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An Association between Music and Academic Performance Enhancement of High School Students - A Systematic Review

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Abstract: ***Due to the stress of e - learning, adolescents' study potential is observed to be lower during the pandemic. The main aspect of this systematic paper review is to examine and analyze relevant studies on the issue of the association between listening to music and study ability in order to determine the efficacy of music and its outcomes. All of the papers in this review are categorized according to the eligible criteria for inclusion and exclusion. The publication years, methods, and participant ages all utilize as inclusion criteria. Furthermore, all articles must be initially screened to see whether they are unavailable or unrelated to the field. In this paper, the Google Scholar and Eric databases were utilized to find papers, and a total of 221 papers were discovered. We found 9 publications related to our topic as a result of our systematic review. A total of five papers were relevant to the relationship between music and second language learning. A total of three papers were related to the field of mathematics. Lastly, a total of one paper was about the effect of music on concentration. Overall, music was indicated to be a positive stimulus for memory, second - language learning, concentration, and mathematical potential. However, the outcome can vary depending on the languages. Music was also found to be highly effective for neurotic participants on the mental arithmetic exam.***

Keyword: memory, second language, mathematics, concentration, systematic review

1. Introduction

Regarding the COVID - 19 pandemic, a global crisis, all students and educators must shift their routines from working onsite to working online starting in 2019. As discovered by Prerna Varma et al. [10], during the early phases of the pandemic, there was significant psychological distress. In comparison to medium and senior age groups, younger age groups were more susceptible, indicating higher levels of stress, anxiety, and depression. According to UNESCO statistics [12], over 1.6 billion students in 195 countries were unable to attend classes on a regular basis. As a result, e - learning became the alternative instructional approach. However, it was predicted that in the long run, it would result in academic loss and mental health issues [11]. For this reason, our team discussed which factors could lead to academic enhancement. In our primary research of related papers, as founded by Meyla Muslimah and Wulan Apriani [8], the finding discovered that most students preferred listening to music while studying. They revealed that listening to soothing music while studying can help students keep their minds calm and enhance their attention by creating a more conducive environment for learning. On the contrary, the finding indicated no relationship between listening to music and academic performance. The average test scores of the sample who were studying under lyrical or instrumental music conditions did not substantially differ. To summarize, listening to music has minimal influence on one's ability to acquire and recall information. As mentioned above, in primary research on related papers, the found information was scattered, which led us to be curious about this subject. Rationally, we settled on researching the factor of listening to music.

2. Objective

This systematic review attempted to analyze all the papers regarding academic potential enhancements that utilized music. We mainly discussed a key question along the lines of "Does listening to music while studying hinder or enhance specific academic potential?".

3. Methodology

To discover related papers for this systematic review, the Google Scholar and Eric databases were used. All titles with the terms "impact of music" and "background music" are included in the index, along with the words "language, " "academic, " "mathematics, " "skills, " "ability, " "memory, " and "concentration. " We reviewed all of the full - text papers that were available. The inclusion requirements for the eligibility criteria are publication year (2000 - 2021), participant age, and methodology. We screened the papers in six steps during the sorting process, sorting them from C1 to C6 as depicted in this flowchart.

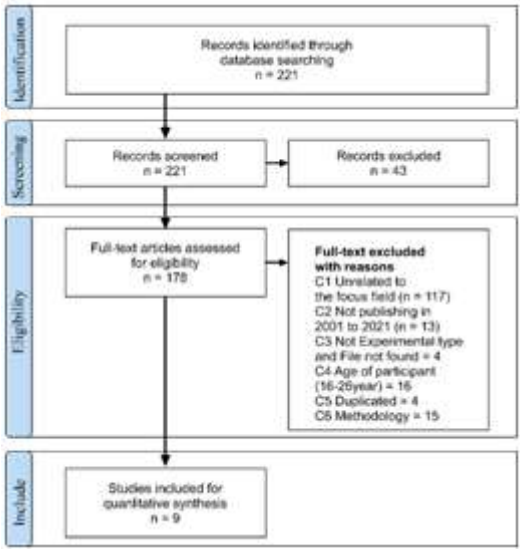

Figure 1: Exclusion process flowchart

Definition of Criteria

C1 Unrelated to the focus field: The paper is not related to listening to music and study potential.
C2: Not published between 2001 and 2021: The paper was published before 2000.
C3: Not an experimental type, and the file was not found: The paper was found to be a review, or the available file got deleted.
C4: Participant age (16 - 26 years): The participant's age does not appear to be between 16 and 26 years old.
C5: Duplicated: The paper from C4 has been discovered to be duplicated.
C6: Methodology: The method could be brain scanning or something else.

