Music: Effects on Students' Achievement, Habits of Mind, and Disposition as Bases for the Development of Music-Enhanced Mathematics Program

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Abstract

Mathematics is a skill subject that requires skills and practice. Often mathematics lacks creative or artistic flair; hence, students find it difficult and boring. Students do not pay attention in class. This study ascertained the effects of background music on students' achievement, habits of mind, test anxiety, and disposition. The respondents are composed of 72 junior high school students from three treatment groups: urban music group, popular music group, and alternative rock music group. The instruments used were the researcher-made mathematics achievement test, Test Anxiety Rating Scale, and Disposition Rating Scale which undergone validation through a panel of experts. The result shows that the pretest mean scores in mathematics achievement of all the three groups were "low." Using music as intervention, the scores of the post-test were "high" among group urban music group and alternative rock music group while "average" among the popular music group. The pretest mean scores in habits of mind of the three groups were "not developed", as revealed in the pretest and became "strongly developed" among the groups introduced to popular music and alternative rock music while the group to urban music was "satisfactorily developed" in the post-test. The pre-test mean scores in disposition among groups introduced to urban music and which were to "liked" in the post-test. As observed, all the background music used had an impact on the improvement of the students' scores in mathematics. The results of the study served as bases for the development of music-enhanced mathematics program.

Keywords: achievement, disposition, habits of mind, music, music-enhanced mathematics program

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Today's trend in education is to cater to students with multiple intelligences. Thus, basic education institutions are encouraged by the Department of Education (DepEd) to put up programs to such student needs. Creating new programs demands a number of skilled teachers, infrastructure and equipment, and sufficient budget. With these demands, one high school stood out and answered the call Iloilo National High School (INHS). Iloilo National High School considered as the first provincial high school established in 1902 in Iloilo. For years, proved excellence not only in academics but also in the fields of arts and sports. It is the haven of gifted and talented students.

Despite these achievements, the Iloilo National High School is not exempted from the idea that mathematics education in the Philippines is somewhat deteriorating. Fifty years ago, the Philippines was among the top Asian countries in promoting quality education. In 2007, the Alliance of Concerned Teachers (ACT) cited the results of the Trends in International Mathematics and Science Survey (TIMSS) among 45 countries. Philippines ranked 41 in science and rank 42 in mathematics. Before, the Philippines ranked second from the top, but now it is a total up-side-down picture (Villaceran, 2011). This fact shows the deterioration of Philippine education. It entails a big difference in the performance of the country's education from being on top and now in the bottom. Also, achievement rates of the basic education in the National Achievement Test (NAT) remain far below the 75% passing rate. The achievement rates for elementary in the school year 2011 – 2012 were 59. 87% for mathematics and 55.15% for science. For the secondary, the achievement rates was 46.37% for mathematics and 40.53% for science.

Most students claim that mathematics is the most difficult subject they encounter in school, dubbing this experience as "mathematics anxiety". People with inability to understand and do mathematics experience strong emotional anxiety because they believe that they are not capable of doing any course or activity in mathematics (Chewning, 2002).

Meanwhile, music has something to do with behavior, emotion, feelings, and life. Everyone has sung a song, create rhythm with their fingers, whistle and clap their hands and produce music. Music is present in all daily routines. It is something people can interact with; it is a way of expression and a part of everyone's existence (Beer, 1998). Through music, stress can be wiped out and it helps people to relax. It can change mood and make a positive energy from a person .Babies, still in the womb, can steadily hear the heartbeats of their mother. It was furthermore found out that playing or having background music can reduce the stress of a person at work (Music Therapy, 1998).

Adding music in the classroom environment can create a specific type of mood. In the study of Castro (2008), students favored having background music in the classroom than without music. In addition, background music to them was very good intervention because silence create an atmosphere that was prone to disruption. Once distracted students had difficulty to focus. This student response simply shows that students' preference to classroom environment changes over a period of time. Students feel more comfortable and at ease when learning since music created a positive mood.

