RESEARCH ARTICLE

DOI: 10.54392/ijpefs2513

International Journal of PHYSICAL EDUCATION, FITNESS AND SPORTS

Effects of Music and Lyrics on Activity Level and Perceived Enjoyment in Elementary Physical Education

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DOI: https://doi.org/10.54392/ijpefs2513

Received: 09-12-2024; Revised: 20-02-2025; Accepted: 28-02-2025; Published: 08-03-2025

Abstract: Previous research has indicted that music is a strong motivator while participating in noncompetitive (e.g. walking, running, weightlifting) and competitive (e.g. sprinting, ultramarathon, road cycling) activities as it stimulates positive affective valence, distract exercisers and athletes from exertion and fatigue, and consequently yield greater physical performance. Some of these affective and physical effects have been found in the limited body of empirical research in K-12 physical education (PE) settings. There is also a lack of research regarding the effects of music lyrics, also in comparison with gender and grade, on pupils' physical and affective responses in PE. Using factorial analysis of variances, this study aimed to examine the effects of music conditions (i.e. music with lyrics, music without lyrics, no music), grade, and gender on the activity level and perceived enjoyment of three kindergarten and three fifth grade classes. Findings revealed significant main effects for music condition, grade, and gender on the physical measures and for gender on the perceived enjoyment. Significant grade × condition interactions were found in the physical measures and significant gender × condition interactions were detected in the perceived enjoyment. One key conclusion indicates that music with lyrics (a) seems to accompany well with activities that require less higher-order thinking skills, and (b) may be a distraction to pupils' focus when tactics and strategies are involved. Future research in this area is warranted to provide PE teachers with the most motivating music catered to different classes by gender, grade, and activity type.

Keywords: Rhythm Response, Musicality, Cultural Impact, Association, Average heart rate, Moderate to Vigorous Physical Activity (MVPA)

1. Introduction

Incorporating music in physical education (PE) is not a novel idea. Based on the 26 PE teachers' testimony, music contributes to the following four factors in a learning environment (Barney & Pleban, 2018). Frist, as a *classroom management* tool, many PE teachers use music to start and stop activities (Barney & Prusak, 2020; Greci, 1997; Harms & Ryan, 2012). The prolonged presence and absence of music in time appear to be more effective than using loud voice or a whistle to get students' attention. When the cue of music is implemented correctly, demonstrating by students' immediate response to the signal, it allows more time for skill learning and game playing.

The second factor is in reference to *student learning*. Most PE teachers believe that music helps students stay focused and feel more comfortable with the learning activities (Barney & Prusak, 2020; Harms & Ryan, 2012). This finding implies that, when students are focused on the task at hand, there would be fewer behavioral issues when music is playing.

Thirdly, music creates a positive *class climate* as PE teachers notice their students' excitement and upbeat mood by dancing or singing to the music. One teacher even goes as far as to say that "if a student comes in upset from another class, listening to a song they really like can help change their mood from negative to positive, as they associate the song with happy uplifting feelings" (Barney & Pleban, 2018). A similar observation is reported by Greci (1997) as his students "snap their fingers, tap their feet, move their bodies or dance in place" to the background music during relatively idle activities (p. 12).

The fourth and last factor addresses using music as a *motivational tool* to reward desired behavior, promote student engagement, and send positive messages. One teacher, for example, allows her students to listen on their phones when they run the mile (Barney & Pleban, 2018). They move better when music is allowed, so she uses it as a reward, which also helps them to stay engaged in the typically exhausted mile run.

Much evidence has indicated that music is a strong motivator for exercise and sport (see Terry et al., 2020 for review). While participating in physical activities, music is proven to stimulate positive affective valence, distract exercisers and athletes from exertion and fatigue, and consequently yield greater physical performance (Hutchinson *et al.,* 2018; Hutchinson & Karageorghis, 2013; Karageorghis *et al.*, 2018). Some of these affective and physical effects have been found in the limited body of empirical research in K-12 schools (Barney & Prusak, 2015; Brewer *et al.*, 2016; Deutsch & Hetland, 2012; Digelidis *et al.*, 2014; Ha & Wong, 2002; Ward & Dunaway, 1995).

1.1 Effects of Music on Perceived Enjoyment

Based on the three experiments, middle and high school students reported to enjoy playing basketball and volleyball, circuit-type exercises, and fitness activities significantly better when music accompanied them (Brewer *et al.*, 2016; Digelidis *et al.*, 2014; Ha & Wong, 2002). It is worth noting that in Digelidis *et al.*'s (2014) study, three conditions of *no music*, *teacher-selected music*, and *student-selected music* were implemented as opposed to the *music* and *no music* comparison in the other studies. This protocol, however, did not yield significant effect on the tenth graders' enjoyment and satisfaction in PE. In addition to the three studies, Deutsch and Hetland (2012) also attempted to examine the impact of music on students' enjoyment. However, the self-rated performance (SRP) questionnaire they administered only included one enjoyment item; the other items were related to work effort, motivation, and performance. Although the combined score might not be closely linked to enjoyment alone, significant differences were found as the SRP scores in the music conditions (i.e., fast-tempo and mild-tempo) were higher than the score in the no music condition.

In terms of gender differences, the male students in Digelidis *et al.*'s (2014) study reported to have greater lesson satisfaction and enjoyment than their female counterparts. Mixed results were reported by Brewer *et al.* (2016) – male students enjoyed playing basketball with and without music better than females, but female students enjoyed playing volleyball with music better than males. Deutsch and Hetland (2012), however, did not find any significant gender effect in their research. Brewer *et al.* (2016) was the only study that examined grade level differences, and they found seventh grade students had the highest enjoyment when playing basketball with music than the eighth and ninth graders.

1.2 Effects of Music on Activity Level

Using a similar research design, Barney and Prusak (2015) and Brewer *et al.* (2016) examined the step count and time in activity of students in grades 3-5 and 7-9 by condition (i.e., music and no music) and activity type (i.e., walking and frisbee, basketball and volleyball). The students' activity levels were found significantly higher in the music condition than the no music condition in either activity type or combined. Deutsch and Hetland (2012) and Ward and Dunaway (1995), on the other hand, were more interested in students' running performance. Adopting the three audio recordings from Cooper Institute's Fitnessgram® (Meredith & Welk, 2010), 72 students aged nine to 11 years ran the Progressive Aerobic Cardiovascular Endurance Run test three times under *the high-tempo music*, *mild-tempo music*, and *no music* conditions (Deutsch & Hetland, 2012). Although the students ran more laps when one of the two music versions was played, the results were insignificant, which was consistent with what Ha and Wang (2002) found. Contrary to the constant presence or absence of music, Ward and Dunaway (1995) created three conditions: (A) baseline with the music on, (B) music contingent upon increased laps per minute, and (C) music contingent upon less laps per minute to assess how four high school students performed during the running interval of a fitness unit. All four students consistently ran at or faster than their baseline pace under the reversal ABCB design combined with a within-condition changing criterion, demonstrating music as a powerful motivator in PE classes.

