The Impact of Music Games on Music Education

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Music games are an extremely popular genre of entertainment that balances the complexity of music theory with the interactivity of video games. Games like Guitar Hero, Rock Band, Dance Dance Revolution, Beat Saber, and Piano Tiles rose to be extremely popular games not only in the genre of music and rhythm but in the overall scope of video games. This popularity was documented in 2022, when the music game market reached a revenue of $2.81 billion and has a projected annual growth rate of 7.23% (*Music Games - Worldwide | Statista Market Forecast*, 2023).

This popularity is not only seen by the consumption of music games through users, but also through content creation that is related to music games. An example of which music games benefited the players is when a well-known band, The Warning, rose to fame after playing music games such as Rock Band. The Warning is a hard-rock band composed of the three sisters Daniela, Paulina, and Alejandra Villarreal Velez who started out their careers by learning how to play rock songs through the Rock Band video game series. The Rock Band series is a set of rhythm games that allow players to play songs on the lead guitar, bass guitar, keyboard, and drums. After learning several songs, they uploaded their performances on YouTube, and their performances gained traction. (Dodwell, 2019).

Though these games are supposed to simulate playing a song using an instrument, how effective are these games when it comes to learning music? I conducted research on the genre of music games and whether they have an impact on musical education. Throughout this paper, I will be answering two questions: How do music games impact music education? Are there any cognitive benefits to people who play music games compared to those who do not? If these two

questions lead to a beneficial relationship between music games and music education, music games can be integrated into the educational system.

This paper aims to pave the way for answering these research questions. For my methods of research, I used ethnography and case studies by interviewing educators, surveying musicians, and conducting a literature review on research papers. I then outlined all my research by describing the feedback from the interviews, the results from the survey, and showing my findings from the literature. Using the results from my research, I performed a comprehensive analysis to determine to answer the two research questions. I also analyzed the relationship between music games, educators, and students using the Actor Network Theory (ANT) framework with the driving force being the motivations of the producers of music games. Finally, I make conclusions based on the results and analysis and discuss future work.

Methods and Frameworks

I used methodologies such as ethnography and case studies to perform this research. The target audience of this study is elementary school educators and members of the fine arts community. I reached out to elementary schools that are local to the Charlottesville area such as Mountain View Elementary School, Woodbrook Elementary School, Venable Elementary School, Jackson-Via Elementary School, Clark Elementary School, Burnley-Moran Elementary School, Walker Upper Elementary School, Ivy Elementary School, and Hollymead Elementary school. Out of the nine schools I reached out to, two schools have agreed to an interview: Woodbrook and Ivy Elementary School. I engaged in an interview with the music teacher at each respective school. Both teachers were general music teachers, so I did not pivot to specific subgenres of music games. I asked a general set of questions for each interview. These questions are more open-ended because there are many ways of teaching music.

1. What is your ideal lesson plan? Does it involve technology?
2. What is your preferred method of teaching music?
3. Are you currently seeing engagement with your students?
4. What is something that your students currently struggle with or have struggled with in music class?
5. How interactive is your music class?
6. Are there any activities that you perform to increase your engagement?
7. Do you think interactive games would help increase engagement in class?
8. If you were to integrate interactive games into your lesson plan if any at all, what kind of games would you use to increase engagement?

For people who are involved in the fine arts community, I asked members of the musical organizations inside and outside of UVA about their relationship with music games. This was in the form of an online survey to ensure that as many people could answer as possible. Because a large demographic in this group already has musical experience, music games would not help as much when learning music because most music games cover the basics of theory. Thus, in some questions, I emphasized slight improvement in musical ability. The questions are more general because the people I surveyed had varying backgrounds and experiences in musicianship and music games. The questions in the survey are outlined below.

1. How did you get involved in music?
2. Did you have any musical inspirations when growing up?
3. Have you played any rhythm or music related games? (Yes/No/Not Sure)
4. If you answered Yes or Not Sure for the last question, what games did you play?