In fact, numerous studies have shown that "Classical music pieces, such as those of Haydn and Mozart, have improved scores in mathematics. This is because these music pieces have clarity, elegance, and transparency. The rhythms and beats stimulate particular responses within the brain. Thus, they can improve concentration, memory, and spatial perception" (Campbell, 1997).

In most studies conducted in late 1990's and 2000's, students had less access to technology. The types of music used were classical music. In this study, different music genres such as alternative rock, popular and urban music were used. Today's generation of students is technologically and musically inclined. Often, these students are seen wearing headphones and listening to music in their cellular phones and music players. Instead of reprimanding or confiscating these devices, the researcher thought of introducing music to improve the performance of students in Mathematics. What might be the possible outcomes to student's achievement, test anxiety, and disposition? Will music reduce the perennial problems encountered by students and mathematics teachers?

Theoretical Framework

This study is anchored on theories that advocate multiple intelligences theory to enhance classroom learning (Gardner, 1993) and using the music as a methodology to create positive mood, deliver a rich and stimulating mathematics learning context, decrease mathematics anxiety, and encourage students to be creative and active with various abilities (Eisner, 2002; Upitis & Smithrim, 2003; Witherell, 2000).

According to the multiple intelligence theory, individuals differ in the strength of these intelligences - the so-called profile of intelligences -and in the ways in which such intelligences are invoked and combined to carry out different tasks, solve diverse problems, and progress in various domains" (Gardner, 1993). Playing background music in the mathematics classroom

helps develop the musical intelligence and the logical-mathematical intelligence of the students.

Research Questions

This study ascertained the effects of background music on students' mathematics achievement, habits of mind, mathematics test anxiety, and disposition in order to establish a bases for the development of a music-enhanced mathematics program.

Specifically, this study sought answers to the following questions:

1. What is the level of students' Mathematics achievement before and after exposure to: a) popular music, b) alternative rock music, and c) urban music?
2. What is the habit of mind level of students before and after exposure to: a) popular music, b) alternative rock music, and c) urban music?
3. What is the disposition level of students before and after exposure to:a) popular music, b) alternative rock music, and c) urban music?
4. Is there a significant difference in the student's mathematics achievement before and after exposure to background music?
5. Is there a significant difference in the habits of mind of students before and after exposure to background music?
6. Is there a significant difference in the disposition of students before and after exposure to background music?
7. What contribution can be made in the curriculum if ever background music can enhance mathematics classes?

Methodology

Research Design

The researchers utilized a quasi – experimental design, specifically, the multiple-group design. Multiple group design, according to Smith and Davis (2007), is an experimental design that compares three or more levels or amount of the independent variable. It can have a control group and two or more experimental groups, or all groups are experimental since multiple-group design does not need to have a control group.

Participants

The participants were chosen through a comprehensive match-pairing based on their pre-test achievement scores and ranks. The music genre assigned to each group was randomly chosen through drawn lots. Table 1 shows the distribution of the respondents.

Table 1

Distribution of the Respondents per Group

Groups	Number of Students	%
SOF (Urban Music)	24	33 1/3%
SA (Popular Music)	24	33 1/3%
RC (Alternative Rock Music)	24	33 1/3%

To insulate the study from threats of internal and external validity, the researchers instructed the students not to write their names, instead, a colleague was requested by the researcher to randomly assign them their respective examinee number during the pre-test and post-test. Hence, their identities relative to their scores were not revealed in the entire research process.

Data–Gathering Instruments

The researcher used four researcher-made tests, namely: mathematics achievement test, proving problems for habits of mind, mathematics test anxiety rating scale, and music disposition rating scale.

Mathematics achievement and habits of mind test. This test had a total of 50 points and was composed of two parts, namely: the 35-item multiple choice type and three proving problems worth 15 points. The 35-item multiple-choice instrument underwent test of validity through three experts in mathematics teaching and a university psychometrician. The instrument underwent internal consistency or reliability test using Kuder-Richardson Formula 21 (KR 21). It showed an alpha level of 0.872, making the instrument highly reliable.