With regard to gender differences, male students were significantly more active across all conditions and activity types than females (Barney & Prusak, 2015; Brewer et al., 2016), but Deutsch and

Hetland (2012) found no significant gender difference in their experiment. Lastly, there was no significant grade level main effect or condition × grade level interaction effect reported by Brewer and colleagues (2016).

In a best practice paper, Stephenson *et al.* (2022) suggested paring synchronous and asynchronous music with lessons. To accomplish the former, PE teachers are to find a song or songs with a set of musical tempo that matches the pace of the planned activity. Endurance and fitness activities such as running and circuit training would work well with synchronous music because it helps students stay on the beat of the songs for a duration of time. Asynchronous music, on the other hand, is often used as a background noise, like one in a sporting event to lighten up the mood. Terry and Karageorghis (2011) called it a planned distraction to help reduce the sensations of exercise-induced fatigue. In the existing literature, much attention has been paid to the effects of musical tempo on exercisers, athletes, college students, and school age students (e.g., Aburto-Corona & Aragón-Vargas, 2017; Bell *et al.,* 2016; Deutsch and Hetland, 2012; Karageorghis *et al.*, 2006). To date, very little territory has been explored about another music variable: lyrics. Therefore, the purpose of this study was to examine the effects of music and lyrics on students' activity level and perceived enjoyment in elementary PE. Specifically, three music conditions, two genders, and two grade levels were the independent variables. Activity level measured by average heart rate (AHR) and percentage of time spent in moderate to vigorous physical activity (MVPA%) and perceived enjoyment were the dependent variables.

1.3 Theoretical Perspective

Karageorghis *et al.* (1999) created a conceptual framework to explain how people response to music. The framework consists of four factors: rhythm response, musicality, cultural impact, and association. *Rhythm response* refers to "the rhythmical qualities of music which inspire bodily movement" (p. 717). Rhythm is related to the tempo or speed of music as measured in beats per minute (BPM; Karageorghis *et al.*, 2006). This factor explains how human bodies react to a piece of music based on its stimulative or danceable qualities. *Musicality* refers to "the melodic and harmonic qualities of the music" (p. 717). It helps determine people's liking (or disliking) toward a piece of music based on its pitch-related elements such as harmony and melody (Karageorghis *et al.,* 2006). *Cultural impact* refers to "the cultural pervasiveness of the music" (p. 717). People may find a piece of music more appealing to the other because of familiarity within a society, the artist, or date of release. *Association* refers to "the degree of association between the music and physical activity" (p. 717). People may be more likely to move with a piece of music if an association is made with a sport (e.g., The Fans' Ole, Ole, Ole), a sporting event (e.g., Vangelis's Chariots of Fire with Olympic glory), or a video (e.g., Beyoncé's Move Your Body). In essence, rhythm response and musicality reflect factors internal to the music, while cultural impact and association reflect how people interpret music.

Karageorghis et al. (1999) claimed that the four factors influence a listener's emotional and physical response hierarchically. Specifically, rhythm response has the greatest influence followed closely by musical harmony and melody (i.e., musicality), with association being the least influential factor to inspire physical activity. This hierarchical structure, at least tempo being the most significant determinant of musical response, has been affirmed by numerous scientific research (Aburto-Corona & Aragón-Vargas, 2017; Bell et al., 2016; Deutsch and Hetland, 2012; Karageorghis et al., 2006). In one study where a partial support regarding preference for fast, medium, and slow tempo music during high-, medium-, and low-intensity exercise was found (Karageorghis *et al.*, 2006). The researchers hypothesized a perfect positive linear relationship between music tempo preference and exercise intensity, but significant results for music tempo preference only transpired in the high-intensity condition. They speculated that music containing lyrical affirmations may have more potent effects to stimulate arousal to initiate, increase, and sustain physical activity and exercise intensity.

In accordance with Karageorghis et al.'s (2006) suggestion, it was hypothesized that students would have higher activity level and enjoy the class better when they listened to music with lyrics (MWL) than music without lyrics (MOL) or no music (NOM) in PE. This research would be valuable insofar as exploring how the impact of music lyrics, which is classified under the least influencial factor in Karageorghis *et al.'s* (1999) hierarchical framework and hardly studied before, has on students' responses. Moreover, previous research in PE showed male students being more active and enjoying lesson activities better than their female counterparts (Barney

& Prusak, 2015; Brewer *et al.,* 2016; Digelidis *et al.*, 2014). Therefore, it was also hypothesized that male students in the present study would be more active and report greater enjoyment than the females in any conditions. Lastly, based on Brewer et al.'s (2016) study, it was hypothesized that no grade level difference would be found on students' physical responses.

2. Methods

2.1 Setting and Participants

The present study was carried out at a public elementary school located in the Mideast USA. There were approximately 760 students at the school from pre-kindergarten to sixth grade. The population was made up of 51% female and 49% male students. In the most recent year, 14% of the students scored at or above the proficient level for math and 27% scored at or above that level for reading. The school enrolled 58% minority and 79% economically disadvantaged students. The student-teacher ratio was 17:1, which was the average in the distract. There was one male PE teacher at the school. During his 32 years of teaching elementary PE, he had coordinated events and raised over US$290,000 for his schools and PE programs. He had also been the recipients of the Elementary Physical Education Teacher of the Year for the state and several other awards for the district. All classes had PE once a week for 45 minutes in a 66,000 square feet gymnasium with retractable bleachers tucked in on one side. The class sizes ranged from 22 students for lower grades to 33 for upper grades.

Teacher, principal, and parental consent forms as well as assent forms for minors were obtained before the beginning of the study to fulfill the requirements of the author's institutional review board for conducting human subject research. The sample included a total of 165 students from six classes: one kindergarten and one fifth grade on three different days. Classes by day were randomly assigned to one of the three music conditions. Student gender and grade level compositions for the three conditions are illustrated in Table 1.

2.2 Playlists

Since the music selector had little influence on students' responses in PE (Digelidis *et al.,* 2014), the author's research assistant, a female undergraduate PE major, was tasked to make two playlists for the study. Another advantage to delegate this task to the research assistant was that she was familiar with the pop culture and knowledgeable about what the younger generation preferred their music from her interactions with school age students during early field experiences.

Following Stephenson et al.'s (2022) recommendation, one playlist of 14 songs ranging 80-110 BPM for warm-up/cool-down and skill practice and another playlist of 33 songs ranging 120-140+ BPM for gameplay were created. Each playlist had two versions: one with lyrics and one without. One the MWL day, the songs in the 80-110 BPM playlist were shuffle-played during the warm-up, skill practice, and cool-down segments, and the songs in the 120-140+ BPM playlist were played also in the shuffle mode during the gameplay part of the lesson. Music control was operated exactly the same on the MOL day except the songs played in the background were instrumental.

