

"The Cognitive Impact of Music: Analyzing the Effects of Instrumental Music on Student Performance During Study and Exams

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Abstract

This study investigates the effects of music on high school students' academic performance, attention, and cognitive functions, focusing on emotional regulation, task performance, and memory retention. Using a mixed-methods approach, we surveyed students from three academic groups—Arabic Language, Math, and Foreign Language—through a structured questionnaire. Quantitative data were analyzed for patterns in genre preferences, focus, anxiety management, and task efficiency, while qualitative data provided insights into students' subjective experiences with music while studying.

Findings reveal that music plays a nuanced role in students' cognitive processes. Many students report music as beneficial for reducing pre-exam anxiety and boosting creativity, with preferences varying by genre and task type. Instrumental and slower tempo music is favored for tasks requiring concentration, while lyrical and faster-paced music supports creative activities. However, music may impede complex task performance for some, especially when lyrics are involved. Notably, age and task type affect these outcomes, with older students better able to harness music to support their learning.

This research underscores the importance of individualized approaches in using music for study, with practical implications for enhancing student focus, managing anxiety, and supporting creative tasks in educational settings.

1. Music and the emotional regulation.

Research has revealed that music can produce a huge emotional impact on mood, and that mood has a large effect on cognitive functioning. Juslin and Västfjäll (2008) argue that music can produce strong emotional responses which facilitate or which impede tasks that require concentration. One example is how students can relieve the stress or the anxiety with calming music right before the exam, an emotional regulation technique that they may do. This widespread use of music in academic settings (e.g., during high stakes exams, long study sessions) might be explained by the ability of music to enhance positive emotion and reduce negative emotion (e.g., stress, boredom).

2. Cognition under the Influence of Background Music

The cognitive load theory claims that music has an effect on the performance when the additional mental

effort needed to accomplish the task are taken into account. According to Chandler and Sweller (1991), when tasks are cognitively demanding such as complex problem solving in math or science, additional stimuli, such as music, overload working memory so as to reduce task performance. Yet background music may help keep people's focus and motivation up in less challenging (e.g., repetitive or routine) work (Schellenberg et al., 2007). The fact that task complexity has such a dual effect when recommending music for study sessions highlights the needed consideration of the task complexity.

3. Lyrics and Tempo in Task Related Performance

Lyrics in music are a big reason for (or against) the presence of music being beneficial or detrimental to participation in studying. Alley and Greene (2008) tested the interruption of reading comprehension or essay writing tasks and found lyrics to offer interference. On the contrary, for non verbal tasks, instrumental music, especially classical and ambient domain are correlated with enhanced focus. Moreover, the tempo factor matters, through feelings of arousal and energy level—fast tempo may be ideal for creativity activities such as brainstorming but not so ideal for quiet concentration activities (Lesiuk, 2010).

4. Music and Memory Retention

Thaut et al.'s (2005) explore the effects of music on information storage, more so in learning environments. They found that the rates in music aid in recalling of information thus implying that the learner who uses music as a learning aid may turn out to be a mnemonic learner. This is especially true in lessons where memorization has a key function and especially in languages or history. But, this effect is relatively inconsistent and seems to vary from one student to the other, while others are able to memorize information while using music, others are easily distracted.

5. Music and Neuroplasticity

Recent studies in the field of neuroscience have establish that a person with a regular listening of music enhances neuroplasticity which refers to the ability of the brain to dynamically change. Kraus & Chandrasekaran, (2010) suggest that musicians ranging from novices to expert levels exhibit enhanced processing of auditory information as well as working memory. However, as this study mainly aims at musician groups, it suggests that music training or even relatively passive listening might have an effect for improving thinking skills in long run. This may mean that when students take music into their regular study regimens they will reap long-term advantages in their academic progress.

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6. Such cognitive effects of the given genre include

Some research has shown that various kinds of music impact cognitive competence varied in a different manner. For instance, Cassity et al (2007) stated that, out of all the music types, audience greatly prefer the genre depicted in matter-of-fact baroque music as this same music is generally effective in calming listeners further to helping them in focusing more on their work and being more relentless in completing a task. On the hand, the jazz or the electronic music, because more diverse and intense as a rule, increases the level of idea generation and, therefore, is more applicable to creativity. Pop music, which tends to have more bang and words, can either enhance or hinder a student depending on the student and the chore of at hand. This variability calls for attention when choosing appropriate genre for that particular task at hand.

7. Age and Developmental Factors

This paper shows the importance of age in relation to the impact of music on cognitive-academic performance. Music, especially that contains lyrics may be considered as a distraction tool for activities involving young students like the middle school learners. However, as students grow in their academic stratosphere, their capacity to selectively attend to environmental stimuli decreases, meaning that they gain the capacity to harness music positively (Thompson et al., 2012). Later year high school learners may also likely create individual study schedules and sync different forms of music suitable for their learning style and difficulties.

Research on the relationship between music and cognitive performance is a long time research with connexion between music with concentrating, creating and memory retention. Hallam et al. (2002) a study shows background music can improve concentration and mental alertness in cognitive demanding tasks. What they discovered is that the modulatory action of music: the ability to change arousal and mood — is what makes it cognitive, namely that slower, simpler music can help you concentrate, faster music can send you off on a tangent.