Music disposition rating scale. The disposition of the students towards background music was determined using the researcher-made music disposition rating scale purposely constructed for this study. Furthermore, it was intended

to elicit either positive or negative disposition of the respondents towards background music. The instrument underwent face and content validation by three experts in mathematics teaching, a university psychometrician, and one whose dissertation is related to the present research.

The respondents were asked to express their responses on a 5 Point Likert Scale. The 5-points are: strongly disagree (1), disagree (2), uncertain/ unsure (3), agree (4), and strongly agree (5) for positive statements; for negative statements, the scale was reversed, that is, the scale values were weighed 5, 4, 3, 2, and 1, respectively. Before the scoring was done, each statement was classified as either positive or negative. All the odd-numbered statements were positive, while the even-numbered statements were negative disposition.

Intervention

To assure the great quality of music for listening, four hyper-surround speakers and a buffer were installed in the three classrooms. These speakers were attached to the music player or laptop to control the volume and the type of music played. In case of power interruptions, the music was played on a laptop or cellular phone.

The background music was played for the whole duration of the class. The volume was decreased when the teacher was doing a lecture or if the students were discussing their solution on the activities. The volume was again increased when the students are doing their independent work and test.

A series of instrumental music were played to each group that was downloaded from a free source on the Internet. The selected music had a tempo of 60 to 88 beats per minute. The number of beats was referred to a resident music artist who is an expert in the field of music since, according Jensen (2005), the tempo of the music is important in setting what one wants the brain to do and 60 to 88 beats per minute is prime for staying focus.

Results and Discussion

Table 2 shows that the students' pre-test mean scores were 11.08, 11.00, and 11.00, respectively, for urban, popular, and alternative rock groups. All the three groups fell in the category of "Low" mathematics achievement. This simply means that prior to the intervention, the students in the three groups did not possess sufficient conceptual understanding of the subject. Thus, the three groups were comparable at the onset of the study.

Table 2

Pre-test and Post-test score in Mathematics Achievement of the Participants Exposed to Urban Music, Popular Music and Alternative Rock Music

Music Genre	Pre-test				Post-test			
	N	SD	M	Description	N	SD	M	Description
Urban	24	2.92	11.08	Low	24	7.79	30.38	High
Popular	24	2.54	11.00	Low	24	8.24	27.75	Average
Alternative Rock	24	2.48	11.00	Low	24	6.18	37.50	High

Note: 40.01 – 50.00=very high achievement; 30.01 – 40.00=high achievement; 20.01 – 30.00=average achievement; 10.01 – 20.00=low achievement; 1.00 – 10.00=very low achievement

On the other hand, the post-test mean scores for urban was 30.38 and 37.50 for alternative rock, which were both "high". While the popular music has a mean of 27.75 and falls to "average". This shows a mean gain in all the three groups, with alternative rock music group performing better than the other two groups.

These findings are supported by the previous study of Chalmers, Olson, and Zurkowski (1999) which claimed that "one of the attributes of back ground music is that it can create a relaxed state of mind conducive in absorbing information at the maximum level".

Table 3 shows that the pre-test mean scores in habits of mind were 0.04, 0.17, and 0.13, respectively, for urban, popular, and alternative rock groups. The results show similarity in the habits of mind scores of the three groups as a result of the very slight difference in the mean score before the intervention was conducted. All the three groups fell in the category of "Not Developed" habits of mind.

On the other hand, the post-test mean scores in popular music was 9.21 and alternative rock music 10.42 were both "Strongly Developed" whereas that in urban music was 7.29, "Satisfactorily Developed".