5. Reflect on your experience with these games. What were the things that you liked? What were the things that you did not like?
6. The games I have played related to rhythm or music helped me learn how to play a song or helped me learn a song (Strongly Disagree -> Agree)
7. The games I have played related to rhythm or music increased my engagement with a song (Strongly Disagree -> Agree)
8. The games I have played related to rhythm or music improved my sense of rhythm (even if it was just a little bit) (Strongly Disagree -> Agree)
9. The games I have played related to rhythm or music improved my sense of pitch (even if it was just a little bit) (Strongly Disagree -> Agree)
10. The games I have played related to rhythm or music helped me learn more about basic music theory (even if it was just a little bit) (Strongly Disagree -> Agree)

For case studies, I looked at pedagogical studies and literature that investigate the success rate of different music games in the context of music education. Furthermore, I performed research on the second research question by looking at the cognitive effects of music games. I also investigated the motivation of the companies who published these music games, Harmonix Unomi, Konami, and Beat Games, and the user groups they catered their product towards using Actor-Network Theory (ANT). There have already been preliminary studies that have investigated the impact of music games on music education. Games like Rock Band 3 have shown to increase engagement among students and potential cognitive benefits (Cassidy & Paisley, 2013). On the other hand, games like My Note Games!, which teach music more traditionally, are found to be not as engaging and are no better than traditional music theory (Hein, 2014). This suggests that some music games benefit music education and others do not

help at all. This reinforces the idea of further investigation through literature into the relationship between music games and music education. As a result, I also looked at other games that incorporate music and/or rhythm like Rock Band such as Guitar Hero and Dance Dance Revolution, and see how the impact of those games have had on my literature review.

Results

First Interview: Lenny Grasso

The first interview I conducted was with Lenny Grasso, the general music teacher for K-5 at Woodbrook Elementary School. The technology he uses for his lesson plan is basic. He uses composing software to help his students learn and compose music. His approach to teaching is to give his students a more visual representation of music and to oppose any musical notation and theory because it would not be something of interest to younger students and should be explored in a choir, band, or orchestra class. Rather, he engages his students by selecting a song, finding access points to the song, and doing call and response or poison pattern for the kindergarten and first graders. His teaching style is adaptive as he listens to what the students want to do and how they learn and behave. As a result, this leads to an interactive and engaging class.

One of the struggles mentioned about instructing his students is with large class size, which makes it difficult to give individual feedback, which is critical for learning music. Another struggle mentioned is that the older students he teaches need a more defined goal for learning music, while the younger students are happy to do any activity. He said music games solve both these problems. Music games have structures that define success and have a low-skill floor typically. They have clear goals to accomplish and give instantaneous feedback which allows students to set individual paths to success. The specific music game genre he would be open to

integrating into his lesson plan is piano-based games that sequence the song for you. He would prefer these games to have some interaction with hardware, show instant feedback, and to show progress or objectives.

Second Interview: Cheryl Wetmore-Simpson

The second interview I conducted was with Cheryl Wetmore-Simpson, the general music teacher for K-5 at Ivy Elementary School. She integrates technology as much as she can into her lesson plans, especially for her older students. She does this by using a large tablet to display all her information. Her teaching style is very hands-on because she does not want her students to sit around and listen to a lecture. She tries to vary each lesson to maintain engagement by letting her students try all kinds of instruments during the last portion of class time. She also has the class participate in games that involve clapping, body percussion, and drum circle. Her goal is to connect with each child individually and try to increase engagement by accounting for the different ways her students learn. If she were to integrate music games into the curriculum, she would use a plethora of games from MusicPlayOnline because she wants her students to interact with fun games that allow improvement in sightreading.

Survey Responses

The survey I wrote got 10 responses. Respondents were primarily involved with some musical organizations at UVA like the Virginia Glee Club and percussionists in the music department. Some were involved in bands not affiliated with UVA. The survey responses are shown in the appendix.

Literature Review

Throughout my findings of the cognitive effects of music and rhythm games, I found a study that focused on the application of music games to rhythmic training made by Valentin Begel and Simone Dalla-Bella from the University of Montpellier. This study reviews 27 music games including Guitar Hero, Dance Dance Revolution, and Rock Band, and analyzes the effectiveness of rhythmic training on these games. It turns out due to latency from user input to the actual game is high enough to have poor temporal precision (Begel & Dalla-Bella, 2017). For example, the study claims Guitar Hero can only achieve a temporal precision of around 100 milliseconds, which is about half the average visual human reaction time (Fakhoury & Ursula, 2021). While the authors mention that the games analyzed are not ideal for rhythmic training, they mention that the games lay the groundwork for temporal training and pattern recognition. More specifically, “temporal prediction fostered by a regular temporal pattern (e.g., a metronome) of sensory stimuli improves performance in non-temporal tasks” (Begel & Dalla-Bella, 2017).

