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RESEARCH PAPER

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Leveraging Popular Music for Enhanced Student Performance in Chemistry: A Combined Pedagogical Approach

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ABSTRACT

This study explores the impact of integrating science popular music tunes into General Chemistry lessons on the academic performance of pre-service teachers. A quasi-experimental design was employed, involving 30 students divided into a control group, which received traditional instruction, and an experimental group, which was taught using a combination of traditional and science popular tunes. Pre-test and post-test assessments were conducted to evaluate learning outcomes. The findings demonstrated a statistically significant improvement in the post-test scores of the experimental group, indicating that music-based learning strategies can effectively enhance engagement, retention, and understanding of science concepts. The study concludes that incorporating science popular tunes into science instruction offers substantial benefits in improving student performance and engagement, advocating for the wider adoption of this innovative teaching method.

Keywords: science popular tunes, quasi-experimental design, academic performance

1. INTRODUCTION

Music is universally appreciated across cultures and age groups, possessing a unique power to evoke emotions, stimulate memory, and captivate audiences. In the educational context, teachers face the challenge of capturing and maintaining student interest, particularly in subjects like science, which can be perceived as difficult or unengaging. However, recent research highlights the potential of music to improve learning outcomes. By stimulating multiple areas of the brain, music enhances cognitive processes, memory retention, and emotional engagement (Menon & Levitin, 2018; Peretz & Zatorre, 2019).

Traditional methods of instruction may not resonate with today's students, who are accustomed to immersive, interactive digital experiences. To address this, innovative teaching strategies leveraging music's cognitive and emotional benefits are essential.

Gardner's (2005) multiple intelligences theory emphasizes musical intelligence as a core component, suggesting students respond positively to music-infused learning. Janata's (2009) whole-brain activity concept also supports music's ability to engage various brain regions, promoting comprehensive learning.

Studies have shown that integrating music into science lessons can help students better grasp complex concepts. For instance, music improves understanding and recall of scientific concepts, particularly in biology, physics, and chemistry (Krikos, 2017; Papadopoulos, 2019). Science-pop tunes—a blend of popular music with science-related lyrics—offer a novel approach to motivating students and enhancing their understanding of key science topics, such as the respiratory system, circulatory system, heredity, and biodiversity.

By incorporating music into science education, educators can create engaging, memorable learning experiences that cater to contemporary learners' preferences. This approach not only fosters emotional investment and motivation but also develops multisensory learning, integrating visual, auditory, and kinesthetic learning styles (Hanna-Pladdy & Mackay, 2011; Hetland & Winner, 2013). As research continues to support music's benefits in education, educators can harness its power to inspire and educate the next generation of learners.

Thus, this study aims to assess the effectiveness of integrating popular tunes into science instruction as a strategy to improve student performance. Specifically, the following research questions guide the study:

1. How may the achievements of the students in pre-test and post-test before and after the integration of science popular tunes in chemistry lessons be compared?
2. Is there a significant difference in the achievements of students in the following:
   2.1 Pre-test of control and experimental groups before the integration science popular tunes in chemistry lessons;
   2.2 Pre-test and post test scores of experimental;
   2.3 Post test scores of control and experimental groups?
3. Is there a significant difference in the achievements of male and female students' in the integration of science popular tunes in chemistry lessons?

2. METHODOLGY

2.1. Research Design

This study employed a quasi-experimental design with both a control group and an experimental group. The control group received traditional science instruction, while the experimental group was taught using a combination of traditional methods and integration science-pop tunes in selected chemistry lessons. . The study followed the "pre-test/post-test control group" model, a robust design for measuring the impact of an intervention. In this case, both groups took a pre-test before the intervention and a post-test afterward to measure learning gains.

2.2. Participants

The participants were 30 students from Bachelor of Secondary Education major in Science in Nueva Ecija University and Science and Technology randomly assigned to two groups. Each group consisted of 15 students, and the assignment was based on their GWA in the 1st semester of AY. 2023-2024 to ensure academic homogeneity. This design aimed to minimize any potential biases or confounding variables that might affect the results.

2.3. Data Collection Instruments

A multiple-choice test was used as both the pre-test and post-test to assess the students' knowledge and retention of the selected chemistry topics. The test items were carefully constructed to cover the major concepts addressed in the intervention. Prior to the study, the instrument was pre-tested on 30 education students major in science from other university in Cabanatuan City to establish its validity and reliability. The test demonstrated good internal consistency, with Cronbach's alpha coefficients of 0.83 (construct validity) and 0.85 (content reliability).

2.4. Procedure

After receiving approval from the school administration, the study was conducted over a 3-month period. At the beginning of the study, students in both groups took a pre-test. The control group was taught using traditional lecture-based methods, while the experimental group received instruction through integration of science-popular tunes. Popular songs were integrated into selected chemistry topics such as chemical bonding, the periodic table, naming compounds, the electronic structure of matter, and different types of chemical reactions. The lyrics of these songs were modified by the researcher to align with the lessons. The experimental group performed the modified songs as part of their performance tasks, while the control group followed traditional teaching methods. At the end of the study, both groups took a post-test to assess their understanding of the science concepts covered.

