandbox that has the ability for the instructor and the learner to build and craft objects and experiences in the virtual world (Tromba, 2013). Minecraft has a unique building feature that allows for musical composition. Within Minecraft, the player can construct note blocks and power them from a material called “redstone” to create sounds. When strung together, they can be used to compose or transcribe music. By using building blocks, students can match the auditory pitch with a numerical value that corresponds to the scale numbers from the tonic pitch of a key. Because of this feature, Minecraft was chosen as the platform upon which the simulation was built.

Metacognitive Learning in Music Theory

Metacognitive learning is “thinking about thinking.” Originally proposed in the early 1980s as a means of increasing student retention, metacognitive learning is seeing a resurgence in the music community (Benton, 2013). The researcher developed the simulation with this in mind by creating lessons that used metacognitive learning strategies within the Minecraft landscape.

Literature Review

The idea of designing a music theory simulation geared towards music educators stemmed from a previous music theory lesson the investigator created within Minecraft. Many students are already very familiar with Minecraft and are utilizing the sandbox in STEM (Science, Technology, Engineering, and Mathematics) activities in the classroom. With advocates pushing for STEAM (Arts added to STEM) to enhance creativity within the sciences, it seemed the next reasonable step is to pursue the Arts (the A in STEAM) within Minecraft. While there is virtually no literature on utilizing Minecraft for music theory instruction, there is an abundance of literature that reviews the efficacy of utilizing Minecraft as an effective mode for instruction. There is also a wide variety of literature studying the effects of metacognitive-based music theory instruction. (Bathgate & Hendrix, 2011).

Usability in Virtual World Learning Environments

Usability studies on simulations within virtual world learning environments (VWLE) have challenges and features that are unique compared to a traditional usability study on a website, mobile app, or even the virtual world itself. These include task performance, interaction with virtual world objects, non-linear user action, and user ability level. Additionally, locus of control of the simulation was not the virtual world, but rather the created material within the environment. Effectively creating a usability protocol for the Crafter's Ear simulation within Minecraft required concepts and examples to be drawn from usability studies done within both virtual worlds and simulations within virtual worlds.

Task performance. Chwen, Siew, Kee, & Chee (2013) created a modified approach for usability testing within a virtual world learning environment (VWLE) that explored areas effective for creating usability tasks. These included effectiveness, safety, efficiency, universality, satisfaction, usefulness, learnability, and navigation. From this list, effectiveness, satisfaction, and navigation were chosen as areas to evaluate during the usability tasks for *The Crafter's Ear* simulation.

Interaction with virtual world objects. Sutcliffe and Alrayes (2010) conducted usability testing in Second Life, focusing on user experience and performance. Task completion through object interaction was utilized successfully in the VLWE. While traditional user tasks often involve clicking on embedded information, VWLE user tasks are multi-faceted. Examples include users manipulating virtual world objects or creating within the virtual world setting. Gabbard (1997) said, "The focus of most existing methods, while properly user-task-based, is on a single user performing isolated, low-level user tasks — very different than the typical VE in which one or more users are performing integrated, shared, multi-threaded tasks." (p. 3) This interaction becomes increasingly complex when multiple users manipulate objects at the same time.

Non-linear user action. In a VWLE, the nature of the virtual world allows users to interact in the environment non-linearly. While a website's design has distinct narrative (with specific information to digest), a virtual world sandbox (i.e. Minecraft) does not inherently provide this. Without specific guidance, the user has complete freedom to interact within the environment with or without purpose. If specific outcomes or goals are desired, specific guidance must be provided in order to gauge the usability of the simulation.

User ability level. Differing from Web 1.0 usability, VWLEs require more than a point-and-click method to interact within the simulation. TREG's Usability tests provided valuable material for the VWLE usability methodology, particularly their discussion on interface, mechanisms, and game-play (Vega, Pereira Soares, Robichez, & Fuks, 2010). The TREG study strongly emphasized leveling the playing field for usability participants. "Because Second Life was chosen as a game development platform, it was necessary for all participants to be aware of some Second Life features needed during the game" (Vega et al., 2010). This led to the development of a separate beginner participant tutorial for helping usability participants start at similar ability levels in Minecraft (See Appendix S).

Methodology

Research Questions/Goals

Research questions were developed to aid in the evaluation process for the target audience.

1. How easy or difficult was it to locate the virtual content design areas of the simulation within the virtual learning environment?
2. How effective was the virtual content design of the musical mechanisms in the sandbox environment for aural theory training for use with teachers of beginner music students age 10-13?
3. What was the level of user satisfaction of virtual content design (space presence, involvement, perceived relevance, and appeal) within the virtual learning environment for use in aural theory training for teachers of beginning music students ages 10-13?

Purpose statement

The purpose of this usability study was to evaluate the navigation, effectiveness of virtual content design and user satisfaction in an aural music theory skills simulation created within the sandbox Minecraft for music teachers to use with their 10-13 year old music students.

Content Analysis

Because an end-result was needed for this simulation, the researcher utilized Wiggins and McTighe (1998) Backward Design Theory. Effective backward design engages three stages in the process: desired results, evidence, and a learning plan. Designing the prototype required identifying the participants' ends needs from the simulation. In The Crafter's Ear simulation, the end goal was to create a platform that teachers could utilize with their beginner music students. The researcher created an instructional design and learning objective chart (See Appendix B) in order to ascertain the material that would need to be presented within the simulation. After gathering details, a 3D wireframe was constructed and labeled with the areas for instructional content.

Because the project was a usability study, the evaluation was not on the instructional content despite the need to include it in the simulation. Backward design played an integral part of the wireframing process. Beginning at the largest area of the simulation, the main teleportation hub was modeled in 3D using game pieces and 3D printed items. The entrance and exit were placed first and then designed backwards in numerical order so that the zones visited were coherent (Figure 1 shows a comparison of the 3D wireframe and prototype). A cognitive walkthrough of the 3D wireframe was utilized to improve the design before the construction of the simulation.

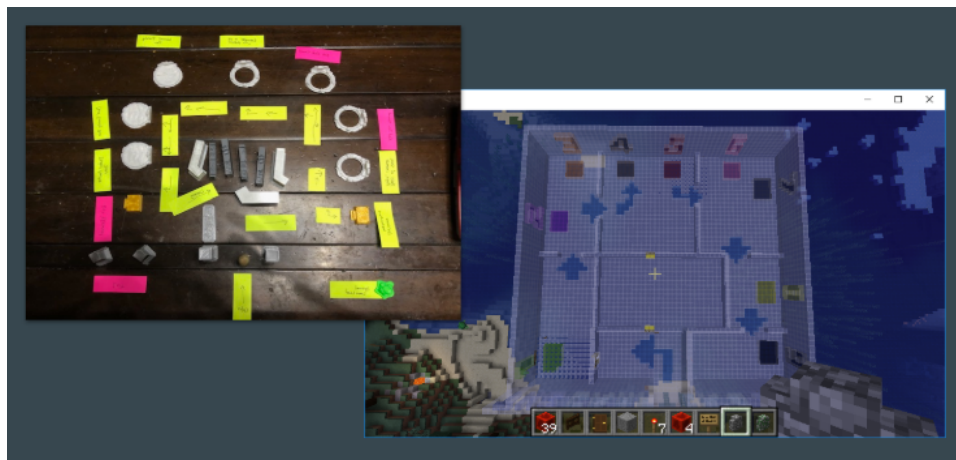


Figure 1. 3D Wireframe comparison to prototype

Participants

The simulation was designed for adult music educators, homeschooling parents, and private lesson music instructors of musicians age 10-13. The participants needed to be able to effectively communicate in the English language. Cognitively, the desire was for the target audience to have at minimum a bachelor's degree in music and/or performance related experience, or at minimum, college level theory and ear-training experience. Participants needed access to a computer, keyboard, mouse, internet, and the game Minecraft in order to participate in the usability study. Prerequisite knowledge of basic music theory principles were necessary to move through the simulation; however, no

formal knowledge of Minecraft was necessary. A tutorial was provided to the participants with little to no experience with Minecraft. Participants were invited verbally, through e-mail, and via social media advertisement.

After passing a pre-screening survey, eighteen participants were invited to The Crafter's Ear simulation within Minecraft Java. Of the 18 who were pre-screened, 13 participants completed the usability study. All thirteen participants had taught privately, ten had public teaching experience and three were homeschool parents as shown in Figure 2. The participants were grouped into three iterations, 5-4-4 respectively.

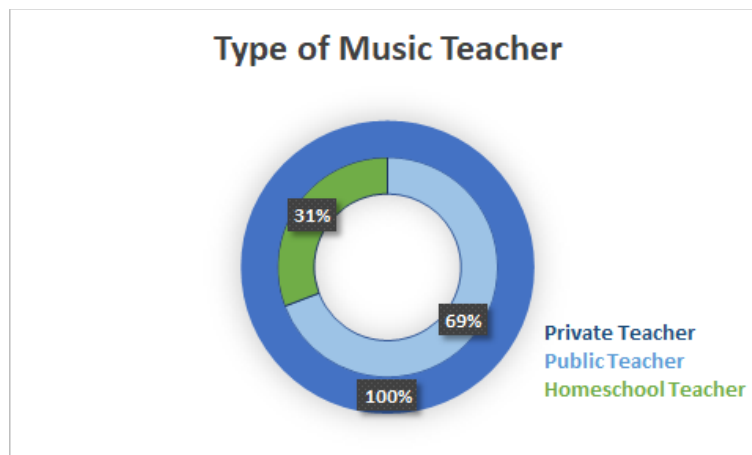


Figure 2. Participant music teacher profile

Evaluation Instruments

Using Slone's (2009) methodology for measuring usability skills through heuristic evaluation, instruments were designed for evaluating The Crafter's Ear.

Usability problems and heuristic evaluation. Every identified usability problem was classified into its appropriate usability criterion/criteria, usability factor(s), scope and level of severity on a scale of 1 to 4. These problems were coded and categorized into different usability criteria based on a consolidated, hierarchical model of usability measurement that unifies various usability standards and conceptual models similar to the QUIM model proposed by Seffah et al. (p. 167)

User profile survey. Downey (2007) proposed using a simple user profile survey with participants in order to classify them based on predetermined characteristics. The purpose of this user profile survey was to ensure the homogeneity of participants who underwent the usability testing process later. This survey took approximately 20 to 30 minutes. The user profile survey was created from a Google Form containing a simple survey of music theory knowledge (including recorded aural theory examples), prior musical experience and computer/gaming literacy. (See Appendix D).

Usability study-plan. This plan was created in order to facilitate appropriate usability task protocol and data collection and analysis (See Appendix K).

Usability checklist. This checklist was created in order to ensure usability task protocol would function at the appropriate time. It included information in order to have both facilitator and participant ready prior to the usability test (See Appendix L).

Usability task protocol. This session was the core of the usability testing process. It took approximately two hours. Selected basic tasks were given to the participants using a set of verbal instructions. For the purpose of the study, the basic tasks given in this testing were to identify objects and to interact with the created simulation and objects. The participants were allowed to ask questions during the testing. Participants performed the basic tasks given to them individually. The facilitator interacted with participants, answered questions, and also minimally prompted them to think aloud. Usability tasks were recorded in Zoom with the participants' consent using the screen share function and stored in a secure location (See Appendix O).

Usability issue discussion and informal interview. Informal interview was conducted with each participant following the usability study to gain further insight and clarify issues in order to improve each iteration of testing (See Appendix O).

Follow-up informal survey. This survey was offered to allow users to further discuss their satisfaction and appeal with use of Crafters Ear Simulation in Minecraft as part of research question #3 (See Appendix P).

Post-study survey. Questions were designed to gain more insight into the three research questions. The survey took approximately 20 minutes to complete. (See Appendix J).

Project Design Strategies

Simulation design drew from Scopes' (2009) Learning Archetypes of Cybergogy and TREG's study (Vega, Pereira Soares, Robichez, & Fuks, 2010) in which Bloom's Taxonomy are paired with 3D activities and applications along a spectrum. According to Lin (2017) recommendations for creating wireframes for 3D environments rather than a paper model help the design develop into a stronger immersive learning environment, rather than a website. The prototype of the simulation was wireframed in a 3D format using board game pieces and primitives printed from a 3D printer. A wooden meeple was used to navigate through the wireframe, and changes were made to the design by shifting the location and angles of the pieces (See Figure 3 for 3D wireframing examples).

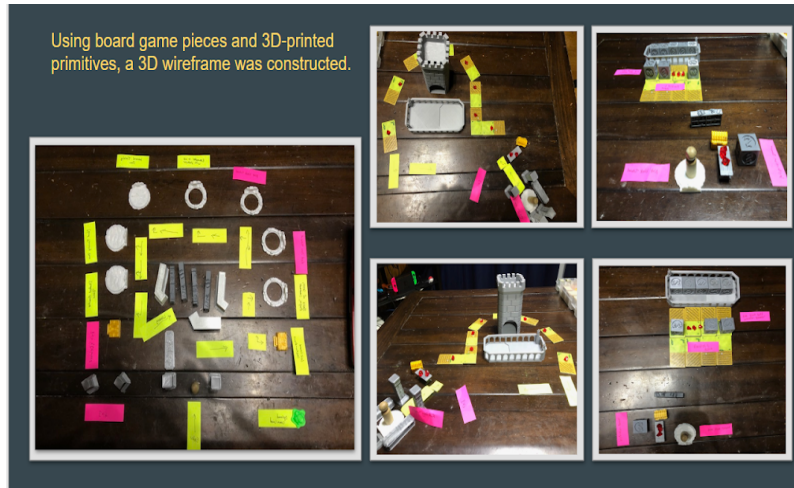


Figure 3. 3D Wireframe for The Crafter's Ear (See Appendix A for close up view)

Once the wireframe was created, The Crafter's Ear simulation began development in Minecraft Java on a server hosted by akliz.net. Through the use of plug-ins (See Appendix B), coding and command blocks, worlds were imported and created with the functionality designed to best deliver the aural theory content (See Appendix B). Due to unfamiliarity with many of the command functions for red stone and several plug-ins, including BannerBoard, many YouTube videos were utilized in order to gain the necessary skills to create the in-world content.

The prototype utilized a “glass house” for a sleek and clean appearance (See Figure 4 for glass house). Eventually, nine stations of the glass house were completed, along with various worlds, tutorials (Figure 5 shows redstone tutorial world), examples (Figure 6 shows triad examples), and practice areas (Figure 7 shows a screenshot of practice instructions) that were synced through command blocks acting as teleporters for the avatars to move freely and easily throughout the multiverse (different worlds connected through command functions on Spigot, a plug-in for Minecraft). The prototype can be seen more thoroughly with a screenshot walk-through (See Appendix Q).



Figure 4. Screenshot of the Glass House of Learning



Figure 5. Screenshot of Red-Stone Tutorial Zone



Figure 6. Screenshot of triad examples



Figure 7. Screen Student Practice Zone instructions

Procedures

In this study, the participants matched the target population. Potential participants were contacted in person, by email, and through social media advertisement. The participants completed the one-on-one usability sessions online using Zoom. A total of thirteen participants completed the usability study along with all pre- and post- surveys. Prior to the usability test, participants were emailed a recruitment letter (Appendix C) and a consent form (Appendix F). The recruitment letter provided the purpose of the study and informed that participation is optional. The consent form contained information about the tasks, the length of the study, the risks and benefits, confidentiality and privacy, and contact information. A link to the pre-screening survey was provided to the participants prior to the usability session (Appendix D) in order to determine eligibility. Participants were also emailed the lists of tasks they would complete during the usability session as a reference (Appendix C).

A pre-study survey was provided prior to the usability study (See Appendix I) to gain insight into demographics and participant expectations. The participants were provided with tutorials on downloading and using Minecraft (See Appendix M) and Zoom (See Appendix N).

With prior permission from the subjects, audio and video of the subjects, along with computer screen activities, were recorded using the online communication software Zoom and stored in a password-protected computer.

There were three parts to the complete usability tasks (See Appendix O). The first task was ten minutes and focused on participant observation and exploration of the simulation utilizing think-aloud method.

The second task set was twenty minutes and explored navigation in the simulation.

1. Please find the teleportation portals.
2. Please take your Avatar to the interval location.
3. Please return to the main teleportation area.

The third section of tasks took approximately forty minutes and dealt with the effectiveness of the simulation's content design.

1. We are now at the interval simulation. I'd like you to use your avatar to walk around and interact with the various objects.
2. Can you open the material dispenser and read the instructions?
3. Please play an interval of a major third.

The study concluded with follow up questions to determine the user satisfaction with the simulation:

1. How did you feel about the use of space?
2. How did you feel about the visual aspect of the simulation?
3. How did you feel about the level of involvement of each of the tasks in each area?

Finally, an informal interview (See Appendix P) and post-survey (See Appendix J) were

given following the usability study to gain a deeper understanding of usability issues. The recorded usability data and informal interview recordings were reviewed by the investigator, and significant information was transcribed onto forms (See Appendices G and H). The recorded information in addition to other data from the surveys and interview were used to evaluate the usability of the simulation.

According to Chwen (2013), participant richness in multiplayer usability recommendation is 36. (p. 697) Because this study focused on single-user, Krug's (2010) recommendation of, 3 subjects for each round of testing was determined to be sufficient and not in conflict with current literature. Both qualitative and quantitative data from the usability tests, the pre- and post- surveys, and post-interview were analyzed to determine usability issues. Each issue was rated by the investigator based on its severity using Nielsen's (1995) 5-level scale for usability problem severity. Based on this rating, the problems with highest severity were fixed first until most of the problems were fixed within the duration of the project. Severity was labeled catastrophic, major, minor, and cosmetic. A timeline of events can be seen in Appendix R.

Results

Across the three iterations, multiple usability issues were identified and resolved. As shown on Figure 8, after each iteration, less usability issues surfaced.

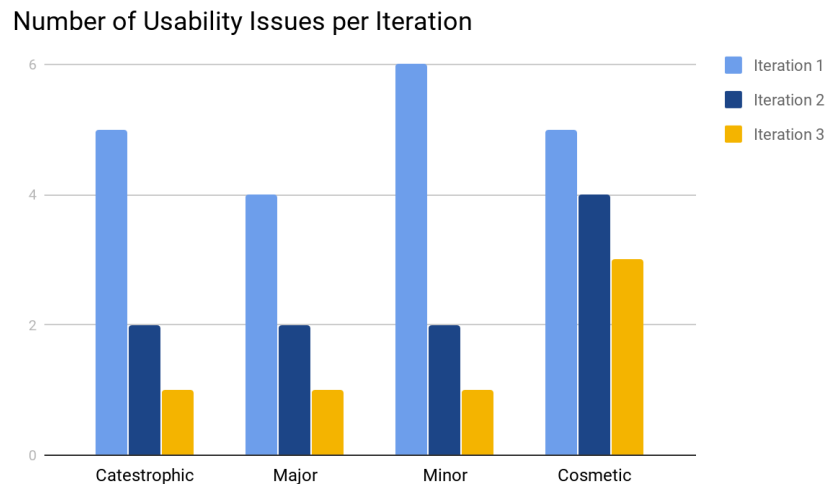


Figure 8. Usability issues from each type decreasing from iteration one to three.

Iteration One

Several catastrophic issues were uncovered in the first iteration which did not occur in the previous evaluation prior to implementation. These catastrophic issues made survival and navigation nearly impossible without the assistance of the researcher. Due to these circumstances, the decision was made to manually teleport the five participants to the interactive areas for appropriate feedback. Feedback recorded from this iteration had

mixed responses. Participants expressed frustration with being unable to appropriately teleport and their avatar being attacked by in-game mobs. When asked to test the note block simulations, a need arose to remind the participant to “right click” on each item. Left clicking destroyed the constructed primitives (prims) and on-the-fly fixes were necessary to continue with the study. The overall feedback from this group was that the idea of the simulation was exciting; however, the implementation had too many issues to successfully use with their own students.

Iteration Two

Iteration two consisted of four participants. During this phase, there were more categories to work from in order to improve the simulation. There were persistent consistency issues, stemming from the FTP client application and Akliz server with coding. While the researcher's avatar was able to teleport and utilize the prims, the participants continue to have similar functional issues from the previous iteration. The suggested fixes primarily dealt with navigation and game mode with the teleporting system, additional STEM content, and issues with directions which paired colors with the note blocks. Figure 9 shows the note block color that did not match the chart on the banner board.

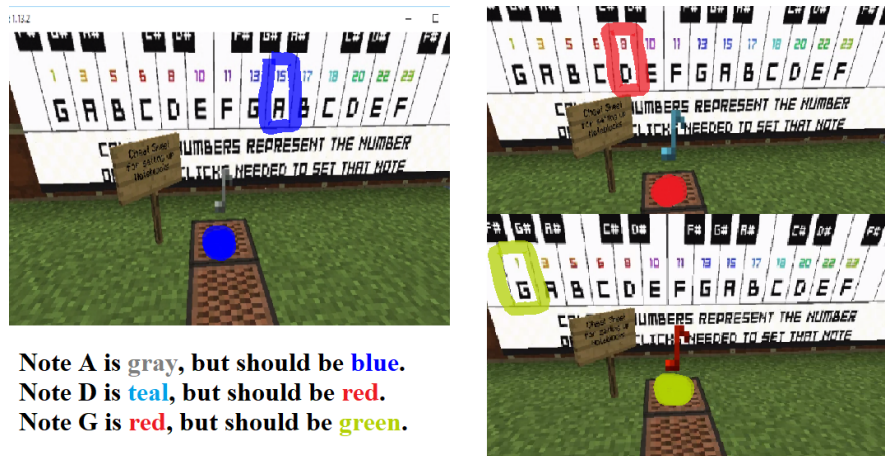


Figure 9. Color mismatch on the note stems when right clicking on the note block

The solution was creating an instructional book with the number of clicks required to change pitch as shown in Figure 10.



