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Use of Rhythm Video Games as a Tool for Rhythmic Listening in Elementary School Music Students

Jennifer Webber

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USE OF RHYTHM VIDEO GAMES AS A TOOL FOR RHYTHMIC LISTENING IN ELEMENTARY SCHOOL MUSIC STUDENTS

A Thesis

Presented to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College
in partial fulfillment of the requirements for the degree of
Master of Music

in

The School of Music

by

Jennifer Marie Webber
B.M.E., Louisiana State University, 2018
May, 2022
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ABSTRACT

This posttest-only control group study sought to examine how rhythm video games, through the use of the rhythm game *Rhythm Heaven*, affect the rhythmic skills of elementary music students, in order to determine if rhythm video games are acceptable supplementary materials for aiding beginning music students in learning rhythm. Research questions were 1) Are participants who receive the rhythm game treatment able to reproduce rhythms more accurately than participants who do not receive the treatment? 2) Can participants who play a rhythm game more accurately imitate longer rhythms than those who do not play a rhythm game? 3) What is the relationship between rhythm game scores and rhythm test scores? And 4) Do differences in score exist based on grade level?

Children in grades Kindergarten through Fourth grade were randomly assigned to either the control group or the treatment group. Participants in the control group took a rhythm test which included imitating heard rhythms to the best of their ability. Participants in the treatment group first played a selection of three games from the rhythm game *Rhythm Heaven* before taking the rhythm test. The accuracy of the two groups’ abilities to imitate the rhythms was compared. Results indicate that playing a rhythm game is beneficial to the development of rhythmic playing skills, as well as the development of rhythmic memory.
CHAPTER 1. REVIEW OF LITERATURE AND NEED FOR STUDY

Since their inception, video games have held a prominent place in pop culture. Additionally, more and more are teachers encouraged to incorporate technology into their classrooms, as well as incorporate things into the curriculum that reflect the experiences of their student population. The inclusion of video games meets both of these requirements, but how educational can video games be? And do video games have a place in the music classroom?

Rhythm games are a genre of video games where the focus is on music. The gameplay requires moving or tapping along to the rhythm of a song, with the goal of obtaining a high score based on how accurately the player performs the rhythm. These games use audio and visual cues to assist the player in performing the rhythms correctly. This study focuses on the educational merit of rhythm video games, specifically on how they can be applied as supplemental teaching tools in the elementary general music classroom to improve the rhythmic listening skills of students.

In this chapter, I will look at how games have previously been incorporated into the general music classroom, how video games have been linked with flow and motivation, followed by an overview of a selection of two rhythm games that have commonly been used in studies like this one, and how these rhythm games have been suggested to improve musical and rhythmic skill and how teachers have incorporated these music video games into their classrooms. Lastly, I will explain the shortcomings of the literature in this review and why this study was needed to fill in some gaps in the research about the educational value of music video games.
1.1. Sound Before Symbol

General music teaching methodologies often promote the idea of “sound before symbol” as the most effective way to approach teaching music to young people (Abeles, et. al., 1994). The phrase “sound before symbol” (alternatively, “rote before note”) comes from the belief that children should learn to listen to, react to, and play along with music before being expected to learn to read notation, similarly to how children learn to speak before they learn how to read and write (McPherson & Gabrielsson, 2002). Suzuki (1983) pioneered the “mother tongue” approach, in which children learn music in a similar way to language: learning to speak, or in the case of music, play, before learning how to read. Similarly, Gordon (1997) in his Music Learning Theory, advocates for teachers to delay the introduction of notation for as long as possible, in order to more deeply cultivate aural and rhythmic skills. Rhythm games, with their emphasis on listening to and playing along with music in varied and fun ways, appear to adhere to this “sound before symbol” philosophy.

In the general music classroom, games are already incorporated into the curriculum to introduce concepts to students. Movement games that involve the whole body, listening games that have the children carefully analyze what they are hearing, and improvisation games that require creativity from the students are some of the types of games included in general music lessons. These games are beneficial for a child’s formal music education, as research has suggested that games can contribute to the progress of young students’ rhythmic abilities (Pollatou et. al., 2012). Video games would just be another type of game to include in the curriculum to support student learning. The following sections will discuss in what ways video
games have already been included in classrooms and in what ways they have been observed to contribute to student learning.

1.2. Video Games and Flow

Video games are a way of inducing a state of flow, defined as the mental state of a person completely immersed in an activity, resulting in energy, focus, and enjoyment. While in a state of flow, a person’s brain is more open to absorbing new information as they try to conquer a challenging task (Csikszentmihalyi, 1990). Csikszentmihalyi (1990) identified a number of “flow elements” that include factors required to enter a state of flow, as well as what a person might feel while in a state of flow.