Table 1. Students gender and grade level compositions by condition

		Music with Lyrics	Music without Lyrics	No Music	Total
Gender	Female	30 (35.7%)	26 (31.0%)	28 (33.3%)	84 (50.9%)
	Male	25 (30.8%)	28 (34.6%)	28 (34.6%)	81 (49.1%)
Grade	Kindergarten	24 (33.3%)	23 (32.0%)	25 (34.7%)	72 (43.6%)
	Fifth	31 (33.3%)	31 (33.3%)	31 (33.4%)	93 (56.4%)
Total		55 (33.3%)	54 (32.7%)	56 (34.0%)	165 (100%)

The only difference was the music conditions during activity time. The music was played from the overhead speakers mounted on the four corners of the gymnasium and controlled on an iPad connected via Bluetooth. When the teacher was giving instructions, music was paused until the next activity time. On the NOM day, the teacher used his whistle or loud voice to start and stop activities.

2.3 Data Collection

Due to school functions and scheduling conflicts, data from nine lessons in all six classes were collected during the spring of 2024. Heart Tech Plus sensors were used to record students' activity level. Students were shown how to wear the sensors on their left upper arms on the first day and were instructed to repeat the same procedure during the semester. Assistance was provided by the author and the research assistant. Once everyone's sensors were on, the teacher began the class and the recording started on the Heart Tech Plus app on an iPad. As soon as the teacher finished his lesson closure, the recording stopped. Students' activity level was assessed in two indicators: AHR and MVPA%. According to Heart Tech Plus (2001), time in MVPA was recorded when a student's heart rate (HR) reached at or above 60% of the estimated maximal heart rate (MHR). Per Cicone and colleagues' (2019) recommendation, the MHR was set at 207 BPM for kindergarteners[1] and 203 BPM for fifth graders[2]. Each student's time spent in MVPA was divided by the duration of the class recorded on a given day. AHR was also collected as a more sensitive data. For instance, while two students could have the same MVPA%, the student with a higher AHR exhibited a greater exercise intensity than the other.

Students' affective responses was measured using the Interest/Enjoyment subscale of the Intrinsic Motivational Inventory (IMI; Center for Self-Determination Theory, 2015). The IMI included 45 items total in seven subscales (i.e., Interest/Enjoyment, Perceived Competence, Effort/Importance, Pressure/Tension, Perceived Choice, Value/Usefulness, and Relatedness). The Interest/Enjoyment subscale was chosen because it was the only subscale related to the purpose of the study. The subscale included seven items on a Likert scale ranging from 1 ("not at all true") to 7 ("very true"). The scale was modified to 5-point to make it easier for students to identify how much they enjoyed the lesson (Appendix A). Per Borgers and colleagues' (2000) recommendation, students aged seven and younger have very limited language and reading skills to conduct an interview or process a survey independently. Therefore, only fifth graders' perceived enjoyment was assessed. Immediately after all sensors were collected, each student was handed a hardcopy of the survey and a writing utensil. They were instructed to rate how much they enjoyed the PE class by circling the number corresponding to each statement. The survey was administered by the author and the research assistant every other week, starting at week two of the semester.

2.4 Data Analysis

During the semester, the kindergarten classes experienced four units: jump rope (lessons 1-2), bowling (lessons 3-4), roller skating (lessons 5-7), and traveling/dodging/fleeing games (lessons 8-9). The fifth grade classes also underwent four units on the same timeline: jump rope, birdie golf, roller skating, and invasion games. To reduce the data points, AHR and MVPA% for each lesson were averaged according to the four units per grade, producing four scores for each physical indicator: L12 AHR, L12 MVPA%, L34 AHR, L34 MVPA%, L567 AHR, L567 MVPA%, L89 AHR, and L89 MVPA% (kindergarten and fifth grade). As for perceived enjoyment, five surveys were collected but the third and fourth ones were during the roller skating unit, so they were averaged as one score, producing four scores: Survey1, Survey2, Survey34, and Survey5 (fifth grade only). All data were entered and analyzed using SPSS.

Frequency and percentage were calculated to describe the sample's gender, grade level, and condition compositions. A 3 (condition) × 2 (gender) × 2 (grade level) analysis of variable (ANONA) was conducted to identify any significant main effects or interaction effects on the eight physical activity scores. A 3 (condition) × 2 (gender) ANONA was computed to locate any significant main effects or interaction effects on the four enjoyment scores. The Bonferroni correction was used for all post hoc comparisons, and alpha was set at .05 for all analyses.

[1] MHR = 208 - 0.7 x (age) + 2.7 = 208 – 0.7 x 6 + 2.7 = 206.5, rounded up to 207 bpm

[2] MHR = 208 - 0.7 x (age) + 2.7 = 208 – 0.7 x 11 + 2.7 = 204.4, rounded up to 203 bpm

3. Results

3.1 Physical Activity Level

There was a significant main effect for gender on the L12 MVPA% score (F(1, 145) = 9.663, p < .01, η^2 = .062, 1-β = .870). As a group, female students (m = 72.61, SD = 14.43) spent a little over 8% longer of time in MVPA than male students (m = 64.46, SD = 17.73) in jump rope activities.

A significant main effect for grade level was found on the L12 AHR score (F(1, 145) = 4.886, p < .05, η^2 = .033, 1-β = .593). During the jump rope unit, kindergarteners had a higher AHR (m = 138.17, SD = 12.51) than fifth graders (m = 132.91, SD = 15.71). Besides, significant main effects were found on both L34 AHR (F(1, 141) = 23.217, p < .001, η^2 = .141, 1-β = .998) and L34 MVPA% scores (F(1, 141) = 4.672, p < .05, η^2 = .032, 1-β = .574). Kindergarteners participating in bowling had a higher AHR (m = 133.46, SD = 12.05) and spent more time in MVPA (m = 63.97, SD = 17.41) than fifth graders learning how to play birdie golf (AHR m = 124.20, SD = 12.53; MVPA% m = 57.49, SD = 20.75). Lastly, there was a main effect on the L567 AHR score (F(1, 143) = 7.031, p < .05, η^2 = .047, 1-β = .750). A similar pattern of AHR was observed during the roller skating unit: kindergarteners had a higher AHR (m = 133.07, SD = 12.31) than fifth graders (m = 128.24, SD = 13.65).

As illustrated in Table 2, significant main effects for music condition were found on both AHR and MVPA% scores in all units but the second. Post hoc analysis revealed that students in the MWL and MOL conditions were significantly more active than those in the NOM condition during the jump rope unit (Figures 1 and 2). During the roller skating unit, students in the MWL condition had a significantly higher AHR and more time spent in MVPA than those in the MOL and NOM conditions. Lastly, during the game unit, students in the MOL condition were significantly more active than those in the MWL and NOM conditions.