Figure 10. A book replaced the colored banner with instructions to change pitch

Due to time constraints between the second and third iterations, the researcher chose to focus primarily upon the catastrophic and major fixes required. Spawn points were reset, mob settings were changed in FTP FileZilla, and material was added to aid in note block settings. Some fixes were unable to be implemented, such as a user manual and lesson plans to go with the simulation. Participants from this round were enthusiastic about the material presented within the simulation and provided multiple suggestions for improvement and enhancement.

Iteration Three

In iteration three, one catastrophic event occurred, and this was due to the multiverse area coding compatibility. Some teleporting issues continued to persist, but workarounds were created so that the avatars could visit the destinations without needing the researcher's assistance. Visual cues from one of the simulation showcased prims was successfully fixed. Despite much more positive feedback in the informal interview and post-usability survey, some participants were still hesitant about utilizing the simulation with their students (Figure 11 shows the likelihood of the participant utilizing the simulation with the students in the future). The Java platform seemed to create the most concern for all participants. The majority preferred to see how the simulation would function in the Minecraft Education Edition setting. Participants from all rounds requested clearer signs and information. The suggestion for an external PDF or website as a user manual was also given by all participants.

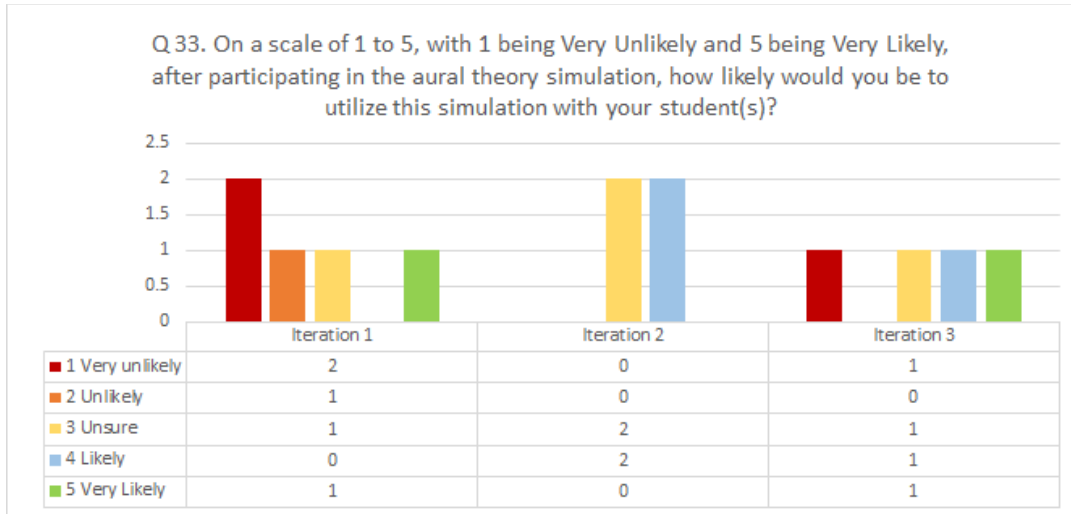


Figure 11. Post-survey results for simulation appeal show an increase in likelihood of use from iteration 1 to iteration 3.

Additional feedback given from post-usability informal interview included:

“I really appreciated the effort this took. Why are you using Minecraft Java? Wouldn’t Minecraft Education Edition solve a lot of the issues I experienced in the simulation?”

“I was hoping this would incorporate more mathematics alongside the music. Our school does STEM and I can see how I could use something like this game to combine both subjects.”

Discussion

Moving forward with this simulation requires rethinking. Minecraft Education Edition (MCEE) has many of the features that would have made implementation faster, simpler, more intuitive, and more user and creator friendly if it had been available to utilize. Unfortunately, this program is only available to schools and universities with Office 365 Education. While the initial assumption was that the majority of public music teachers would not have access to MCEE, all except two had access in their school networks.

The researcher thought that utilizing multiverse plugins would create the space and diversity needed for the separate simulation areas, particularly to avoid sound overlap. Unfortunately, many issues arose from utilizing these plugins. In retrospect, the simulation would have functioned better if it were confined to only one world instead of many. Distance and sound overlap could have been easily achieved by building each portion across biomes within the simulation. It was not feasible to rebuild the project in order to achieve better functionality within the allotted research time.

Finally, conclusions based upon the research questions were as follows:

1. *How effective was the virtual content design of the musical mechanisms in the sandbox environment for aural theory training?*

The design has several persisting issues that ultimately came down to utilizing plugins within multiverse aspect of Minecraft. In the future, the design should would work best using only one world and teleporting strictly within that environment.

2. *What was the level of user satisfaction of the virtual content design (space presence, involvement, and perceived relevance) within the virtual learning environment?*

The first two iterations had low level user satisfaction within the 3D VLE. This was due to catastrophic issues that persisted and frustration with the inability of the users' avatar to adequately experience the simulation in the time frame. After the majority of catastrophic and major issues were resolved, users were able to experience the showcases unhindered. This resulted in a positive shift in user satisfaction in iteration three showing an overall high level of user satisfaction within the 3D VLE. Every participant in iteration 3 could see the benefit of the program.

3. *How appealing was the designed virtual learning environment for use in aural theory training for ages 10-13?*

All users felt that if the design functioned without issues, the concepts behind the simulation were age appropriate and could be used with their students. 86% of participants would use a working version if they were provided it. 57 % would be willing to use the concepts to design their own project for their students.

Was it worth it? Will people use it? For this particular version of the simulation, the answer is no. Much work needs to be done for the project to be advertised for use with music students. From the feedback, participants wanted a more intuitive experience, one in which they could use an already familiar game provided by their schools. The simulation idea and primitives designed in Minecraft were very popular and the majority of participants would utilize this with their music students if the simulation was available in Minecraft Education Edition. Most participants felt that they did not have the time or the ability to develop a simulation like this, but would readily utilize a pre-made simulation such as The Crafter's Ear if available on their preferred platform. The researcher anticipates the results of this study will support a growing need to identify and improve upon best practices for virtual world simulation usability studies in the future.

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Appendix A Wireframe

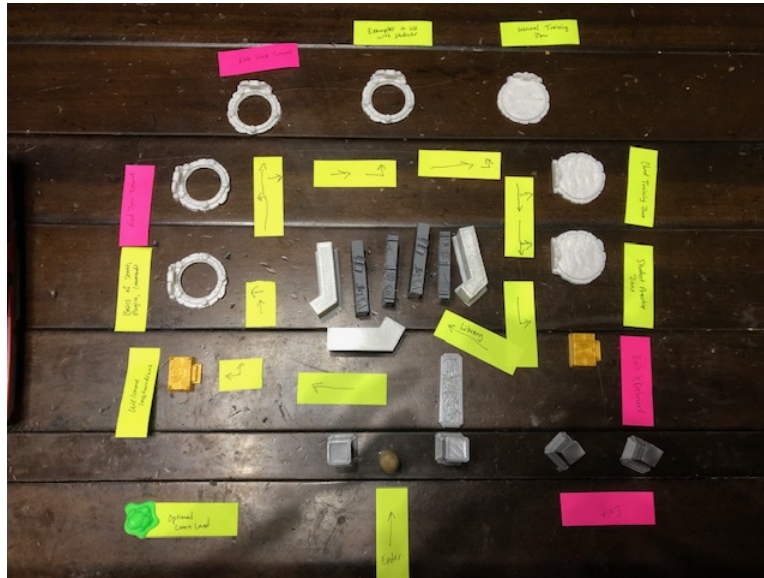


Figure A1. Photograph by Sarah Espinosa of a 3D wireframe of The Glass House of Learning, the spawn point for the Minecraft simulation, *The Crafter's Ear*.

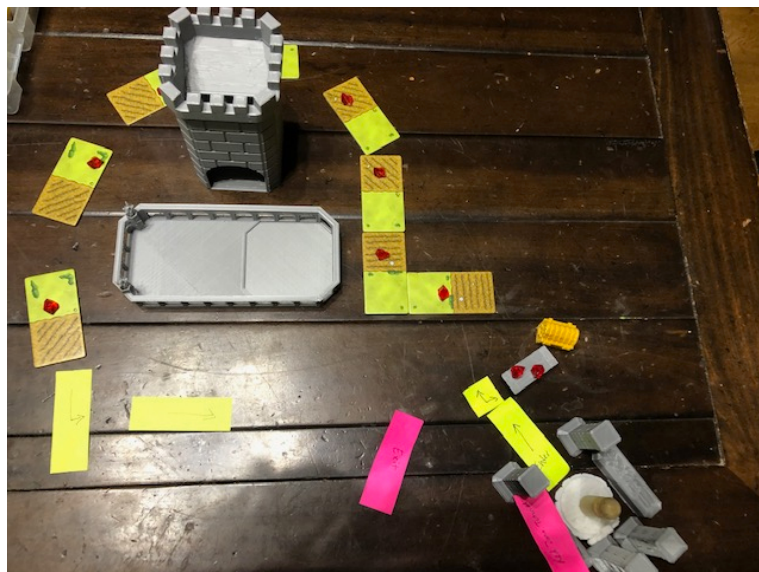


Figure A2. Photograph by Sarah Espinosa of a 3D wireframe of the Duomo: Red Stone Tutorial Zone, a multiverse tutorial world attached to the Minecraft Simulation, *The Crafter's Ear*.

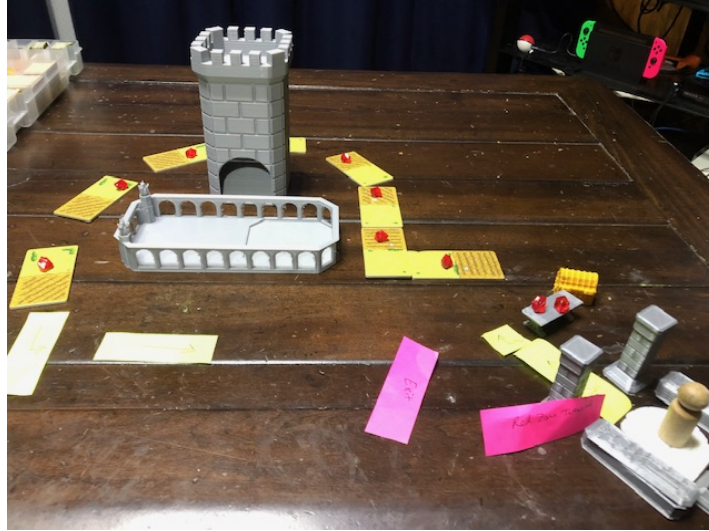


Figure A3. Photograph by Sarah Espinosa of a 3D wireframe of the Duomo: Red Stone Tutorial Zone, a multiverse tutorial world attached to the Minecraft Simulation, *The Crafter's Ear*. Alternative view shown.

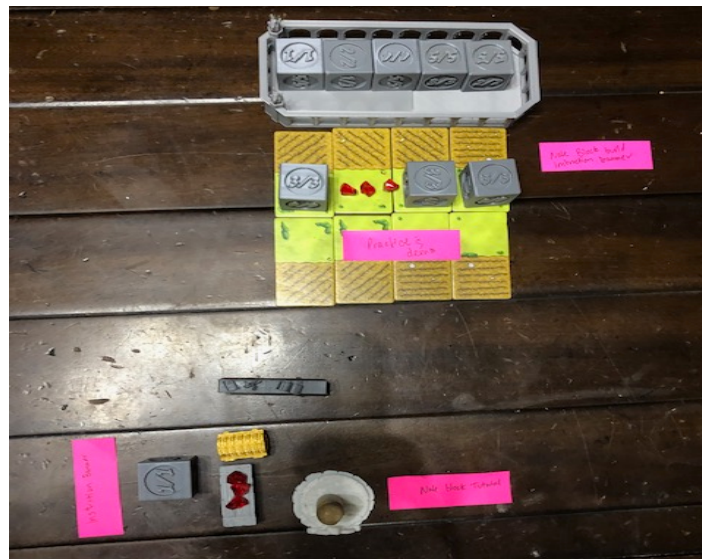


Figure A4. Photograph by Sarah Espinosa of a 3D wireframe of the Note Block Crafting Zone, a multiverse tutorial world attached to the Minecraft Simulation, *The Crafter's Ear*.

Appendix B Objectives/Standards

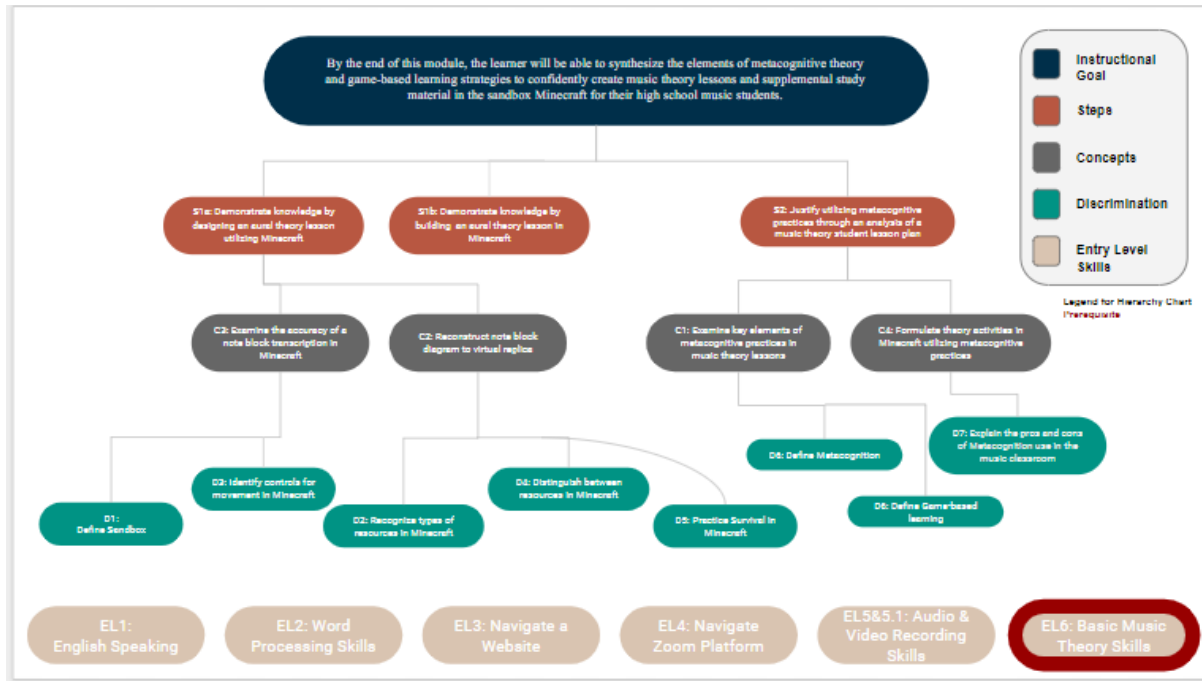
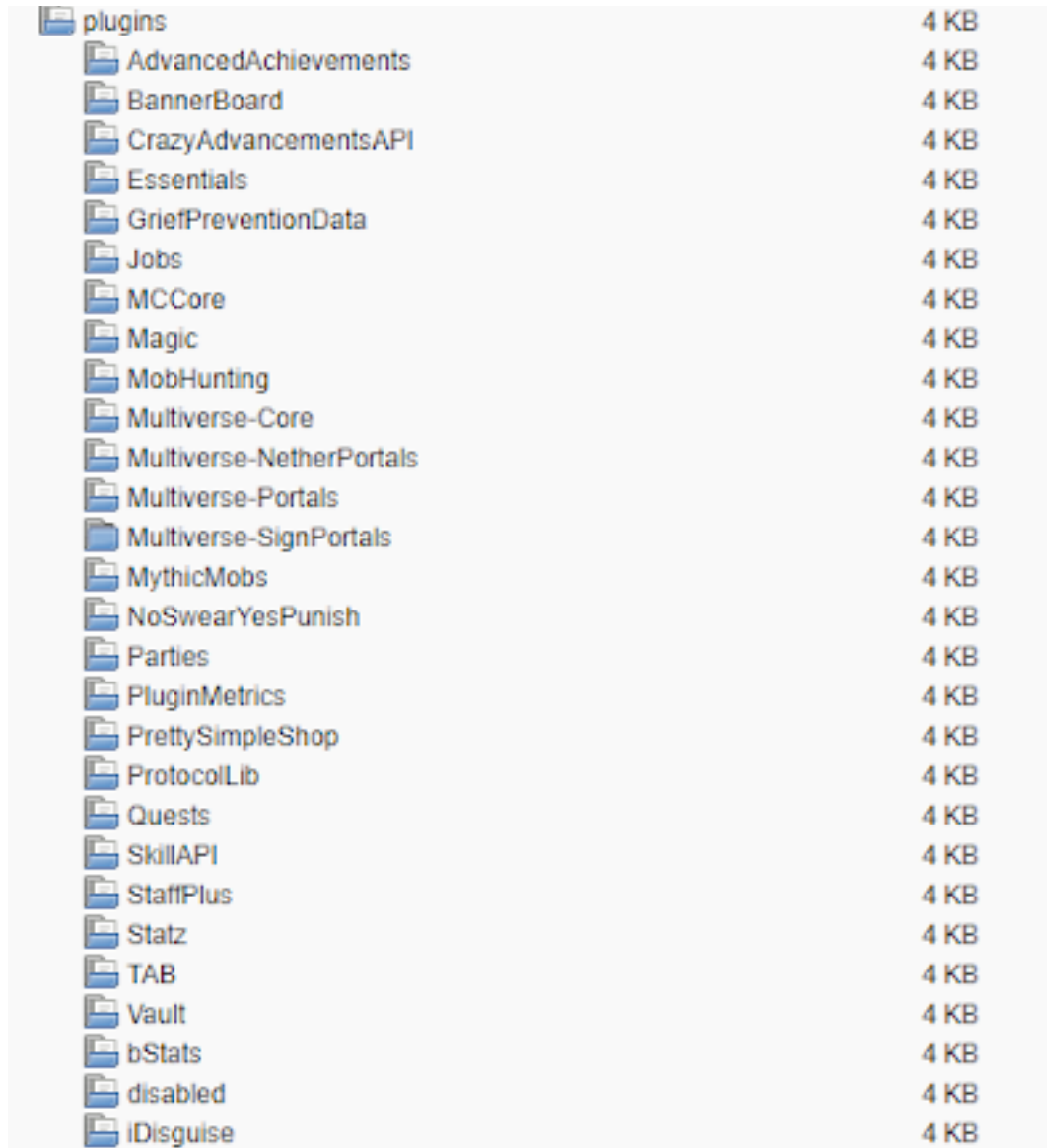


Figure B1. Learning Objective Hierarchy Map used to determine content to deliver within the Minecraft Simulation.

	CLUSTER	OBJECTIVES	TIME
Module Sequence	1	Unit 1: Introduction to Metacognition and Game-based learning D6: Define Metacognition D8: Define Game-based learning D1: Define Sandbox D7: Explain the pros and cons for using Metacognition in the music theory classroom Subunit 1a: Introduction to Minecraft D3: Identify Controls for Avatar Movement within Minecraft D2: Recognize Types of Resources in Minecraft Subunit 1b: Resource Gathering in Minecraft D4: Distinguish between resources in Minecraft D5: Practice survival in Minecraft	Week 1
	2	Unit 2: Crafting Music 1 Sub-unit 2a: Basic Crafting in Minecraft D9: Build a crafting table C2: Reconstruct note block diagram to virtual replica Sub-unit 2b: Melodic and Harmonic Dictation D10: Practice intervals listening to note blocks in Minecraft C5: Create interval quiz in Minecraft Sub-unit 3b: Visualizing Intervals and Triads C1: Examine key elements of metacognitive practices in music theory lesson	Week 2
	3	Unit 3: Crafting Music 2 Composition and Contemporary Techniques C4: Formulate theory activities in Minecraft utilizing metacognitive practices Assignment: Scavenger Hunt	Week 3
	4	Unit 4: Lesson Plan Creation in Minecraft S1a: Demonstrate knowledge by designing an aural theory lesson utilizing Minecraft S2: Justify utilizing metacognitive practices through an analysis of a music theory student lesson plan	Week 4
	5	Unit 5: Project Presentation and Debrief S1b: Demonstrate knowledge by building an aural theory lesson in Minecraft	Week 5

Figure B2. Module material from Units 2 through 4 utilized within Aural Theory Simulation.



plugins	4 KB
AdvancedAchievements	4 KB
BannerBoard	4 KB
CrazyAdvancementsAPI	4 KB
Essentials	4 KB
GriefPreventionData	4 KB
Jobs	4 KB
MCCore	4 KB
Magic	4 KB
MobHunting	4 KB
Multiverse-Core	4 KB
Multiverse-NetherPortals	4 KB
Multiverse-Portals	4 KB
Multiverse-SignPortals	4 KB
MythicMobs	4 KB
NoSwearYesPunish	4 KB
Parties	4 KB
PluginMetrics	4 KB
PrettySimpleShop	4 KB
ProtocolLib	4 KB
Quests	4 KB
SkillAPI	4 KB
StaffPlus	4 KB
Statz	4 KB
TAB	4 KB
Vault	4 KB
bStats	4 KB
disabled	4 KB
iDisguise	4 KB

Figure B3. Plugins used on the Akliz server for the Aural Theory Simulation in Minecraft.