Table 1. Flow Elements

<table>
<thead>
<tr>
<th>Clear goals</th>
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<tbody>
<tr>
<td>Immediate feedback</td>
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<tr>
<td>Equal challenge and skill</td>
</tr>
<tr>
<td>Deep concentration on task</td>
</tr>
<tr>
<td>The experience is intrinsically rewarding</td>
</tr>
<tr>
<td>A sense of being in complete control</td>
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<tr>
<td>Altered sense of time</td>
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<tr>
<td>Forgets self while in flow state, but self-esteem rises afterward</td>
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</table>

When interviewed, people who enjoy playing video games said their enjoyment stems from the entertainment they provide as well as the challenge they present (Gumulak & Webber,
With challenge being one of the elements to achieve a state of flow, playing video games, where challenging the player is a main component, becomes a way to reliably induce a flow state. Cowley, et. al. (2008), in their study, investigated the relationship between the player and the video game and how the gameplay is related to a flow state. They hypothesized that the activity of playing the video game forces the player to enter a flow-like state due to the video game including each of the flow elements mentioned above. For example, video games give the player complete control through their familiarity with the game’s controls and gameplay mechanics; the game gives the player clear goals by having a succession of missions or levels that the player must beat; and the game can raise the player’s self-esteem once they successfully beat a level or attain a new high score (Cowley, et. al., 2008).

Their (Cowley, et. al., 2008) research suggests that video games induce flow because the game introduces a problem to the player and then gives them the tools and the information to solve that problem. The game also starts with presenting the player a simple problem; it then presents progressively more difficult problems, in which the player, in order to solve, must draw upon the skills gained thus far and hone those skills in order to solve this new, more challenging problem. The way video games are structured induce flow in the player through immersion and problem-solving (Cowley, et. al., 2008), making them an ideal addition to the classroom when introducing or reinforcing material.

Because video games are first and foremost games, they were not necessarily created with the intention to be educational tools, but they were created to be fun. Teachers who have used video games in classroom have said that in addition to helping the students develop certain
skills, they incorporate video games into their lessons to promote their students’ motivation, increase their interest in a subject, and make learning more fun (Wastiau, et. al., 2009).

1.3. Video Games and Motivation

Additionally, previous research has suggested that video games can be motivational, with educational video games inciting the curiosity of learners to know more on the subject (Denis, 2005). Gumulak & Webber (2011) explored the reasons that people were motivated to play video games. The main reasons the subjects in their study were motivated to play video games were the entertainment and the challenge. The participants gained satisfaction from success in the game, and they mentioned they were motivated to improve their skills in a video game for no other reason than to just be better at it. The participants also mentioned actively seeking out games that challenge their skills. This internal motivation to play video games and improve skills can be useful when applied to the classroom. When students are motivated to play a video game that includes skills in the subject they are studying, improving their skills in the video game can likewise improve their skills in that subject.

Video games can be a transitional tool in music education when first introducing a concept to students. Rhythm games have previously been observed to ease students into playing an instrument, as the video game can introduce skills needed to play the instrument and present it in a fun way. Students may feel pressured to quit learning an instrument because of frustration of not being able to pick it up quickly. Video games can make this transitional period easier and more fun for the student (Denis, 2005; Jenson et. al., 2016). Some of these rhythm games have even inspired individuals to start learning an instrument (Ingram, 2009). Results of a survey included in the Ingram (2009) article indicated that 67% of the Guitar Hero and Rock Band
players that did not play an instrument indicated that they would be likely to start playing a real instrument, and 72% of musicians who played games like these have spent more time playing their real instrument(s) since they began playing the games. Utilizing games like these as early as in the elementary music classroom can start students with the skills they need to succeed, as well as piquing their interest in joining an ensemble in their secondary education.

1.4. Rhythm Games

There are many different types of rhythm games that each require different inputs from the player, which can be applied to the music classroom in different ways depending on the needs of the teacher and students. On the simpler side of the spectrum are games like Rhythm Heaven, the game used in this study, that only have a single input (tapping). Some rhythm games are more complex. For example, the game Guitar Hero requires the use of a controller shaped like an actual guitar. On the “frets” are five buttons that the player must press with their left hand in time with the music, but in addition to pressing the correct button(s), the player must also “strum” the guitar with their right hand, requiring coordination between both hands, much like an actual guitar. The game Rock Band uses a similar guitar controller, in addition to a controller emulating a drum set, where the player must tap the correct drum(s) in time with the song, having to coordinate between both hands, as well as with their foot for the “bass drum” button. Rock Band also includes a singing role, where the vocalist is rated based on their pitch accuracy while singing the song.

These two games are just a few examples of rhythm games used in previous studies; the specific rhythm game used in the current study will be discussed in detail in the Methodology section. All rhythm games in some way visually represent the rhythms for the player to perform,
and the player must decode what is happening on screen in order to perform the correct rhythms. The visual notation in rhythm games share some features with traditional music notation, including meter recognition and pattern identification (Hein, 2014). The decoding skills used to be successful in rhythm games can be transferrable to the kind of symbol decoding skills needed to read music notation.

Rhythm video games can be used with all ages of music students. Children are able to tap rhythms faster as they get older, with kindergartens not able to tap very fast at all (Grieshaber, 1987). The ability to start the younger students with easy rhythms, while challenging the older students with more advanced rhythms can easily be done with rhythm games. Video games have difficulty settings that the player is able to change based on their skill level. For example, Guitar Hero has four difficulties—easy, medium, hard, and expert—for the player to choose from. “Easy” only uses three of the five buttons, “Medium” uses four, while “Hard” and “Expert” use all five buttons. Allowing the student to choose a difficulty based on their individual skill level and customize their experience will result in a task that is neither too easy nor too difficult for the student, an key component of entering a flow state (Csikszentmihalyi, 1990).

