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So you think you can play: An exploratory study of music video games

ABSTRACT

Digital music technologies have evolved by leaps and bounds over the last 10 years. The most popular digital music games allow gamers to experience the performativity of music, long before they have the requisite knowledge and skills, by playing with instrument-shaped controllers (e.g. Guitar Hero, Rock Band, Sing Star, Wii Music*), while others involve plugging conventional electric guitars into a game console to learn musical technique through gameplay (e.g.* Rocksmith*). Many of these digital music environments claim to have educative potential, and some are actually used in music classrooms. This article discusses the findings from a pilot study to explore what high school age students could gain in terms of musical knowledge, skill and understanding from these games. We found students improved from pre- to post-assessment in different areas of*

KEYWORDS

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music video games
game-based learning rhythm
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musicianship after playing Sing Party, Wii Music *and* Rocksmith, *as well as a variety of games on the iPad.*

INTRODUCTION

Digital technology is increasingly establishing its place in twenty-first century music education classrooms. Computer software is routinely used to notate, transcribe, record, playback and compose. More recently, digital games have enabled technologically mediated forms of musical engagement, from production to consumption, through digital interfaces and handheld and gesture-based controllers. Since *Guitar Hero* arrived on the market in 2005, a variety of music performance games gained enough popularity to significantly impact digital game demographics. Some of these, like *Wii Music* (2008), claim educative potential (Ng 2009).

Do music games now have a place in music classrooms? To explore the evidence and possibilities that video games might effectively instruct students in music, it is first necessary to know how music education is currently understood and promoted within the public system. Specifically, what kinds of learning are we looking for? What kinds of musical experience are considered educational ones and why? What constitutes musical knowledge at school, and what other ways of knowing might need to be recognized and valued in contemporary music education? What kind of interactions – between students and technology – might constitute musical creativity and lead to informed and educated musical engagement? Further, what roles might video games play in promoting musical knowledge?

This article describes a pilot research study to explore the capacity for music video games to provide students with musical skills and knowledge applicable beyond the ludic environment (Linderoth 2012). It requires us to look for connections between success in the game (where metrics are scores, levels' badges, inventory, etc.) and musical accomplishments beyond the terms of the game. And the key *problem*, of course, is that transfer of skills and knowledge from the context of one medium to any other media does not always work well – but more of that later.

One of the biggest barriers to participating in musical expression, and by extension, in the production of music, is the skill needed to play an instrument. Gamifying musical performance requires a simplified instrument that allows players to produce music without needing the technical skills and musical knowledge that would otherwise be essential. This allows them to produce a quality of musical performance that encourages continued engagement. In educational discourse, this phenomenon is referred to as 'performance before competence' (Cazden 1997). The next section is a review of studies to date related to music and video games. We then describe the reasons for the games we chose, the study design, how we structured play and the design of the outcomes assessment. The article concludes with preliminary findings of the pilot study and directions for the next phase of research.

RELATED STUDIES

In reviewing studies on music games for education, we sought work that might address our overarching research question, 'Can music games "teach" educationally recognized music skills?' In other words, can music games

support and/or facilitate the acquisition of specific musical competencies? Research to date, however, is primarily qualitative, anecdotal or uses such a small sample of participants (sometimes only a single player) that it is unlikely results would be replicable (Mayer 2014). Indeed, there has been a wave of enthusiasm for using music video games as part of a technologically enhanced media education curriculum, without corresponding evidence to support its effectiveness. For example, in 2009, the US National Association for Music Education announced that it was partnering with Nintendo to put *Wii Music* into public schools (Crecente 2009). To date, no results have been published from that initiative that are publically available.