A study performed by Goichi Hagiwara, Daisuke Akiyama, Ryosuke Furukado, and Shunichi Takeshita from Universidad de Alicante focused on the psychological training and cognitive benefits of rhythm games. They performed a study on the game Osu! which involved ten college male students who regularly play video games. They measured the students’ power change in the beta wave band of the EEG before and after playing the game. Students had an increase in selective attention during gameplay and had positive cognitive benefits (Hagiwara, Akiyama, Furukado, & Takeshita, 2019).

Another study was performed by Matthew Gaydos from the University of Wisconsin Madison. This paper analyzes eight of the Guitar Hero II songs which involved participants in tasks related to tapping and listening to assess the participant's knowledge of the rhythmic

metrical structure of each song. Participants did not acquire the knowledge to understand the metrical structure for each song (Gaydos, 2010).

Another study by Josh Trout and Karra Zamora investigated using Dance Dance Revolution in physical education. They developed a model on how to integrate Dance Dance Revolution into the classroom. This would assume that students have some basic rhythm and tempo skills such that they can transition into Dance Dance Revolution easily. While they claimed that it would be a new avenue for cardiovascular activity in P.E., they also claimed that it would understand rhythm and tempo and improve their rhythm skills (Trout & Zamora, 2005). They also noted that there were no empirical studies of using Dance Dance Revolution in the classroom at the time the paper was published. However, in 2012 Dance Dance Revolution Classroom edition was published (Ellis, 2019). This reduced childhood obesity, but no studies have been made analyzing the impact it has on students' rhythmic capability.

Brent Auerbach led and established A Dance Dance Revolution lab at the University of Massachusetts Amherst in the Fall of 2006. He introduced a pilot course with the underlying goal of improving students' rhythm and sightreading abilities. At the end of the course, the students were surveyed about the course outcomes. Out of the 33 students, 66.67% of them agreed that Dance Dance Revolution was an enjoyable portion of the course. When asked about improvement of rhythm and sightreading abilities, 60.7% of the students had a favorable or neutral response. (Auerbach, 2006)

Motives Behind the Publication of Music Games

Lastly, the motivation behind publishing Rock Band, Guitar Hero, Beat Saber, and Dance Dance Revolution were cited by their respective publishers Harmonix, Beat Games, and Konami,

either through their mission statement or their intended goal of the product. In Harmonix's mission statement, they stated that "Harmonix aspires to create the world's most beloved interactive music experiences, made by people who love making them" (Harmonix, 2024). In Beat Games' description of Beat Saber, they describe "Our goal is to make players almost dance while cutting the cubes and avoiding obstacles. Each cut is strongly supported by great sound and visual effects to emphasize the rhythm." (Beat Games, 2018). Yoshihiko Ota, the director of Dance Dance Revolution Extreme, gave an interview in which he claimed, "The original concept behind DDR was "how much can we make players look cool and stand out?". The birth of DDR came about as a chance encounter with Beatmania. The first time I played it was a huge shock! Having a game that actually made players cool was a totally new concept. Had there ever been a game where just playing it made you look as cool as in Beatmania?" (Ota, 2020). Unfortunately, there is no public motivation behind publishing Piano Tiles from Umoni.

Analysis

With all the results compiled, this section will tie everything together and answer the two research questions mentioned earlier. The interviews were more open-ended, but all had a general theme. Unlike music classes in universities, high schools, and middle schools, elementary school students are in the early stages of their neural development. As a result, the educators I interviewed tried to pivot their teaching styles to be more hands-on and follow a "Repeat After Me" model like the Orff Schulwerk method, which builds confidence and creativity and assists with cognitive therapy (Music & Arts, 2024). Elementary school students need more interactive and digestible ways to learn according to the teachers I interviewed. They also need individual feedback because, unlike classes like math and science, it is easier to tell what a student did wrong just by listening. Furthermore, music exercises the right part of the

brain, which allows for more creativity (Hines, 2018). For many children, their creativity will peak before the age of 6 (Anthony, 2021). By building a good foundation of musical ability, they will be able to explore different avenues of music that will build them up for any musical aspiration students may want to pursue in their career. This is why finding the right way to teach students music is so important.

Analysis of Interviewee's Feedback

Based on the results from the interviews, music games if implemented into the music curriculum would help students increase engagement in learning music because there is a defined goal for music games. On the other hand, traditional methods of teaching might have goals outlined in the syllabus, but they are not as explicit when going through a course. In traditional classes, most students only care about the grade they receive rather than what they learn. With music games, students may care more about reaching a specific objective in that game, whether that would be completing a song with minimal inaccuracies or learning a specific chord. The structure of music games is already laid out and would give students feedback on their work. Music games are also hands-on because you would be interacting with an actual device rather than learning from a lecture. Music games are rather simple and easily digestible because it breaks down a piece of music into different segments. This would integrate seamlessly into the methods utilized for the interviewees because they would rather have their students interact with something, whether it would be an instrument or a computer, to learn. While the interviewees were not specific about what music games they would want to integrate into their curriculum, they specifically mentioned attributes of a game they would like to see that would be beneficial to music education.