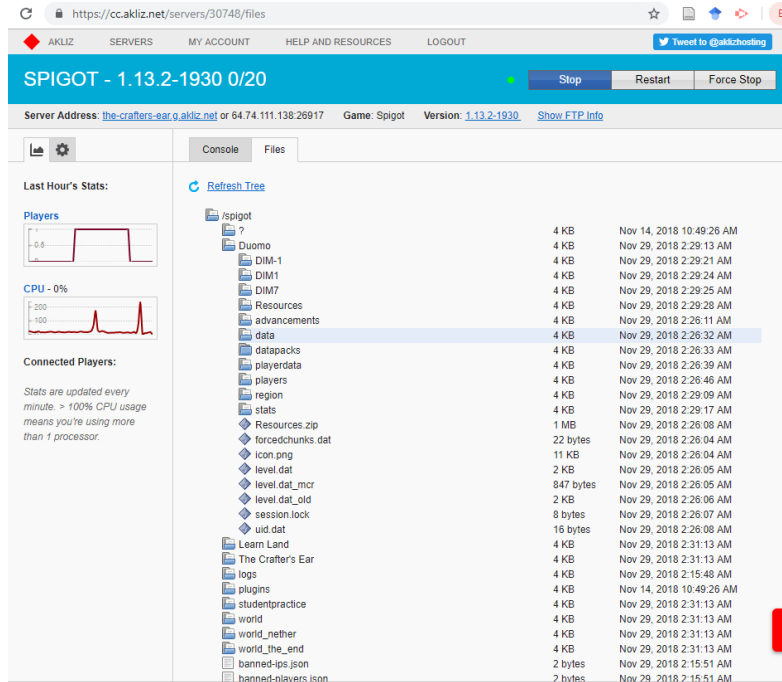


Figure B4. Spigot Server, the-crafters-ear.g.akliz.net hosted on Akliz

Appendix C Recruitment Material

Invitation to Participate in an Aural Theory Virtual Simulation Usability Study



Sarah Espinosa <sbespi@hawaii.edu>
to Participant's e-mail



Aloha [Participant's First Name],

My name is Sarah Espinosa and I am a Master's student in the Online Learning Design and Technology Department at the College of Education, University of Hawai'i at Mānoa. I am emailing you today because you are a [private music teacher/musician/music educator/homeschool parent] and have experience teaching beginning music students. As part of my final Master's project, I have developed a virtual simulation in Minecraft for musicians to use with their music students to introduce aural theory concepts. I would like to extend an invitation to you to participate in my usability study by entering the virtual world of Minecraft (at no cost) and test the simulation for its effectiveness, user satisfaction, and navigability. Your feedback will be invaluable to the evaluation of the developed simulation and its subsequent revisions.

Participation in this usability study is strictly voluntary. The usability study involves an individual interview with you and will take no more than 2 hours of your time. Individual interviews will be conducted online utilizing an online software program called Zoom in conjunction with Minecraft Java. The interview will involve a 5 minute Pre-Questionnaire [Online form]; 75-85 minutes testing of the simulation; a 10 minute Post-Questionnaire [Online Form], and a 15-20 Informal Interview. I will be conducting three rounds of interviews during the following dates:

- Round 1: 1/18 - 1/27
- Round 2: 2/1 - 2/10
- Round 3: 2/15 - 2/25

Upon the completion of each round, changes will be made to the simulation based on your feedback. If you are interested, willing and available to participate in the study, please complete this pre-screening questionnaire [link]. Once completed, I will follow up with a confirmation email and a Consent to Participate form. We will go through the consent form again during the time of interview. Mahalo nui loa for your time and consideration.

Warmly,

Sarah Espinosa, Project Investigator, sbespi@hawaii.edu

Figure C1. Example recruitment email sent to potential participants. The link within the email takes the participant to a Google Form pre-screening questionnaire (see Appendix D).

Aural Theory Virtual Simulation Usability Study Participant Update



Sarah Espinosa <sbespi@hawaii.edu>
to Participant's e-mail



Aloha [Participant's Name],

Thank you so much for completing the pre-screening survey. I know your time is valuable and am honored that you considered participating in my research study. Unfortunately, I have filled all of my available slots and no longer require additional participants. I do appreciate your willingness to participate. If you would like to find out more about this project in the future, I will be presenting the results online at this year's Teaching, Colleges and Community conference in April of 2019. "The Teaching Colleges and Community Worldwide Online Conference (TCC) is a virtual conference held annually online. This event is designed for faculty, staff and administrators in higher education worldwide to share their expertise and engage in productive forums about innovations and practices that accompany the use of technology in teaching and learning." Feel free to visit <https://tchawaii.org/presentations/> for more information. Thank you again!

Warmly,

Sarah Espinosa, Project Investigator, sbespi@hawaii.edu

Figure C2. Example of follow-up email for participants who did not pass the pre-screening requirements.

Aural Theory Virtual Simulation Usability Study Participant Invitation



Sarah Espinosa <sbespi@hawaii.edu>
to Participant's e-mail

Attachment



Aloha [Participant's Name],

Thank you so much for completing the pre-screening survey. I know your time is valuable and am honored that you are considering participating in the usability study for the Minecraft aural theory simulation. Again, your participation is strictly voluntary and you may end your participation in the study at any time. I have attached the Informed Consent form for your consent to participate in the study. Please read through the form as it will provide more information about the study and what you'll be doing, should you consent. If you agree to participate, please sign and date the form and return it to me via e-mail or in person. If you have any questions about the study, please do not hesitate to contact me.

Warmly,

Sarah Espinosa, Project Investigator, sbespi@hawaii.edu

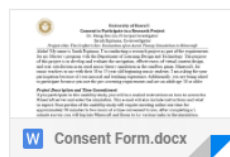


Figure C3. Example of follow-up email for participants passing pre-screening requirements. This email is the official invitation to participate and contains the attached consent form (See Appendix E.).

Thank You For Your Participation in the Aural Theory Simulation Usability Study



Sarah Espinosa <sbespi@hawaii.edu>
to Participant's email

Zip file of The Crafter's Ear Revised world map



Aloha [Participant's Name],

The usability testing has been completed and the final revision of the simulation has occurred for the semester. As promised, in appreciation for your willingness to participate in the study, I am enclosing the file for The Crafter's Ear for your personal use in Minecraft. Please be advised that if you do not have a personal Minecraft account, the simulation will not work. You will likely need additional plug-ins that are not included in the file. The file is solely the simulation that was developed and revised as part of my Master's project. You may use the file as is or you may modify it for personal use. This file is not for resale. Feel free to e-mail me with any questions; however, I will not be providing ongoing, online support for this revision. The Crafter's Ear is NOT AN OFFICIAL MINECRAFT PRODUCT. It is NOT APPROVED BY OR ASSOCIATED WITH MOJANG. Please see Mojang's Commercial Usage page prior to distributing The Crafter's Ear to other parties: https://account.mojang.com/documents/commercial_guidelines. Thank you again for your participation and happy crafting in the future!

Warmly,

Sarah Espinosa, Student Investigator, sbespi@hawaii.edu

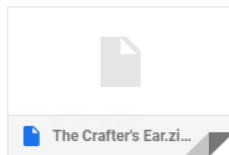


Figure C4. Example of final email to participants upon completion of the final project. The email includes a zip file attachment with the world map of the revised prototype as compensation for participation.



Figure C5. Example recruitment post on investigator’s personal Facebook wall. The privacy setting is set to “Only Me” until IRB approval has been granted. This recruitment post will also be duplicated in groups such as Horn People, Musicians Married to Military, Christian Homeschool Families, and Classical Conversations with prior admin approval.

Verbal Invitation Script:

Hi [Participant's Name],

Thanks so much for agreeing to speak with me about my upcoming project, The Crafter's Ear. (If I don't know them personally: My name is Sarah Espinosa.) I am a Master's student in the Online Learning Design and Technology Department at the College of Education, University of Hawai'i at Mānoa. I am talking to you today because you are a [private music teacher/musician/music educator/homeschool parent] and have experience teaching beginning music students. As part of my final Master's project, I have developed a virtual simulation in Minecraft for musicians to use with their music students to introduce aural theory concepts. I would like to extend an invitation to you to participate in my usability study by entering the virtual world of Minecraft (at no cost) and test the simulation for its effectiveness, user satisfaction, and navigability. Your feedback will be invaluable to the evaluation of the developed simulation and its subsequent revisions.

Participation in this usability study is strictly voluntary. The usability study involves an individual interview with you and will take no more than 2 hours of your time. Individual interviews will be conducted online utilizing an online software program called Zoom in conjunction with Minecraft Java. The interview will involve a 5 minute Pre-Questionnaire [Online form]; 75-85 minutes testing of the simulation; a 10 minute Post-Questionnaire [Online Form], and a 15-20 Informal Interview. I will be conducting three rounds of interviews during the following dates:

- Round 1: 1/18 - 1/27
- Round 2: 2/1 - 2/10
- Round 3: 2/15 - 2/25

Upon the completion of each round, changes will be made to the simulation based on your feedback. If you are interested, willing and available to participate in the study, please let me know and I will e-mail you a pre-screening questionnaire [link]. Once completed, I will follow up with a confirmation email and a Consent to Participate form. We will go through the consent form again during the time of interview. Do you have any questions? Would you be interested in participating?

If so: May I please have your e-mail address? Thank you so much

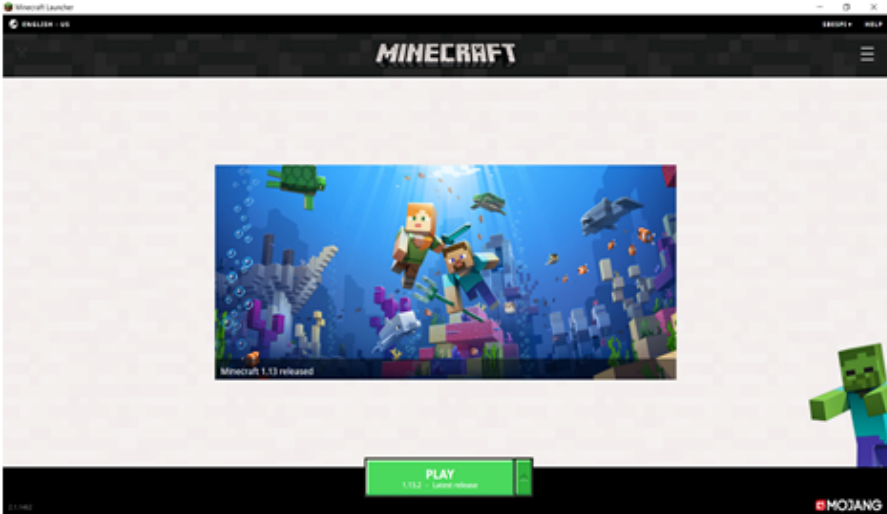
If not: No problem! Well, if you change your mind, feel free to e-mail me. (provide e-mail address)

Thank you so much for being willing to chat about this. I appreciate your time!

Figure C6. Screenshot of the written script used to verbally invite participants to the usability study.

The Crafter's Ear:

Evaluating an Aural Theory Simulation in Minecraft



Are you 18 or older and give music lessons to a child age 10 to 13?


If the answer is **YES...**

Sarah Espinosa would like to invite you to participate in a research study.

The purpose of this usability study is to evaluate the navigation, effectiveness of virtual content design and user satisfaction in an aural music theory skills simulation, *The Crafter's Ear*, created within the sandbox Minecraft for music teachers to use with their 10-13 year old music students.

- Usability testing (1 interview per participant) will take place online in Zoom and Minecraft.
- Study volunteers will receive *The Crafter's Ear* file for personal use as compensation.
- A summary of the results of certain tests performed during the study will be available to study volunteers.

To learn more about the study,
please e-mail Sarah Espinosa at sbespi@hawaii.edu



Scan me

UH IRB Approval Date TBD

Figure C7. This digital flyer will be used on social media posts such as Facebook and Instagram, as well as printed and posted in appropriate locations.

Appendix D Screening Documents

These characteristics were identified in order to choose participants who are qualified to involve in the usability testing. Musical background was used to ensure participants recruited were capable of performing necessary tasks in the usability study as well as identify which participants matched the target audience. All participants were also required to have basic computer literacy skills to ensure their capability to use generic computer input devices, such as a mouse and keyboard to interact with the system. The characteristic for gaming was to identify which participants may need a tutorial or refresher in Minecraft basics.

Thank you for taking this short quiz and survey.

Please confirm your eligibility:

1. **I am at least 18 years old or older.**

Mark only one oval.

- Yes
 No

2. **I have studied music (personally, privately, or in a group setting).**

Mark only one oval.

- Yes
 No

3. **I know what a usability study is.**

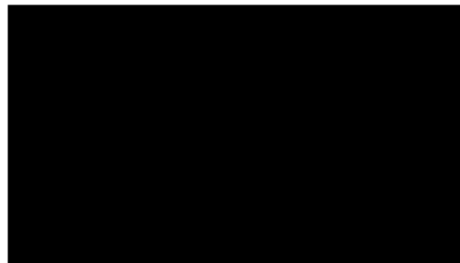
Mark only one oval.

- Yes
 No
 Unsure

**Below you will be asked a series of aural theory questions.
Please answer to the best of your ability.**

Click on the video and answer the question below.

Interval #1



<http://youtube.com/watch?v=Q4Zpc6-1qBQ>

4. **Please listen to and identify interval #1.**

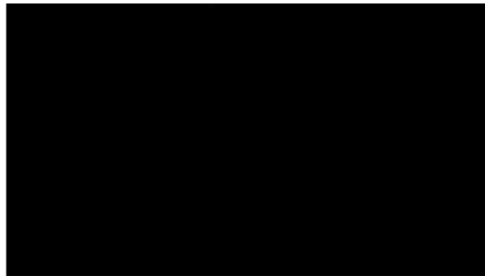
Interval #2



http://youtube.com/watch?v=tPRXj_Ak66I

5. Please listen to and identify interval #2.

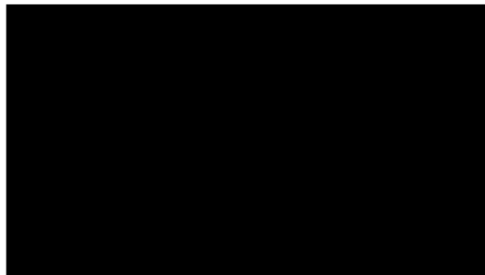
Interval #3



<http://youtube.com/watch?v=ftKk6nqW-xk>

6. Please listen to and identify interval #3.

Interval #4



<http://youtube.com/watch?v=IAaj5hJ2oRA>

7. Please listen to and identify interval #4.

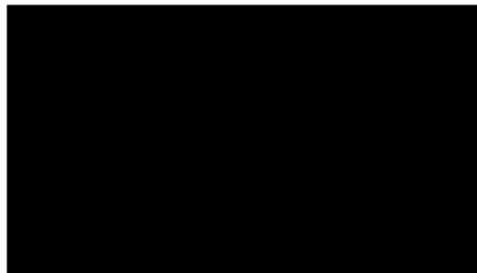
Chord #1



<http://youtube.com/watch?v=vnFoYMqYtiQ>

8. 8. Please listen to and identify the quality of chord for chord #1 (Major, minor, diminished, Augmented).

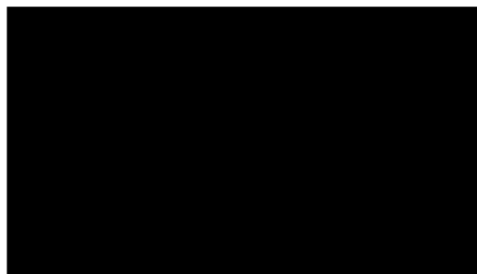
Chord #2



<http://youtube.com/watch?v=LlFQOWBqpNM>

9. 9. Please listen to and identify the quality of chord for chord #2 (Major, minor, diminished, Augmented).

Chord #3



<http://youtube.com/watch?v=XvbwlhcrfvI>

10. 10. Please listen to and identify the quality of chord for chord #3 (Major, minor, diminished, Augmented).

Chord #4

<http://youtube.com/watch?v=vjyQVr2-T4w>

11. 11. Please listen to and identify the quality of chord for chord #4 (Major, minor, diminished, Augmented).

Musical Experience

Please answer the following survey items to the best of your ability.

12. 12. Please check all that apply.

Check all that apply.

- I am a music teacher.
- I have in the past or am currently a homeschool parent.
- I have never taken a music theory course.
- I have studied music theory informally.
- I have taken a formal music theory course (i.e. high school or college course).

13. 13. On a scale of 1 to 5, with 1 feeling no confidence and 5 feeling very confident, how would you rate your confidence level of ability to identify basic intervals?

Mark only one oval.

1 2 3 4 5

No Confidence Very Confident

14. 14. On a scale of 1 to 5, with 1 feeling no confidence and 5 feeling very confident, how would you rate your confidence level of ability to identify basic chord types?

Mark only one oval.

1 2 3 4 5

No Confidence Very Confident

15. **15. Check all that apply. I teach (or have taught) music to students from the following age categories:**

Check all that apply.

- I do not teach music.
 Children age 5 and under
 Children age 6 -10
 Children age 11-13
 Children age 14 -17
 Adult musicians 18 years of age or older

Computer and Gaming Literacy

Please answer the following questions based upon your own personal experience.

16. **16. I have access to a computer.**

Mark only one oval.

- Yes
 No
 Unsure

17. **17. I have access to internet.**

Mark only one oval.

- Yes
 No
 Unsure

18. **18. I have a mouse.**

Mark only one oval.

- Yes
 No
 Unsure

19. **19. I have a microphone (built-in or separate) from my computer.**

Mark only one oval.

- Yes
 No
 Unsure

20. **20. I have used Zoom.**

Mark only one oval.

- Yes
 No
 Unsure

21. **21. I know how to screen-share.**

Mark only one oval.

- Yes
 No
 Unsure

22. **22. Choose the best answer that describes your experience.**

Mark only one oval.

- I have played virtual games online.
 I have not played virtual games online.
 I do not know what a virtual game is.

23. **23. Choose the best answer that describes your experience.**

Mark only one oval.

- I have heard of Minecraft.
 I have not heard of Minecraft.

24. **24. On a scale of 1 to 5, with 1 having never played Minecraft to 5 considering yourself a Minecraft expert, how would you rate your Minecraft experience?**


Mark only one oval.

	1	2	3	4	5	
I have never played Minecraft	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	I consider myself a Minecraft expert.

25. **25. If you have no or limited Minecraft experience, would you be willing to participate in an in-game tutorial session prior to the usability study? No purchase of Minecraft is necessary.**

Mark only one oval.

- I feel comfortable in Minecraft and do not need a tutorial.
 Yes
 No
 Maybe

Powered by
 Google Forms

Please submit your name and e-mail in order to receive an invitation to this usability study.

Your e-mail address is completely optional. If you choose to provide your e-mail, you will only receive e-mails about The Crafter's Ear usability test. No third party will receive your e-mail.

26. **My name and e-mail address are:**

Figure D1. Pre-screening Survey and Aural Quiz (On the actual survey, there are not duplicate numbers).