For the purpose of this article, we examined studies that explored the use of 'rhythm games' and one that examined pitch accuracy through game playing. Rhythm games are identified as such because the player is required to follow a visual cue to perform an action in time with the music. Whether playing the drummer's part in the song 'Yellow Submarine' in the game *Rock Band*, riffing along to 'Ziggy Stardust' in *Guitar Hero* or moon walking to 'Billie Jean' in *The Michael Jackson Experience*, visual cues tell players when to perform an action. Studies of rhythm games are small scale and qualitative (Cassidy and Paisley 2013; Gower and McDowall 2012), comment on the authenticity of musicianship required to be successful in the game (Arsenault 2008), assess whether playing digital games might motivate someone to learn to play a 'real' instrument (Ingram 2009) or examine whether playing might contribute to an appreciation for music and provide engagement with music outside the classroom (Cassidy and Paisley 2013). Some research has concluded that rhythm games such as *Guitar Hero* and *Rock Band* do not improve perception of metre (Gaydos 2010; Richardson and Kim 2012), while others conclude that game players were able to show *in-game* advancement in rhythmic accuracy and 'intuition' (Downtown et al. 2009). Another study by Peppler et al (2011) of *Rock Band* played in an after-school context concluded that the rhythm skills of participants increased after 9 months.

Studies that examine playing commercially available video games as a way to improve pitch accuracy are less common than those that have explored rhythm games. Paney's (2013) study of 33 adult, undergraduate participants playing *Karaoke Revolution Presents: American Idol Encore* demonstrates that music video games can be used to support pitch accuracy. He asked participants in the study to sing 'Happy Birthday to You' (with accompaniment) before and after playing *Karoake Revolution* for 10 minutes. The study concluded that the difference in pitch accuracy from pre- to post-test was statistically significant. Paney argues that for non-musically trained people, singing games allow them 'to begin to hear and feel what pitch-making is' (p. 55).

Finally, some scholars considered the potential of music games to teach increased music appreciation and knowledge, as well as a fuller range of the elements of music, including instrumental technique, tonality, metre, tempo and dynamics (Gower and McDowall 2012; Gumulak and Webber 2011; Thaler and Zorn 2010; Tobias 2012). These studies were designed to assess students for increased musical aptitude like the ability to sight sing and distinguish/repeat rhythm/metre and the ability to follow the notation system set-up by the game. They generally found that students both self-reported enjoyment playing music games and felt that they learned from their play. Richardson and Kim's (2012) mixed methods study found that some of their participants improved at reading in-game notation relative to performing game actions in time; however, they were unable to transfer these skills across musical

domains outside the game context. These studies point to a kind of hopefulness that through their accessibility, music games might well lead to a greater appreciation for music, and this indeed was a key exploratory question for this study. In the next section, we detail the games we selected for study and offer a rationale for their inclusion.

CHOOSING MUSIC GAMES

One very important feature of a music game is the kind of controller that is used to scaffold the player so that they can both participate and improve their performance. When considering how to design our study, we chose games that had varying degrees of resemblance to physical instruments so that we might determine whether playing an authentic instrument or an instrument-shaped controller made any difference in students' willingness to participate, their perception of difficulty, their improvement in the game and their improvement in the potentially transferrable areas of musical aptitude already outlined: rhythm, melody and historical and contextual musical knowledge.

The games chosen for this study included *Rock Band*, *Rocksmith*, *Sing Party*, *Wii Music* and a variety of music theory/literature games and rhythm games made for the iPad. In *Rock Band*, players use controllers shaped like a guitar, a bass and drums. Players who choose the fretted instruments press buttons on the controller's fretboard and click a switch in the centre of the guitar's body so that they might feel like they are manipulating strings on a guitar. Drummers use drumsticks to strike the 'drum heads' (circular-shaped sensor pads) while simultaneously playing the bass drum pedal with their foot to simulate playing a four-piece drum kit. *Rock Band* also uses the famous scrolling notation made popular by its predecessor, *Guitar Hero*, in which a fretboard advances towards the player with coloured boxes that indicate which button the player should press (see Figure 1). As the boxes hit the closest point in the screen, the player presses down the corresponding button on the controller with her left hand and 'strums' the note with a 'guitar-pick' switch using her right. In these games, although the controllers are shaped like instruments and are designed

Figure 1: Typical graphic notation score for Guitar Hero *and* Rock Band. Guitar Hero 3 *Wii by Raùl. Creative Commons License Image. Accessed 20 May 2015 at https://goo.gl/vDkWzT.*