1.5. Video Games and Musical Skill

Although video games are a fun way to engage students, they are able to serve educational purposes, as well: in previous studies, video games have been observed to improve certain musical skills of participants (Gower & McDowall, 2012; Jenson et. al., 2016; Keeler, 2020; Lesser, 2020; Paney, 2013; Richardson & Kim, 2011). The skills used to play rhythm video games, such as quickly interpreting symbols into action and split-second decision making, can be transferrable to other musical activities. Other than musical skills, video games can help
the acquisition of general musical knowledge, such as teaching students aspects of musical structure and form, as well as exposing students and having them play along with different types of musical styles (Gower & McDowall, 2012).

Because of how each rhythm game is unique with differing play styles and difficulties, they can be used to teach different musical skills. In the categories of written pitch, oral pitch, music literature, and rhythm, the games *Wii Music, Rock Band, Sing Party, Rocksmith*, and various music games for the iPad, each game produced the highest score for a different category: participants who played *Sing Party* scored highest in written pitch; *Sing Party* and *Rock Band* both had positive results in oral pitch; those who played the iPad games, *Rocksmith*, or *Rock Band*, scored well in music literature; and all games produced a positive overall improvement when the participants were tested on rhythm (Jenson et. al., 2016). These results suggest that video games do have educational potential and can be used to teach or enforce musical concepts. Different games strengthen different skills, so the teacher will need to examine a diverse array of music games to include ones that will be most beneficial to their students. One game that has not been examined in studies before is the game *Rhythm Heaven*, which will be used in the current study.

Research suggests that these video games can even make people more musical. Non-musicians who take part in rhythm or music video games scored higher against those who did not play video games when tested in different musical skills, such as melody, tuning, tempo, and rhythm. Musicians, who had been playing an instrument for at least five years, did not score significantly higher than the gamers when tested on the same skills (Pasinski, 2016). These findings suggest that enhanced musical aptitude can be found among those who regularly play
video games. Including video games as part of the music education curriculum can develop students’ musical perceptions. The population that stands to gain the most from these games are those with only minimal or no musical training (Jenson et. al., 2016), making these games especially relevant to the elementary music classroom, where most, if not all, of the students are just beginning their music education. Alternatively, music video games can provide musical knowledge and skills to those who are otherwise unable to play an instrument or take part in a music class, making music more accessible to all.

Non-rhythm video games have been tested in previous studies and are suggested to be beneficial to students’ music educations. One of the musical skills video games have been suggested to improve is pitch accuracy. Singing video games like Rock Band and Karaoke Revolutions score players based on their pitch accuracy. Participants who played these games for ten minutes were found to have significantly improved from their pre-test scores to their post-test scores when graded on their pitch-matching (Paney, 2013). If singing video games can help teachers’ develop their students’ pitch-matching skills, then it is feasible to expect rhythm video games to be able to help students improve their rhythmic playing and recognition skills.

1.6. Video Games in the Music Classroom

Guitar Hero and Rock Band have been used in various studies that have suggested that rhythm video games can be used as a bridge to connect formal and informal music learning (Cassidy & Paisley, 2013; Peppler, 2011). Teachers are always looking for new ways to engage students, as students may grow bored of the same structured formal learning day in and day out (Dillon, 2004; Cassidy & Paisley, 2013). Therefore, introducing informal learning methods, such
as video games, into the music classroom can break up the monotony and make children excited to learn.

Children have been observed to self-correct when making mistakes, particularly when it comes to rhythm (Burton, 2015). Rhythm video games, with their instant feedback on whether or not the player hits a note, can serve as tools for the students, helping them gain intuition on how to play in time or how to play certain difficult rhythms correctly. Rhythm games also intuitively connect visuals to the sound and music, further helping the students see and hear the correct rhythms they are supposed to be playing. Also, allowing a student to examine their own feedback, as opposed to being told by someone with more experience if what they played was correct or not, as it normally happens in music class or private lessons, can increase their independence in musical listening and evaluation skills (Peppler, 2011). Learning where rhythms land on the beat in rhythm video games can translate to other types of music-making throughout the student’s life, training their ear so they know when to self-correct.

Video games should not be seen as a replacement for quality teaching, however. Students who played video games in combination with teacher instruction were shown to score higher when tested on various musical skills compared to students who just played a video game or received instruction in isolation (Lesser, 2020). Video games are not an alternative to instruction, but should rather be incorporated into the curriculum as a supplemental material, and should be included into the curriculum after careful deliberation from the teacher about how the use of a video game could best serve the students’ music education.
1.7. Addressing Criticisms

One criticism of using video games in the music classroom is it is unclear how accurately it translates to actual music performance. For example, games like Guitar Hero and Rock Band are accused of simplifying and misrepresenting real instruments. However, with the evidence presented so far, it seems that the skills used in rhythm video games improve skills that are used in performance (Miller, 2009). Singing video games can teach phrasing, articulation, and pitch accuracy, all without musical notation, making it accessible to even the youngest music students (Tobias, 2012). The representations of pitch and rhythm in the video games can help students quickly learn notation when the time comes for that. Even in games like Guitar Hero, where the controller emulates the real instrument, the game serves as an accurate simulation of performance, due to how it models many different aspects of an actual performance (Arsenault, 2008). Furthermore, the playing of these rhythm games in and of themselves can serve as a pseudo-performance, with the students having to play the game in front of their peers. This can acclimate students to performing in front of an audience, assuaging their performance anxiety (Hein, 2014).