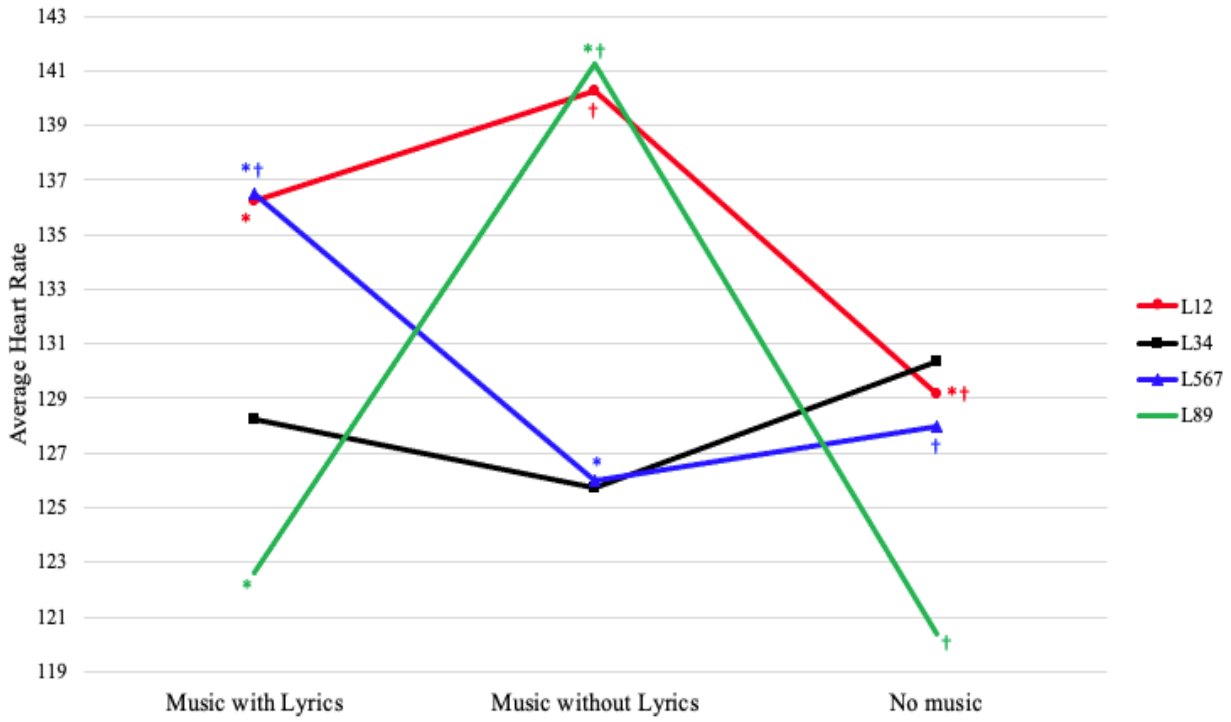
The factorial ANOVAs indicated significant grade level × condition interactions on all scores, except for the L12 MVPA% score that was marginally significant (Table 3). Since the interaction patterns were very similar between the AHR and MVPA% scores within the same unit, interaction plots for units 1 and 2 were illustrated using AHR (Figures 3 and 4), and interaction plots for units 3 and 4 were illustrated using MVPA% (Figures 5 and 6).

3.2 Perceived Enjoyment

A significant main effect for gender was found on Survey2 (F(1, 77) = 9.296, p < .01, η^2 = .108, 1-β = .853). The finding indicated that male fifth graders (m = 4.11, SD = .80) enjoyed playing birdie golf more than their female counterparts (m = 3.42, SD = 1.30). There was no significant main effect for music condition; however, significant gender × condition interactions were detected on Survey2 (F(1, 77) = 3.473, p < .05, η^2 = .083, 1-β = .634) and Survey34 (F(1, 76) = 3.858, p < .05, η^2 = .092, 1-β = .682). The interaction plots during birdie golf and roller skating units were illustrated in Figures 7 and 8.

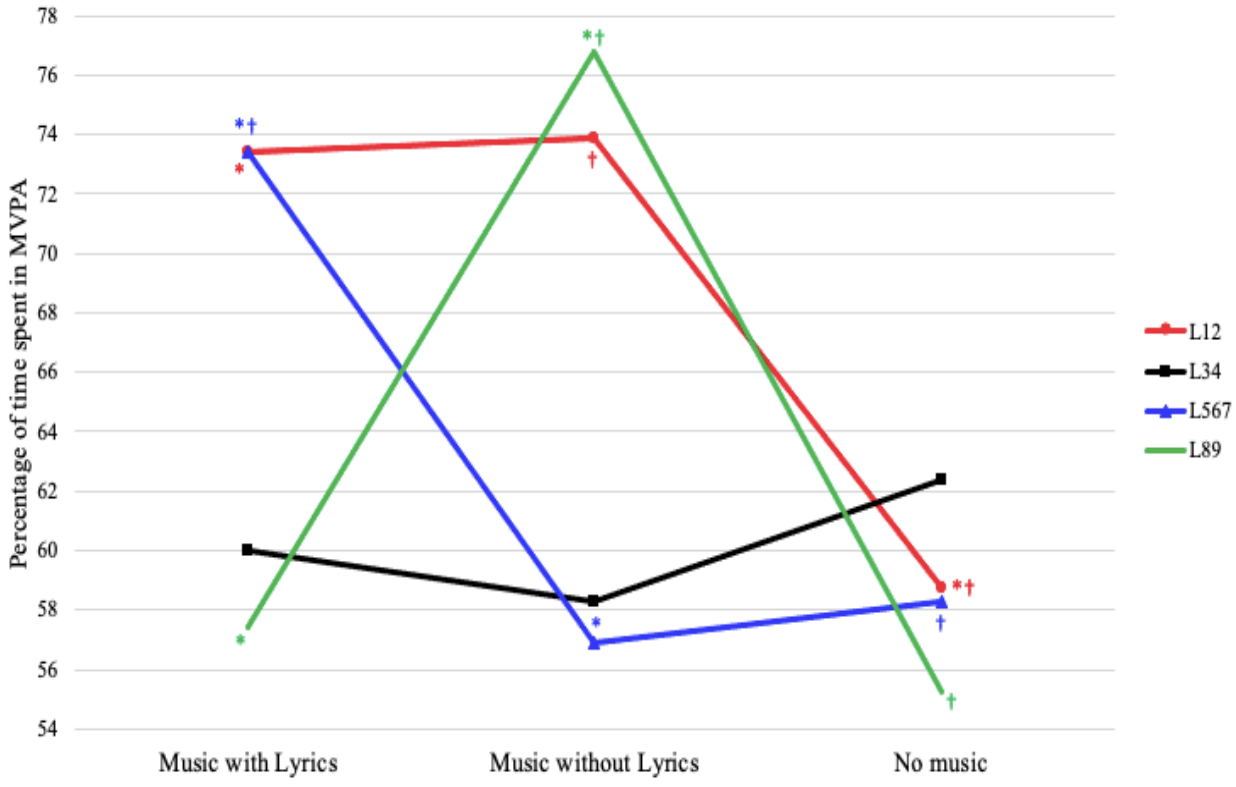
Table 2. ANOVA results of main effects for music condition on AHR and MVPA%.