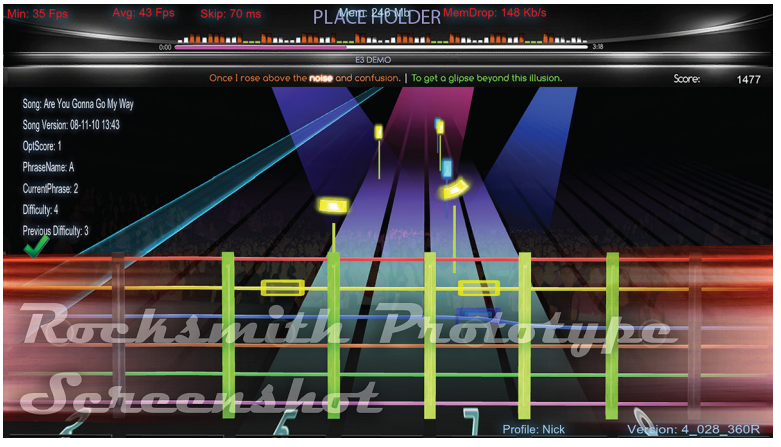

Figure 2: Rocksmith *interface*. Rocksmith. *Creative Commons License Image. Accessed 20 May 2015 at https://farm8.staticflickr.com/7041/6986848013_74213c110f_h.jpg*.

to imitate the motions and posture of playing an instrument, the only 'musical skill' that is practiced is syncing the button press + strum with the scrolling notation that is (hopefully) in sync with the music. The object of the game is to earn the most points and perform increasingly difficult songs with 100% accuracy. We chose the game *Rock Band* because it allows for more than one player at a time but maintains the same concepts and similar repertoire as its predecessor *Guitar Hero.*

A more recent development in music console games was *Rocksmith*, in which the player plugs a guitar or a bass into the console or computer. Using a hybrid notation that is part colour-coded nodes a-la *Guitar Hero* and part interactive tablature (complete with a colour system for each string), the game guides the player through exercises and jam sessions that gradually teach the user to play the electric guitar or bass (Figure 2). Unlike *Guitar Hero* or *Rock Band*, the game is adaptive and adjusts to the player's skill. If the player becomes competent at playing a few basic notes, the game offers a more complicated riff; if the notation is too difficult, the game simplifies the song. Players pluck the strings on the guitar with their right hand and frets the string with their left, sounding the actual notes. The motivation for this game is not so much to earn points as the actual cultivation of skill on the instrument chosen, and the game is marketed as an informal training tool for the guitar and bass.

Karaoke games are a popular subset of the music game genre in which the only instrument used is the player's voice (Figure 3). *Sing Party*, for example, evaluates the player based on their pitch accuracy and rewards accurate (on pitch and in time) singing with points. The singer is prompted with the words displayed on a game pad (in the case of Wii U or on the TV screen in other consoles) and sings along with the instrumental accompaniment while a line scrolls horizontally across the screen to display the song's melodic contour (a kind of graphical score of tonality). Usually, the game also displays the actual pitch contour that the player sings in real time so that they can compare their performance with the correct pitch. We chose *Sing Party* because it has an option for team play (so up to four players can compete against each other)

Figure 3: Typical graphic notation score for Karaoke musical games. Karaoke game screen. Wikimedia Creative Commons License. Accessed 20 May 2015 at http://screenshots.de.sftcdn.net/de/scrn/314000/314415/ultrastar-deluxe-26.jpg.

and because it was released on the new Wii U, which we were interested in bringing into the classroom.

Wii Music is a game by Nintendo that offers the player the ability to play a variety of mostly classical Western instruments. The game is able to do this by using the controllers (the wiimote and the nunchuck) to simulate the motions of playing these instruments, one of which the player chooses for her avatar then uses the controllers and buttons to simulate the motions of playing. For example, the player can hold the wiimote to her face and press buttons as if playing the trumpet or move the wiimote and the nunchuck up and down at her waist to imitate playing a piano. *Wii Music* is made up of a series of mini games: in the first one, players can jam alone or in a group on their preferred instruments; in the second, players must perform a bell piece correctly using scrolling coloured nodes; in the third, players practice pitch recognition and in the fourth, players conduct an orchestra by holding and waving the wiimote and nunchucks like a baton. We chose to use *Wii Music* because of its explicit mandate for music education and its reliance on Western Classical Music, which is a staple of the Canadian music curriculum.