UNIVERSITY
of HAWAI’I
MĀNOA

Office of Research Compliance
Human Studies Program

SCREENING AND ENROLLMENT LOG

Principal Investigator: Meng-Fen Grace Lin, PhD

IRB Number:

Protocol Title: Pre-screening for The Crafter’s Ear Usability Study

Protocol ID:

Date Screened	Subject Initials	Screening Results			Date of Consent	Enrollment Number
		Pass	Fail	Reason for Fail		

Figure D2. Pre-Screening and Enrollment Log

Appendix E CITI Training Certificates



Figure E1. Human Subjects Research (HSR) Exempt Researchers and Key Personnel
www.citiprogram.org/verify/?wd3b15d9a-f0f8-4811-9937-07b05684ac1f-25808804

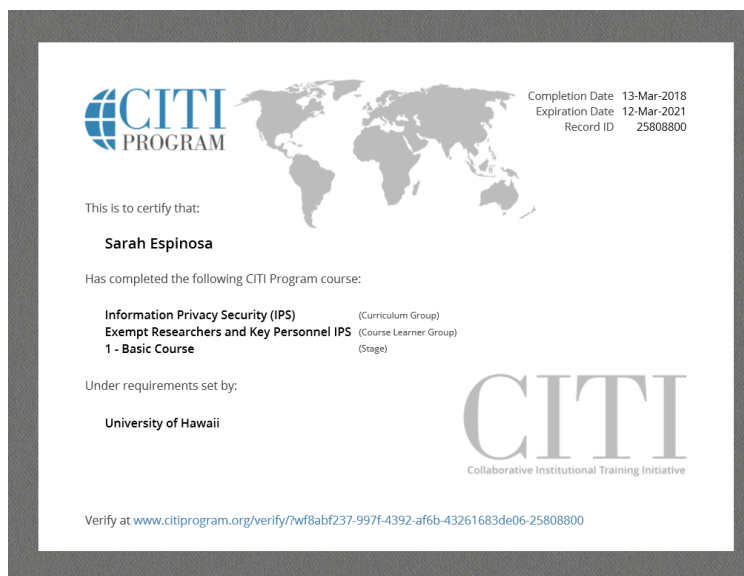


Figure E2. Information Privacy Security (IPS) Exempt Researchers and Key Personnel
IPS
<https://www.citiprogram.org/verify/?wf8abf237-997f-4392-af6b-43261683de06-25808800>



Figure E3. Human Subjects Research (HSR) Non-Exempt Social and Behavioral Sciences Researchers and Key Personnel
www.citiprogram.org/verify/?we1c46edb-c75b-4e80-9f85-cd28659d4463-29327332

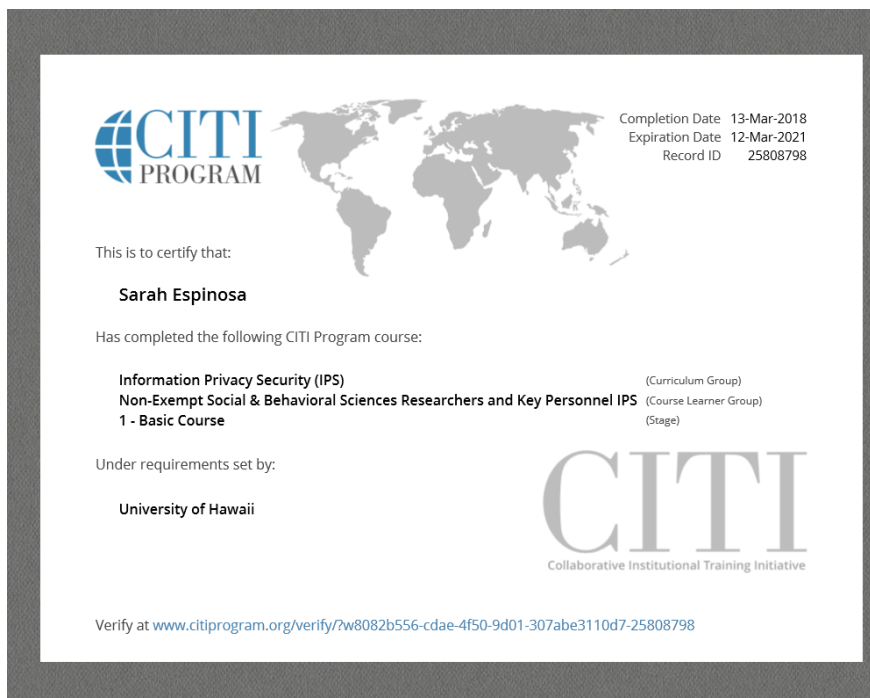


Figure E4. Information Privacy Security (IPS) Non-Exempt Social and Behavioral Sciences Researchers and Key Personnel IPS
www.citiprogram.org/verify/?w8082b556-cdae-4f50-9d01-307abe3110d7-25808798



Figure E5. Social and Behavioral Responsible Conduct of Research:
www.citiprogram.org/verify/?w181a52c4-dba5-46eb-8746-01a6d8977b5d-26472266

Appendix F Consent Form



University of Hawai'i
Consent to Participate in a Research Project
Dr. Meng-Fen Lin, Principal Investigator
Sarah Espinosa, Co-investigator

Project title: The Crafter's Ear: Evaluation of an Aural Theory Simulation in Minecraft

Aloha! My name is Sarah Espinosa. I'm conducting a research project as part of the requirements for my Master's program with the Department of Learning Design and Technology. The purpose of this project is to develop and evaluate the navigation, effectiveness of virtual content design, and user satisfaction in an aural music theory simulation in the sandbox game, Minecraft, for music teachers to use with their 10 to 13 year old beginning music students. I am asking for your participation because of your musical and teaching experience. Additionally, you are being asked to participate because you met the pre-screening requirements and are an adult age 18 or older.

Project Description and Time Commitment

If you participate in this usability study, you will be e-mailed instructions on how to access the Minecraft server and enter the simulation. This e-mail will also include instructions and what to expect. Your portion of the usability study will require meeting online one time for approximately 90 minutes to two hours at a time convenient to you. After completing a 5 minute survey, you will log into Minecraft and Zoom to try various tasks in the simulation.

The tasks you will be prompted with will be similar to these, "We are now at the interval simulation. I'd like you to use your avatar to walk around and interact with the various objects. Please think aloud as you move within the simulation." "What do you notice?" "How did you feel about the visual aspect of the simulation?" You will interact with various portions of the simulation for approximately 75 to 85 minutes. After this, you will be led through a semi-structured informal interview which will help me gain more insight into your thoughts and allow you provide valuable feedback.

Only you and I will be present during the interview. With your permission, I will audio-record the study so that I can later transcribe the interview and analyze the responses. With your permission, I will also video-record the study within Zoom so that I can analyze any facial cues you might give that will help me prompt you to think aloud or recognize a potential issue within the simulation. All recordings will be stored in a password-protected computer. The analyzed data, NOT the recordings, will be shared in the report and conference. The recordings will be erased from the computer once the project is concluded.

Taking part in this study is your choice.

Your participation in this project is completely voluntary. Should you feel discomfort or stress during the simulation or during the interview, you may take a break. You may stop participating at any time. If you stop being in the study, there will be no penalty or loss to you.

What are the risks and benefits of taking part in this study?

I believe there is little risk to you for participating in this research project. You may become stressed or feel uncomfortable while navigating in a virtual environment. If you do become stressed or uncomfortable, you can skip the task or take a break. You can also stop the interview or you can withdraw from the project altogether. There may be no direct benefit to you for participating in this interview. The results of this usability study may help improve the development of the aural music theory simulation in Minecraft and may benefit future music teachers and students in their music theory studies.



University of Hawai'i
Consent to Participate in a Research Project
 Dr. Meng-Fen Lin, Principal Investigator
 Sarah Espinosa, Co-investigator

Project title: The Crafter's Ear: Evaluation of an Aural Theory Simulation in Minecraft

Privacy and Confidentiality:

I will keep all study data secure in a locked filing cabinet in a locked office/encrypted on a password protected computer. Only my University of Hawai'i advisor and I will have access to the information. Other agencies that have legal permission have the right to review research records. The University of Hawai'i Human Studies Program has the right to review research records for this study. Your name and any identifiable information will not be used when reporting results. The answers you provide will be aggregated so that it cannot be connected to you personally. Your privacy and confidentiality will be kept at all times to the extent of the law.

Compensation:

For participating in this study, you will receive the updated simulation file of The Crafter's Ear for personal use in Minecraft Java after all usability testing has been completed.

Questions:

If you have any questions regarding this study, please feel free to email me sbespi@hawaii.edu. You may also contact my advisor, Dr. Grace Lin, at [gracelin@hawaii.edu]. You may contact the UH Human Studies Program at 808.956.5007 or uhirb@hawaii.edu to discuss problems, concerns and questions; obtain information; or offer input with an informed individual who is unaffiliated with the specific research protocol. Please visit <http://go.hawaii.edu/jRd> for more information on your rights as a research participant.

If you agree to participate in this project, please sign and date this signature page and return it to: sbespi@hawaii.edu

Keep a copy of the informed consent for your records and reference.

Signature(s) for Consent:

I give permission to join the research project entitled, "*The Crafter's Ear: Evaluating an Aural Theory Simulation in Minecraft*"

Please initial next to either "Yes" or "No" to the following:

- Yes No I consent to be audio-recorded for this study.
 Yes No I consent to being video-recorded for this study.

Name of Participant (Print): _____

Participant's Signature: _____

Signature of the Person Obtaining Consent: _____

Date: _____

Mahalo!

Appendix G

Observation Instruments: Transcript form for Usability Study Recording Analysis

Prototype ____ (1, 2, or 3)

Evaluation for: The Crafters Ear, Aural Music Theory Simulation in Minecraft Java

Date of Usability Study/Interview: _____ Duration: _____

Participant # _____ Minecraft Level: Novice/Intermediate/Advanced Participated in Tutorial: Y/N

Usability Study Transcribed by: _____ Date: _____

Preliminary Script Questions and Responses	
1. Prior to participating in the study, had you heard of Minecraft?	
2. Prior to participating in this study, had you played Minecraft?	
3. Did you participate in the beginner or intermediate Minecraft user tutorial prior to this session?	
4. How often do you use online games that require navigation?	

<p>5. What is your general perception of online games?</p>	
<p>6. Have you ever used an online game or virtual learning tool in an educational setting? If so, please elaborate.</p>	

Music Server Tour: Free Roaming Within Simulation/Thinking-Aloud (___ Minutes)

See the principles and scale below. For each principle, indicate choice for how the design performed according to the scale. In addition, provide specific feedback if any usability issues are identified (anything scoring 2 or higher should be provided comments about specific items to be addressed).

Severity Rating Scale

- 0: No specific usability problem identified
- 1: Cosmetic problem only -- need not be fixed unless extra time is available on project
- 2: Minor usability problem -- fixing this should be given low priority
- 3: Major usability problem -- important to fix, so should be given high priority
- 4: Usability catastrophe -- imperative to fix this before product can be released

Principles (Heuristics)	Scale				
<p>1. Speak the users' language. Use words, phrases, and concepts familiar to the user. Present information in a natural and logical order.</p>	0	1	2	3	4
<p>1.1. Various kinds of communication between avatar and simulated material</p>	0	1	2	3	4
<p>1.2. Interaction between avatars is analogous to people interaction in the real world</p>	0	1	2	3	4

6. Navigational feedback.	0	1	2	3	4
6.1. Navigation is intuitive and memorable	0	1	2	3	4
6.2. Minimal use of additional windows	0	1	2	3	4
6.3. Minimal use of deep hierarchical structure	0	1	2	3	4
6.4. The system ensures the consistency between navigation information	0	1	2	3	4
6.5 Search for all kinds of content.	0	1	2	3	4
7. Accessibility. Provide appropriate alternatives and a clear structure for supporting accessibility.	0	1	2	3	4
7.1 Extending the functionality of the virtual world using given tools	0	1	2	3	4
7.2 A basic set of rules is applied to virtual world content. The rules define licensing, protection of intellectual property and object creation and modification.	0	1	2	3	4

[Evaluation protocol and scale adapted from: Levi and Conrad (1996) "A Heuristic Evaluation of a World Wide Web Prototype," *Interactions Magazine*, July/August, Vol.III.4, pp. 50-61 and from Butuke and Lapin (2010) "Usability Heuristics for Online Virtual Worlds," [https://www.researchgate.net/publication/228826733_Usability_heuristics_for_online_virtual_worlds.](https://www.researchgate.net/publication/228826733_Usability_heuristics_for_online_virtual_worlds)]

Navigation Task Segment Transcribed: (__ minutes)

Scenarios for Usability Study aligned with Research Question #1
 How easy or difficult was it to locate the virtual content design areas within the virtual learning environment?

1. Please find the teleportation portals.	
2. Please take your Avatar to the interval location.	

<p>3. Please return to the main teleportation area.</p>	
<p>4. Please take your Avatar to the chord location.</p>	
<p>5. Please return to the main teleport area.</p>	
<p>6. Please take your Avatar to the composition area.</p>	
<p>7. Please return to the main teleportation area.</p>	

See the principles and scale below. For each principle, indicate your choice for how the design performed according to the scale. In addition, provide specific feedback if any usability issues are identified (anything scoring 2 or higher should be provided comments about specific items to be addressed).

Severity Rating Scale

0: No specific usability problem identified

1: Cosmetic problem only -- need not be fixed unless extra time is available on project

2: Minor usability problem -- fixing this should be given low priority

- 3: Major usability problem -- important to fix, so should be given high priority
- 4: Usability catastrophe -- imperative to fix this before product can be released

Principles (Heuristics)	Scale				
<p>2. Consistency. Indicate similar concepts through identical terminology and graphics. Adhere to uniform conventions for layout, formatting, typefaces, labeling, etc.</p> <p>2.1. Prediction of the result of performed actions</p> <p>2.2. Ability to the influence of past actions to present state</p> <p>2.3. Ability to apply an experience from other systems</p> <p>2.4. Ability to perform more than several tasks at the same time</p>	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
<p>5. Progressive levels of detail. Organize information hierarchically, with more general information appearing before more specific detail.</p> <p>5.1 Information delivery and presentation</p> <p>5.2. The convenience of information transfer, acquirement and search.</p> <p>5.3. The simulation provides only complete and updated information</p> <p>5.5. Information is delivered consistently and coherently</p> <p>5.6. The simulation provides help for users</p>	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4
	0	1	2	3	4

[Evaluation protocol and scale adapted from: Levi and Conrad (1996) "A Heuristic Evaluation of a World Wide Web Prototype," *Interactions Magazine*, July/August, Vol.III.4, pp. 50-61 and from Butuke and Lapin (2010) "Usability Heuristics for Online Virtual Worlds," [https://www.researchgate.net/publication/228826733_Usability_heuristics_for_online_virtual_worlds.](https://www.researchgate.net/publication/228826733_Usability_heuristics_for_online_virtual_worlds)]

Effectiveness of Virtual Content Design Task Segment Transcribed: (__ minutes)

Scenarios for Usability Study aligned with Research Question #2
 How effective was the virtual content design of the musical mechanisms in the sandbox environment for aural theory training for use with teachers of beginner music students age 10-13?

<p>1. We are now at the interval simulation. I'd like you to use your avatar to walk around and interact with the various objects.</p>	
<p>2. Can you open the material dispenser and read the instructions?</p>	
<p>3. Please create an interval of a major third.</p>	
<p>4. Please play the interval of a major third.</p>	
<p>5. Please interact with two minor intervals.</p>	

<p>6. We are now at the chord simulation. I'd like you to use your avatar to walk around and interact with various objects.</p>	
<p>7. Can you open the material dispense and read the instructions?</p>	
<p>8. Please create a diminished chord of three notes.</p>	
<p>9. Please play the diminished chord you created.</p>	
<p>10. Please interact with the other chords in the area, identifying them as you play them.</p>	
<p>11. We are now at the composition simulation. I'd like you to use your avatar to walk around and interact with various objects.</p>	
<p>12. Can you open the material dispenser and read the instructions?</p>	

<p>13. Please find and play the song, “Row, Row, Row Your Boat.”</p>	
--	--

See the principles and scale below. For each principle, indicate choice for how the design performed according to the scale. In addition, provide specific feedback if any usability issues are identified (anything scoring 2 or higher should be provided comments about specific items to be addressed).

Severity Rating Scale

- 0: No specific usability problem identified
- 1: Cosmetic problem only -- need not be fixed unless extra time is available on project
- 2: Minor usability problem -- fixing this should be given low priority
- 3: Major usability problem -- important to fix, so should be given high priority
- 4: Usability catastrophe -- imperative to fix this before product can be released

Principles (Heuristics)	Scale				
<p>1. Speak the users' language. Use words, phrases, and concepts familiar to the user. Present information in a natural and logical order.</p>	0	1	2	3	4
<p>1.1. Various kinds of communication between avatar and simulated material</p>	0	1	2	3	4
<p>1.2. Interaction between avatars is analogous to people interaction in the real world</p>	0	1	2	3	4
<p>2. Consistency.</p> <p>Indicate similar concepts through identical terminology and graphics. Adhere to uniform conventions for layout, formatting, typefaces, labeling, etc.</p>	0	1	2	3	4
<p>2.1. Prediction of the result of performed actions</p>	0	1	2	3	4
<p>2.2. Ability to the influence of past actions to present state</p>	0	1	2	3	4
<p>2.3. Ability to apply an experience from other systems</p>	0	1	2	3	4
<p>2.4. Ability to perform more than several tasks at the same time</p>	0	1	2	3	4

<p>3. Aesthetic and minimalist design. Create visually pleasing sites. Eliminate information which is irrelevant or distracting.</p> <p>3.1. Redundant usage of colors is avoided</p> <p>3.2. Usage of animated and graphical elements is limited</p> <p>3.3. Multiple interfaces with the tools of messaging, maps, inventory, avatar movement control, search, object editor, etc.</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>
<p>4. Chunking. Provide narrative written material that is short and does not contain excessive information in one section. Also, do not force the user to access multiple documents to complete a single thought.</p> <p>4.1 Create virtual content and manipulate virtual objects.</p> <p>4.2 Ability to use the tool</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>
<p>5. Progressive levels of detail. Organize information hierarchically, with more general information appearing before more specific detail.</p> <p>5.1 Information delivery and presentation</p> <p>5.2. The convenience of information transfer, acquirement and search.</p> <p>5.3. The simulation provides only complete and updated information</p> <p>5.5. Information is delivered consistently and coherently</p> <p>5.6. The simulation provides help for users</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>
<p>7. Accessibility. Provide appropriate alternatives and a clear structure for supporting accessibility.</p> <p>7.1 Extending the functionality of the virtual world using given tools</p> <p>7.2 A basic set of rules is applied to virtual world content. The rules define licensing, protection of intellectual property and object creation and modification.</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>

[Evaluation protocol and scale adapted from: Levi and Conrad (1996) "A Heuristic Evaluation of a World Wide Web Prototype," *Interactions Magazine*, July/August, Vol.III.4, pp. 50-61 and from Butuke and Lapin (2010) "Usability Heuristics for Online Virtual Worlds," <https://www.researchgate>

Free Exploration and Think Aloud (__ Minutes)

User Satisfaction Segment Transcribed: (__ minutes)

Questions for Usability Study aligned with Research Question #3
 What was the level of user satisfaction of of virtual content design (space presence, involvement, perceived relevance, and appeal) within the virtual learning environment for use in aural theory training for teachers of beginning music students ages 10-13?

<p>1. How did you feel about the use of space?</p>	
<p>2. How did you feel about the visual aspect of the simulation?</p>	
<p>3. How did you feel about the level of involvement of each of the tasks in each area?</p>	
<p>4. On a scale of 1 to 10, with 1 representing very easy and 10 representing very difficult, how would you rate your experience during today's testing?</p>	

<p>5. Please think back to other virtual games you have visited before. Have you ever needed to perform tasks like the ones you did in the usability test today? Compared to your prior experience, would you say that the tasks you performed today were easier or more difficult? Why?</p>	
<p>6. After participating in this study, would you recommend this simulation for use with your beginner music students? Why?</p>	

See the principles and scale below. For each principle, indicate your choice for how the design performed according to the scale. In addition, provide specific feedback if any usability issues are identified (anything scoring 2 or higher should be provided comments about specific items to be addressed).

Severity Rating Scale

- 0: No specific usability problem identified
- 1: Cosmetic problem only -- need not be fixed unless extra time is available on project
- 2: Minor usability problem -- fixing this should be given low priority
- 3: Major usability problem -- important to fix, so should be given high priority
- 4: Usability catastrophe -- imperative to fix this before product can be released

Principles (Heuristics)	Scale
-------------------------	-------

<p>1. Speak the users' language. Use words, phrases, and concepts familiar to the user. Present information in a natural and logical order.</p> <p>1.1. Various kinds of communication between avatar and simulated material</p> <p>1.2. Interaction between avatars is analogous to people interaction in the real world</p>	0	1	2	3	4
<p>2. Consistency.</p> <p>Indicate similar concepts through identical terminology and graphics. Adhere to uniform conventions for layout, formatting, typefaces, labeling, etc.</p> <p>2.1. Prediction of the result of performed actions</p> <p>2.2. Ability to the influence of past actions to present state</p> <p>2.3. Ability to apply an experience from other systems</p> <p>2.4. Ability to perform more than several tasks at the same time</p>	0	1	2	3	4
<p>3. Aesthetic and minimalist design. Create visually pleasing sites. Eliminate information which is irrelevant or distracting.</p> <p>3.1. Redundant usage of colors is avoided</p> <p>3.2. Usage of animated and graphical elements is limited</p> <p>3.3. Multiple interfaces with the tools of messaging, maps, inventory, avatar movement control, search, object editor, etc.</p>	0	1	2	3	4
<p>4. Chunking. Provide narrative written material that is short and does not contain excessive information in one section. Also, do not force the user to access multiple documents to complete a single thought.</p> <p>4.1 Create virtual content and manipulate virtual objects.</p> <p>4.2 Ability to use the tool</p>	0	1	2	3	4

<p>5. Progressive levels of detail. Organize information hierarchically, with more general information appearing before more specific detail.</p> <p>5.1 Information delivery and presentation</p> <p>5.2. The convenience of information transfer, acquirement and search.</p> <p>5.3. The simulation provides only complete and updated information</p> <p>5.5. Information is delivered consistently and coherently</p> <p>5.6. The simulation provides help for users</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>
<p>7. Accessibility. Provide appropriate alternatives and a clear structure for supporting accessibility.</p> <p>7.1 Extending the functionality of the virtual world using given tools</p> <p>7.2 A basic set of rules is applied to virtual world content. The rules define licensing, protection of intellectual property and object creation and modification.</p>	<p>0 1 2 3 4</p> <p>0 1 2 3 4</p> <p>0 1 2 3 4</p>

Appendix H
Observation Instruments: Informal Interview Template for Transcription

Prototype ____ (1, 2, or 3)
Informal Interview Transcript for The Crafters Ear,
Aural Music Theory Simulation in Minecraft Java

Date of Usability Study/Interview: _____ **Duration:** _____

Participant # _____ **Minecraft Level: Novice/Intermediate/Advanced** **Participated in Tutorial: Y/N**

Informal Interview Transcribed by: _____ **Date:** _____

Informal Interview prompts and response	
1. Did you think this would have potential use with your music students? Why or why not?	

<p>What were some of the most difficult things you found in the simulation?</p>	
<p>What concerns did you have?</p>	

<p>What were some positive features you noticed?</p>	
<p>What do you think would help make the simulation more easier to use?</p>	

Other comments:

Appendix I

Pre-Study Survey for The Crafter's Ear: Demographics and Perception Questions (2 parts)

Part 1: Demographics Questions

The Crafter's Ear: An Aural Theory Simulation in Minecraft, Pre-Study Survey

Demographics

This survey should not take any longer than 15 minutes. No names are recorded. Your information will be kept confidential. This portion of the survey will collect demographic data of usability study participants. All information gathered from this survey will be used to improve the Aural Theory Simulation in Minecraft. Participation is voluntary. Thank you for your time!