Table 3

Pre-test and Post-test score in Habits of Mind of the Respondents Exposed to Urban Music, Popular Music, and Alternative Rock Music

Music Genre	Pre-test				Post-test			
	N	SD	M	Description	N	SD	M	Description
Urban	24	0.48	0.04	Not Developed	24	5.09	7.29	Satisfactorily developed
Popular	24	0.20	0.17	Not Developed	24	3.50	9.21	Strongly developed
Alternative Rock	24	0.45	0.13	Not Developed	24	3.65	10.92	Strongly developed

Eventually, the students developed the habituated characteristics of habits of mind (Driscoll, 1999) after listening to music and the series of practice activities in proving (Selden & Selden, 2009).

Table 4

Pre-test and Post-test score in Disposition to Music of the Respondents Exposed to Urban Music, Popular Music, and Alternative Rock Music

Music Genre	Pre-test					Post-test				
	N	SD	M	Description		N	SD	M	Description	
Urban	24	0.47	3.71	Liked	Positive	24	0.47	3.78	Liked	Positive
Popular	24	0.51	3.46	Partially Liked	Positive	24	0.36	3.67	Liked	Positive
Alternative Rock	24	0.57	3.25	Partially Liked	Positive	24	0.48	3.54	Liked	Positive

Note: 4.51 – 5.00 =very much liked; 3.51 – 4.50= liked; 2.51– 3.50=partially liked;

1.51 – 2.50=partially disliked; 1.00 – 1.50=very much disliked; 2.51 – 5.00=positive; 0.00 – 2.50=negative

Table 4 shows that the mean scores in disposition to music were 3.71, 3.46, and 3.25, respectively, for urban, popular, and alternative rock groups. The two groups fell in the category of "partially like" and the latter to "like" disposition to music.

On the other hand, the post-test mean score of all the three groups were

all interpreted as "like" (M = 3.78, M = 3.67, M = 3.54). Moreover, students have positive disposition to music in the entire duration of the study.

The above findings are supported by the result in the previous studies of Csikszentmihalyi and Rathunde (1993) that a positive mood may also increases focus and full involvement when taking their examinations, and music, according to the study of Thompson, Schellenberg, and Husain (2001), has shown to foster this type of mood.

To determine whether significant differences would exist in the pre-test and post-test scores in achievement, habits of mind and, music disposition of the respondents exposed to urban music, popular music, and alternative rock music, the researcher used the Wilcoxon-Signed Ranks Test.

Table 5 shows that significant differences existed in the pre-test and post-test scores in mathematics achievement test of urban music group (z = 4.289, p = 0.000), popular music group (z = 4.287, p = 0.000), and alternative music group (z = 4.288, p = 0.000). This reveals that the students performed better in the post-test. The findings are supported by the previous study of Whitehead (2001) which claimed that the full treatment (50-minute background music during the instruction given five times per week) reveals a significant increase in mathematics than the other two groups (limited treatment: one day with music and no treatment: no music instruction).

Moreover, significant differences existed in the pre-test and post-test scores in habits of mind of urban music group (z = 4.293, p = 0.000), popular music group (z = 4.293, p = 0.000), and alternative music group (z = 4.302, p = 0.000). This shows that the students performed differently in the pre-test and in the post-test. Further, this result is fortified by the study of Chesky and Hipple (1997) which reveals that habits of mind are distinctive among music students and can be generalized to other areas that contributes to much higher self-esteem and success.

Furthermore, significant differences existed in the pre-test and post-test scores in music disposition of popular music group (z = 2.207, p = 0.027) and alternative music group (z = 2.285, p = 0.022). The students in these groups liked the background music. However, no significant difference was noted between the pre-test and post-test music disposition in the urban music group (z = 0.618, p = 0.536). This shows that the music disposition of the students in the pre-test is almost the same as that in the post-test. The findings confirmed the result of the study previously done by Hallman and Price (1998) which claimed that background music played properly in the classroom can create a positive environment and promote learning.