A final group of digital music games selected for the study, completely removed from the physical experience of an analogue music instrument, is those played on an iPad. These are comprised of games that vary in terms of their relationship to musical skills or knowledge, such as rhythm games like the *Michael Jackson Experience*, where the player uses various combination of swipes to make MJ dance on cue, or beat-matching games that require the player to respond to visual and auditory cues to tap the screen at the right time. There are also a few memory games in which the player must listen to melodic patterns of increasing difficulty and play them back from memory by tapping the correct order, name that tune games that test musical knowledge, and finally music theory games that offer drills in analysis and ear training.

STUDY DESIGN

This study took place in a high school in the greater Toronto area during the winter semester in 2013 (January to April),[1] approaching its research through mixed methods. Qualitative methods included observations, field notes and audio–video recorded data. Quantitative methods involved a questionnaire that asked participants about their general gameplay habits and media consumption and both pre- and post-musical assessments. The pre- and post-assessment had four primary components: music literature; pitch; rhythm; improvisation and creativity, and the same questions were administered for both pre- and post-assessment. Each of these will be described in detail in the next section.

Participation in the study was fully voluntary and took place on a Friday in the school library during regular school hours. In total, three teachers and almost half of their classroom compliment (55 at the outset) agreed to participate, in over eight 35-minute sessions. Participants were aged 14–15 years, and all participants' parents had signed the parental informed consent document. Minor participants had also been apprised of the study verbally, were given a hand-out to explain the study and provided their own written assent to participate. Participation was not dependent on answers to the questionnaire or to their pre-assessment, which were administered only after participants consented to the study.

After the students assented to participate in the study, the pre-assessment was carried out over 2 days prior to the study, on a rotating schedule as it demanded that students were individually assessed. The post-assessment repeated the same questionnaire as the pre-assessment, involving the same process, and was completed within a week of gameplay. Following the pre-assessment, each participant was randomly assigned to one type of game for the duration of the study.

Games were set up so that there were six participants playing at each of the game stations (*Rocksmith, Wii Music, Rock Band, Sing Party* and the iPads) for 35 minutes a piece, at which point a new group of students was set up to play, for a total potential number of 55 participants. At any given time, numbers of participants varied because of everyday attendance and teacher discretion. Gameplay sessions occurred once a week for 8 weeks – with three sessions of 35 minutes to accommodate all participants. All play sessions took place in the school library, which was spacious enough to accommodate the consoles and televisions/monitors. Students assigned to *Rocksmith* and iPads were given headphones and played individually, while the other games were played in groups. While 55 participants were initially enrolled in the study, 38 completed both the entry and exit assessments and played relatively consistently (at least five out of the eight sessions). Of those who completed the study, five students played games on the iPad, seven played *Rocksmith*, eight played *Sing Party*, nine played *Rock Band* and nine played *Wii Music* (see Table 1), totalling 21 males and 17 females. For this particular study, the attrition rate was likely due to the fact that students were only allowed to participate if they had finished their homework for the week. Because the study was perceived and used by teachers as an incentive, students who did not complete their homework were not allowed to attend the play sessions and those students who did not attend regularly and who did not complete the post-assessment were also dropped from the analysis reported on here. The imbalance in terms of numbers in each of the groups was due to this attrition.

1. We do not report on sex-based differences here as there were relatively equal numbers of participants – 26 males and 21 females to begin with – and there were no statistically significant differences between sexes in the quantitative analyses, nor were there any observed differences between males and females.

Group	Number of students
Ipad	5
Wii Music	9
Rock Band	9
Sing Party	8
Rocksmith	7

Table 1: Number of student participants in each gaming group.

INSTRUMENTS: QUESTIONNAIRE AND ASSESSMENT

At the beginning of the study, each student filled out a basic questionnaire, which included questions about student demographic data, technology use, game play habits and musical experience. The questionnaire was used to gauge relative familiarity with video games (and music-based video games), as well as gain a preliminary sense of how much music education and training participants had.