1. What is your age range?

18-24 35-44
 25-34 45+
 30-44 Prefer not to say
 45-54

2. What is your gender? (If you prefer not to answer, please type N/A.)

3. Which of the following best describes you?

Employed – working full time
 Employed – working part time
 Not employed – student
 Not employed – retired
 Not employed – looking for paid work
 Not employed – not looking for paid work

4. Please check each box that applies to you.

Home school Parent
 Non-home school Parent
 Military (Active Duty, Reservist, Veteran, Retired)
 Government Contractor
 Educator (Public or Private)
 Other (please specify)

5. Please check each box that applies to you.

I have never taught music.
 I teach (or have taught) instrumental music students (i.e. piano, strings, percussion, winds, world instruments)
 I teach (or have taught) vocal music students.
 Other (please specify)

6. Please check each box that applies to you.

I have never taught music. I teach (or have taught) music students ages 13-17.
 I teach (or have taught) music students under the age of 13. I teach (or have taught) music students ages 18 or older.
 I teach (or have taught) music students ages 10-13.

7. Please check each box that applies to you.

I have never taught music. I teach (or have taught) music in a home school co-op.
 I teach (or have taught) private music lessons (one-on-one). I teach (or have taught) music in a classroom setting (choir, band, ensembles).
 I teach (or have taught) small group lessons (not in a public, private, or home school setting). I teach (or have taught) music as an after school club or group.
 I teach (or have taught) music in another capacity (please specify below).

or Copy and paste questions

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1 of 27 questions

Part Two: Perception Questions

The Crafter's Ear: An Aural Theory Simulation in Minecraft, Post-Study Survey

Navigate within Aural Theory Simulation

This portion of the survey should take approximately 5 minutes. Your answers are recorded. Your information will be kept confidential. This survey will collect data of usability study participants with regards to your navigation experience within the simulation. All information gathered from this survey will be used to improve the Aural Theory Simulation in Minecraft. Your participation is voluntary. Thank you for your feedback!

19. On a scale from 1 to 5 with 1 being Extremely Difficult and 5 being Extremely Easy, how would you rate your ability to navigate to the following areas within the simulation?

	Extremely Difficult 1	Difficult 2	Neutral 3	Easy 4	Extremely Easy 5	I did not go to this location
a. Locating the entrance to The Crafter's Ear Glass House of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Navigating within The Crafter's Ear Glass House of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Locating the Red Stone Tutorial Display	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Transporting to the Red Stone Tutorial Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Transporting back to the Glass House of Learning from the Red Stone Tutorial Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Locating the Stone Block Tutorial Zone Display	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Transporting to the Stone Block Tutorial Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Transporting back to the Glass House of Learning from the Stone Block Tutorial Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Locating the Wooden Building Zone Display	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Transporting to the Wooden Building Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
b. Transporting back to the Glass House of Learning from the Wooden Building Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
c. Locating the end of the Glass House of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
aa. Locating the Music Library of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
a. Locating the teleport to the Stone Block Dealer Zone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

20. On a scale of 1 to 5, with 1 being Extremely Unhelpful and 5 being Extremely Helpful, how beneficial were the navigation cues for enabling you to locate tasks within the simulation?

Extremely Unhelpful 1	Unhelpful 2	Neutral/Helpful 3	Helpful 4	Extremely Helpful 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

21. On a scale of 1 to 5, with 1 being Extremely Unhelpful and 5 being Extremely Helpful, how beneficial were the banner based instructions for enabling you to locate tasks within the simulation?

Extremely Unhelpful 1	Unhelpful 2	Neutral/Helpful 3	Helpful 4	Extremely Helpful 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

22. What was one of the most frustrating aspects about locating tasks?

23. What did you find most beneficial for locating tasks?

24. What could be improved in order to help with locating tasks and locations within the simulation?

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Part 3: Effectiveness (8 minutes, 8 Questions)

The Crafter's Ear: An Aural Theory Simulation in Minecraft, Post-Study Survey

Effectiveness of Aural Theory Simulation

This portion of the survey should take approximately 8 minutes. No names are recorded. Your information will be kept confidential. This survey will collect data of usability study participants on the perceived effectiveness of the aural theory simulation. All information gathered from this survey will be used to improve the Aural Theory Simulation in Minecraft. Your participation is voluntary. Thank you for your feedback!

25. On a scale of 1 to 5 with 1 being Very Poorly and 5 being Very Well, how well did the simulation match the aural material presented?

Very Poorly 1	Poorly 2	Fair 3	Well 4	Very Well 5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

26. On a scale of 1 to 5 with 1 being Not at All and 5 being Very Effective, how effective did you find the following areas of the simulation for teacher use?

	Not at all Effective 1	Not Very Effective 2	Somewhat Effective 3	Mostly Effective 4	Very Effective 5	Not
A. Case Studies of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Real Time Tutorial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Non-Block Tutorial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Internal and Chord Simulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Student Practice Area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Library of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

27. On a scale of 1 to 5 with 1 being Not at All and 5 being Very Effective, how effective did you find the following areas of the simulation for use with your student(s)?

	Not at all Effective 1	Not Very Effective 2	Somewhat Effective 3	Mostly Effective 4	Very Effective 5	Not
A. Case Studies of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
B. Real Time Tutorial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
C. Non-Block Tutorial	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
D. Internal and Chord Simulation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
E. Student Practice Area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
F. Library of Learning	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

28. What area of the simulation did you find most effective for teachers? Why?

29. What area of the simulation did you find most effective for students? Why?

30. What area of the simulation would you be most likely to use with your music student(s)? Why?

31. What area of the simulation did you find least effective for teachers? Why?

32. What area of the simulation did you find least effective for use with student(s)? Why?

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Part 4: User Satisfaction (7 minutes, 9 questions)

The Crafter's Ear: An Aural Theory Simulation in Microsoft, Post-Study Survey

User Satisfaction of Aural Theory Simulation

The purpose of the survey should take approximately 7 minutes. No names are recorded. Your anonymity will be kept confidential. The survey will collect data of usability study participants on the user satisfaction of the aural theory simulation. All information gathered from this survey will be used to improve the aural theory simulation at Microsoft. Your participation is voluntary. Thank you for your feedback!

32. Please take a moment to look over this list of words and choose five that best describe your user satisfaction experience with the aural theory simulation. Type each word into the blocks below and explain why you chose the word.

Accessible	Decisive	Easy on the eye	Personable	Stimulating
Appealing	Easy to use	Hard to fix	Personal	Time consuming
Attractive	Efficient	High quality	Practical	Time saving
Clear	Engaging	Insightful	Reliable	User friendly
Colorful	Exciting	Interesting	Relaxed	User-centric
Complex	Familiar	Simple	Rigid	Unusable
Comprehensive	Fast	Well-thought	Simple	Unconventional
Convincing	Flexible	Very suitable	New	Unpredictable
Convenient	Fast	Organized	Unfamiliar	Usable

Word 1:

Word 2:

Word 3:

Word 4:

Word 5:

33. On a scale of 1 to 5, with 1 being Not Likely and 5 being Very Likely, after participating in the aural theory simulation, how likely would you be to utilize this simulation with your student(s)?

Very Unlikely 1 Unlikely 2 Even 3 Likely 4 Very Likely 5

34. On a scale of 1 to 5, with 1 being Much Lower and 5 being Much Higher, how did the simulation meet your expectations?

Much Lower 1 Lower 2 Near 3 Higher 4 Much Higher 5

35. On a scale of 1 to 5, with 1 being Very Unlikely and 5 being Very Likely, how likely would you be to recommend this simulation to your colleague?

Very Unlikely 1 Unlikely 2 Even 3 Likely 4 Very Likely 5

36. Has your perception of teaching aural theory online improved, stayed the same, or declined after participating in this simulation?

Improved

Stayed the same

Declined

Other (please specify)

37. The learning curve for a virtual learning environment can seem steep at the beginning. Do you feel that the aural theory simulation benefits would outweigh the time commitment needed to implement this simulation into your lesson material for your music student(s)? Why or why not?

38. What was the most appealing part of the simulation? Why?

39. What was the least appealing part of the simulation? Why?

40. Feel free to provide any additional comments here.

Thank you. Your input has been extremely valuable and the data from the survey will enable us to make the necessary revisions to create a successful aural theory simulation. Your time is truly appreciated!

PREV DONE

Powered by SurveyMonkey

THE CRAFTER'S EAR

4 of 27 questions

Appendix K
Protocols: Usability Study Plan

1. Usability study plan for virtual learning, Minecraft-created music theory world

2. Purpose

Type of research project: Usability Study

Topic: Effectiveness and User Satisfaction of Crafter's Ear: Music Theory World
(link to created realm here)

Participants: Homeschool Parents and Music Teachers of Beginner Music students (10-13)

Research Site: Sarah's Zoom Room - <https://zoom.us/j/6281115879>

Purpose Statement:

The purpose of this usability study is to evaluate the navigation, effectiveness of virtual content design and user satisfaction in an aural music theory skills simulation created within the sandbox Minecraft for music teachers to use with their 10-13 year old music students.

3. Areas of inquiry

- Navigation
- Effectiveness
- User Satisfaction

4. Research Questions

1. How easy or difficult was it to locate the virtual content design areas within the virtual learning environment?
2. How effective was the virtual content design of the musical mechanisms in the sandbox environment for aural theory training for use with teachers of beginner music students age 10-13?
3. What was the level of user satisfaction of virtual content design (space presence, involvement, perceived relevance, and appeal) within the virtual learning environment for use in aural theory training for teachers of beginning music students ages 10-13?

5. Methods

This study will take place in Zoom during scheduled sessions in Spring 2018. Three phases of usability testing and data collection will occur with a minimum of three participants in each phase. The usability test will include both task giving to the user and follow up questions regarding given tasks.

6. Participants

The participants are members of the target population and are familiar with music theory with basic computer literacy skills. They will most likely have limited experience with usability testing. All are educated and have a positive incentive to participate in this music simulation usability study.

7. Instrumentation

For the evaluation, a variety of instruments will be necessary. The user will need a functional computer with adequate internet access, microphone and computer camera. All users must have access to Minecraft Java and Zoom provided prior to the testing. Once the test participant is online and logged in to both Minecraft Java and Zoom, delivery of the usability instructions and procedure for the evaluation will occur. Screen sharing function of Zoom will be utilized.

8. Logistics

- Begin/end the screen recorder and note the start time
- Facilitate Zoom and online testing and set the pace for online interaction
- Provide overview of study to participants
- Define usability and purpose of usability testing to participants
- Icebreaker: Occupation? Online behavior? Virtual environment experience?
- Instruct the participant to 'think aloud' so that a verbal record exists of their interaction with the virtual simulation
- Record participant's actions and comments
- Identifying problems, concerns, bugs, and procedural errors
- Respond to participant's requests for assistance
- Take notes
- Conduct participant and observer debriefing sessions

9. Timeline (Total of 60 minutes per person)

- Welcome Script and/or icebreaker questions (if necessary): 5 minutes
- Music Theory World Tour: 10 minutes
- Actual Usability Test: 40 minutes
- Wrap-Up: 10 minutes

10. Budget

Minecraft Java costs \$26. Two accounts have been purchased in order to provide usability participants with the ability to participate at no personal cost. No funding will be provided to compensate volunteers for participating. All equipment and programs used to conduct this evaluation are owned by facilitators or participants (in the case of personally owned computer, microphone, and computer camera).

<https://docs.google.com/forms/d/e/1FAIpQLSdhG2d83MHBHzNKttdY4cDCwICsOgZDiX40Vb-7eeHJgr9y0g/viewform>

(Fill in this as a text version)

Appendix L
Protocols: Checklist

Checklist for Your Usability Test
The Crafter's Ear
Sarah Espinosa

At-A-Glance

1. Before
 1. Email Zoom participant the [link](#) to access Zoom meeting room before scheduled session time.
 2. Have **this** usability technology checklist and [plan](#) handy
 3. Launch Zoom and connect with your usability study participant
 4. Welcome and explain the test to your participant
 5. Double check to make sure Zoom is recording
 6. Direct your participant to start Share Screen in Zoom and ensure that they share their entire desktop
 7. Work through your [usability protocol](#) with your participant
2. During
 1. Be prepared to perform any technical support needed
 2. Ensure that your participant is “thinking aloud” - remind him or her as necessary
3. After
 1. Direct your participant to stop Share Screen in Zoom
 2. Thank your participant and ask if they have any further questions
 3. End Zoom for all participants - End Share Screen
 4. Your archived Zoom recording is now stored as a video in “My Documents” called “Zoom.”

Setting Up & Conducting the Study:

1. Set up your computer; connect to a power outlet (don't trust the battery).
2. Make sure you are connected to the Internet
3. Set up audio and test
 - a. Ensure the microphone is working
 - b. Ensure the volume is at a reasonable level
4. Login in to Zoom account
5. Schedule for Participant/Facilitator to connect to your Zoom meeting room at your scheduled time.
 - a. How to test if Zoom is working:
 - i.* Start a meeting by clicking on ‘host a meeting’ on top right of the account page next to your name.
 - ii.* At the scheduled time when the participate/facilitator is ready to

- participate in the study, notify participant to click on emailed link to join Zoom meeting.
- b. Participant will join the Zoom meeting at the scheduled time.
6. To begin recording your session, click on the grey button labeled "Record."
 - a. Alternatively, a box can be checked when setting up the meeting to automatically record.
 - b. Once you end your Zoom meeting and terminate your session, your recordings will be saved in the Zoom folder within My Documents on your default drive.
 7. Explain your study to participant. Ensure that they understand all directions.
 8. Next, guide your participant to sharing their screen. This can be done by clicking on the "Share Screen" link on their right-hand navigation in the Zoom window.
 9. When the participant has completed their tasks, direct the participant to end "Share Screen."
 10. Thank them for their participation and ask if they have any further questions.
 11. When you feel that the conversation is complete, you may click on "End Recording" Your study will be saved and posted to "My Documents > Zoom" folder with date and time.
-

After the Study:

1. Navigate to "My Documents > Zoom" to ensure that the video is available and saved to your computer.
2. Quickly scrub through the video to ensure the integrity of the audio and video.
3. Add video to Google Drive.
4. Send Google Form survey.

Appendix M
Protocols: Minecraft Set-Up Instructions

Getting Started with Minecraft Java

Thank you again for your participation in The Crafter's Ear Usability Study. In order to participate, you must have access to Minecraft Java. There are **three** options available for participation:

1. You already own your own account.

If you already own an account, please follow the directions on Part 2.

2. You would like to use an account free of charge.

Please follow the directions on Part 1. When you have finished, email me at sbespi@hawaii.edu for a username and password.

Please note that you will only have access to this account during the usability interview. Afterwards, the password will be changed. If you want to use Minecraft Java for personal use, you will need to purchase your own unique account.

3. You are planning to purchase an account.

To purchase (\$27): <https://minecraft.net/en-us/store/?ref=m> -or- you can buy a digital keycode from [Amazon](#) if you are living outside of the United States. While you can play Minecraft Java for free, it is only a demo version.

Part 1:

To download Minecraft Java: <https://minecraft.net/en-us/download/>

If you need some additional help see the customer service instructions to [install Minecraft Java](#) on your computer. If your computer does not have good enough hardware you might have to run Minecraft in windowed mode and turn all of the graphics settings to a minimum for it to function well. See [here](#) and [here](#) for performance settings tips if you do not have a high end computer.

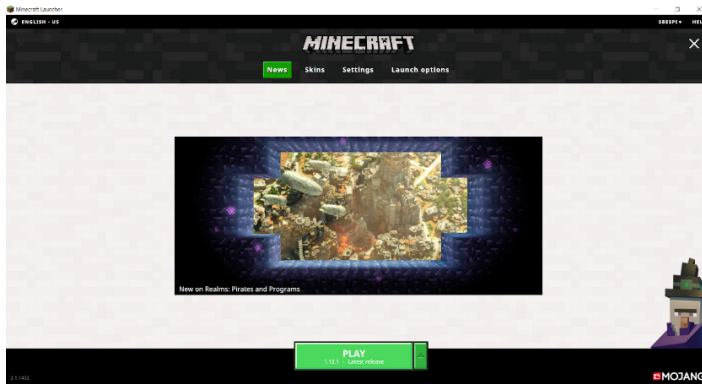
Once you open the program, you should see the Minecraft Setup Wizard. Click next and follow the instructions for saving it to your computer.

*****Stop here if you plan to utilize the free option.** Please email me for your username and password.

For those purchasing a personal copy only: You will need to register and create login name and password. Your login in name will be visible as your avatar name.

Part 2:

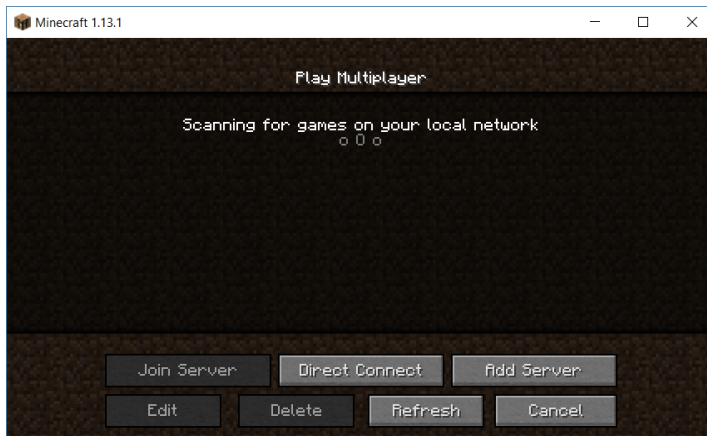
Once you've set up your account, you should see a screen similar to this:



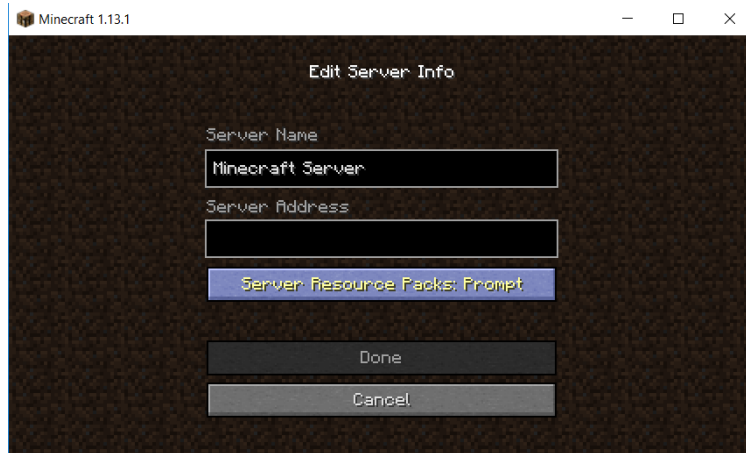
Check to make sure your Play button has the latest version (example: 1.13.1) and then click Play. Your screen will change to this:



Choose **Multiplayer**. Your screen will then change to this:



If this is your first time playing multiplayer in Minecraft, you will have no servers showing. Click on **Add Server**. Your screen will look like this:



Your server name and address will need to be filled in:

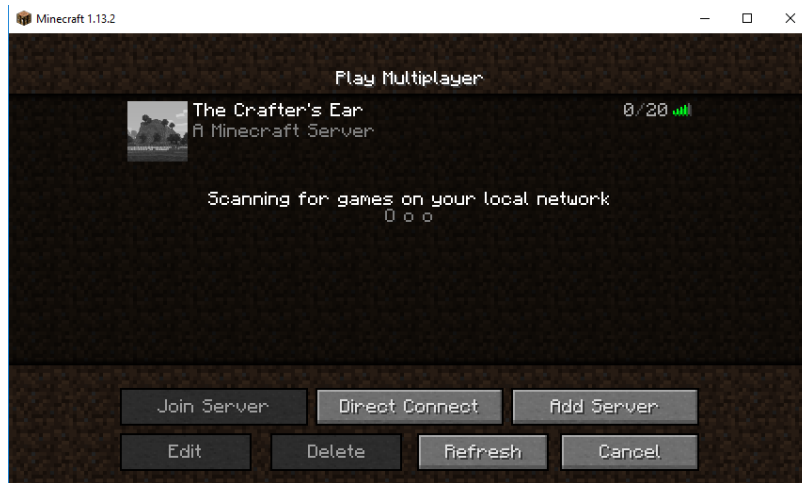


In **Server Name** you may type anything you like to remember the name of the server. The example shown here is The Crafter's Ear.

For **Server Address** fill in: the-crafters-ear.g.akliz.net or 64.74.111.138:26917

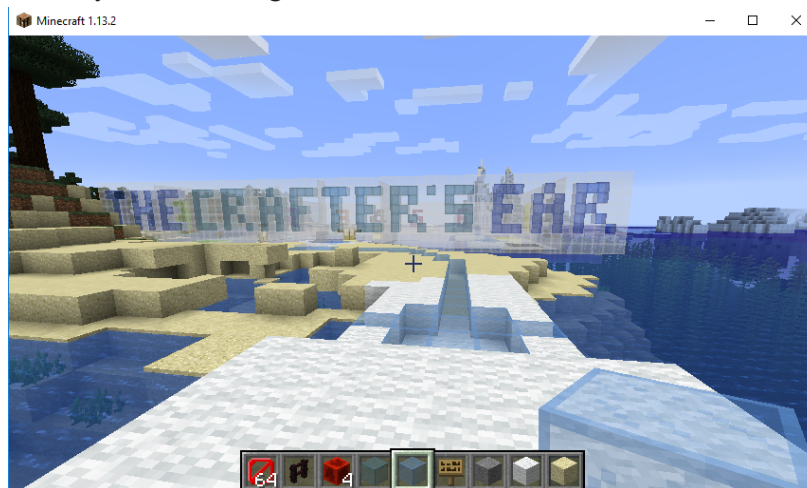
When you are finished, Click on **Done**. This will bring you back to the Multiplayer Server Page.

Now you should have the Server Name you typed in showing as a choice to join:



Click on the server name and then click **Join Server** and your avatar will be teleported into *The Crafter's Ear* Aural Theory Simulation.