4. Results

A total of 10 papers were selected from a total of 221 papers during the paper selection process. All papers were excluded in order from C1 to C6 after screening and eliminating irrelevant papers (figure 1). This is the order in which the results were discovered.1.) 117 papers were excluded for being unrelated to the field, 2.) 13 papers were rejected for publication prior to the year 2000, 3.) 4 papers were eliminated because they were discovered to be reviewed or because the available file was deleted, 4.) 16 papers were excluded because the participants' age was not between 16 and 26 years old, 5.) 4 papers were excluded because they were duplicated, and 6.) 13 papers were excluded because the methodology appeared to be a brain scan or other. As a result of the selection, a total of 9 high - quality papers on the relationship between using music and testing essential study skills were discovered.

A total of five publications were relevant to investigating the effect of music on second language learning [7] and verbal fluency [5]. The participants from one study were required to learn standard practice before being evaluated on their language skills, including recalling, translation, memory, and pronunciation, under both the music and control conditions. In one study on second language learning, [7] participants were divided into two groups based on their preferred languages and then started on a standard study track for those languages. Following that, the language skills test was assessed. The result from this study indicated that there was no significant difference in recalling and translation between the music group and the control condition in one language. In another language, however, it illustrated a converse outcome. Surprisingly, under two scenarios, no significant differences in pronunciation were discovered. In line with the verbal fluency study [5], no significant differences were founded among the groups. In other papers regarding the concern of short - term memory [1], [2], [9], one study found that music had a better effect on memory and learning capability than the control condition. [1] In compare with the condition of lyrical and instrumental music, although the findings illustrated that music has little effect on boosting one's learning and remembering capacity, no statistical significance was indicated. [9] Still, in long - term memory, recalling has been proven to be ineffective. As well as another study, which indicated a better memory for vocabularies under a control condition than under a music condition. [2]

A total of three papers were related to the investigations in the field of mathematics. One study that used music of Mozart in the music condition to evaluate mathematical aptitude indicated that the Mozart group had a higher mean than the control group. [3] Another research examined the ability to do limits and derivatives test [4] and found that the group under music condition had a higher mean score than the control group. Besides, Soft - rock music was also found to be beneficial for the participants who had to take the limit and derivatives tests. In a similar study, music was found to be more beneficial than the control condition especially participants with neuroticism on a mental arithmetic exam. [5]

A total of one study investigating the effect of music on concentration was discovered. [8] A qualitative survey methodology was used in this investigation. The result from this study found that the majority of respondents felt that listening to music while studying could help them concentrate better and stay awake. Conversely, the others were against it since it could be a source of distraction.

For the synthesis on other aspects, one survey research paper offered the results on the association between the genre of music and subjects. [6] According to the poll results, the majority of respondents preferred listening to music while learning mathematics over social courses. Nonetheless, no relation was discovered between the style of music and specific courses. Another study focused on neuroticism, the Wonderlic Personnel Test (WPT), and Raven's advanced progressive matrices under music and control settings. [5] The result from this study found that, when compared to music and distracting stimuli, the WPT score was better in silence. Furthermore, there was no relation between it and neuroticism. Along with the progressive matrices, no significant association was found between the surrounding music, silence, and neuroticism conditions.