	Degree of freedom	F value	p value	Partial eta squared (η^2)	Observed power (1-β)
L12 AHR	2, 145	9.322	< .001	.114	.976
L12 MVPA%	2, 145	18.243	< .001	.201	1.000
L34 AHR	2, 141	.925	= .399	.013	.208
L34 MVPA%	2, 141	.094	= .911	.001	.064
L567 AHR	2, 143	13.996	< .001	.164	.998
L567 MVPA%	2, 143	16.589	< .001	.188	1.000
L89 AHR	2, 133	26.986	< .001	.289	1.000
L89 MVPA%	2, 133	20.651	< .001	.237	1.000



*†Significant differences within the unit.

Figure 1. Average heart rate of different units by condition



*†Significant differences within the unit.

Figure 2. Percentage of time spent in MVPA of different units by condition

Table 3. ANOVA results of interaction effects for grade and condition on AHR and MVPA%.

	Degree of freedom	*F* value	*p* value	Partial eta squared (η^2)	Observed power (1-β)
L12 AHR	2, 145	6.593	$p < .01$	.083	.906
L12 MVPA%	2, 145	2.951	= .055	.039	.567
L34 AHR	2, 141	3.252	$p < .05$	.044	.611
L34 MVPA%	2, 141	3.109	$p < .05$	.042	.591
L567 AHR	2, 143	8.715	$p < .001$	.109	.967
L567 MVPA%	2, 143	5.405	$p < .05$	.070	.838
L89 AHR	2, 133	24.928	$p < .001$	.273	1.000
L89 MVPA%	2, 133	25.123	$p < .001$	.274	1.000

Appendix A. Perceived enjoyment survey

	Not at all true				Very true
I enjoyed doing this activity very much.	1	2	3	4	5
This activity was fun to do.	1	2	3	4	5
I thought this was a boring activity.	1	2	3	4	5
This activity did not hold my attention at all.	1	2	3	4	5
I would describe this activity as very interesting.	1	2	3	4	5
I thought this activity was quite enjoyable.	1	2	3	4	5
While I was doing this activity, I was thinking about how much I enjoyed it.	1	2	3	4	5

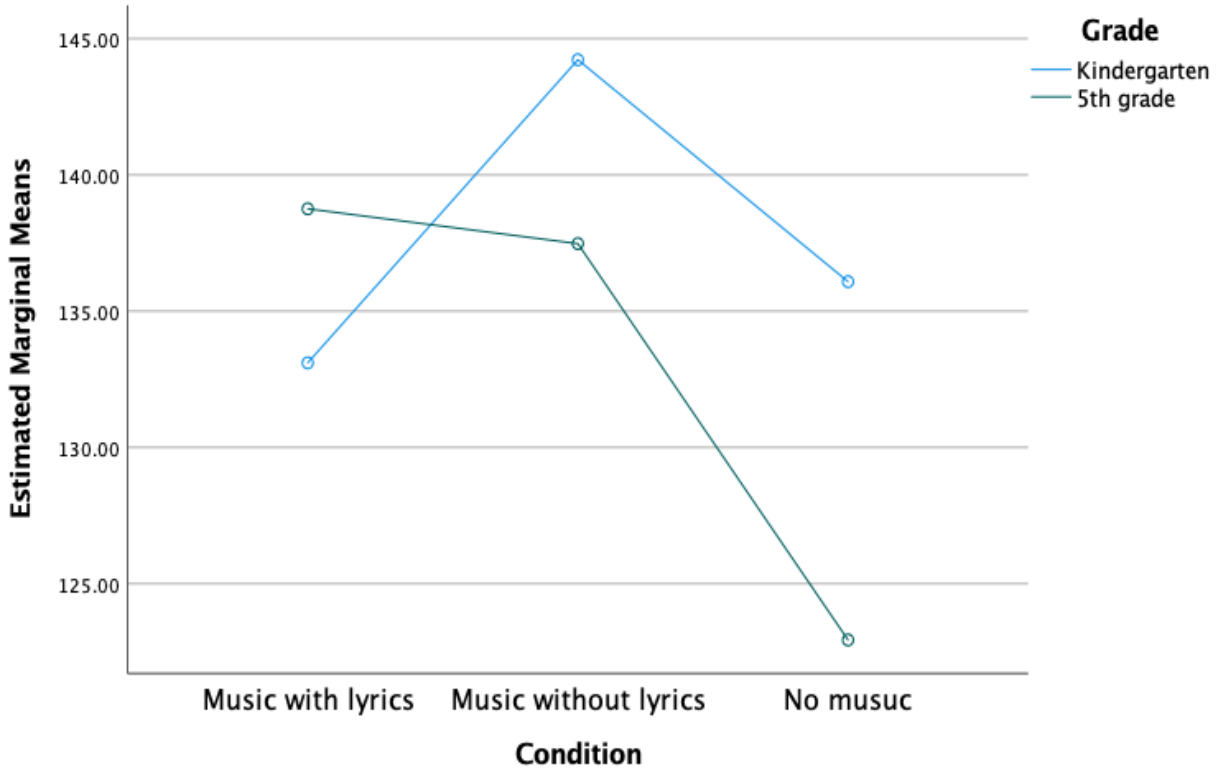


Figure 3. Interaction plot for average heart rate during lesson 1 and 2.