1.8. Need for Study

As the purpose of music education is arguably to teach children to love music (Hargreaves & North, 1997), teachers should be responsible for constantly finding new ways to engage students and connect to them. Video games, now more popular than ever, can be a way to do just that: bridge the gap between pop culture and the music classroom.

The studies explored in this review of literature, while helpful in creating a foundation for the current study, all focused mostly on written notation and rhythmic literacy. While important,
the ability to read music is not the only component of a comprehensive musician. Therefore, this study seeks to further expand on the less-often-focused rhythmic listening and memorization aspects of rhythmic understanding.

The purpose of this posttest-only control group research study is to examine the effect the rhythm video games, through the use of the game *Rhythm Heaven*, on the rhythm listening skills of elementary general music students, in order to determine if rhythm video games are acceptable supplemental materials for aiding beginning music students in learning rhythm. Research questions include 1) Are participants who receive the rhythm game treatment able to reproduce rhythms more accurately than participants who do not receive the treatment? 2) Can participants who play a rhythm game more accurately imitate longer rhythms than those who do not play a rhythm game? 3) What is the relationship between rhythm game scores and rhythm test scores? And 4) Do differences in score exist based on grade level?
CHAPTER 2. METHODOLOGY

2.1. Participants

The participants of this study were elementary students from grades Kindergarten to fourth grade from a large urban school district in the southern United States. The subjects were student volunteers chosen by the cooperating music teacher and were individually sent to the researcher to partake in the study. The researcher would then randomly assign the subjects, via the use of a random selection app, into either the control group or the treatment group.

Once selected, the participants would join the researcher out in the hall, where they would not be disturbed by the class. If the subject was randomly assigned to the control group, they would take the rhythm test and then return to class, and another student was then randomly selected to partake in the study. If the subject was randomly assigned to the treatment group, they would first play the rhythm game before taking the rhythm test.

2.2. Instruments

The rhythm game used for the current study is Rhythm Heaven. Rhythm Heaven is a rhythm video game series with, at the time of writing, four titles: the original Rhythm Tengoku for the Gameboy Advance (released only in Japan), Rhythm Heaven for the Nintendo DS, Rhythm Heaven Fever for the Nintendo Wii, and the most recent title Rhythm Heaven Megamix for the Nintendo 3DS. Megamix is the game used in the current study. None of the games in the Rhythm Heaven series have yet to be used in a formal study, but it has been speculated that this game (specifically Rhythm Heaven Fever) could be directly integrated into the music class, being featured in lessons about steady beat, syncopation, rhythmic echoing, triplets, and/or tempo
changes (Reyher, 2014). Whereas in games like Guitar Hero and Rock Band, the same concepts are used for each song, in Rhythm Heaven, each song is different with unique concepts each time.

The rhythm game used for this study was Rhythm Heaven Megamix. The participants played this game on a Nintendo 3DS. The game consists of several unique rhythm mini-games where the player must play in-time with the rhythm of the song with the goal of achieving a high score. Each game lasts one to three minutes, depending on that game’s song length. The way the player taps to the rhythm and interacts with the game differs from song to song. The game may ask the player to tap along to the beat, respond to musical or visual cues, or repeat a rhythm pattern. The three games chosen for this study cover all of the game types listed: Air Rally (keep the beat), Hole in One (respond to cues), and Rhythm Tweezers (repeat a pattern).

Air Rally features a cartoon cat and dog playing badminton while they fly planes. The player assumes the role of the dog and must tap to send the birdie back to the cat. The cat hits the birdie on counts 1 and 3 of the song, while the player is responsible for hitting it back on counts 2 and 4. Occasionally, the cat will cue the player to wait until count 3 to hit the birdie before returning to their usual beats 2 and 4.

Figure 1. Air Rally
Hole in One features the player character (a human) being pitched golf balls by a monkey and a mandrill. The monkey gives the player a two-beat cue when throwing the golf ball, and the player must tap to hit the ball one beat after the second beat of the cue. The mandrill has a four-beat cue, and the player must hit the ball on the fourth beat of the cue.

The final game included in this study, Rhythm Tweezers, involves the player controlling a pair of tweezers to pluck the hairs off of various vegetables. The hairs grow in a 4-beat rhythm pattern, and the player must copy the pattern to successfully pluck the hairs.
These three particular games were chosen due to their ease of controls and beginner-friendly nature. They are easy to pick up, even for someone who has never played a rhythm game before. Additionally, ease of controls is important, as this study includes children as young as kindergarteners. The series *Rhythm Heaven*, in general, is one of the more kid-friendly rhythm games, with its simple controls, short songs, and cartoony graphics. The subjects used headphones when playing the games to attempt to eliminate outside distractions and allow them to listen closely to the rhythmic cues the game was giving them.