Table 1: Researches summary

Hi Jee Kang, Victoria J. Williamson (2013)	*Participant*	Two groups were formed from 32 participants. Each group was divided into two more groups to examine in both musical and non - musical situations. The representative chose the language on his own. The sub - group was also classified according to the National Adult Reading Test (NART), age, and the amount of years spent practicing music.
	Method	In this paper, before the primary second language learning trial began, all representatives completed a quick questionnaire to gather information on previous experience in music practice and to evaluate self - awareness. This experiment had two languages: Chinese and Arabic, as well as two music conditions: music and no music between subjects. In this study, all participants were required to study the main second language for three weeks, depending on the subject they chose. Participants were provided with a diary booklet to keep track of their daily work progress and ensure that they were following the learning schedule. Finally, the participants were asked to undergo a language test, which included the Operation Span task

		(OSPAN), NART task, speaking test, and understanding test.
	Result	In accordance with the multivariate analysis of covariance (MANCOVA), derived statistics from a data analysis gathered from a representative group, there was no significant difference in Arabic learning between music and no music situations. However, when it came to Chinese learning, the researchers discovered that music played a minor role in both memory and translation. Surprisingly, no significant impacts of music on pronunciation scores were found in either language (p >.05) Separate univariate analyses revealed that music had a substantial effect on both the Chinese recall and translation tests when compared to the Chinese no music conditions. Musicality had no significant effect on any of the test results as a covariate.
	Conclusion	Music has the ability to be both good and detrimental in any cognitive work. When music is complicated and loud, it can drastically impair cognitive performance. However, music with a low level of complexity, such as minimal tempo shifts or non - verbal elements, was proven to enhance cognitive task performance. With music, performance on memory and translation tests in Mandarin Chinese significantly improved. On the other hand, there was no discernible influence on Arabic.
Serpil Umusdaş (2015)	*Participant*	481 students of different ages in Turkey
	Method	The researcher constructed a questionnaire based on the advice of three professionals in this research. The aim of the questionnaire was to query and gather information on the following topics: 1.) What type of music do the respondents listen to while studying?, 2.) What is the subject the respondents were studying while listening to music?, 3.) Is the music instrumental or a song with vocals?, 4.) Who is the artist of the song?
		, 5.) Which city does the respondent live in?, 6.) Are there any recommended songs or artists? The researcher analyzed the frequency and percentile of the responses and utilized a Chi - square analysis to find the correlation between music and study genre after the questionnaire was returned.
	Result	The study's findings revealed that, while studying, the participants primarily listen to "Turkish pop music" (n=113) and "pop music" (n=90). It was discovered that 51.1 percent of students listened to music while attending numerical courses while the other 48.9% of students attending social studies classes. It was obvious that students in numerical courses were more likely to listen to music than students in social courses. However, the Chi - square test revealed that there was no significant link between music type and study, nor between music type and student level.
	Conclusion	Since more students preferred listening to music when studying numerical courses, it was concluded that the music they listened to may interfere with their concentration on the topics they are studying. It was also said that music hindered one's capacity to concentrate on social courses while enhancing one's ability to concentrate on numerical courses.
James Reynoldset. al. -2014	*Participant*	A sample of 70 students (26 men and 44 females) aged 16–18 (M = 16.71 years, SD = 0.68 years) from a London college.
	Method	The NEO - test was selected as the first questionnaire to sort the representatives as the presence study provides that the trait of neuroticism can be related to cognitive performance. Apart from the neuroticism test, there are other tests: 1. The Wonderland Personnel Test (WPT) consists of 50 items. The task was graded in difficulty by testing problem solving using a range of algebraic and geometric techniques. 2. Baddeley's sentence - checking test is a 64 - question test administered in 3 minutes measuring verbal fluency. 3. The Lock mental arithmetic exam requires participants to answer as many questions from a list of 30 as possible in 15 minutes. 4. Raven's advanced progressive matrices are used to study cognitive performance. 5. Neuroticism is measured using the NEO - Five Factor Inventory. Afterwards, each participant completed each task, in either silence, noise, or music. Two digital voice recorders were involved in the procedure. The first captured background noise, while the second recorded music stimuli. The researcher utilized a Chi - square test for statistical analysis to determine the association between the components.
	Result	Neuroticism had a substantial negative association with mental arithmetic skills but no correlation with any other test. Performance on both the sentence - checking and mental arithmetic tasks was significantly correlated with WPT performance. The associations, on the other hand, were weak. Raven's performance did not correlate with any other test.
	Conclusion	It was unexpected that music could benefit those with neuroticism in a numerical course rather than a silence course. However, there was no significant association withother tests. Neuroticism also demonstrated a negative significant link with the mental arithmetic exam, according to the analysis results. The WPT and Baddeley's test had a positive association, although the finding was not statistically significant. There was no indication that noise had an adverse effect on performance by the time of research, and there was a little evidence that music had an effect. There was also minimal indication that music had a detrimental effect on performance.
Annette M. B de Groot-2006	*Participant*	36 first - year psychology students from University of Amsterdam and moderately experienced foreign language (FL) learners. All of them were native Dutch.
	Method	Half of the participants were placed in a musical state, and the other half remained silent. The experiment was conducted using 64 pairs of learning media. Each consisted of real words, or concrete words, and non - real Dutch words, or abstract words. The non - words varied in phono - tactically typical and atypical ways. All participants were divided into two sections, the first of which consisted of three learning and testing sessions and the second of which consisted of three testing sessions spread out over a week. Each learning - and - test session comprised of two learning sessions and one test. There were four tests in total. The words appeared on the screen for 10 seconds, then a Dutch translation appeared. Tests were repeated, and participants were tested again without having to repeat the same learning. An investigation was conducted to