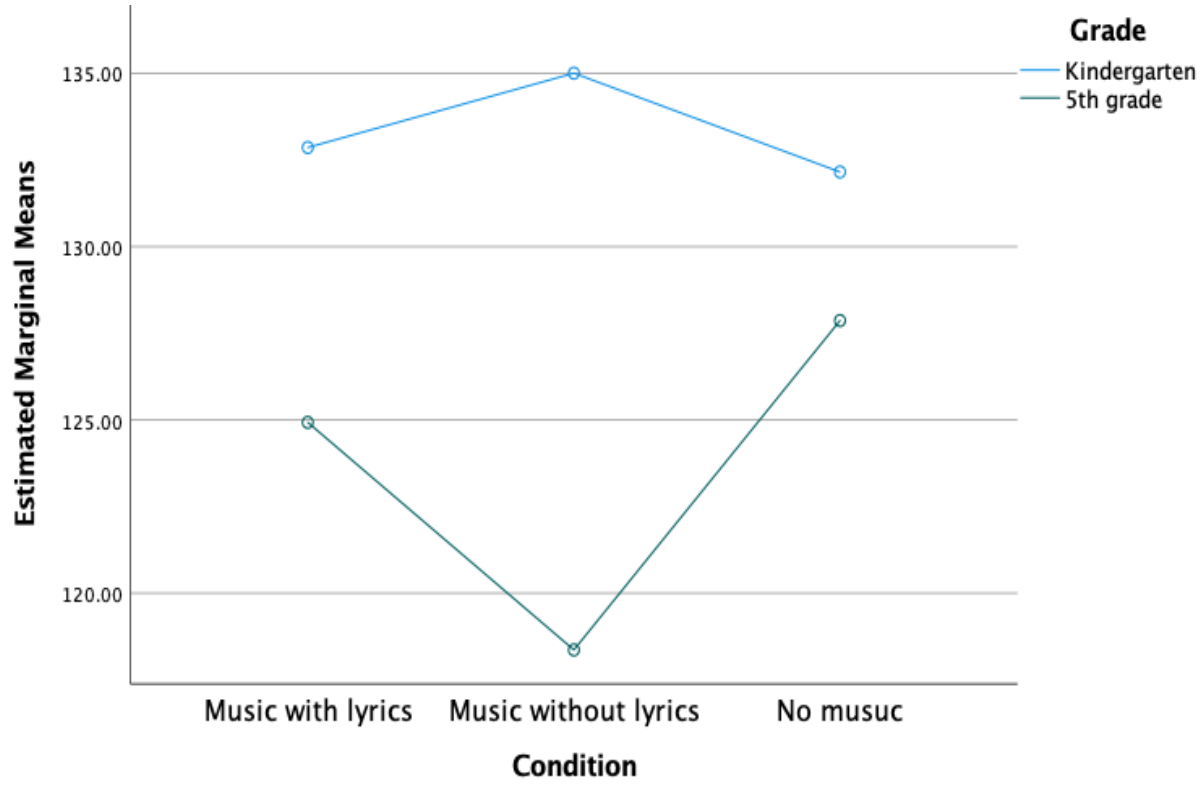


Figure 4. Interaction plot for average heart rate during lesson 3 and 4.

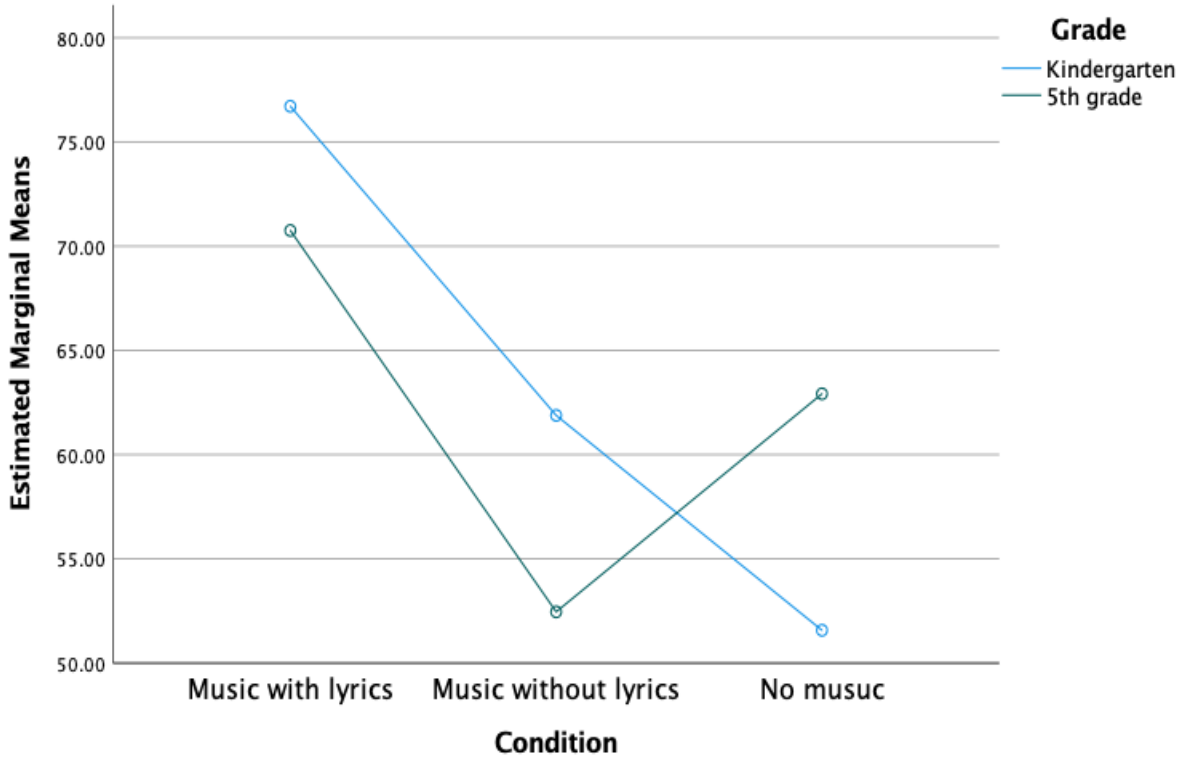


Figure 5. Interaction plot for percentage of time spent in MVPA during lesson 5 to 7.