Establishment of Interviewee's Requirements

I evaluated the requirements established from the interviews across multiple music games to determine if they benefit music education. The main requirements are instantaneous feedback, clear progress and objectives, entertainment, and sightreading components. Looking at games like Guitar Hero, Beat Saber, Dance-Dance Revolution, Rock Band, and Piano Tiles, I will see if these games meet all the requirements outlined by the interviewees. With these requirements established, it is safe to say that the games mentioned above meet most of the requirements. From the elementary school educators' perspective, games like Guitar Hero, Beat Saber, Dance Dance Revolution, Rock Band, and Piano Tiles might be beneficial for music education. It would be a method to get instant feedback and clear goals, while potentially having an engaging experience. These games could potentially help in sightreading, which is one of the skills acquired when learning music theory. There is a fundamental flaw with these requirements which would prevent me from making a firm conclusion on the research questions. These requirements could be applied to many genres of games. Other than sightreading, these requirements are not specifically targeted towards learning music.

Analysis of Survey Responses

The survey dives deeper into specific skills acquired when learning music. The survey specifically asks if music or rhythm games helped with improving rhythm, pitch, and music theory. Out of the eight respondents who have played music or rhythm games, seven of them had a favorable or neutral opinion that these games helped improve their sense of rhythm. Five out of eight respondents either strongly or slightly agreed that music or rhythm games increased engagement with a song. This matches the requirement of music games being engaging. On the other hand, five out of eight respondents had an unfavorable opinion that music and rhythm games taught them basic music theory and six out of eight respondents had an unfavorable

opinion that music and rhythm games improved their sense of pitch. Furthermore, four out of eight respondents had an unfavorable opinion that music and rhythm games helped them learn a song. Popular games amongst the respondents are the games I am investigating like Beat Saber, Dance Dance Revolution, and Guitar Hero. As a result, it is feasible to claim that music and rhythm games do not help with improving pitch or knowledge in music theory. However, more investigation is needed to conclude if music games help with improving rhythm and learning a song because there is not a strong opinion on it.

Analysis of Literature Review

The results from Matthew Gaydos indicate that Guitar Hero II may help you with improving your sense of rhythm but does not help you learn the rhythm of the song. This matches up with the survey answers. While not directly helpful when learning a song, it would still build one of the fundamental skills needed to play a song. In a sense, Guitar Hero II could help you improve your sense of rhythm to a point where you could be capable of playing a song you previously struggled with because of newfound skills.

Dance Dance Revolution is a special type of music game. Dance Dance Revolution is an intersection between rhythm-based games and physical activity. While there is clear evidence that Dance Dance Revolution reduces physical inactivity. It is not as clear for how they can improve students' sense of rhythm. While the paper from Trout and Zamora, has some promising ideas for the implementation of Dance Dance Revolution in a classroom setting, they fail to show that implementation.

Luckily with both the release of Dance Dance Revolution Classroom edition and the pilot course by Brent Auerbach, there now is a classroom implementation of Dance Dance

Revolution. From the results of the course evaluation in the University of Massachusetts Amherst, most students have reflected that Dance Dance Revolution do help with rhythm and sightreading. Unfortunately, it is unclear if this curriculum was brought back for future semesters of the Aural Skills III course. Thus, there is only a small data pool of experiences with Dance Dance Revolution in the context of learning music rather than physical exercises.

The literature review indicated that music games do have a strong indication of cognitive benefits. Games like Guitar Hero, Dance Dance Revolution, and Rock Band improve non-temporal skills and even help with pattern recognition. While one of the studies indicated that Osu! increased selective attention, there are many parallels with Osu! and games like Guitar Hero, Dance Dance Revolution, and Rock Band. They all have the same underlying goal and structure but have slightly different methods of doing so. Even with games like Dance Dance Revolution being used in the classroom more as a physical activity, it would have similar cognitive benefits to physical exercise. This can include increased cognitive function, confidence, and stability while also having decreased anxiety, depression, and tension (Mandolesi, 2018). Additionally, individuals acquire a cognitive boost (STL Rock School). Musical skills have cognitive benefits such as intelligence, visuospatial abilities, processing speed, executive control, attention, and episodic and working memory (Budson, 2020). With music games being a combination of musical skills, reactions, and sometimes physical activity, many benefits are reaped from music games.