Table 5

Wilcoxon-Signed Rank Test Results for the Difference in the Pre-test and Post-test in Achieveemnt, Habits of Mind, and Music Disposition of the Students Exposed to Urban Music, Popular Music, and Alternative Rock Music

	N	Mean	Mean gain	*z*	Sig.
Urban Music					
Mathematics Achievement					
Pre-test	24	11.08	19.75	4.289*	0.000
Post-test	24	30.38			
Habits of Mind					
Pre-test	24	0.04	7.25	4.293*	0.000
Post-test	24	7.29			
Music Disposition					
Pre-test	24	3.71	0.07	0.618	0.536
Post-test	24	3.78			
Popular Music					
Mathematics Achievement					
Pre-test	24	11.00	16.75	4.287*	0.000
Post-test	24	27.75			
Habits of Mind					
Pre-test	24	0.17	9.04	4.293*	0.000
Post-test	24	9.21			
Music Disposition					
Pre-test	24	3.46	0.21	2.207	0.027
Post-test	24	3.67			
Alternative Rock Music					
Mathematics Achievement					
Pre-test	24	11.00	26.50	4.288*	0.000
Post-test	24	37.50			
Habits of Mind					
Pre-test	24	0.13	10.29	4.302*	0.000
Post-test	24	10.42			
Music Disposition					
Pre-test	24	3.25	0.29	2.285	0.022
Post-test	24	3.54			

Conclusions

Background music, be it urban, popular, or alternative rock, when played properly and at the right time in the classroom can serve as a positive stimulant to the brain and promote learning. Likewise, popular and alternative rock music caused the mathematical habits of the mind of the students to improve from "not developed" to strongly developed. Moreover, listening/ exposure to music can make a difference in the test anxiety of students, that is, music sets the mood and induces students to worry less, focus, improve concentration, and perform better. Furthermore, music created a positive environment for students to learn mathematics. Music hanged the disposition of students from "partially liked" to "liked". Thus, integrating music in the classroom can help alter the mood of students.

Alternative rock music showed increased effect in almost all the variables tested: mathematics achievement, mathematical habits of the mind, test anxiety, and mathematics disposition. Thus, music brings positive changes in the individual student. Additionally, listening to background music can enhance the proving skills of students who ultimately developed mathematical habits of the mind. This is because in proving, students are required to perform the following processes: illustrate, make statements, find reasons to prove those statements, verify, and justify that tend to develop their critical and analytical skills which are all enhanced when there was background music. However, music has no definite effect on test anxiety of the students. It may or may not reduce test anxiety, depending on how well music sets the mood of students in an examination. Test anxiety is "built-in" for every test taker. Likewise, all the music genres used as background were effective in creating a positive mood among students. Though no significant difference was observed in urban music, this happened because the students already liked the idea of integrating music in the classroom, and this never changed in the duration of the study.

Music can enhance mathematics achievement, set the mood for positive disposition and develop mathematical habits of mind; therefore, it needs to be integrated in the mathematics curriculum. Thus, to guide in the integration of music in the mathematics curriculum, a music-enhanced mathematics program was developed.

Recommendations

On the basis of the findings, conclusions, and implications of this study, the following are hereby suggested:

Some classrooms should have built-in system for background music, particularly alternative rock music, to enhance learning and improve the mathematics achievement of students. The Music-Enhanced Mathematics Program, an off-shoot of this study, is hereby recommended.

Teachers should explore other music genres aside from popular and alternative rock music to determine the most appropriate background music that can positively set the mood of the students for mathematics instruction and consequently develop students' mathematical habits of the mind through proving and solving other mathematics problems.

Teachers should be innovative and resourceful on how background music can be played in the classroom- if there is no built-in music system, and in what the period of students' exposure to music can increase their enthusiasm towards the subject and improve their span of attention and focus on classroom discussion.

The school should allocate budget for the sound-proofing and fixtures of music gadgets in classrooms used for mathematics instruction. It is now the 21st century, and more students are technologically inclined.

The duration of exposing mathematics classes to background music should be extended to determine how extensive the effects of music are, namely: increase in focused attention, strongly developed mathematical habits, positive disposition, and reduced test anxiety on the mathematics achievement of students.

Similar studies may be conducted using different music genres in various grade levels of students to verify the results and further improve the evidence of this research.

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