You may see something like this:



If your avatar is showing hearts and food icons, this means you are playing in “survival mode.” These icons represent how much life you have and food/stamina, but for the usability interview, we will initially be playing in “creative mode.” To change your game mode, type: **/gamemode creative** and hit enter. You should no longer see hearts or food icons. If you have any issues with logging in or with these instructions, please do not hesitate to contact Sarah Espinosa at sbespi@hawaii.edu, and we will troubleshoot this prior to the usability test.



This is how your avatar should appear (no hearts or food icons). While in creative mode, you are safe from monsters and you have the ability to fly. If you see the food and heart icons pop up again (meaning you are back in survival mode), you can always change it back to `/gamemode creative` to go back into creative mode.

At this point, you have successfully joined the game. **REMEMBER:** Please **ALWAYS** right-click on your mouse to interact with objects in Minecraft. Using the left-click will break/destroy the objects.

NOTE:

If you have never played Minecraft or have limited experience and want to participate in a beginner's tutorial, we will cover navigation/camera controls, building, and survival at a future time that fits into your schedule. The link to the tutorial site is:

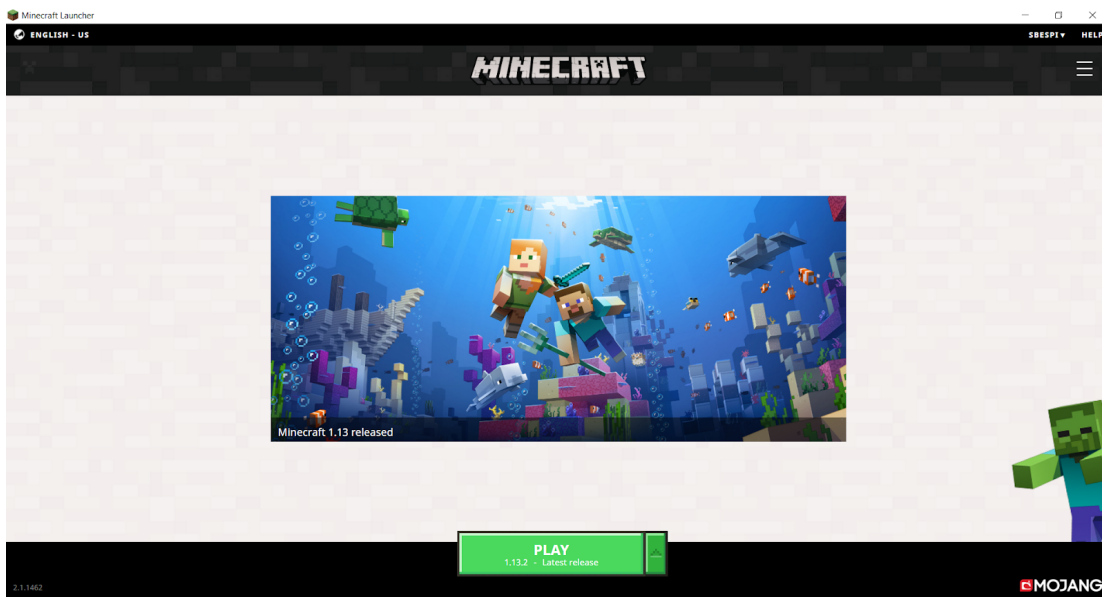
<https://fab5idteam.wixsite.com/minecraft4parents>

This tutorial WILL NOT be included in the usability study. Its sole purpose is to enable you to start with a basic skillset to maneuver and understand basic commands within in the game. A supplemental PDF is also available from the site or can be emailed to you upon request.

SAMPLE (This instructional guide will be sent if Minecraft updates during usability testing (all participants must use the same version for the sake of continuity) The versions of both sets of instructions are subject to change based upon the build prior to the start of the usability study.)

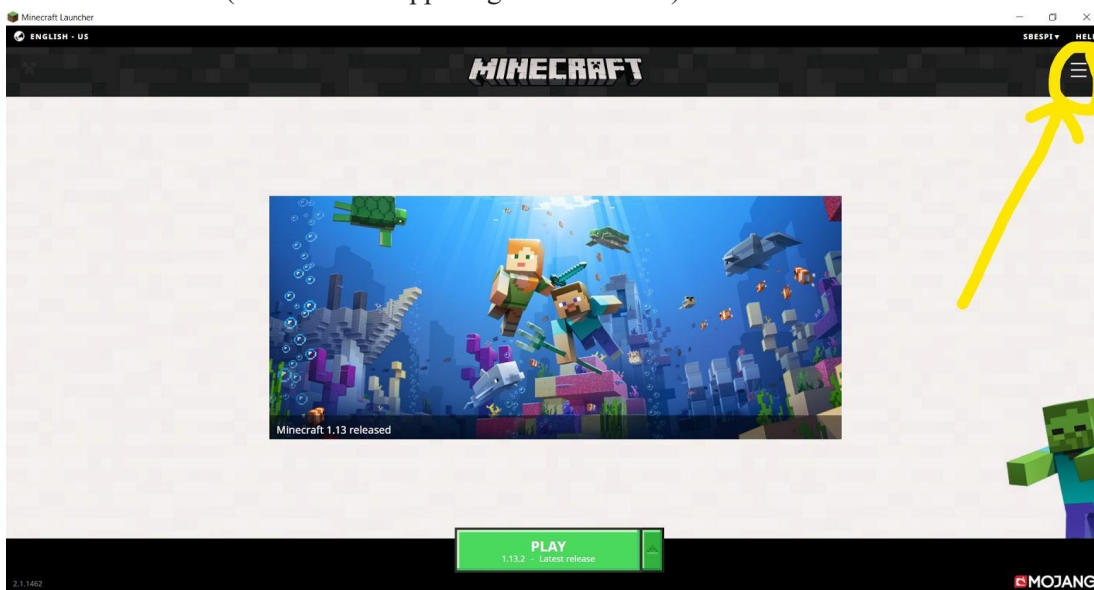
UPDATE: Minecraft 1.13.1 has recently been updated to version 1.13.2. The Crafter's Ear is on version 1.13.1. If future updates occur, **please follow these steps to gain access to the correct version.** The example provided shows how to go from version 1.13.2 back to version 1.13.1, but it will work for any version you are looking for, as long as you select the correct number of the version you are looking for.

Launch Minecraft:

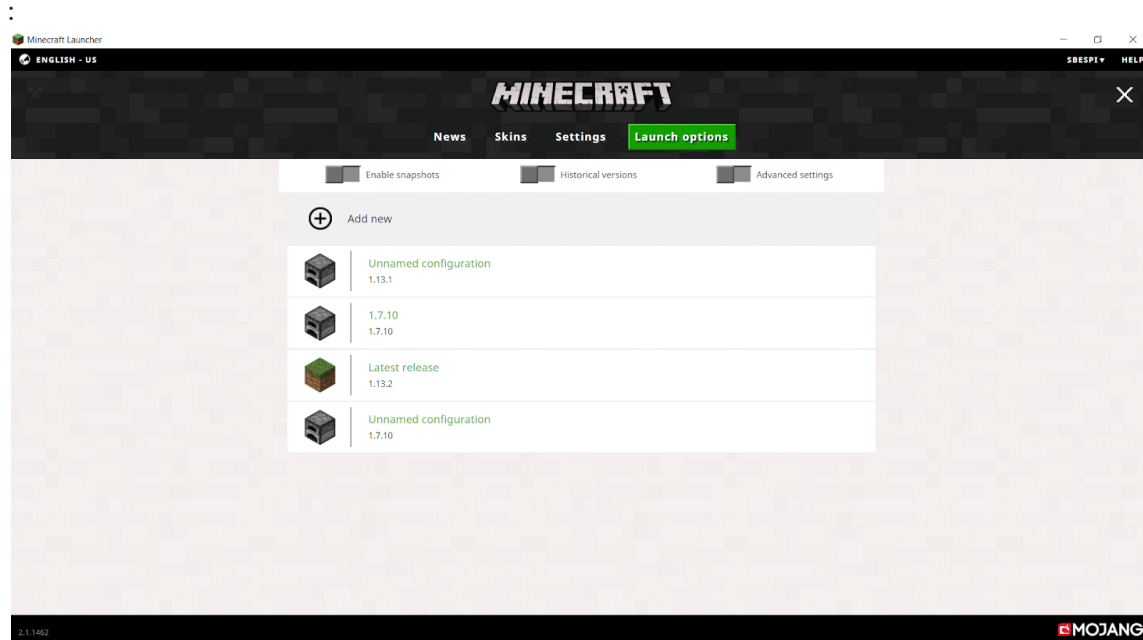


Notice that your green PLAY button says 1.13.2 - Latest release

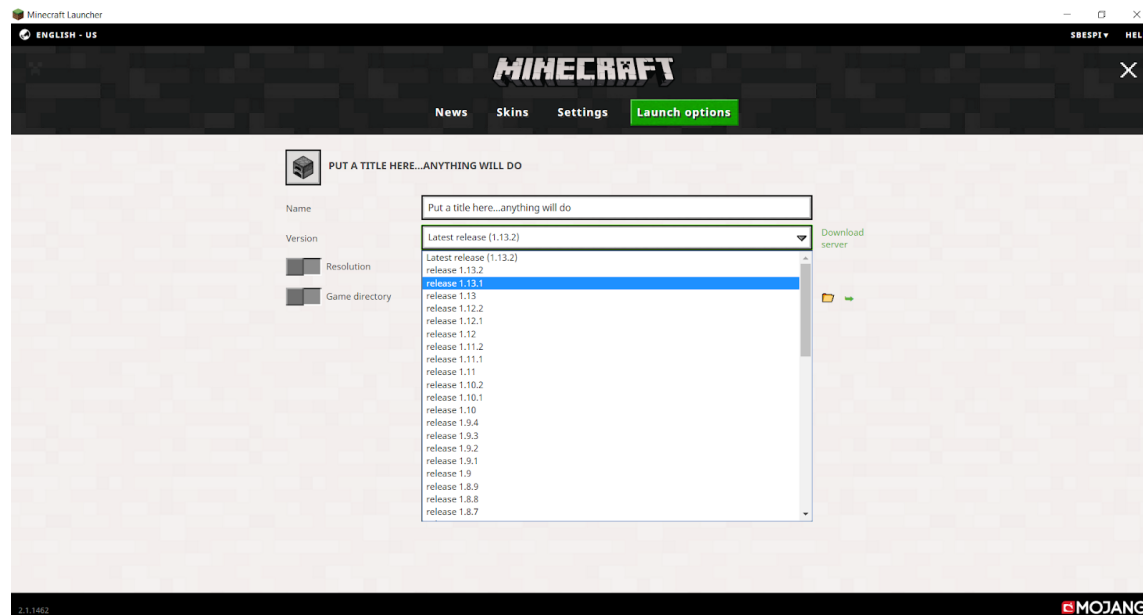
Click on the menu (circled in the upper right hand corner).



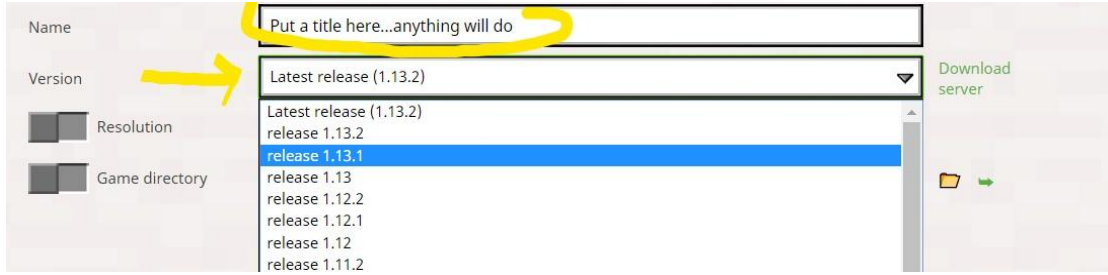
Your top bar should now look like the screen below. You will need to choose Launch options.



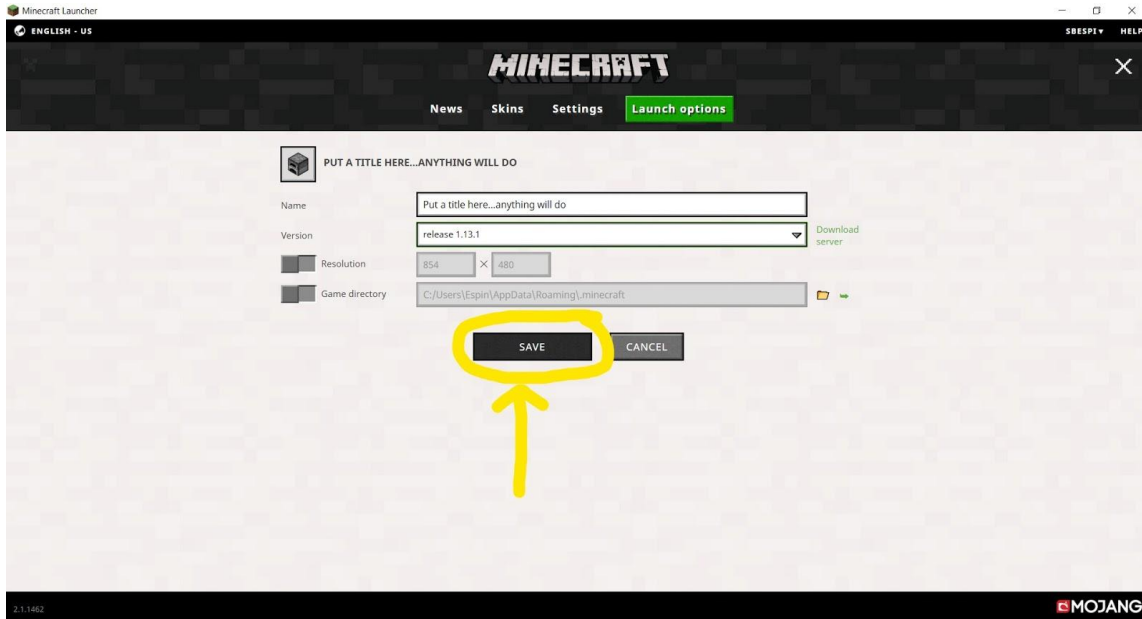
Your screen should now look like this:



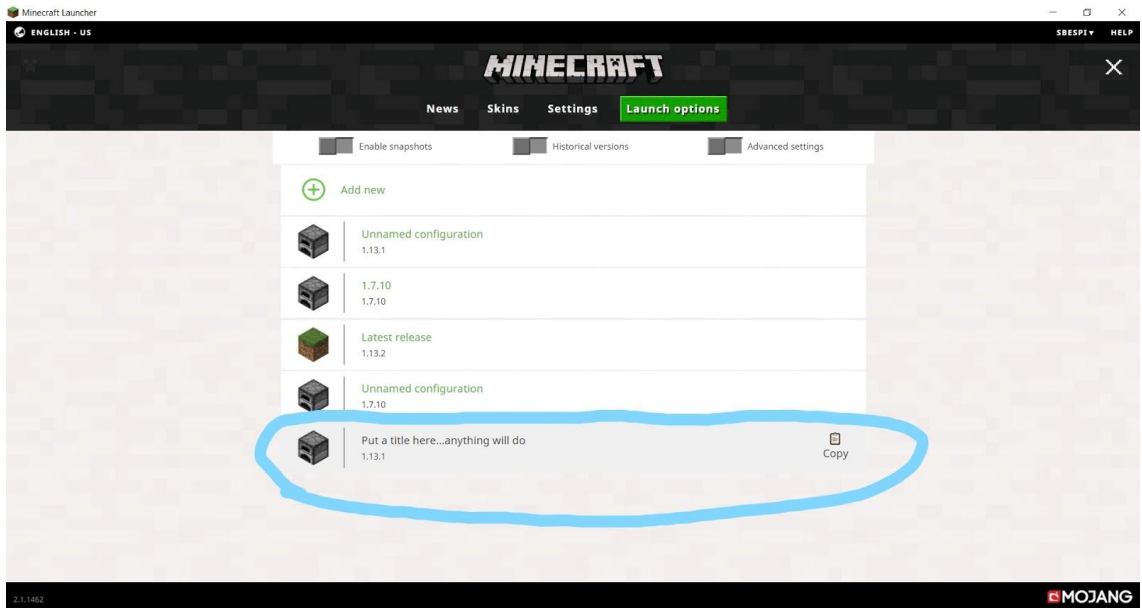
Name your version and click the version bar to change it to release 1.13.1:



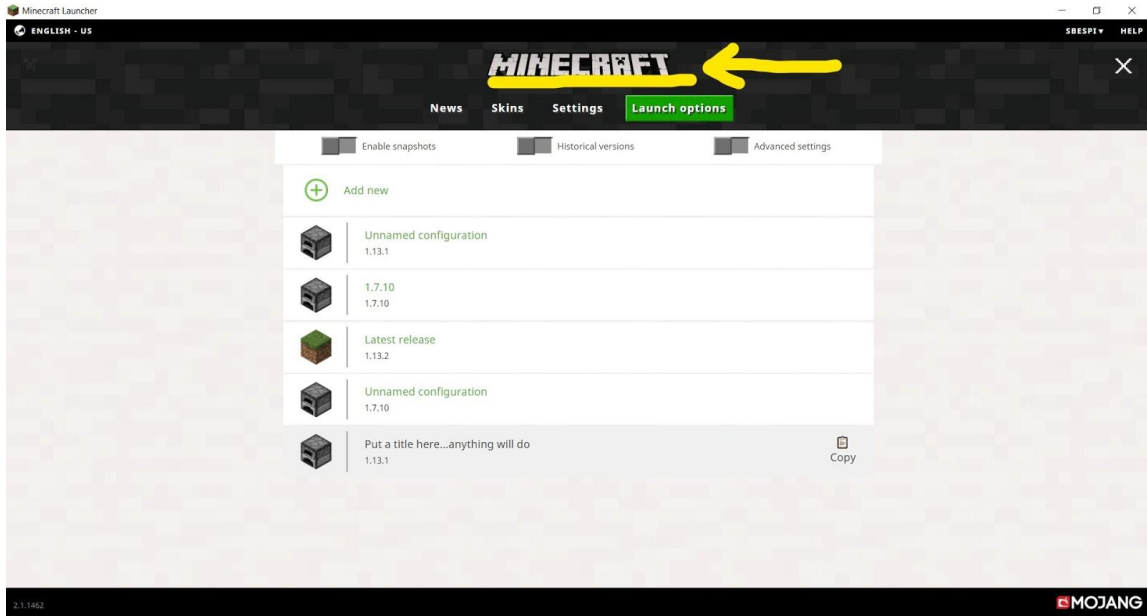
Now save release 1.13.1.