		determine how much forgetting happened throughout the week between learning and retesting in relation to learning with and without music.
	Result	The scores reflected the percentage of participants who remembered the answers of the stimuli correctly in the test conditions. In the recalling analysis, there was no significant relationship between recalling scores in both the music and silent conditions. In the learning analysis, the scores obtained under the music condition were higher than under the silent condition. The music effect was lowest in the 1st test (4.6) and highest in the 2nd test (11.6), whereas it dropped to 9.9 in the 3rd test. In the forgetting analysis, both music and silent conditions showed no effect on remembering the words. The interactions between the tests on one side and the rest of the variables were particularly correlated because the researchers pointed to the dosing, not the main effect. The impact of concrete was particularly large. In the first phase of learning, the corresponding forgetting analysis set showed interaction between the concrete and the test. It was demonstrated that during the one - week interval between tests, more abstract words are forgotten than concrete words.
	Conclusion	Over the 1 - week test and retest interval, data suggested that both the musical and silent conditions do not help with recalling and led to equal amounts of forgetfulness. It was found that after the retest, the words learned a week ago were forgotten. In the learning analysis, after a week of study, all types of mnemonics were significant during learning in music than when learning in silence. However, the effect of music was only generalized over items, not over participants. The result of this indicated that, under the music condition, only a minority of the participants benefited from the presence of background music. In all cases, the recall scores for translation pairs with atypical non - words were lower than for those with typical non - words in comparison.
Meyla Muslimah, Wulan Apriani-2020	*Participant*	24 college students participated in this study. Participants were students who study semester 5 English education majors at Universitas Ibn Khaldun in the academic year 2019 - 2020.
	Method	The qualitative technique was applied to this paper. The participant's information was obtained by the researcher through a series of questions, an interview, and observation. It was done to determine whether they preferred to be tested in musical or non - musical conditions, as well as the reasons for their decision. The participants were divided into two groups depending on their preferences.
	Result	According to the findings of this study, eighteen of the twenty - four students preferred to listen to music while studying, whereas the other six did not. According to the responses of students who prefer to listen to music, about fourteen pupils said they listen to music based on their current mood. Two pupils did it on occasion, while one student did it on a regular basis. They also claimed that listening to music while studying might assist to calm the mind, prevent sleepiness, and filter out distracting noises. Furthermore, Soft music was determined to be the most popular since it may aid with concentration as well as relax people. On the other hand, around 66.7 percent of students who preferred not to listen to music while studying claim that music was distracting, while the remaining students express a different rationale.
	Conclusion	It was discovered that the majority of students listened to music while studying, particularly soft music. It was suggested that soft music could aid to calm the mind, enhance attention, and promote a good learning environment.
GAO Qi, BAI Xuejun-2018	*Participant*	A total of 90 university students who passed CET6, with an average age of 23, were randomly selected at Tianjin Normal University.
	Method	In this finding, the researchers utilized a two - factor mixed experimental design. Between - participants design was used for the music, while within - participants design was used for the vocabulary. The experiment was designed comprise of three forms of music for the music condition: non - musical, Chinese pop, and English pop. In addition to the types of language, Chinese and English words were included. Experiment 1 applied familiar Chinese and English nouns for memory tasks, while Experiment 2 applied unfamiliar Chinese and English words. During the investigation, the participants were presented with 32 Chinese and English words. Each vocabulary block was displayed on the computer screen for 2 seconds in a Latin square design. Participants must recall and write down the words in 2 minutes without considering the orders.
	Result	Toevaluate the outcome, participants received one point for each word correctly recalled. Participants in the first trial performed better when no music was played; nevertheless, no significant link between music conditions and word type was discovered. The difference in vocabulary recognition quantity between the two language types was not evident in the condition of music. The result of the second trial was comparable to the first, indicating that memorizing under non - musical conditions is superior to memorizing under musical conditions.
	Conclusion	Lastly, lyrical pop was discovered to be interfering with the process of memory. However, the more the familiarity of the lyrics, the more interference was detected in the initial trial. As a result, when the difficulty of the memorizing task was high, there was no significant interference between the lyrics of different familiarity levels; however, music with lyrics in the same language as the vocabulary was less interfering, as demonstrated in the second trial. The study claimed that task complexity had a higher influence on memory efficiency than auditory input language familiarity.
Judy M. Taylor, Beverly J. Rowe-2014	*Participant*	The participants were 128 undergraduate aviation students who received course credit.
	Method	The participants were separated into two groups: the silence group and the music group, comprising of 59 and 69 members, respectively. During the test, all members of the music group listened to Mozart. All participants enrolled in a compulsory trigonometry class chosen at the researcher's discretion and assigned with a total of six tests over the course of a semester. The silence group was examined in the classroom without background music, whereas the music group was examined with low - volume background Mozart music. Furthermore, in order to test group homogeneity, the researcher gatheredparticipants' SAT scores as much as possible.
	Result	The Mozart group's means for the six tests were 81.55, 94.06, 73.16, 80.70, 94.83, and 71.67, respectively.