Before each of these games, there is an in-game tutorial to show the player on what beat or beats to tap, as well as familiarizing the player with the cues they would be hearing in the actual game. If the player is struggling with the tutorial, the game will visually show the breakdown of beats on the screen, along with playing a metronome, with an icon indicating on which beat the player should tap. In time with the metronome, each beat will be highlighted, and

Figure 4. Rhythm Help Screen
when the beat with the “tap” icon is highlighted, the player should tap. The game refers to this as the “rhythm help screen.”

After the game is over, Rhythm Heaven gives the player a score out of 100 and a ranking, based on how well they played the rhythms asked of them. A score of 80 to 100 gives the player a “Superb” ranking, a score of 60 to 79 gives an “OK,” while a score of 0 to 59 has the game tell the player to “Try Again.” For the purposes of this study, the participants in the treatment group would only play each game a single time, even if they received the “Try Again” ranking.

SmartMusic was used to measure the rhythmic aptitude of the participants. The ten rhythms for the rhythm test (refer to Figure 5) were input into SmartMusic using the “compose” function. The rhythms were played using rhythm sticks, to eliminate any differences in clapping timbre or volume the participants may have had that may have influenced how SmartMusic would have scored the subjects.

2.3. Rhythm Test

The dependent variable to test whether or not playing the rhythm game improved the participants’ rhythmic perception was a test score that the participant would receive upon taking a rhythm test consisting of ten rhythms: eight 4-beat rhythms, and two 8-beat rhythms to test rhythmic memory. The rhythms were intentionally made to be above the reading level for the ages of the participants of this study, as the goal of this study was not to test notation reading skill, but rather rhythmic listening, playing, imitation, and memory skills. The rhythm test was inspired by and adapted from Bebeau’s (1982) study on rhythm literacy.

For the independent variable, participants were randomly assigned to one of two groups: the control group or the treatment group. The cooperating teacher would randomly select a
student to send to the researcher, who would then randomly assign the student to a group with the use of a random selection app. Those in the control group would only take the rhythm test, while those in the treatment group would first play the three games from *Rhythm Heaven Megamix*, listed above, then take the rhythm test afterward.

Figure 5. Rhythm Test

To test the subjects’ rhythmic accuracy, the researcher would first play the rhythm on rhythm sticks, and the participant would repeat the rhythm on their rhythm sticks to the best of their ability. *SmartMusic*, through the researcher’s laptop, would record the participant’s attempt.
and give a percentage score of how correctly they reproduced the rhythm. The missed or incorrectly played rhythms would be highlighted in red, while the rhythms played at the correct time were highlighted in green. *SmartMusic* would then calculate the score based on the rhythms it recorded being played at the correct time. This percentage score was recorded for each of the ten rhythms. At no point did the subjects ever see the rhythms they were playing.

![Figure 6. Example of *SmartMusic* Grading a Rhythm](image)

The treatment group played the three games described above in the order of *Air Rally*, then *Rhythm Tweezers*, then *Hole in One*. *Rhythm Heaven Megamix* gives the player a score out of 100 after the song is completed based on how accurately the player performed the rhythms in the game. These scores for each game were recorded for each participant in the treatment group. After playing all three games, the subjects in the treatment group would then take the rhythm test.

### 2.4. Procedure

Participants \((N = 31)\) were randomly assigned to the control group \((n = 17)\) and the rhythm game treatment group \((n = 14)\). The participants would individually join the researcher in the hallway outside the classroom to prevent distractions from the class. The researcher, after briefly demonstrating to the subjects how to hold and use the rhythm sticks, presented a couple
“practice” rhythms to make sure the subjects knew when they were expected to repeat the rhythm. The participants in the control group received the demonstration then took the rhythm test.

The treatment group played the above mentioned selection of games form the rhythm video game *Rhythm Heaven Megamix*; each game had a tutorial before the game started, and the researcher asked the subject if they would like it read to them or if they would like to read it by themselves. The researcher gave a brief explanation on how to play, including where and how they should tap the screen. If the subject was having trouble understanding the in-game tutorial, even after the rhythm help screen appeared, the researcher would ask if they would like help, and show them what they were supposed to do. The researcher then let the subject complete the tutorial and the subsequent game on their own. Afterward, the subjects in the treatment group were given rhythm sticks, received the same demonstration as the control group, and took the rhythm test.

Each of the ten rhythms were recorded in *SmartMusic* and scored individually. For the scoring, *SmartMusic* was set to its most sensitive setting, “strict tolerance,” with the other settings being “easy,” “lenient,” and “average tolerance,” easiest to hardest, respectively. The participants were informed that there were ten rhythms in total and that they could request a break or to stop at any time. Before the final two rhythms, the participants were informed that these rhythms were longer than the others, so they were not caught off guard, as they had been repeating after only four beats up to this point. If for any reason *SmartMusic* did not hear the participant’s attempt at imitating the rhythm, either due to them playing too softly or picking up
miscellaneous noise, the participant was asked to repeat their attempt. Under no other circumstances was a participant allowed to repeat an attempt at imitating a rhythm.
CHAPTER 3. RESULTS

There were 31 participants tested, but one outlier was removed, resulting in a total of 30 participants included in the data analysis. The outlier was removed due to scoring 3 standard deviations higher than the mean of either group, and, because of the small sample size per grade, this participant’s score skewed the results of the Kruskal Wallis test, showing one grade testing significantly higher than the other grades, when this was most likely not the case. The other data analysis tests showed similar results and similar significances with and without the outlier, but it was still removed for the sake of consistency.