In order to more fully assess and document participants' musical knowledge and aptitude prior to and on completion of the 8 weeks of gameplay, they completed an entry and exit assessment (pre- and post-assessment). This assessment allowed us to identify whether participants improved on any measurable musical competency after playing their assigned game(s). The assessment was designed to include content in three musical areas: (1) rhythm, metre and melody, modelled from the musicianship assessments administered by the Royal Conservatory of Music in Toronto, Ontario (http://www.rcmusic.ca/); (2) music literature, which included questions about repertoire from each of the games; and (3) musical creativity and improvisation, which were assessed through three different exercises (see explication below). These three areas were organized into four sections: music literature, pitch, rhythm and creativity and improvisation.

The *music literature section* was comprised of five songs played to the group of participants. One song was chosen from each of the games, and students were asked to write down the songs by name, the decade the song was written and the performer. In the *pitch section*, students were asked a variety of questions that required both written and sung responses. First, in a group, students were played two pitches and had to identify (by circling on paper) whether the second pitch was higher, lower or the same as the first. One series of these questions focussed on intonation, one series focussed on intervals and another on melody. Individually, students were asked to identify a series of intervals by singing them back, were played a triad and asked to sing back the lowest, middle and highest note and were asked to repeat a short melody by singing it. Finally, students were played a four-part harmony and asked to sing back the highest line. The *rhythm section* of the assessment included a group of questions in which students individually listened to a rhythm and were asked to clap it back. In the *creativity and improvisation section*, participants were given a choice of using a keyboard, voice or guitar and were asked to play a seven-note melody and complete the melody using their chosen instrument. Next, they were asked to perform a 'happy' piece of music and a 'sad' piece of music using their same chosen instrument. Finally (and still individually), the students listened to the well-known first 60 seconds of the first movement of

Beethoven's Fifth Symphony. Immediately afterwards, the same section was played back for them while they were given a baton and asked to conduct it.

Given the mixed methods approach to this study, analysis was carried out through two means. The qualitative, observational data collected over the eight sessions, and the second was a quantitative comparative analysis of pre–post assessment scores. For the qualitative analysis, we had over 200 hours of video to review and observational field notes from three different researchers. Thematic coding was applied both to the videos and the field notes and while we do not fully report here on the qualitative data that was collected, because of its sheer quantity, we do note that it provided valuable intersectional analyses that would not have been possible otherwise, especially around what games seemed to be enjoyed more than others.

The quantitative data were analysed through inductive coding of responses to pre- and post-assessments. The co-authors of the article and research assistants constructed levelled answers to the pre- and post-assessments, based on a numerical system that moved from 0 for incorrect, 1 for partially correct and 2 for correct. Fifteen pre- and post-assessments were coded and then checked for inter-rater reliability. Differences were then discussed in a meeting that included the study's authors and the students, and then all assessments were recoded according to the agreed on schema. Finally, all codes were inputted into SPSS, and we conducted a two-way analysis of variance to test whether or not there were any statistical differences between pre- and post-assessment scores.

ANALYSIS: QUALITATIVE OBSERVATIONS

Because of the sheer volume of qualitative observational data we collected, it is not possible to report on it all here; however, we do comment on what games were played and which had the most engagement as those observations intersect with the quantitative data we report on. From a research standpoint, *Wii Music* play made for the most interesting observations, because it not only encourages competition among players, but participants very much played it competitively. In the first *Wii Music* play session, students learned how to play all of the instruments in the game and then moved on to conducting music: a completely open, performative activity. In subsequent sessions, they began competitions for points in the hand bell game (where players have to ring their hand bells in time with a musical score) and continued these throughout most of the study. Towards the end of the study, those playing *Wii Music* grew tired of the game and began to lose interest in playing. One reason for this could be that *Wii Music* lacks depth: once a player has made their way through the instruments and has played the mini games (like the hand bell game, which only has five available songs), there is little left to experience. In addition, some of the types and quality of musical material were considered by both the researchers and the participants to be more juvenile and therefore less engaging than the other games in the study.