How the Motives of Publishers influence the Actor Network

For the company behind Guitar Hero and Rock Band, Harmonix, their goal is to create an interactive music experience and want their product to get people to engage with music. This may be people who do not play video games at all, people who have no musical experience, or

somewhere in between those two. The human entities in this case would be people of all ages, including students and educators, who are looking for an engaging musical experience. The non-human entity would be Harmonix, the games themselves, and the advertising. Harmonix is looking to have more engaging experiences with music games, and they can do so with the help of the player's feedback. This creates a feedback loop with the main metric both sides use is engagement with music. This may not be directly related to music education, but one of the things that was mentioned by the educators I interviewed was they wanted to keep their students engaged. This would shift the network to have the human entities be more of students and educators and the feedback they would give would not only be from musical engagement from the game but also how the game helps students learn music. This actor network also agrees with the survey answers and interviews.

For the company behind Beat Saber, Beat Games, they wanted to emphasize rhythm in their game. Like Harmonix, this would be intended for people of all ages. Unlike Harmonix, the driving force of the network would be the rhythm component of the game. The feedback from the players would be focused on how well the rhythm aspect is integrated into the game for Beat Games to give a defined response. If used by educators, it would shift the rhythm component to an educational standpoint.

For the company behind Dance Dance Revolution, Konami was focused on something that would stand out and be cool. This unfortunately is not related to the key takeaways of learning music; thus, the actor-network would not be relevant to this argument. There was no known of the motivation behind Piano Tiles so Actor Network Theory cannot be applied to this game. Despite Piano Tiles and Dance Dance Revolution not having a relevant actor network for the research questions, it does not mean that they do not impact music education.

Conclusions from the Analysis

With this information, I can conclude the following. Music games do not generally help with learning music theory, improving pitch, or learning a song. However, they do increase engagement in the classroom and give students room to improve their sense of rhythm because of the instantaneous feedback, clear goals, and real-time gameplay. As a result, music games do not help in all aspects of music education, but they are useful for practicing rhythm. In that sense, music games could be integrated into lesson plans and rhythm exercises while also having the current teaching methods educators use in elementary schools. For the specific games analyzed, Guitar Hero, Rock Band, Beat Saber, and Dance Dance Revolution would help with improving a sense of rhythm, but there is not enough information on Piano Tiles to make any conclusions.

Conclusion

Discussion of Findings

Music games have shaped the landscape of gaming culture. It introduced a new way to play games by integrating well-known songs into digestible scores that create a challenge for the player to accomplish. While there is an argument that video games are harmful to children, music games are a special case. When integrated properly, there can be more benefits than shortcomings. Music games could help improve a sense of rhythm and increase engagement with music if in the right hands. There are also a variety of cognitive benefits of music games. The field of research on this topic is still developing, and much work is needed. While this paper laid the groundwork for the relationship between music games and music education, there is still much more to be done.

Future Work

Due to time constraints, I did not get to interview as many educators as I wanted to or get enough respondents to the survey. As a result, this may not be fully representative of music educators or members of the fine arts community. If any future work were to be done, I would suggest getting a larger pool of respondents for the survey and potentially adding people who do not have as much musical experience to get a more diverse set of results. Furthermore, interviewing people outside the Albemarle-Charlottesville area would have given me a more unique set of data. Because I interviewed people local to the area, this may not be representative of the relationship between music games and music education globally. To improve on this, interviewing music educators around the globe would be beneficial in getting a more solidified answer to the research questions. Lastly, more questions should be asked about specific games rather than the whole genre of music games because it was shown earlier that some music games are shown to be beneficial while others are not. Questions like how do some music games benefit music educations while others do not? Overall, this was a great stepping stone in research on the intersection of music games and education.