3.1. Research Question #1

In order to determine if differences existed in the rhythmic imitation skills of elementary music students who were in the control group and those in the that received the rhythm game treatment, the researcher administered a rhythm test and compared the groups’ scores by using a Mann-Whitney U test. The researcher used a Mann-Whitney U test as opposed to the

<table>
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<tr>
<th>Grade</th>
<th>Control Group</th>
<th>Treatment Group</th>
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<tr>
<td>Total</td>
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Number of participants in each group per grade, excluding the outlier
Independent t-test due to not meeting the homogeneity of variance assumption. The treatment group \( (n = 14, \text{mean rank} = 20.00) \) scored significantly higher on the rhythm test than the control group \( (n = 16, \text{mean rank} = 11.56) \) \( (U = 49.00, Z = -2.62, p < .01, r = .49) \). These results suggest that playing a rhythm game is beneficial to the development of the rhythmic skills of elementary general music students.

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<th>Group</th>
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### 3.2. Research Question #2

To compare the means of the scores of the 8-beat rhythms between the two groups, the researcher conducted an independent t-test. The researcher established homogeneity of variance through the Levene test for equality of variance \( (F = 1.872, p = .182) \). Once again, the treatment group \( (M = 65.61, SD = 15.41) \) scored significantly \( (p < .05) \) higher on the rhythm test for the 8-beat rhythms than the control group \( (M = 48.53, SD = 23.65) \). These results suggest that rhythm games are beneficial to the development of the rhythmic memory of elementary general music students.

### 3.3. Research Question #3

In order to examine if any relationship existed between the treatment group’s scores in *Rhythm Heaven* \( (M = 53.53, SD = 6.21) \) and their scores on the rhythm test \( (M = 67.66, SD = \)
11.67), the researcher conducted a Pearson correlation analysis and found a significant ($p < .01$) and moderate positive correlation ($r = .689$) between the two scores. These results suggest that skill in the rhythm games somewhat correlates with rhythmic skill, and becoming skilled at these games can translate to increased rhythmic skill.

![Figure 7. Scatter Plot of Pearson Correlation Analysis](image)

### 3.4. Research Question #4

A Kruskal Wallis test was used to determine whether there was a significant difference in the test scores among the grade levels included in the study. No significant differences in score were found among the five grade levels ($H = 8.19$, $df = 4$, $p = .085$). No grade scored significantly higher or lower than any other grade, however, first grade had the highest difference.
between treatment group scores and control group scores, indicating that they benefitted most from the rhythm game treatment. These results suggest that students of all grades can benefit in similar ways from playing a rhythm game.
CHAPTER 4. CONCLUSION

4.1. Discussion

The game *Rhythm Heaven* was shown to effect the rhythmic accuracy of elementary aged music students. In this section, I will share observations I had during the testing, as well as what effects the independent variable in the treatment group produced that resulted in significantly higher participant test scores.

This study’s results suggesting playing a rhythm game can improve rhythmic skill corresponds with the results of Jenson, et. al.’s (2016) study, in which they tested the effects of multiple music games in multiple music content categories. All of the rhythm games they tested had a positive effect on their participant’s rhythmic abilities, but *Rhythm Heaven* was not included in their study. The current study suggests that *Rhythm Heaven* can have the same positive effect on the rhythmic ability of students.

Furthermore, Pasinski (2016) observed that non-musicians can gain a variety of musical skills from video games, including tuning, tempo, melody, and rhythm. This was similarly observed in the current study in how the participants, who all had minimal musical experience due to their age, demonstrated significantly different test scores depending on whether or not they played a rhythm game. When having their rhythm playing graded by *SmartMusic*, the treatment group. As in Pasinski’s (2016) study, tempo also appeared to be a factor in the treatment group’s success, as they were quicker than the control group to match the researcher’s tempo when initiating their imitation of the rhythm. Whereas the control group would often speed up or slow down the tempo at which I demonstrated the rhythm, the treatment group would match my tempo more accurately and keep that tempo throughout their playing of the
rhythm. The rhythm game had the subjects playing along with a song, forcing them to match tempo, similarly to playing with a metronome. This awareness of the tempo seemed to carry over to the rhythm test, but this cannot be confirmed, as the current study was not testing for tempo accuracy. This will be discussed further in “Suggestions for Future Research.”

*Rhythm Heaven* allows plenty of opportunity for the player to self-teach and self-correct while playing. Self-correction after making mistakes is, according to Burton (2015), a sign of formation of musical understanding. I observed multiple instances of students correcting themselves and improving while playing the game, unprompted by any outside instruction. Multiple participants began the game by tapping on the screen wildly, only hitting the correct beat through sheer luck. However, as the game continued, the participant became accustomed to the tempo and beat of the song and began to tap along to the beat, as was expected of them by the game. The audio and visual indication used by the games when a mistake is made allow the player to examine their mistake and deduce what they need to do to not continue to make that mistake in the future. The length and continuous nature of these games are also beneficial to learning: when a mistake is made, the game does not stop and tell the player what they did wrong, rather, the player must quickly figure out for themselves. At no point does the game stop because of a mistake, much like how there are no do-overs in a musical performance. The way the game is structured can teach children to keep going despite mistakes.