		The average score was 82.66. The means for the six tests for the control group, on the other hand, were 79.73, 88.10, 56.36, 83.64, 89.03, and 69.93, respectively. This group's combined mean was 77.80. There was no statistically significant difference in the means of the two groups' SAT scores.
	Conclusion	To summarize, the Mozart Effect was found to have an influence on mathematical learning. The mean difference between the two groups was statistically significant, according to the results. However, for other topics, such as, priming cortical firing patterns, reducing anxiety, and/or generating arousal was beyond the scope of this experiment.
Cenk Keşan et. al.-2012	*Participant*	The participants were 98 freshmen in Izmir DokuzEylul University, Buca Faculty of Education, and the department of Elementary Mathematics Teaching.
	Method	In this study, the researcher looked at limits and derivatives and obtained data from four trials. Two of them were musical groups, while the other was not. Before the experiment, the researcher sorted the participants into ten homogeneous groups and inquired them about their top five musical preferences. The music that was most preferred among the members of the group was selected. The participants then took examinations in limits and derivatives with and without music.
	Result	Regarding the limit, the average score of the group who preferred classical music was 1.1 less compared to the group that did not. When compared to those who did not listen to music, those who favored soft rock had a higher average score by 12.5. When taking the exam while listening to pop music, the group's average score was 8.8 points higher than when not listening to music. In the derivatives topic, the average score of the group who favored nature music was ten points higher than that of the group that did not prefer music. The group who preferred soft rock music outperformed the group that did not. When taking a test while listening to Pop music, the group's average score was 13.4 points higher than when not listening to music.
	Conclusion	Solving questions using soft rock and pop music could assist learners in enhancing their ability to answer correctly in the Limits course. In the Derivatives topic, the students' ability to solve problems while listening to their favorite music, soft rock, could help them answer the questions correctly as well.
Nathaniel T. Lutmer-2018	*Participant*	30 undergraduates at a small, midwestern liberal arts college.
	Method	This study was carried out by using a convenience sample approach to recruit individuals. Based on block - random assignment, each participant was randomly allocated to either a control or one of two experimental groups. The first research group listened to a brief part of a popular song while reviewing a list of unusual terms and definitions before being evaluated on their ability to retain this knowledge. Before being assessed, participants in the second research group listened to a brief section of the instrumental version of the same hit song as the first research group while learning the same list of terms and definitions. Individuals in the control group studied the identical list of unusual terms and meanings without the music stimuli and were then evaluated on their memory abilities. To assess and understand the findings of the study, the researcher used the SPSS data analytics tool.
	Result	Instrumental music listeners (M= 7.7, SD= 1.16) outperformed lyrical music listeners (M= 7.6, SD= 1.43) and the control group (M= 7.2, SD= 1.55). The average score from those who listened to lyrical or instrumental music while studying and people who did not listen to music while studying did not differ significantly.
	Conclusion	Based on a one - way ANOVA, there was no significant impact from listening to either instrumental or lyrical music, F (2, 27) =.363, p =.699, since neither group scored substantially higher than the other. When analyzed, the test scores from both the control and the experimental groups indicated no relation between music and the study capacity. These findings show that music has little effect on one's learning and remembering capacity. The mean indicated that music may result in a modest boost in studying capacity, since the experimental groups have a slightly higher average test score.