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Appendix

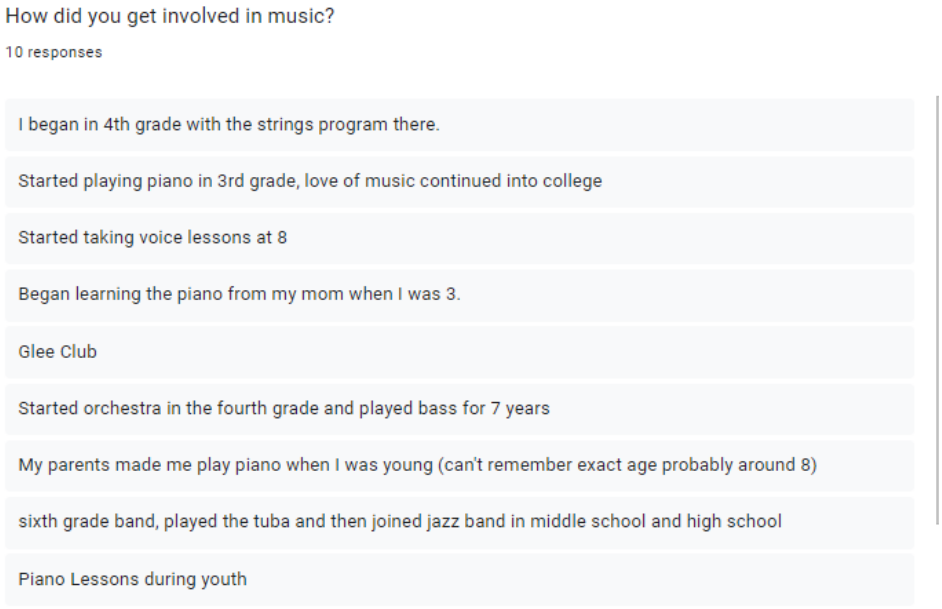

Figure 1: Survey Responses from Question 1

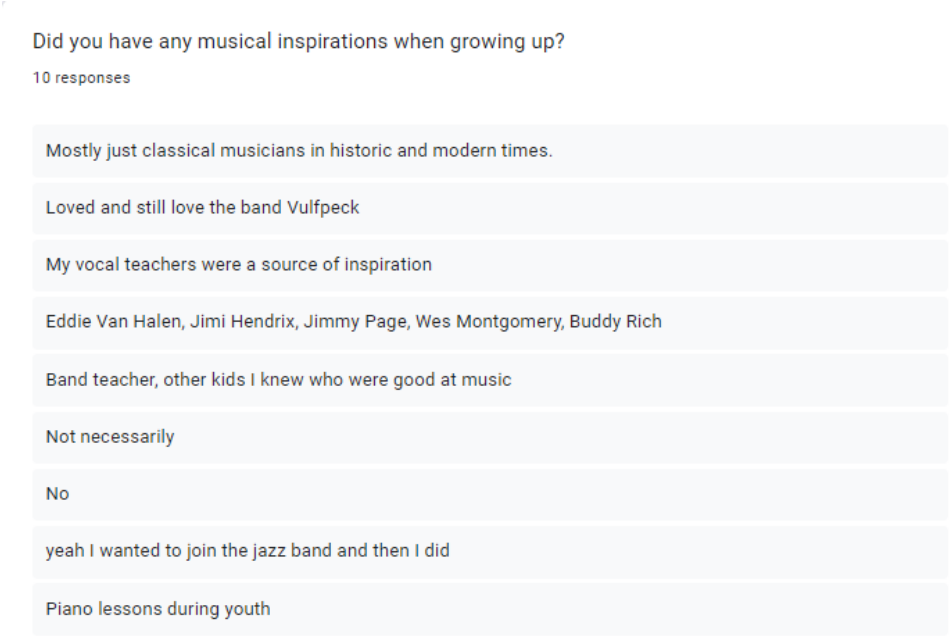

Figure 2: Survey Responses from Question 2

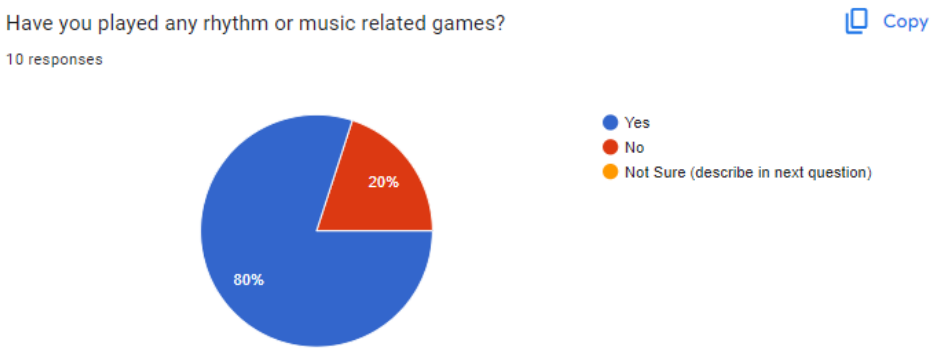

Figure 3: Survey Responses from Question 3

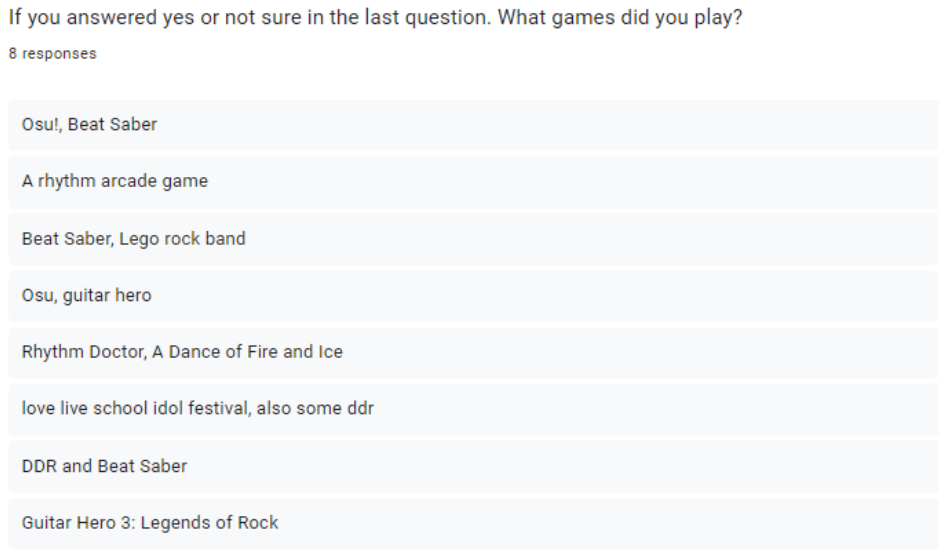

Figure 4: Survey Responses from Question 4

Reflect on your experience with these games? What were the things that you liked? What were the things you didn't like?

8 responses

The diversity of song choices, the input mechanics, and how adjustable some settings were like hit time desync and trails.

I enjoyed the music selection. I didn't as much enjoy the complexity of certain movements I had to make. The instructions were explained very briefly.

They were just fun and challenging due to the pace

I enjoy music cues in traditional games since they can elicit certain responses in a player. Rhythm games are really neat because i love music in general and "playing" the song in a different medium is really neat to me.

The music itself was good. Rhythms lined up well. Sometimes syncing with music could be off (calibration can be annoying).

things I liked: rhythm difficulties, and the music. things I did not like: gacha mechanics

How it forces you to think about the music in a unique way that is somewhat removed from the music itself

Figure 5: Survey Responses from Question 5

The games I've played related to rhythm or music helped me learn how to play a song or helped me learn the rhythm to a song