2.5. Data Analysis

Descriptive statistics, including mean, standard deviation, and frequency, were used to describe the pre-test and post-test performance of the participants. A two-tailed t-test was employed to assess whether there was a statistically significant difference in the gain scores between the control group and the experimental group. The significance level was set at $p < 0.05$, meaning that results were considered significant if the probability of the observed difference occurring by chance was less than 5%.

3. RESULTS

3.1. Summary of Scores Before and After the Integration of Popular Tunes in Selected Chemistry Lessons

Table 1. Summary of Scores Before and After the Integration of Popular Tunes in Selected Chemistry Lessons

	CONTROL GROUP				EXPERIMENTAL GROUP			
	PRETEST		POSTTEST		PRETEST		POSTTEST	
	F	%	F	%	F	%	F	%
0-15	1	3.3			9	30		
16-30	29	96.7	4	13.3	20	66.7	2	6.7
31-45			25	83.3	1	3.3	19	63.3
46-60			1	3.3			9	30
Total	30	100	30	100	30	100	30	100

Table 2. Difference in the Pre-test Scores in the Control and Experimental Group Before the Application of Strategic Instructional Module

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PRE-TEST	Equal variances assumed	6.73	0.012	0.673	58	0.504	0.63333	0.94112	-1.25	2.51719
	Equal variances not assumed			0.673	46.47	0.504	0.63333	0.94112	-1.26	2.5272

The table shows the pre-test and post-test scores of both the control and experimental groups after the integration of popular music in selected chemistry lessons. In the pre-test, the majority of students from both groups demonstrated low mastery of General Chemistry, with 96.7% of the control group and 66.7% of the experimental group scoring between 11-20 points. A few students in the experimental group (30%) scored even lower, within the 0-10 range. After the intervention, there was a notable improvement in both groups, with 83.3% of the control group and 63.3% of the experimental group scoring between 21-30 points in the post-test. However, the experimental group showed a more significant leap, with 30% of its students reaching the higher score range of 31-40 points, compared to only one student (3.3%) in the control group. These results indicate that while both groups improved, the traditional method paired with the integration of science-popular tunes had a more profound impact on student performance. Research supports the positive impact of integrating music into educational instruction, particularly in enhancing student engagement and performance. For instance, a study by Galińska et al. (2022) found that incorporating music into lesson plans significantly improved student motivation and academic performance in various subjects, including science. Furthermore, a meta-analysis by Ritchie et al. (2021) revealed that musical activities could enhance memory retention and recall, which are essential for mastering complex topics such as chemistry. Additionally, Traver et al. (2023) reported that students exposed to music-based instructional strategies showed higher engagement levels and better comprehension of scientific concepts. This evidence

Table 3. Difference in the Pre-test and Post test Scores of Experimental Group

Paired Samples Test									
		Paired Differences					T	Df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	PRETEST POSTTEST	-15.866	4.65	0.849	-17.6	-14.12	**-18.68****	29	.000

**t is significant at the 0.01 level (2-tailed)

Table 4. Difference in the Post test Scores of Control and Experimental Group

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
POSTTEST	Equal variances assumed	3.055	0.086	-4.439**	58	0	-4.733	1.066	-6.867	-2.598
	Equal variances not assumed			-4.439**	51.3	0	-4.733	1.066	-6.873	-2.592

Table 5. Difference in the Achievements of Students After Exposure to Strategic Instructional Module Across Gender

	Respondents	N	Mean	F	Sig(2-tailed)
SCORES	Male	15	30.2667	2.173*	0.038
	Female	15	26.6667		

*F is significant at the 0.05 level

aligns with the findings in the current study, where students in the experimental group, exposed to a science-pop tunes strategy, showed higher post-test scores, suggesting that the integration of music as an instructional tool not only makes learning more engaging but also contributes to better academic outcomes.

3.2. Difference in the Pre-test Scores in the Control and Experimental Group Before the Application of Strategic Instructional Module

The table presents the results of the statistical analysis comparing the pre-test scores of students before the application of popular tunes in selected chemistry lessons. Levene's test for equality of variances showed a significant F-value of 6.73 (Sig. = 0.012), indicating that the variances between the two groups were not equal. However, the t-test for equality of means revealed a t-value of 0.673 with 58 degrees of freedom and a significance level of 0.504, suggesting that there was no statistically significant difference between the mean pre-test scores of the two groups. The mean difference of 0.63333, along with a standard error of the difference of 0.94112, indicates a slight score variation, but the 95% confidence interval (-1.25 to 2.51719) includes zero, reinforcing the conclusion of no significant difference in pre-test understanding of the material. This means that both groups have the same prior knowledge in General Chemistry . Furthermore, the pre-test result explained the need for instructional strategy that will facilitate comprehension in selected chemistry lessons. and thereby improve their scores in post test. Based on the data gathered, there is no significant difference in the pre-test scores of control and experimental groups.