By contrast, *Rocksmith* maintained participant interest but proved difficult for students to adjust to the style of play, as the game does not formally train them how to hold or tune the guitar. This made it necessary for the researchers to stay close during the first few sessions to coach them in the basics of form, tuning and strumming, so that they could advance to actually playing the game. Overall, the observations made in field notes commented on players being challenged and engaged. *Rock Band* seemed to hold the player

attention, and most participants happily played it competitively, sharing their scores with each other and the researchers. As one of the researchers noted an interaction with a student:

> At the end of the second group's time, one girl told me that she was disappointed with her score, which was somewhere in the neighborhood of 75%. [...] She then shared with me that it was better than what she got last week, and she was going to go for 80% next week. Her male group member had already achieved that score the week prior, she said.

Sing Party proved to be one of the most popular games, not only for participants of the study but for other students who were using the library or computers for other classes. In fact, the staff and researchers had to gently remind an enthusiastic following that they had to let the participants in the study perform as well (although we did not want to discourage ad hoc participation or camaraderie). According to field notes, the *Sing Party* participants improved a great deal in their singing accuracy (the game does not record scores, so researchers tracked scores in field notes).

Finally, the students who played the iPad games were also competitive, especially the boys, even though the games were single player, and each player was wearing headphones. For the most part, students in the iPad group were very concentrated on playing, spending a good deal of time on *The Michael Jackson Experience* and *Tap Tap Radiation*, both beat-matching rhythm games.

ANALYSIS: QUANTITATIVE FINDINGS

Next, we report on the data analysis that included the music literature, pitch and rhythm sections of the pre- and post-evaluations. Pitch and rhythm questions were coded into three categories by research assistants: incorrect (0), partially correct (1) and fully correct (2). As there was little room for discussion (correct, incorrect, partially correct), inter-coder reliability was 100% when we tested it after coding the same assessments and checking for difference. This coding strategy allowed participants to score partial marks if they sang back pitches within a half step or clapped only half of a rhythm accurately. As a result, the scoring system for each assessment section worked as follows: written pitch was coded for a total possible score out of 10; oral pitch out of 16; music literature out of 15 and rhythm out of 8. In the tables that follow, italicized indicates statistical significance, and bolded black indicates significance via T-tests. We chose to report mean change as we think it better represents what might be a statistical trend had there been a larger sample, but more importantly, to highlight what might well show in a full study, a firm finding.

Overall, the improvements demonstrated after playing music video games appear to be slight and, in some cases, negative. What we do not know, however, is what kinds of improvements typically result from comparable time spent in traditional music classrooms learning about pitch, rhythm and musical literature. Much more work is needed, obviously, before we are able to determine whether these learning outcomes provide weak, neutral or strong improvements relative to existing music education curricula. In the following paragraphs, we report a breakdown of the average change in score aligned by both music game condition and assessment section. With that, we intend to provoke deeper thinking about what might be happening for learners as they play these different kinds of games. At this pilot stage, we are looking

Group	Mean change
Ipad	0.0
Wii Music	0.0
Rock Band	–1.71
Sing Party	0.71
Rocksmith	–0.17

Table 2: Average change by group on written pitch section (out of 10).

Group	Mean change
Ipad	–0.5
Wii Music	1.4
Rock Band	0.71
Sing Party	**2.17**
Rocksmith	0.2

Table 3: Average change by group on aural pitch section (out of 16).

primarily at how we can better design a more extensive study of what is learned from playing digital music games. What follows, therefore, is meant to be more suggestive than definitive.

When we examined the written pitch questions (Table 2), only the *Sing Party* group had a small average positive change, while the other groups stayed the same or experienced a negative change. Interestingly, *Rock Band* participants registered a sizeable negative change (almost 2 points out of possible 10) that we are unable to account for, especially as *Rock Band* does have a pitch element with one person singing as others play the guitar, bass and drums. What is also worth noting here is that the game which required the most accuracy in actually producing the correct pitch with one's own singing voice (*Sing Party*) seemed to better attune students' ears to pitch discrimination in ways that games focussing on rhythm did not, and improvement on pitch discrimination was also noted in field notes by researchers.