Copy

8 responses

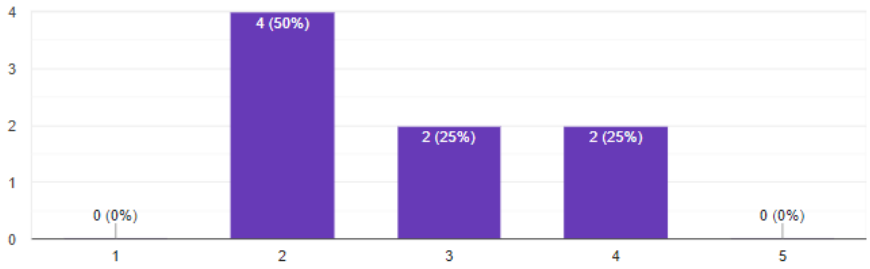

Figure 6: Survey Responses from Question 6

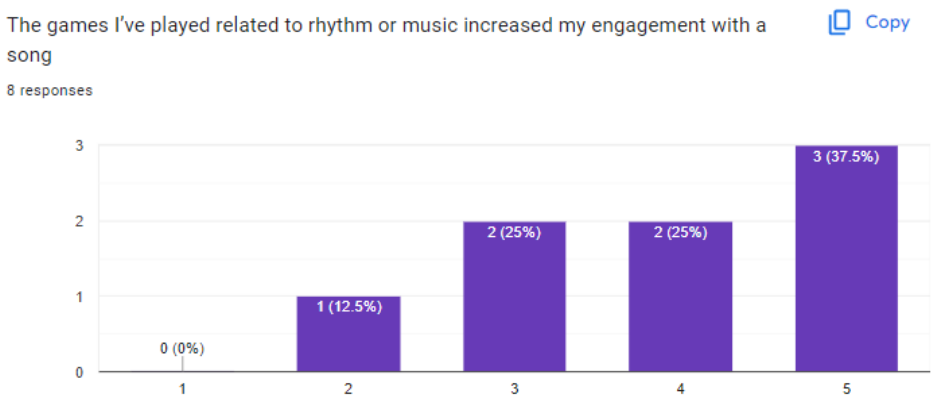

Figure 7: Survey Responses from Question 7

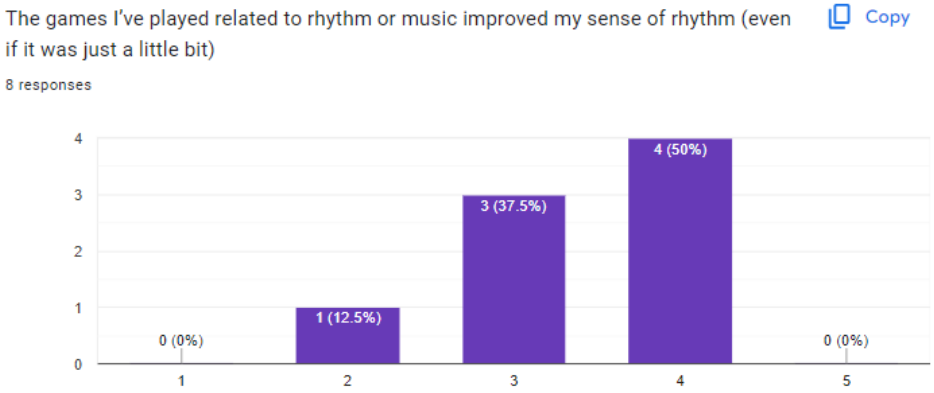

Figure 8: Survey Responses from Question 8

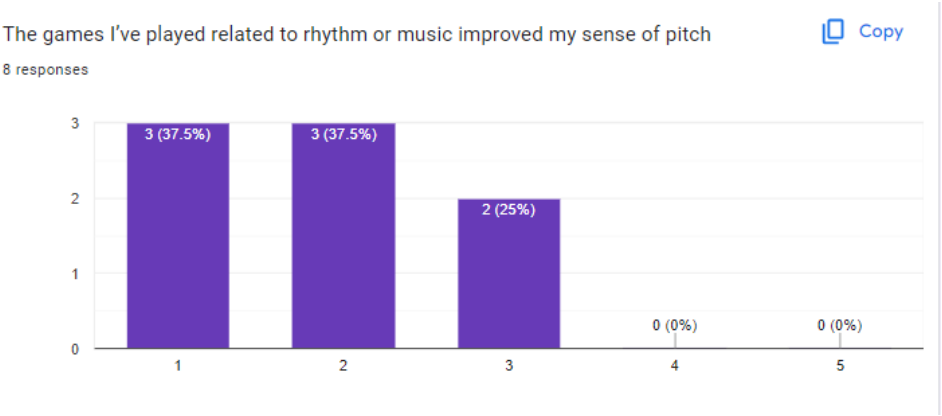

Figure 9: Survey Responses from Question 9

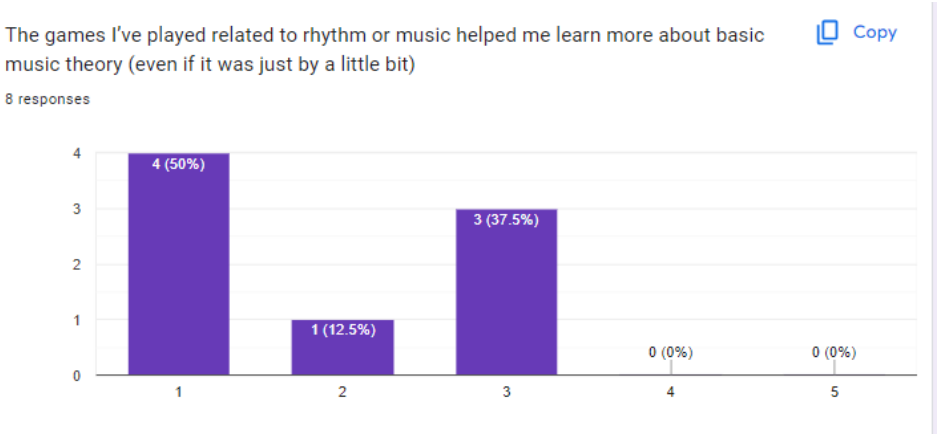

Figure 10: Survey Responses from Question 10