Additionally, I noted that participants in grades 3 and 4 responded more consistently to the rhythmic cues the game gave them, while younger participants in grades K through 2 would more often simply tap the beat of the song. The same game would allow the younger and older participants to practice different skills. For younger, or less skilled, participants, they would
practice tapping the beat to song, similar to skills they were working on in class. Older, or more skilled, participants could practice responding to cues, changing rhythms, and other listening skills, preparing them for higher levels of music. The game allowed the participants to adjust the challenge based on their skill level: an important step when entering the flow state (Csikszentmihalyi, 1990). Even though they were playing the same game, they would play it differently, possibly connecting the skills they were learning in their music class and applying it to how they would play the game. This suggests, once again, that these games can benefit students no matter their age or grade level, and it also suggests that in addition to introducing musical concepts, these games could be a useful way to reinforce musical ideas and have them apply concepts they are learning in a new way.

As discussed in the Methodology section, each game in Rhythm Heaven is preceded by a tutorial that introduces the player to the skills needed to play that particular game and what to listen for. These tutorials do not include any musical terms. This adheres to the “sound before symbol” philosophy, as the game will not explain to the player to, for example, play on beats 2 and 4. Instead, the game will give the player vague instructions, and the player will have to use their listening skills and intuit when to tap (see Figure 8). Even without telling the player explicitly that that should be tapping on beats 2 and 4, the game still effectively conveys on which beats the player should tap. The player, instead of being told, must figure it out by doing. This is a suggested way for teachers to introduce concepts: by having the students do and play first before telling them what rhythms they are playing (Abeles, et. al., 1994).
4.2. Application to the General Music Classroom

Previous research, as well as the current study, suggest that rhythm games can improve musical and rhythmic skill, supporting the idea to include these games in the classroom. Students possessing the ability to correctly hear and play rhythms is the first step to teaching them rhythmic literacy. Rhythm games can give students the skills they need to aurally and visually decode rhythms, as well as give them practice playing these rhythms in the context of a song.

Many methodologies recommend a “sound before symbol” approach (Abeles, et. al., 1994; Suzuki, 1983; Gordon, 1997), where the students learn how to play the rhythm before they learn how to read it. Rhythm video games ask the player to play rhythms with no notation, forcing them to rely on their listening skills. The way rhythm games are played can have multiple applications to the classroom. As the data above shows, as well as the research discussed in the literature review, rhythm video games have been shown to have a positive relationship with musical skill (Gower & McDowall, 2012; Jenson et. al., 2016; Keeler, 2020; Lesser, 2020). As
for how to incorporate these games into the classroom, a skilled teacher can find the best ways to apply them to their own classroom depending on the needs of their students, but I will share a few ideas of my own in this section.

One way to incorporate rhythm games into the classroom is to include them as a station. Stations are useful when wanting students to study individually or in small groups. Multiple stations can be going at once, with the students rotating stations after a certain amount of time. *Rhythm Heaven*, or your rhythm game of choice, would be included as one of the stations. In stations, students are already working independently with the teacher serving as mostly just a facilitator, stepping in when needed. Playing rhythm games, as they include tutorials, would not be difficult for a student to teach themselves to play in the context of a station.

Rhythm games could also be incorporated in a full class setting. Some rhythm games, like *Guitar Hero*, would be difficult to play with the entire class at the same time because of the complexity of the controls; the students would have to take turns on the controller. For a game like *Rhythm Heaven*, with simple controls and only one input, the class could all play at the same time by clapping whenever the player would be expected to tap the screen. While this approach would lose the self-correction aspect the game provides when playing alone, playing as a group would allow the students to listen to and learn from their peers, allowing those that struggle with rhythm on their own to be supported by more advanced students as they all play together (Vygotsky, 1978). The clapping could also be replaced with a movement, as incorporating movement activities when teaching rhythm is suggested to be beneficial to student learning (Pollatou et. al., 2012). The games in *Rhythm Heaven* show character performing actions in time with the rhythm that could be easily mimicked by the students: for example, for “Air Rally” or
“Hole in One,” two of the games used in this study, the students could pretend to swing their racket or club to the rhythm.

The games used in the classroom could also be adapted to what the students are currently learning. If a teacher plans to use *Rhythm Heaven* in their own classroom, I recommend becoming acquainted with all of its games in order to choose the correct ones to best serve as a helpful supplement to the concept they are teaching. However, I will highlight a few games here and what concepts they could potentially be used to teach. Some of these games may fall into multiple categories, but I am only listing them once for a more concise list.