Table 3 shows results from the aural pitch section, where students were asked to sing back notes, intervals and a melody. Here, the iPad group had a small negative average change while all of the other groups had a positive overall change. The *Sing Party* group had a particularly high average change (over 2 points out of possible 16) followed by the *Wii Music* group. Here again, participants who played *Sing Party* improved most in the ability to correctly sing back notes, intervals and melody, with *Rock Band*, in which only one player would be singing at any given time, also registering a small positive change. With regard to the *Wii Music* result, even though it does not require players to produce pitch, the game has a particular focus on pitch in several subsections, including very explicit representations of differences in pitch in its mini games.

On the music literature section, changes were most negligible, and we found that students who played the iPad games, as well as *Rocksmith*, and *Rock Band*, experienced an average positive change in the music literature questions (see Table 4), while those who played *Sing Party* and *Wii Music* had a small negative average change. A potential explanation for this result is that many of

Group	Mean change
Ipad	0.5
Wii Music	–0.25
Rock Band	0.57
Sing Party	–0.14
Rocksmith	**1**

Table 4: Average change by group on music literature section (out of 15).

Group	Mean change
Ipad	**1.5**
Wii Music	**1.83**
Rock Band	0.37
Sing Party	0.17
Rocksmith	0.0.4

Table 5: Average change by group on rhythm section (out of 8).

the iPad games, as well as *Rocksmith* and *Rock Band*, feature the title of a song and the related artist or band, thus reinforcing that content for the duration of the song. *Wii Music* on the other hand very rarely indicates the title, artist or band associated with the music players are engaging with.

With regard to rhythm section of the assessment, after examining pre-to-post changes, we found that all of the groups experienced a positive overall improvement. Interestingly, the least changes registered were in *Sing Party*, with it being not explicitly a rhythm game, and *Rocksmith*, which is designed to scaffold players who want to learn to play guitar (see Table 5). Surprisingly, given the strong drum-based component of *Rock Band*, it too registered little of a positive change, in contrast to *Wii Music* where participants improved by almost 2 points out of possible 8, followed closely by the iPad group.

Finally, reported previous musical experience displayed an interesting trajectory of change in the study. While participants with more instrument/musical training (scored from 0 to 5) started out with higher pretest scores in all categories, in the written and aural pitch sections of the assessments, the most experienced students showed no change or even a negative change in score (see Table 6). Particularly in the aural pitch sections, it was in fact students with the least reported instrument/musical training that seemed to benefit the most from playing music video games.

None of the above-reported differences were statistically significant, because of the small numbers in each music game condition by the time the study was completed. Nevertheless, these changes might suggest patterns of potential significance and point to interesting possibilities for using music games as educational tools.

DISCUSSION

Based on the qualitative and quantitative data we collected from this pilot study, students who played the iPad games, *Rocksmith*, *Sing Party* and *Wii Music* all demonstrated improvement in different areas. Those who played

Level of musical experience	Mean change written pitch	Mean change aural pitch
0 (no experience)	0.9	1.7
1 (played an instrument >1 year)	0.4	1.25
2 (played an instrument >2 years)	1.5	0.0
4 (belong to a school ensemble)	2.0	1.67
5 (take private music lessons)	–3.0	0.0

Table 6: Average change by musical experience group on written and aural pitch assessment.

Wii Music showed the highest positive change on the rhythm assessment (almost 2 points out of possible 8), followed closely by students who played the iPad games. In fact, students who played *Wii Music* improved their scores on both the rhythm assessment and the aural pitch section. These findings might suggest that if students are somehow motivated to play even with its more abstracted mode of musical interaction, there is, in fact, transferable educative potential in this game, as indeed Nintendo claims.