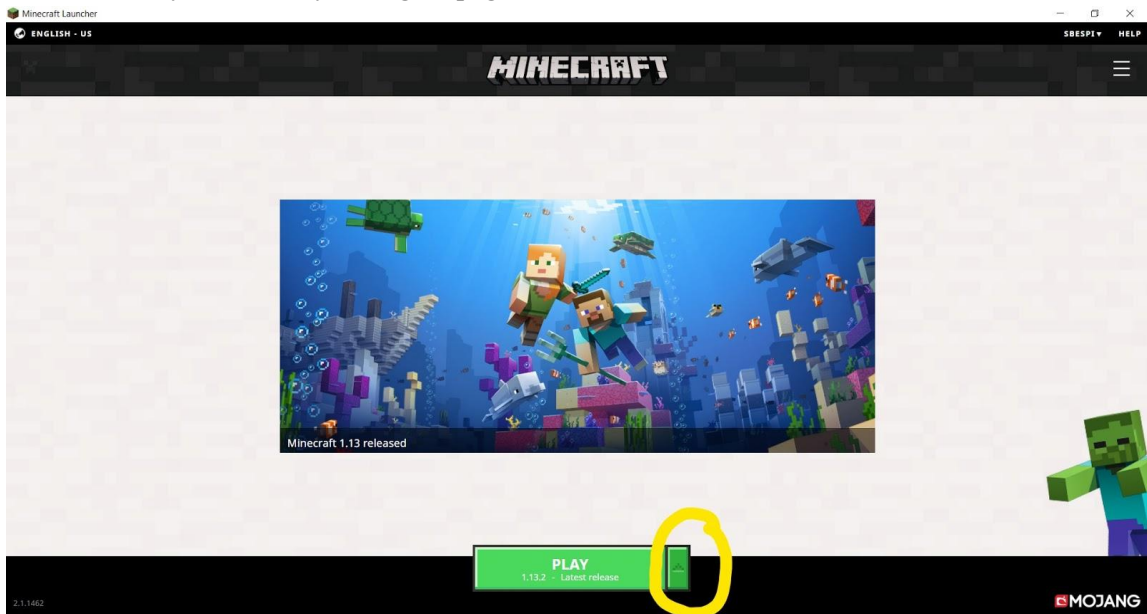
Your saved release should now show up in your Launch options area:



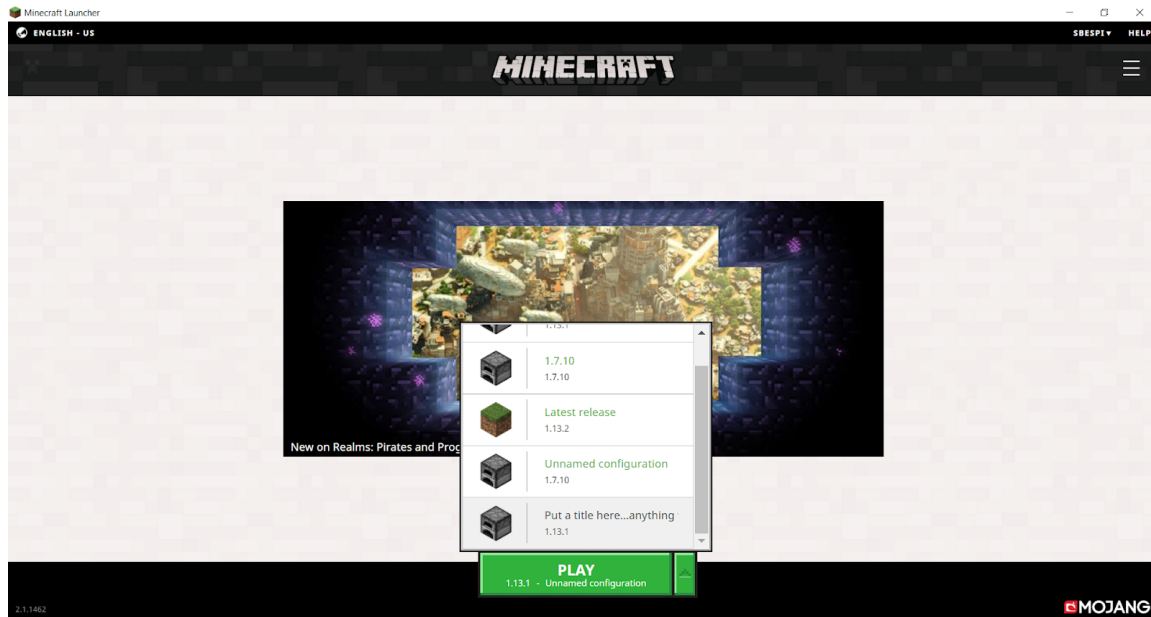
Now click on the word MINECRAFT at the top:



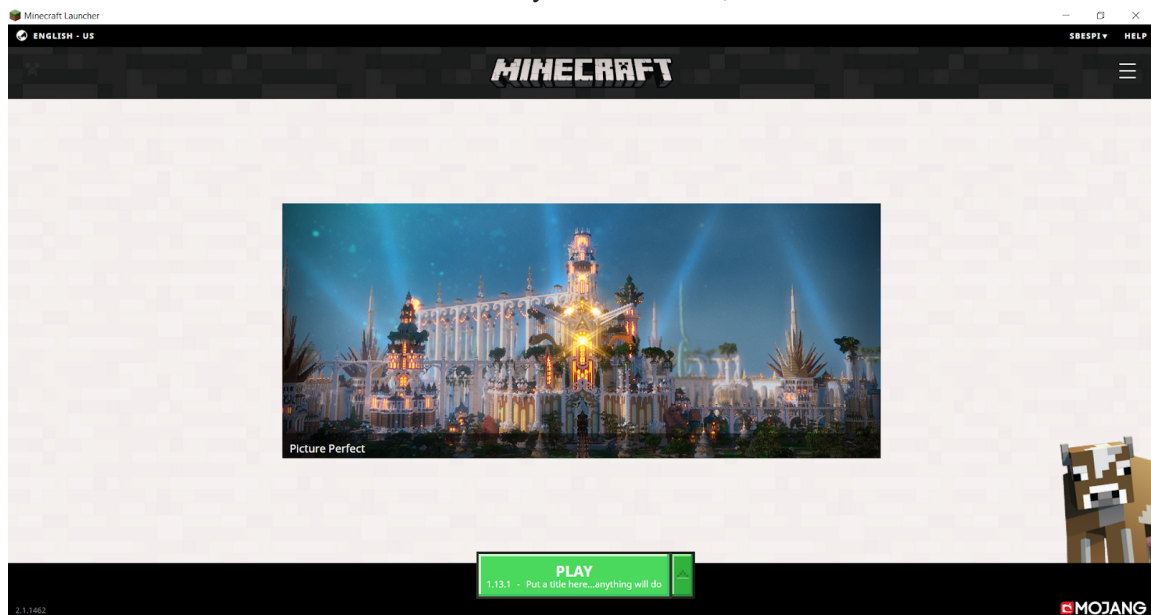
This will take you back to your log on page. Click the arrow to the left of the PLAY button:



This will bring a menu up:



Choose version 1.13.1 which will have what you've named it, as well:



Now check on the green PLAY button. It should be showing the old 1.13.1 version. Go ahead and click PLAY and Minecraft will launch in the previous version.



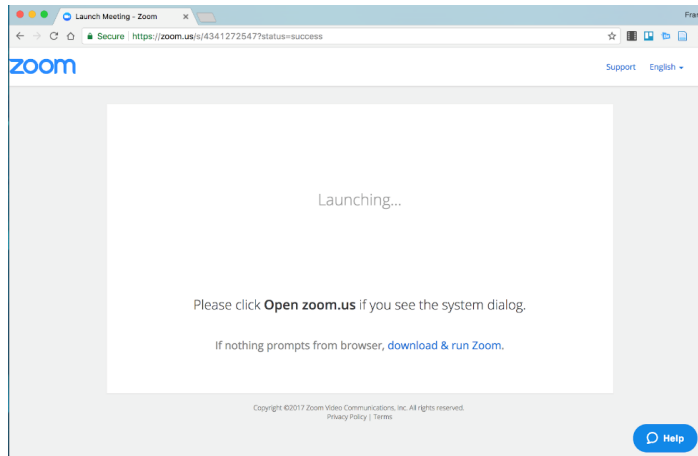
Notice that the version is in the upper left and lower left hand corner. If your version does not say 1.13.1 at this point, you will need to go back through the steps. If you do have version 1.13.1 showing, click Multiplayer.

If you have any questions at all, please do not hesitate to reach out and send me an email (sbespi@hawaii.edu). Please ensure you are able to connect to the correct version of Minecraft and enter our server before the study. Mahalo!

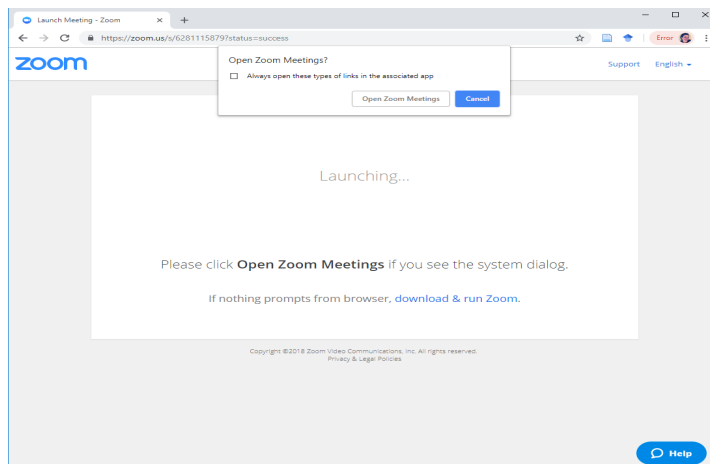
Appendix N
Protocols: Zoom Set-Up Instructions

Quickstart Guide for Zoom

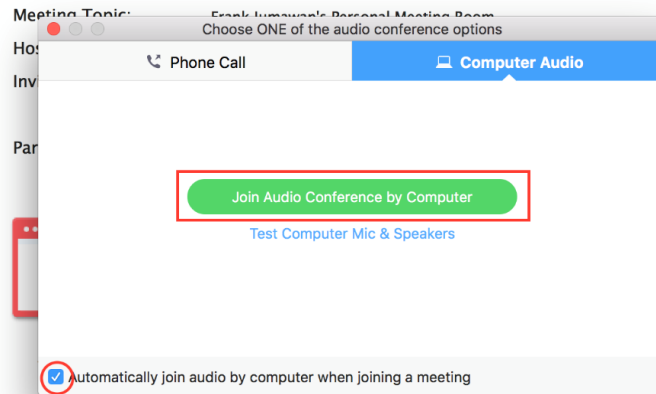
1. Be sure to use the latest version of [Google Chrome](#) or [Mozilla Firefox](#) for the best experience.
2. Click on this link to my Zoom office: [Sarah's Zoom Room](#)
3. If you are a new user, you will be prompted to download the Zoom installer:



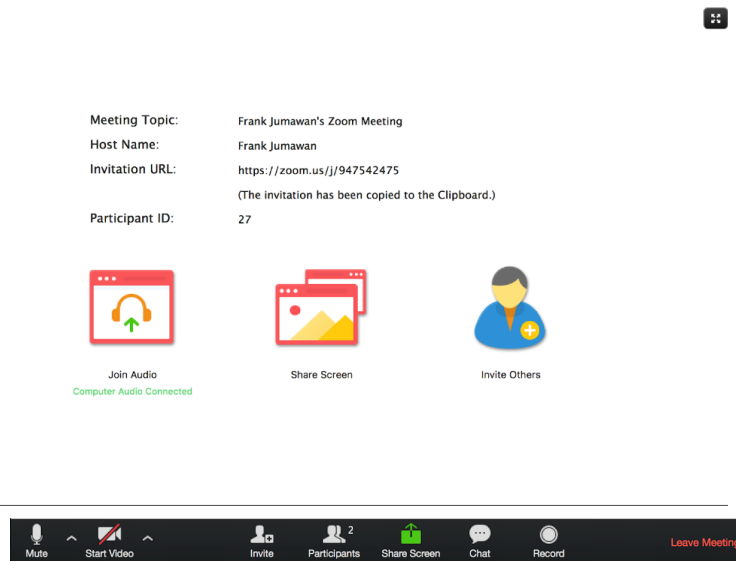
4. Once you have downloaded Zoom, please join the meeting:



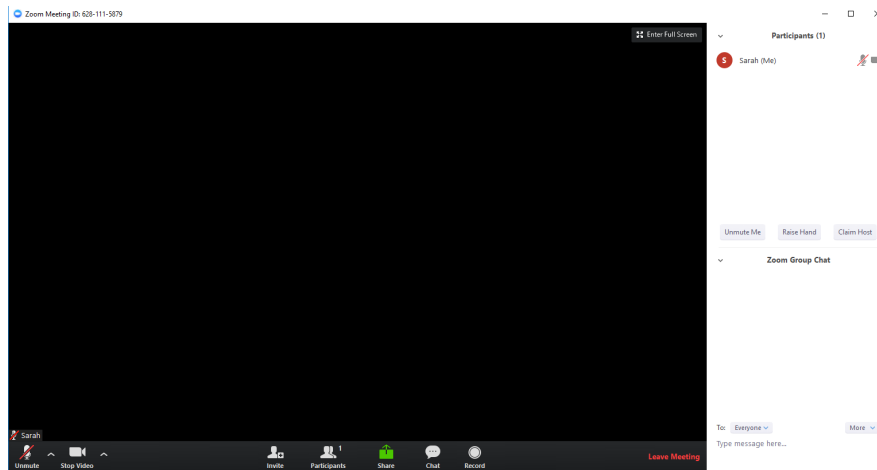
5. Choose Audio Conference Options and check the box in the lower left-hand corner:



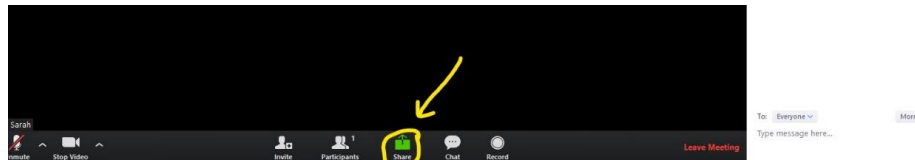
6. Your screen may appear similar to this:



7. You can view the chat or participants windows by clicking on the icon on the bottom of your screen. When both windows are chosen, your screen will look similar to this:



8. Choose the lower left-hand icons to mute/unmute and start video/stop video.
9. To share your screen, click the Share Icon as shown below:



10. Please test your microphone, camera, and the share function prior to the usability interview. If you need any help, please email Sarah Espinosa at sbespi@hawaii.edu.

Appendix O
Protocols: Usability Study Script and Task

**Usability Protocol
The Crafter's Ear**

Technology Set-Up Checklist (Facilitator Computer)

1. Facilitator should set up her computer and connects to a power outlet (don't trust the battery).
2. Make sure a strong Internet connection is established.
3. Set up audio and test
 - a. Ensure the microphone is working
 - b. Ensure the volume is at a reasonable level
4. Log in to Zoom account
5. Log in to Minecraft Server.
6. Contact participant and ask if participant's computer is set up and participant is ready.

After Participant computer is set up:

7. Facilitator invites participant to Zoom meeting room.
8. How to test if Zoom is working:
 - a. Start a meeting by clicking on 'host a meeting' on top right of the account page next to your name.
 - b. At the scheduled time when the participant/facilitator is ready to participate in the study, notify participant to click on emailed link to join Zoom meeting.
9. Facilitator invites participant to Minecraft Server
10. How to test if Minecraft is working:
 - a. Log into Minecraft Music Server through Minecraft Java Multiplayer
 - b. At the scheduled time when the participant/facilitator is ready to participate in the study, notify participant to log into Minecraft Music Server
11. Run an audio and screen-share test with Zoom account
 - a. If it does not work, then review preparation of Facilitator's computer for Zoom and retest
12. Ensure participant can screen-share Minecraft.
 - a. If it does not work, review participant's trouble-shooting guide (create link).

Technology Set-Up Checklist (Participant Computer)

13. Participant sets up his/her computer and connects to a power outlet (don't trust the battery).
14. Make sure a strong Internet connection is established.
15. When contacted, participant should login to Zoom by following the link provided by the facilitator, which will be emailed to the participant beforehand.
16. When contacted, participant should log into Minecraft Music Server by following the instructions provided by the facilitator, which will be emailed to the participant beforehand.
17. Set up audio and test
 - a. Ensure the microphone is working
 - b. Ensure the volume is at a reasonable level
18. Check functionality of Minecraft and Zoom running together.
19. Wait until both parties (i.e. participant and facilitator) are ready, and then begin recording

Facilitator Script

☐ *START the Zoom Session by clicking on the button labeled "Start Recording"*

Welcome Script/Icebreaker Questions (5 min.)

Hi, [PARTICIPANT]. My name is Sarah Espinosa, and I'm going to be walking you through this session today.

Before we begin, I have some information for you, and I'm going to read it to make sure that I cover everything. I'm asking people to try using a music simulation that I created in Minecraft Java. I would like to see if it works as intended. The session should take approximately one hour.

The first thing I want to make clear right away is that I'm testing the *simulation*, not you. You can't do anything wrong here, so don't worry about making any mistakes.

As you use the simulation, I'm going to ask you as much as possible to think out loud: to say what you're looking at, what you're trying to do, and what you're thinking. This will be a big help to me.

Also, please don't worry that you're going to hurt my feelings. I'm doing this to improve the simulation, so I need to hear your honest reactions.

If you have any questions as we go along, just ask them. I may not be able to answer them right away, since I'm interested in how people do when they don't have someone

who can help. But if you still have any questions when we're done, I'll try to answer them then.

Do you have any questions so far?

☐ Ask participant a few preliminary questions:

OK. Before we interact with the simulation, I'd like to ask you just a few quick questions about your computer and virtual world experience.

1. Prior to participating in the study, had you heard of Minecraft?
2. Prior to participating in this study, had you played Minecraft?
3. Did you participate in the beginner or intermediate Minecraft user tutorial prior to this session?
4. How often do you use online games that require navigation?
5. What is your general perception of online games?
6. Have you ever used an online game or virtual learning tool in an educational setting? If so, please elaborate.

OK, great. We're done with the questions, and we can start testing out the simulation.

☐ Ask the participant to log into Minecraft JAVA Music Server:

Use the chatroom feature of Zoom or send your participant an email with the instructions for Minecraft Music Server. Ask participant to join if they haven't already done so.

(LINK TO SERVER)

☐ Ask participant to begin the screen share:

Please start 'Share screen' by clicking on the 'Share screen' link on bottom toolbar of your Zoom window.

Music Server Tour (10 min.)

☐ Have participants do a narrative of the simulation's overall appearance, 10 minutes, at most:

I'm going to ask you to look at this simulation area, and this area only and tell me what you make of it: what strikes you about it, what do you think it's for, what you can do here. Just look around and do a little narrative. You can walk your avatar around if you want to, but don't click on anything yet. Please remember to think out loud.

□ *Ask participant to complete a few specific tasks based off of their scenarios sheet:*

Actual Usability Test (40 min.)

Thanks for doing that. You did a great job. Now I'm going to ask you to try doing some specific tasks. I'm also going to ask you to interact with various items. We are going to do this in three parts and I will let you know when we move on to each section of usability. And just as another reminder, it will help me if you can try to think out loud as you go along.

Allow the user to proceed from one task to the next until you don't feel like it's producing any value or the user becomes very frustrated. Repeat for each task or until time runs out. (10 minutes)

Scenarios for Usability Study for Research Question #1

How easy or difficult was it to locate the virtual content design areas within the virtual learning environment? (DO NOT READ)

Navigation questions (10 minutes):

1. Please find the teleportation portals.
2. Please take your Avatar to the interval location.
3. Please return to the main teleportation area.
4. Please take your Avatar to the chord location.
5. Please return to the main teleportation area.
6. Please take your Avatar to the composition area.
7. Please return to the main teleportation area.

Thank you so much for your help. You did a great job. Now I'm going to teleport you to locations and ask you to interact with various items in each location. Do not worry about doing anything wrong. And again, if you can try to think out loud as you go along, it will be extremely helpful.

Allow the user to proceed from one task to the next until you don't feel like it's

producing any value or the user becomes very frustrated. Repeat for each task or until time runs out. (30 minutes)

Scenarios for Usability Study for Research Question #2

How effective was the virtual content design of the musical mechanisms in the sandbox environment for aural theory training for use with teachers of beginner music students age 10-13? (DO NOT READ)

Effectiveness of simulation questions (30 minutes):

1. We are now at the interval simulation. I'd like you to use your avatar to walk around and interact with the various objects.
2. Can you open the material dispenser and read the instructions?
3. Please create an interval of a major third.
4. Please play the interval of a major third.
5. Please interact with two minor intervals.
6. We are now at the chord simulation. I'd like you to use your avatar to walk around and interact with various objects.
7. Can you open the material dispense and read the instructions?
8. Please create a diminished chord of three notes.
9. Please play the diminished chord you created.
10. Please interact with the other chords in the area, identifying them as you play them.
11. We are now at the composition simulation. I'd like you to use your avatar to walk around and interact with various objects.
12. Can you open the material dispenser and read the instructions?
13. Please find and play the song, "Row, Row, Row Your Boat."

Thank you so much for your help. You did a great job. Now I'm going to bring you back to the main teleport area and ask you to move around the simulation again with your avatar. Using the remaining time, please explore freely and talk aloud about your impressions. Do not worry about doing or saying anything wrong. The more you can speak your thoughts aloud, the more helpful it is.

Allow the user to proceed from one task to the next until you don't feel like it's producing any value or the user becomes very frustrated. Repeat for each task or until time runs out. (remaining time left of the entire 40 minutes process)

Thanks, that was very helpful.

Note: If the participant gets stuck or is silent, use the follow phrases from the chart.

WHEN THIS HAPPENS:	SAY THIS:
You’re not absolutely sure you know what the participant is thinking.	“What are you thinking?” “What are you looking at?” “What are you doing now?”
Something happens that seems to surprise them. For instance, they click on a link and say “Oh” or “Hmmm” when the new page appears.	“Is that what you expected to happen?”
The participant is trying to get you to give him a clue. (“Should I use the _____?”)	“What would you do if you were at home?” (Wait for answer.) “Then why don’t you go ahead and try that?” “What would you do if I wasn’t here?” “I’d like you to do whatever you’d normally do.”
The participant makes a comment, and you’re not sure what triggered it.	“Was there something in particular that made you think that?”
The participant suggests concern that he’s not giving you what you need.	“No, this is very helpful.” “This is exactly what we need.”

The participant asks you to explain how something works or is supposed to work (e.g., “Do these support requests get answered overnight?”).	“What do you think?” “How do you think it would work?” “I can’t answer that right now, because we need to know what you would do when you don’t have somebody around to answer questions for you. But if you still want to know when we’re done, I’ll be glad to answer it then.”
The participant seems to have wandered away from the task.	“What are you trying to do now?”

- ❑ *Request from the participant that they end their shared screen by clicking on the “Share Screen” link on their top right-hand navigation in the Zoom window.*

Answer the participant's questions if time permits.

Wrap Up (5-10 min.)

We are done with the main questions, but I have a few more general questions to ask you.

Usability Study for Research question #3

What was the level of user satisfaction of of virtual content design (space presence, involvement, perceived relevance, and appeal) within the virtual learning environment for use in aural theory training for teachers of beginning music students ages 10-13?
(DO NOT READ)

General Questions (10 minutes):

1. How did you feel about the use of space?
2. How did you feel about the visual aspect of the simulation?
3. How did you feel about the level of involvement of each of the tasks in each area?
4. On a scale of 1 to 10, with 1 representing very easy and 10 representing very difficult, how would you rate your experience during today's testing?
5. Please think back to other virtual games you have visited before. Have you ever needed to perform tasks like the ones you did in the usability test today? Compared to your prior experience, would you say that the tasks you performed today were easier or more difficult? Why?
6. After participating in this study, would you recommend this simulation for use with your beginner music students? Why?

That's the last question, Do you have any questions for me, now that we're done? I want to thank you for your time and willingness to be a participant in this study. I will be sending you the follow-up survey for some more in-depth questions regarding your simulation experience today.

Stop the Zoom recording by clicking on the button labeled, "end recording."

After the Session:

1. Go into My Documents on facilitator computer to make sure Zoom recording has been saved into the Zoom folder.
2. Quickly scrub through the video to ensure the integrity of the audio and video are

- satisfactory.
3. Upload the Zoom file to Google Drive to be used for data collection.
 4. Send follow-up survey via email with Google form link.