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<tr>
<th>Musical Concept</th>
<th><em>Rhythm Heaven</em> Game</th>
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<tr>
<td>Steady beat</td>
<td>Air Rally, Micro-Row, Flock Step, Marching Orders, Night Walk</td>
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<tr>
<td>Rhythmic imitation</td>
<td>Rhythm Tweezers, Shoot-'em-up, First Contact, Working Dough</td>
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<tr>
<td>Responding to cues</td>
<td>Hole in One, Figure Fighter, Munchy Monk</td>
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<tr>
<td>Held rhythms</td>
<td>Fillbots, Screwbots</td>
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<tr>
<td>Upbeats</td>
<td>Monkey Watch, Lockstep, Mr. Upbeat</td>
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<td>Tempo changes</td>
<td>Sneaky Spirits, Built to Scale (Fever), Coin Toss</td>
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<tr>
<td>Counting rests</td>
<td>Exhibition Match, Bunny Hop, Charging Chicken</td>
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### 4.3. Limitations

The limitations for this study were time and sample size. I was only able to visit the cooperating school twice, resulting in a limited sample size, as well as limited time allowed for the playing of the game. If this study were to be replicated, more time allowing the subjects to
play the rhythm game should be allocated, possibly over several sessions. After these sessions, the rhythm test would be administered as described above. The time limitation also dictated how many games from *Rhythm Heaven* I could have the participants play. In the end, I narrowed it down to the three games discussed in the Methodology section, but if this study were to be replicated with more time allowed, I would include more games for the treatment group to play. It is possible that other rhythm games not used in this study would have had a different effect upon the rhythmic accuracy of the participants.

### 4.4. Suggestions for Future Research

The participants in the treatment group consistently showed higher scores when taking the rhythm test, which I believe is due in part to how the game trained them to play in tempo. Further research on this subject could include examining how rhythm games influence the internal beat of participants. There are multiple games within *Rhythm Heaven* that require the player to wait or rest for an extended period of time to test whether or not they can keep the beat themselves. Some examples of games to use for this sort of study (again, from *Rhythm Heaven*) would be “Exhibition Match,” “Coin Toss,” and “Bunny Hop.” These games all require the player to keep the beat/count in their head, sometimes playing syncopated music, or even no music at all, in the background to make this task more difficult for the player. Utilizing these games as learning opportunities for the students could benefit their ability to keep a consistent beat or tempo even without the assistance of a metronome.

Another suggestion for future research is analyzing the relationship between students playing rhythm games and the speed at which they pick up new musical concepts. Previous research findings suggest that rhythm video games enhance musical aptitude (Pasinski, 2016),
but can those who play these games demonstrate competency or proficiency in certain musical
skills more quickly than those who do not play rhythm games? During the current study,
participants who played the rhythm game were able to imitate rhythms they had not yet learned
in class, such as triplets and off-beats, more accurately than their control group counterparts.
When being taught these rhythms in class, will the rhythm game players be able to understand
how to read, write, and play these rhythms more quickly? This should be examined as a possible
way to benefit student learning, as well as a way to increase efficiency when teaching new
musical concepts.
APPENDIX A. IRB APPROVAL

TO: Daniel Scott Isbell
LSUAM | Col of MDA | Music

FROM: Alex Cohen
Chairman, Institutional Review Board

DATE: 21-Oct-2021

RE: IRBAM-21-1014

TITLE: Use of Rhythm Video Games as a Supplemental Teaching Material in the General Music Classroom

SUBMISSION TYPE: Initial Application
Review Type: Expedited Review
Risk Factor: Minimal
Review Date: 20-Oct-2021
Status: Approved
Approval Date: 20-Oct-2021
Approval Expiration Date: 19-Oct-2022
Expedited Categories: 07

Requesting Waiver of Informed Consent: Yes
Re-review frequency: Annually
Number of subjects approved: 80

By: Alex Cohen, Chairman

Continuing approval is CONDITIONAL on:

1. Adherence to the approved protocol, familiarity with, and adherence to the ethical standards of the Belmont Report, and LSU’s Assurance of Compliance with DHHS regulations for the protection of human subjects*
2. Prior approval of a change in protocol, including revision of the consent documents or an increase in the number of subjects over that approved.
3. Obtaining renewed approval (or submittal of a termination report), prior to the approval expiration date, upon request by the IRB office (irrespective of when the project actually begins); notification of project termination.
4. Retention of documentation of informed consent and study records for at least 3 years after the study ends.
5. Continuing attention to the physical and psychological well-being and informed consent of the
individual participants, including notification of new information that might affect consent.
6. A prompt report to the IRB of any adverse event affecting a participant potentially arising from the study.
8. SPECIAL NOTE: When emailing more than one recipient, make sure you use bcc. Approvals will automatically be closed by the IRB on the expiration date unless the PI requests a continuation.

*All investigators and support staff have access to copies of the Belmont Report, LSU's Assurance with DHHS, DHHS (45 CFR 46) and FDA regulations governing use of human subjects, and other relevant documents in print in this office or on our World Wide Web site at http://www.lsu.edu/research

Louisiana State University
131 David Boyd Hall
Baton Rouge, LA 70803

O 225-578-5833
F 225-578-5983
http://www.lsu.edu/research
APPENDIX B. TABLES OF RAW DATA

Control Group Scores

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REFERENCES


VITA

Jennifer Marie Webber was born and raised in Mobile, Alabama. She received her Bachelor of Music Education from Louisiana State University in 2018 and moved to Houston, Texas to teach elementary general music and band for two years before returning to LSU for her Master’s degree. Upon completion of her master’s degree, she plans to return to teaching elementary music in Houston. She plans to receive her Master’s this May 2022.