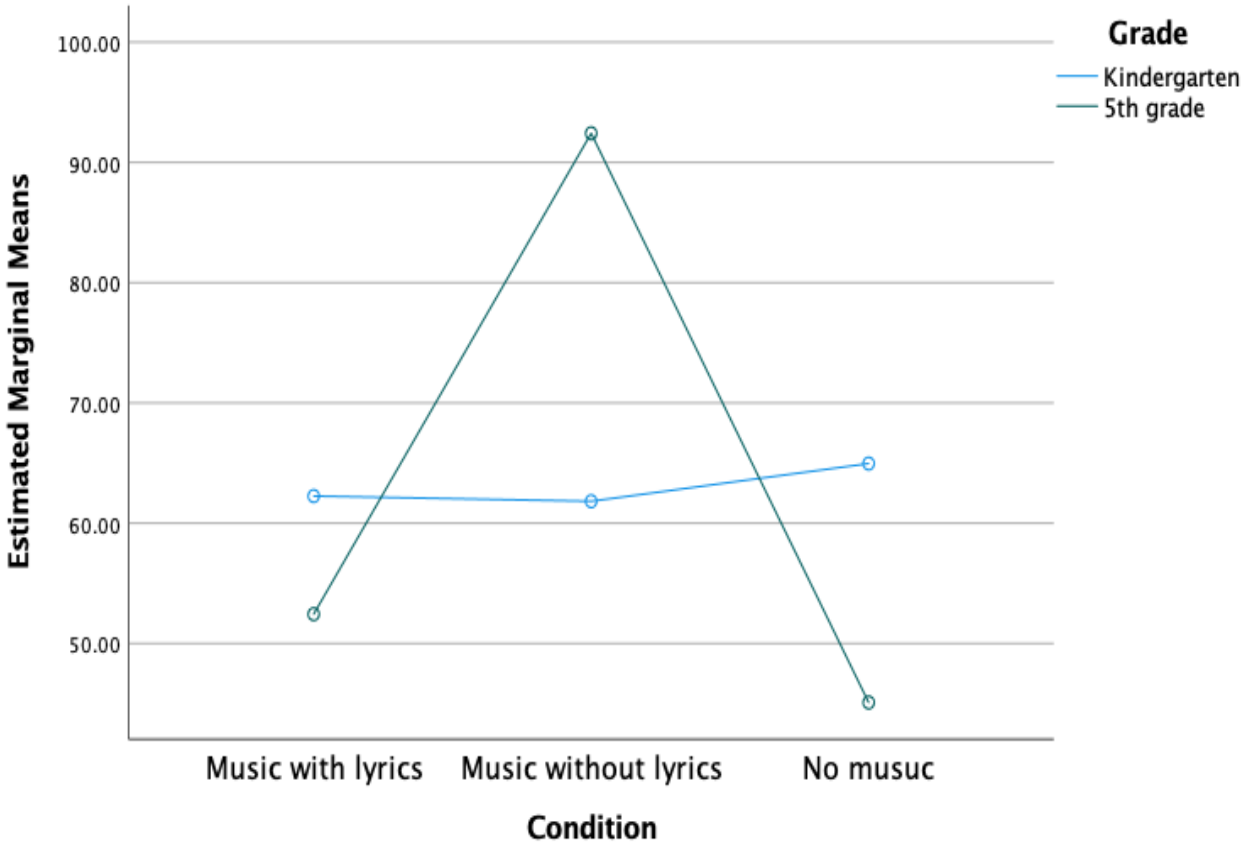


Figure 6. Interaction plot for percentage of time spent in MVPA during lesson 8 and 9.