The music literature assessment section was less successful. Students who played *Rocksmith* marginally improved their music knowledge scores. The increased score, as mentioned previously, may indicate that students do pay attention to composers and song titles when they are integrated in the gameplay, thus gaining both knowledge and an appreciation for the music that they are attempting to play. Finally, students who played *Sing Party* showed most improvement on the aural pitch section and slightly less improvement on the written pitch section. This finding is most aligned with a hypothesis that pitch-based games might increase students' outside-game pitch accuracy because, as noted above, this is what the game primarily requires: singing with accurate pitch to earn points. Researchers reported anecdotally that students in the *Sing Party* group made the most marked and regular improvement in playing the game throughout the sessions, compared with students in the other game groups. This significant relative improvement may also suggest that the high levels of engagement in the gameplay observed by researchers were conducive to learning. The qualitative data indicating improvement in *Rock Band* (reflected in higher scores), without improvement in the examined areas on the post-assessment, are consistent with studies that suggest that rather than improving their more transferable musical skills, players simply improve at playing the game (Gower and McDowall 2012). In particular, the sizable negative change in the written pitch section of the assessment in *Rock Band* aligns with a hypothesis that as a primarily hands-on, rhythm-driven game, it ends up de-emphasizing training in pitch accuracy. A similar pattern is observed in *Rocksmith*, a game specifically oriented to guitar training, in contrast to a wide-spectrum musical skills game such as *Wii Music*.

What these preliminary findings indicate is that each type of game has a different kind of educational potential, and its format, interface and ludic mechanics all contribute to varying types of advancement. The group/social games were very successful at improving students' confidence in playing and at engaging their attention, especially in the case of *Sing Party*. This may have been both because of the social structure of the game and because the music was more familiar to students, and it was also music that they liked (as noted

in researchers' field notes). *Wii Music* was successful despite reports that students did not enjoy the game or engage in as much social play as the other two group games. As noted above, the *Wii Music* repertoire was more classical and far less popular in its content, meaning students might be less familiar with the musical selections, which might also be less appealing to these young participants. However, its specific focus on a recognizably traditional music curriculum gives it an advantage over other games in supporting prescribed music education curricula. Also surprisingly effective in practicing rhythm was the iPad interface, doubtless because of the particular games students focussed on, as well as the fact that they wore headphones, allowing them to dedicate more directed attention and become immersed in their individual experience. Even though the iPads were not social in the way other games were, field reports indicate that iPad group students played competitively, trying to beat each other's scores. These factors could have made the iPad platform engaging and may have maintained student focus and that, in turn, may have contributed positively to the iPad's multiple indicators of measurable improvement.

CONCLUSION

There is much to be learned from the remaining data from this pilot, and the second phase of the study is currently in process. These findings challenge what kinds of learning and participation are considered valuable in the classroom, including the types of musical aptitude that we consider important for students to leave the classroom with. What is even more valuable, as our preliminary experience points to, is the fact that there are alternative and complementary methods that spark interest, inspire participation and appreciation and help players become immersed in music cultures. This suggests that music games can help students develop a better ear than if they were exposed only to those methods offered through a conventional music education curriculum.

These findings ratify the (unsurprising) commonplace assumption that people learn what is explicitly taught and practiced, so it is imperative that teachers interested in the potential of digital games to support learning spend sufficient time identifying both what is taught in a game and what it is that players are actually required to do in order to succeed at that game. Clearly, there are strong and well-defined differences among the games we used in this pilot, and more work is required exploring those. Further, and well worth more focussed attention in follow-up studies, is the question of any discernible pattern connecting game fidelity with measurable improvement in transferrable musical skills and knowledge. The most dramatic numbers for aural and written pitch perception came from *Sing Party*, which makes use of players' voices, but the next largest improvements came in rhythm from the two digital games, on the iPad (at 1.5 points of possible 8) and *Wii Music* (almost 2 points of possible 8). Further exploration will require us to distinguish between fidelity at the level of the controller and interface and *functional* fidelity, where, as with iPads, the technology may look nothing like a musical instrument, yet the actions players are required to produce in play, and the way the iPad reacts to player actions may come very close indeed to the kind of practice required to develop rhythmic competence on any traditional instrument. Finally, given that this study's strongest positive results occurred with the singing game, we may explore hopes that digital games of this specific kind may help students develop a better musical ear than they presently develop through conventional music education.

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