Table 2: Researches' field summary

Field	*P1*	*P2*	*P3*	*P4*	*P5*	*P6*	*P7*	*P8*	*P9*	*Note*
Memory	X		X	X		X			X	
Languages	X		X	X		X			X	
Concentrations					X					
Mathematics			X				X	X		
Others		X	X		X					

5. Discussion and Conclusion

In line with the finding of this systematic review, we analyzed all investigations pertaining to the effects of music on language skills, mathematics, memory, concentration, and other potential outcomes. In the term of memory, according to Annette M. B de Groot, music has a substantial tendency to help with short - term memory but not long - term memory. [1] As Hi Jee Kang et al. point out, the outcome may differ depending on the language used. The study revealed no significant improvement in Arabic language abilities under music conditions, although it did in Chinese. [7] As mentioned by GAO Qi et. al., the investigation indicated a better memory for vocabularies under a control condition than under a music condition. [2] As well as Nathaniel T. Lutmer, no significant differences between the conditions of instrumental and lyrical for short - term memory were indicated. [9] Regarding the findings of the study on the relationship between music and mathematics, music was useful for better calculation in mathematics. [3], [4] In addition to the mental arithmetic exam, the music condition resulted in a higher score than under the silence for neurotic participants. [5] In the term of concentration, the majority of respondents in a survey regarding concentration using music agreed that listening to music helps them concentrate. Unfortunately, there was no discernible link between the musical genre and the subjects. [6] To be more specific, all of the studies included in this review eliminated any possible bias among the group of participants by sorting them based on their standard test score. This was done to confirm the presence of a credible experimental group.

Overall, music was found to enhance both academic progress and relevant abilities. As a result of online learning, students' academic potential declined, according to

the findings of the current study in 2021. In the same way, all students could improve their academic potential and relevant abilities by incorporating music into their studies. In a nutshell, adding music to academic courses in mathematics, languages, or social sciences improves learning.

6. Limitations

In this systematic review, a limitation in the number of relevant publications in this sector was observed, as there were a few studies on the effect of music on academic abilities in the past five years, according to our selected databases. Furthermore, several of them are off - limits to the general public. As a result, in order to acquire broader coverage of the topic, we had to expand the area of relevant study to a total of 20 years. Our team agreed that the scope of relevant search resources for studies should be broadened in order to synthesize more relevant material in future systematic reviews in this subject. In terms of experimental recommendations in this topic, we propose looking into the influence of music on long - term memory, as there is currently little content on the subject. As a result, further research into this area would be extremely valuable in order to support the newly revealed data.

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