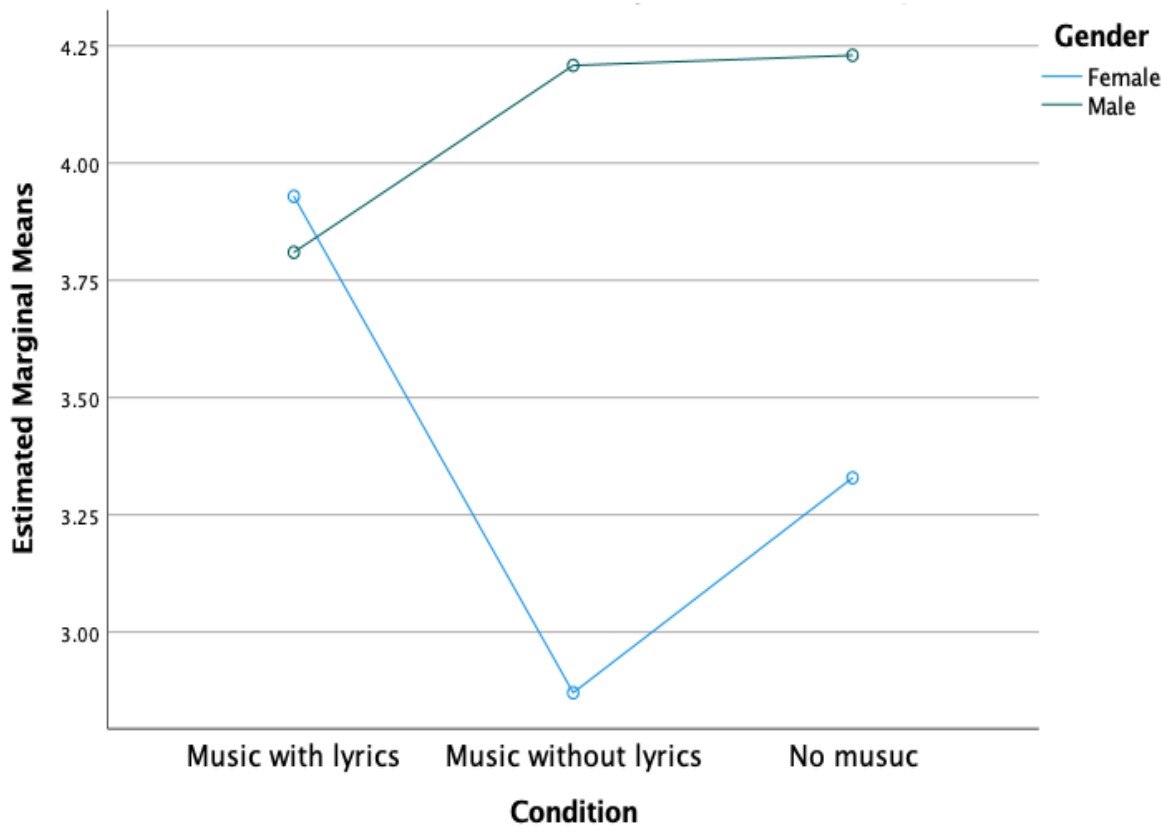


Figure 7. Interaction plot for enjoyment during birdie golf unit

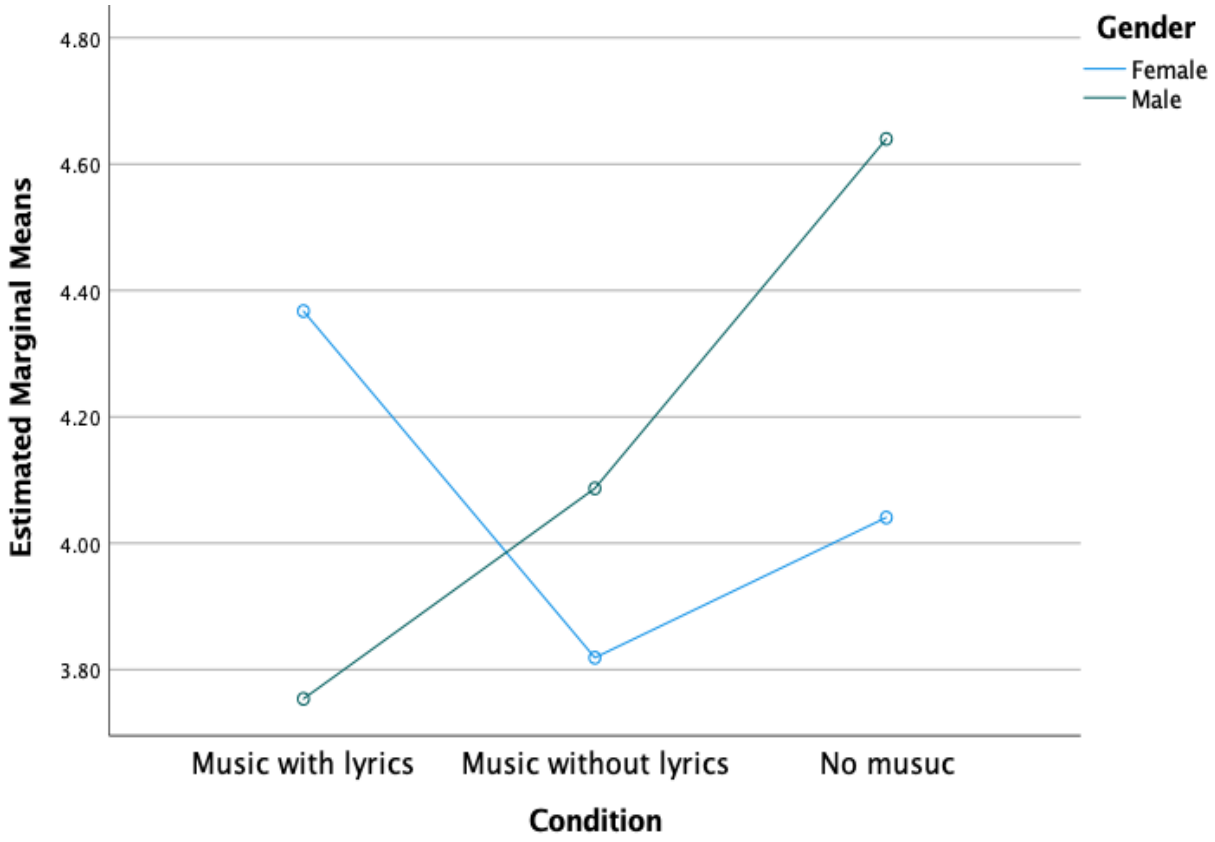


Figure 8. Interaction plot for enjoyment during roller skating unit

4. Discussion and Conclusion

The findings are partially congruent with previous research that students are more active in PE when music is played than no music at all (Barney & Prusak, 2015; Brewer et al., 2016). This is supported by the significantly higher AHR and MVPA% scores in the MWL and MOL conditions than the NOM condition in the jump rope unit (red line in Figures 1 and 2). Besides, adding the lyrics component, this research helps explain Karageorghis et al.'s (2006) speculation with regard to music containing lyrical affirmations and its potential effects in two ways. First, MWL seems to accompany well with activities that require less higher-order thinking skills, so students may sing along while participating in the repetitious movements. This is supported by the significantly higher AHR and MVPA% scores in the MWL condition than the MOL and NOM conditions in the roller skating unit (blue line in Figures 1 and 2). Second, MWL may be a distraction to students' focus when game strategies are involved. Students in the MOL condition had significantly higher AHR and MVPA% than those in the MWL and NOM conditions during the various game unit (green line in Figures 1 and 2), suggesting the presence of music is still preferred than silence, but lyrics may be too much of a distraction. With no significant finding in the perceived enjoyment, the results indicate partial support of the first hypothesis.

Contrary to Brewer and colleagues (2016), the younger students in the present study are more active than their older peers during the jump rope, bowling/birdie golf, and roller skating units. Combined with music conditions, kindergarteners are the most active listening to MOL, while fifth graders are almost equally active listing to music regardless of lyrics with a drastic drop on the activity level when no music is present during the jump rope unit (Figure 3). The grade level × condition interaction indicates two interesting observations during the second unit. First, as shown in Figure 4, the kindergarteners in the bowling unit are much more active than the fifth graders in the birdie golf unit. It is worth noting that the bowling lessons were given by the PE teacher at the school who used stations and assigned multiple roles within the group to promote activity time. The birdie golf lessons were delivered by two staff members from the local park and recreation department who did not have PE background or experience. The lessons consisted of three swings per student in a group of five, waiting time in between swings, and picking up birdies as a class after everyone took their three swings. Second, MOL has a

complete opposite effect between the two grades with a highest AHR of 134.88 (*SD* = 9.75) on the kindergarteners and the lowest AHR of 118.37 bpm (*SD* = 15.40) on the fifth graders. Moreover, the lyrics component is once more pronounced in the grade level × condition interaction effect during the roller skating unit (Figure 5). Both grades show the highest activity level when listening to MWL, despite the contrasting effects in the MOL and NOM conditions. Lastly in the game unit, the younger students show an indifferent trend between the three conditions, whereas the older ones are highly active in the MOL condition over the other two conditions (Figure 6). Collectively, the results reject the third hypothesis that no grade level difference would appear on the students' physical responses.

For comparisons between gender, female students in this study spend more percentage of time in MVPA than males in the jump rope unit, which stands opposed to Barney & Prusak (2015) and Brewer et al. (2016) claiming the male students are more active than females in their experiments. Gender comparison in perceived enjoyment, however, is congruent with Deutsch & Hetland (2012) that male students enjoy the birdie golf lessons more than their female peers. Furthermore, when taking both gender and condition into account, the effects only transpire affectively, not physically. As illustrated in Figure 7, the male students appear to have much greater time playing birdie golf in the MOL and NOM conditions than the MWL condition, which is aligned with the male students' perception toward the basketball activity in Brewer *et al.*'s (2016) study. The female, on the other hand, show the highest enjoyment when listening to MWL in the same unit. Finally, during the roller skating unit, the female students report the greatest enjoyment while listening to MWL, to which the male students indicate as the least enjoyable condition (Figure 8). The combined results yield partial support of the second hypothesis, where male students would be more active and show greater enjoyment in any conditions than females.

There are a few limitations to this study. Based on the partial eta squared (η2) and observed power (1-β) values, although some exceed the 80% acceptable power to detect a statistical significance, one must take precautions against generalization due to the small effect sizes (Tables 2 and 3). Besides, unexpected technological malfunction happened on several occasions, which failed to record some of the students' data on a given day. Another data-related limitation is that the perceived enjoyment survey was collected at the end of the class, which was also the end of the school day. The students may feel rushed to answer the items; hence, did not give genuine responses about the lesson. Finally, this study is limited to one kindergarten and one fifth grade class. Future research regarding the effects of music and music lyrics needs to gather extensively more data from other elementary and secondary grade levels. An extended line of research in this area will provide PE teachers with the most motivating music catered to different classes by gender, grade level, and activity type so students can have fun while learning the skills needed to live a physically active lifestyle.

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Funding Information
No funding was received for this research.

Informed Consent
The consent form was signed before the commencement of the study.

Conflict of Interest
The author declare that there was no conflict of interest.

Does this article pass screening for similarity?
Yes