3.3. Difference in the Pre-test and Post test Scores of Experimental Group

The paired samples test results presented in Table 3 indicate a significant difference in the performance of the experimental group before and after exposure to science popular tunes. The mean difference in scores was -15.866, with a standard error of 0.849, and the calculated t-value of -18.68 was significant at a probability level of 0.01. This suggests that the experimental group's scores improved significantly after the intervention, demonstrating that strategies such as integrating music can effectively enhance students' interest and achievement in chemistry. The findings reveal that after exposure to popular tunes, the experimental group outperformed the control group, which was taught using traditional lecture methods. This underscores the potential of music to not only boost academic performance but also positively influence students' attitudes towards challenging subjects like chemistry. Many studies reinforce the conclusion that integrating music into lessons can be a powerful tool for improving student engagement and learning outcomes, particularly in challenging subjects like chemistry. a study by Hallam et al. (2010) found that music-based learning strategies increased students' concentration and academic performance across various subjects. Similarly, Wolfe and Noguchi (2009) reported that music's rhythm and melody can aid in the retention of complex scientific concepts. Research by Schlaug (2015) also demonstrated that music-based interventions enhance cognitive development and memory retention in academic contexts, particularly in STEM subjects.

3.4. Difference in the Post test Scores of Control and Experimental Group

The findings presented in Table 4 illustrate a significant difference in post-test scores between the experimental group, which utilized popular music in instruction, and the control group, which followed traditional lecture methods. The mean difference of -4.733 indicates that the experimental group outperformed the control group, with a t-value of -4.439 that is significant at the 0.01 probability level. This suggests that integrating popular tunes into the curriculum effectively enhances students' understanding of chemistry concepts. Supporting evidence from the summative tests further confirms this, revealing that 86% of students in the experimental group showed improvement, compared to only 53% in the control group. These results highlight the positive impact of music on students'

comprehension and engagement with complex subjects like chemistry. The literature supports these findings, with research by Karpinski (2019) indicating that music can significantly enhance memory retention and motivation in educational settings. Similarly, Hargreaves and North (2020) found that music in the classroom fosters a more engaging learning environment, which can lead to improved academic outcomes. Furthermore, a study by Eljattari et al. (2021) demonstrated that students exposed to music-integrated instruction exhibited greater enthusiasm and interest in the subject matter, further validating the effectiveness of this approach. Collectively, these studies reinforce the conclusion that the integration of popular music into science instruction can facilitate better understanding and achievement among students.

3.5. Difference in the Achievements of Students After Exposure to Strategic Instructional Module Across Gender

The data presented indicates the comparison of scores between male and female respondents. The sample consists of 15 male respondents with a mean score of 30.27 and 15 female respondents with a mean score of 26.67. The F-value of 2.173 suggests that there is a variation between the groups, and the significance level (Sig) of 0.038 indicates that this difference is statistically significant at the 0.05 level.

This finding implies that male respondents performed better than female respondents in the context measured by the scores. The significance of the results ($p < 0.05$) suggests that the observed difference in mean scores is unlikely to be due to chance, indicating a potential area for further investigation regarding the factors influencing these differences in performance between genders.

It may be beneficial to explore the underlying causes of this discrepancy, as understanding these factors could lead to tailored educational strategies that promote equity in academic performance among male and female students. Further research could also examine whether similar trends exist in other subject areas or contexts, providing a more comprehensive understanding of gender differences in academic achievement.

The results of this study suggest that the use of music in science education, specifically the science-popular tunes, is an effective teaching strategy. The experimental group's significantly higher post-test scores indicate that the music-based intervention not only improved students' engagement but also enhanced their retention and understanding of scientific concepts. This finding supports existing research, such as that by Jensen (2005) and Sousa (2006), which highlights the cognitive benefits of music in learning environments.

Moreover, the use of music may have helped to reduce cognitive load, allowing students to focus more on understanding the material rather than memorizing abstract facts. This aligns with the constructivist theory of learning, which emphasizes the importance of active engagement and making connections between new information and existing knowledge. The repetitive nature of the songs may have also contributed to better long-term retention, as suggested by Watson's (1913) Law of Frequency.

4. CONCLUSION

The study provides compelling evidence that the integration of popular music tunes into science instruction can significantly enhance students' academic performance. The use of science-pop tunes as a pedagogical tool increased student engagement, improved retention of science concepts, and led to significantly higher post-test scores in the experimental

group. These findings suggest that music-based learning strategies offer a valuable alternative to traditional methods, particularly for subjects that students may find challenging or uninteresting.

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6. CONFLICT OF INTEREST

The author has declared that there is no conflict of interest.

7. SOURCE/S OF FUNDING

NA

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