Appendix P
Protocols: Interview Prompts

Thank you so much for agreeing to discuss the Minecraft Music Server in an informal setting. Your feedback is greatly appreciated and will be used to further improve the effectiveness, navigation, and user satisfaction of the simulation.

I was hoping to gain some more of your thoughts on the Minecraft and Music. Did you think this would have potential use with your music students? Why or why not?

What were some of the most difficult things you found in the simulation?

What concerns did you have?

What were some positive features you noticed?

What do you think would help make the simulation more easier to use?

(Use the answers to these questions to continue gaining valuable feedback)

Appendix Q Product Screenshots

This is the initial spawn point in the Simulation. The player's avatar loads here and walks the lighted path to the entrance of the Simulation. This is the very beginning "Zone" and all areas within the simulation are referred to as Zones. Some Zones are in the same world as this starting area (Titled: The Glass House of Learning), while others are in separate worlds called "multiverse" and require a teleporter to get to the destination. (This is why navigational tasks will be vital to the functionality of the simulation.)



Once inside the Glass House of Learning, a welcome sign and directional markers walk the learner through expectations and directions.



This area marks the entrance to the first Zone of the simulation.



The aerial view of the main area is:



Zone 1 has an overview of what would be learned in the simulation if taken as a course. There is no teleporter in this area because the Zone provides showcased examples of the Noteblocks and how they function to produce aural theory drills (intervals and chords). A

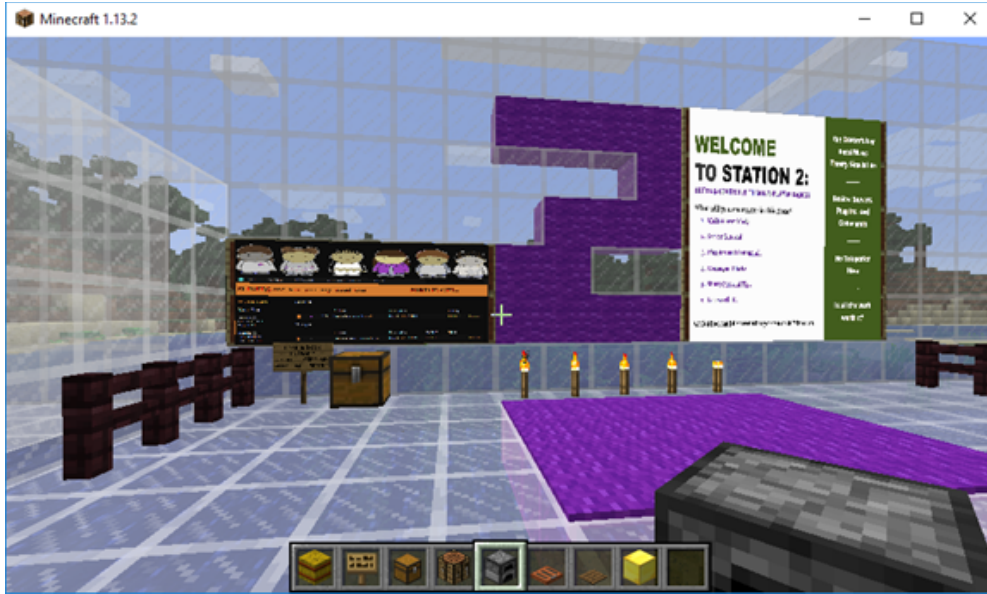
dispenser and chest are located in the Zone to provide extra directions and a place to keep notes.



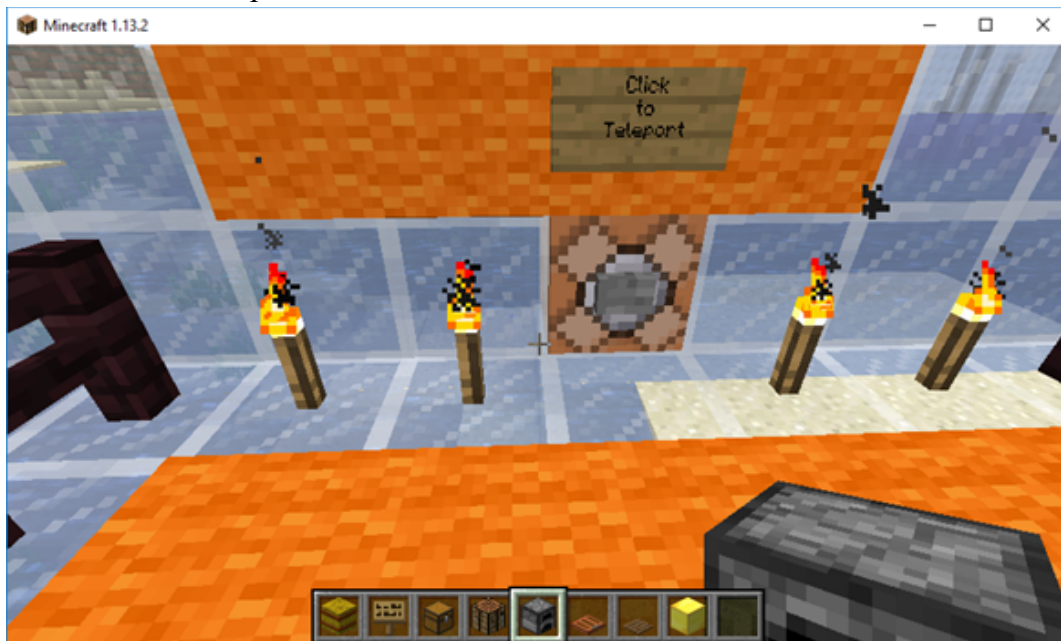
This is an aerial view of Zone 1 with the functioning musical examples. These examples are powered by red stone and function by right-clicking on a button attached to a command block. This task is very simple to do and simply requires the right-click of a mouse to hear the sounds played in succession.



Zone 2 provides direction for typing commands, utilizing plug-ins, basic coding script, and setting up a multi-player server. This does not go too far in-depth but merely provides an overview.



Zone three has a teleporter to take the Avatar to the Duomo or Red Stone Tutorial Area.



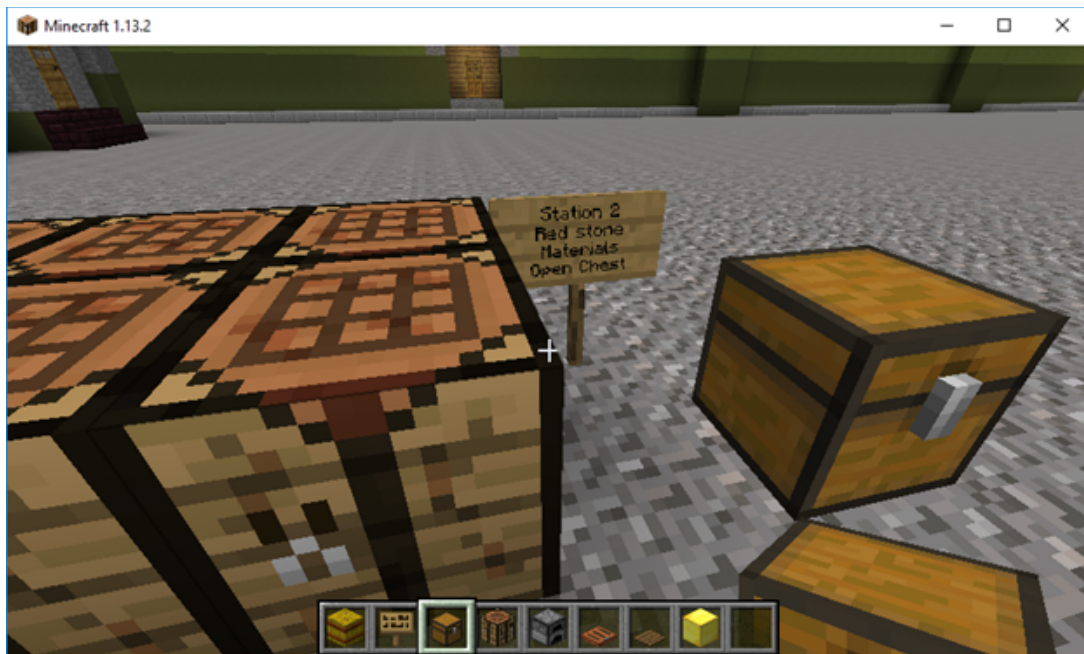
When the teleporter is right-clicked, the avatar spawns here, where Guido (the father of music and aural theory) beckons the participant.



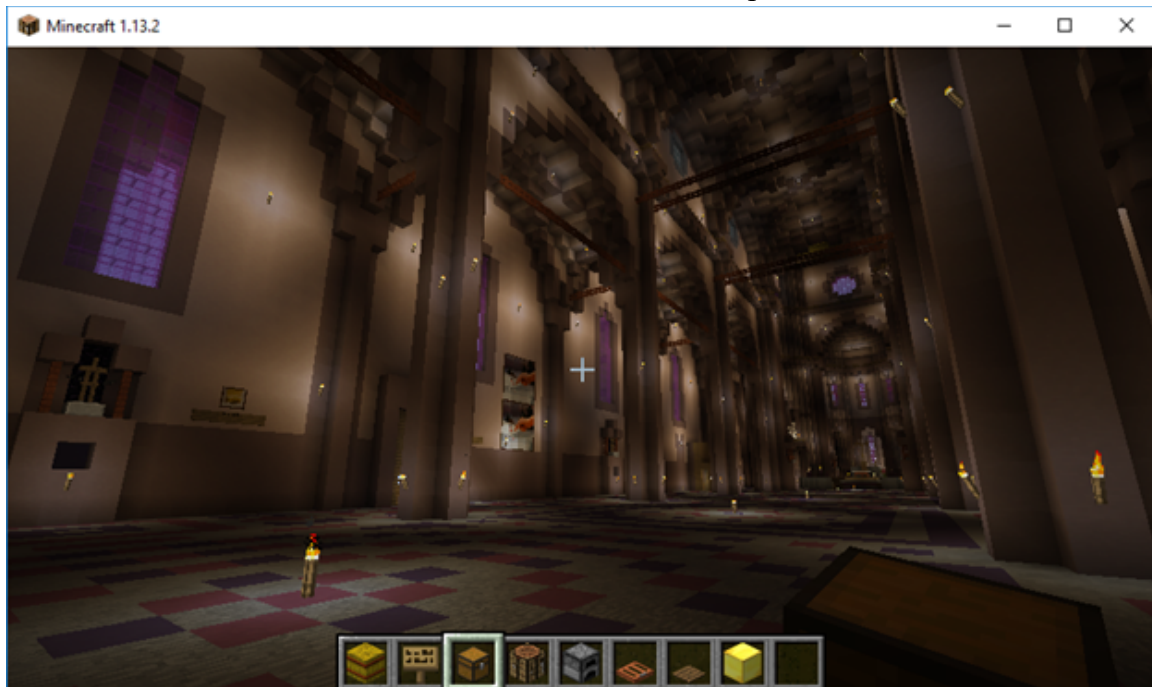
Still in Zone 3, The Red Stone Zone, are stations that describe the function of red stone, provide materials, and offer the user a chance to practice creating their own red stone materials. The road is marked with gold.



And stations are labeled:



Time permitting, I would like to add a workable piano, organ inside the Duomo. This is possible, but time consuming and not a necessity to the functionality of the simulation. However; it would enhance the immersive element to this portion. Inside the Duomo:



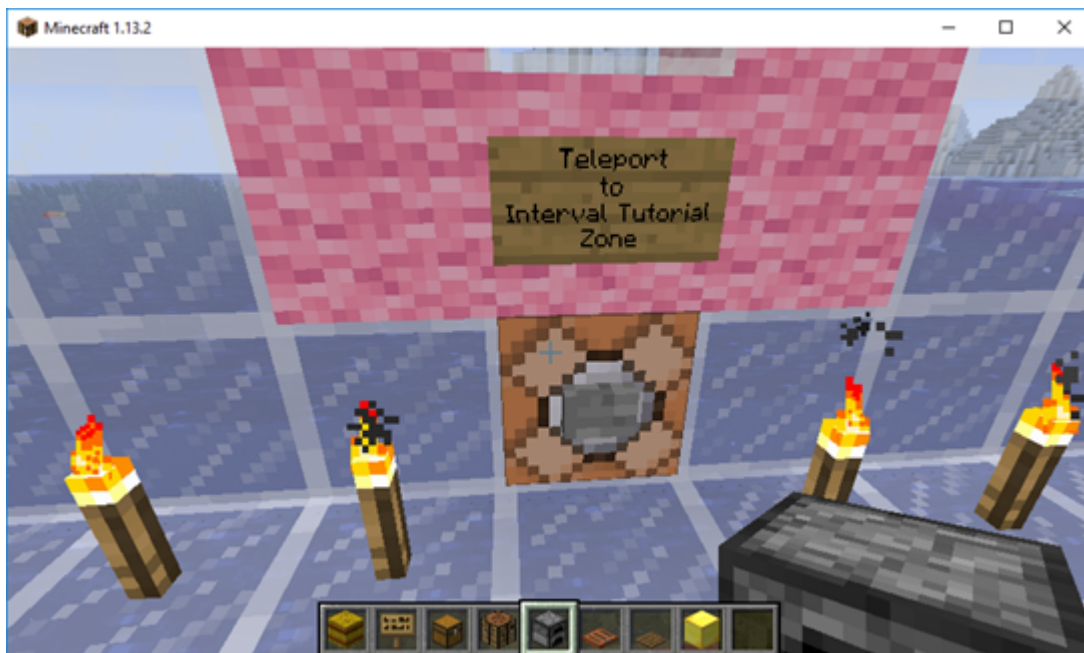
Zone 4 Teleports the Avatar to the Note Tutorial Zone. Here, the participant is shown step by step how to make note blocks function in various ways.



This Teleporter 5 brings the Avatar to some examples of how Minecraft can be used for Stem and Steam. These examples are not my own and have been downloaded in with permission.



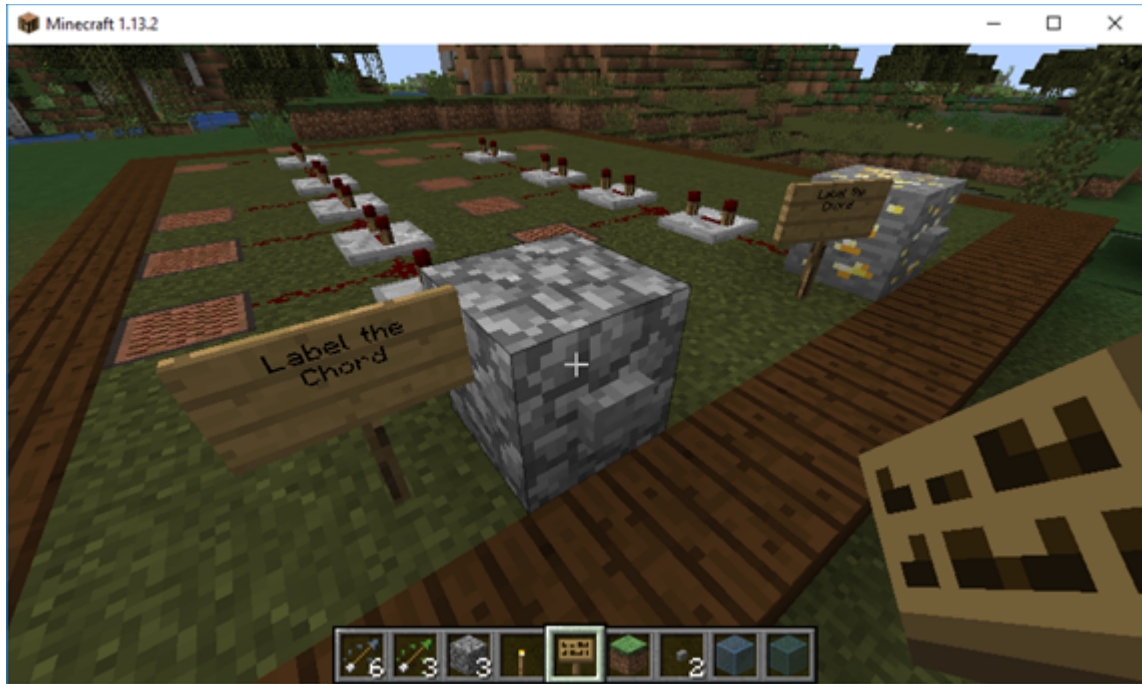
Teleporter 6 is specifically focused on intervals. The next three teleporters work within the same world as The Glass House of Learning and do not require the multiverse coding. They are relatively close together, but function in separate ways, so they have been given their own teleport coordinates.



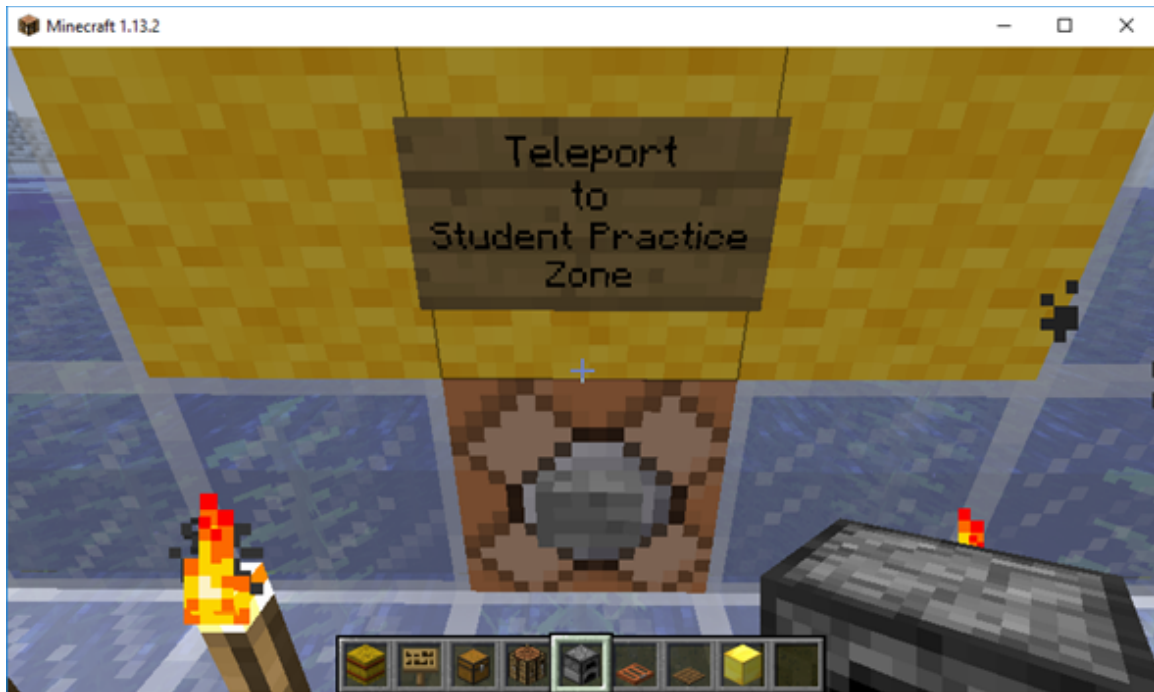


Zone 7 is extremely similar but deals with chords:





Zone 8, again, very similar to 6 and 7 and close in proximity. These can actually be reached from teleports in each area.





There is actually a completely blank world, as well, that the teacher's can access from here in order to create tests and quizzes for their students. The navigation will be tested but nothing else, since it is simply a blank slate for creations.



The last Zone is 9, and is a quick debrief that consists of material to read available in the chest. Ideally, it would be nice to be able to have the survey available here, as well, and have the participant turn it in as part of simulation; however, I haven't found a plug-in yet

that will allow me to do this. The post-study survey will either be available here after the usability test is done (if I can find a way to do this in the simulation) or provided afterwards. Screen shot of Zone 9 with Chest and Instructions:



Finally, the teleporter at the end is labeled and takes the avatar across the divider to the beginning of the tutorial. The participant can exit through the main door or visit the Learning Library in the center of the main simulation area.



Learning Library



Appendix R
Timeline/Sequence of Events

Usability Study Project Goals and Timeline (Saragosa, 2014)

Date	Task
October	<ul style="list-style-type: none"> • Begin writing detailed project plan. • Begin the IRB approval process. • Create data collection tools such as surveys, record sheets, journal/notes templates. • Solidify Minecraft Multiplayer Server • Begin building the simulation within Minecraft.
November	<ul style="list-style-type: none"> • Continue drafting and revising project plan • Improve simulation within Minecraft • Submit application for IRB approval (11/23/2018 deadline)
December	<ul style="list-style-type: none"> • Finalize project plans • Continue simulation finalization.
January	<ul style="list-style-type: none"> • Upon IRB approval begin project implementation. • Send invitations to usability study participants. • Schedule interviews round #1 • Usability Study round #1
February	<ul style="list-style-type: none"> • Continue implementing project • Schedule interviews round #2 • Usability Study round # 2 • Continue implementing project • Schedule interviews round #3
March	<ul style="list-style-type: none"> • Usability Study round #3 • Analyze data • Apply for clinician deadline (March 11) • Complete final paper draft
April	<ul style="list-style-type: none"> • Create TCC Presentation Slides • Conduct TCC Presentation
May	<ul style="list-style-type: none"> • Complete final paper

Appendix S
Minecraft for Parents Beginning Tutorial

Links to tutorial which is not part of the usability study, but referenced:

[Website: FabFive Minecraft for Parents](#)

[Youtube Step-by-Step Video Tutorials](#)

[Minecraft for Parents PDF \(print in color\)](#)
[HP Reveal Directions on website](#)