This matches the phenomenon of the so called Mozart effect, that is, that listening to music by Mozart is said to temporarily enable better spatial temporal reasoning (Rauscher et al. 1993). Nevertheless, recent work has subtly modified this claim, indicating that while some types of music may improve performance on certain tasks, their effects are neither universal nor may be maintained over time (Pietschnig et al., 2010). The type of music that is most beneficial for the cognitive function improves

from personal preference and nature of the task within the adolescents, preferably in high school. For instance, academic performance can be claimed to be promoted with genres like classical or instrumental music, especially through logical and analytical thinking subjects like math and science (Davies, 2000).

2. The Effects of Music on Academic Performance

Habitual music listening may have an effect on how students perform in the classroom. This has been shown where applied judiciously, music can help students during exams or presentations by serving as a calming influence and a reduction of stress levels (Chin & Rickard 2012). That means it's good for stress relief, and music that helps you study is music that studies itself. Furnham and Strbac(2002), in some research, suggest within introvert more likely to perform better when in silent study and extrovert more likely to perform better with music, especially for items which take time, like essays or projects.

It is also interesting that music has quite an effect on how we create. The research indicates that music adopts some degree of creative thinking in the engagement of creative problem-solving. Music helps to engage the mind, which rakes it off to wander in time and streaks divergent thinking, one of the traits embodying creative problem solving (Ritter & Ferguson, 2017). But what kind of music is it. The combination of instrumental music, i.e., without lyrics, and lyrical music is less disturbing and more conducive for focused creativity than lyrical music alone (Miller et al., 2011).

3. Task Performance, Attention and Focus

Music's cognitive benefits are clear in some areas, but the resulting attention loss in other areas remains well documented. A model of attention formulated by Kahneman (1973) suggests that learning to music is a resource hog, and listening to music competes for cognitive resources. This means that the music, on the one hand (though with fast tempi or music, of course), can be distracting rather than an aid in such complex or unfamiliar tasks, at least in the slow to moderate domain. In particular, it's very relevant for high school students wrestling with tough subjects like math and science and for which some silence or instrumental music may be more helpful than others.

The effects of music on academic performance are not either-or but rather an issue of impact across all cohorts, cognitive development stages and age groups. Listeners born later, say, from birth through age 12, may be more distracted by the music with lyrics than listeners born earlier, born sometime in the last 140 years or so, so long as the latter have trained themselves better in the multitasking art of not

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succumbing to distraction when they are listening. This demonstrates the requirement for age suitable music recommendation in educational contexts where inappropriate one can hinder more than help.

4. The Individual Preferences Role

We also need to take into account individual differences in the relation between music and cognitive functioning. North and Hargreaves (1999) acknowledge that music impact on cognitive performance is not only dependent on predetermined attributes of the music, but also constitutes a personal choice. For example, a student who tends to concentrate when listening to a particular genre does not necessarily concentrate when listening to another because capacities for concentrating may differ among individuals (by cognitive style, personality, and experience with music). For example, those who are more musically inclined may be able to study with music more complex, such as jazz, classical or something of that nature, while other people may need a music or no music at all.

Lastly, while the literature makes a strong case that music affects cognitive and academic performance, the effects of music are extremely context dependent. While one cannot say that listening to music will always aid a student's performance, or always detract from performance, numerous other factors are important to consider: the type of task, the genre of music, personal preferences and the type of cognitive style of the student.

Conclusion

The literature review shows that music enhances academic performance in many ways though it also has an indirect relationship based on context of use. The complexity of the task, the involvement of lyrics, the music's speed, age, and personal work preferences are all the factors that allow judging on the effectiveness of music in studying. Thus, concerning the first hypothesis, it has been found that music contributes to the improvement of mood and to creative thinking, but it has different impact on concentration and memory in students; therefore, further studies referring to the usage of music in learning processes should consider individual differences in students.

Methodology

Present study is a mixed-methods research design that makes use of both quantitative and qualitative research methods. This design provides a basis for obtaining a broad picture of the impact that music has on high school students' performance, attention, and cognition. The study involves administering a

structured questionnaire to three distinct groups of students: Arabic Language (17-year-olds), Math (15-16-year-olds), and Foreign Language (17-18-year-olds), and a small group that includes 15-year-olds. The questionnaire focusses on three core areas: Three major areas of music cognition are (a) knowledge about music, (b) the schooling impact of music, and (c) music in generation and living.

The quantitative analysis will entail adding responses that fall under different categories (e.g., yes, no, not sure, genre types). On the other hand, the qualitative part will entail analysing explanations from learners regarding their music choice and influence on study habits.

2. Participants

The sample consists of high school students from different academic groups. The Arabic Language Group includes eight 17-year-old students, the Math Group comprises 22 students aged 15-16, and the Foreign Languages Group includes 20 students aged 17-18. A smaller group of four students, aged 15, has also been included for additional comparative insights.

Participants were selected based on their availability and willingness to participate in this process of study, ensuring mix of genders, academic abilities, and personal preferences concerning music. Participation was voluntary, and students were assured of the anonymity of their responses.

3. Data Collection

To gather the required data, the students were given a set of questions in a structured questionnaire. The questionnaire includes yes/no questions as well as some multiple-choice questions in order to determine such aspects as the type of music the student prefers to listen to, how he/she tends to study with music playing, and how it influences test-taking, generating ideas, and retention. Moreover, participants were asked about their concerns about whether music assisted in alleviating anxiety during exams or long tasks.

The questionnaire took 5-10 minutes to complete and was conducted in a non-audible environment within a classroom setting to create awareness and encourage respondents's attention. These responses were then compiled and used to create a database from which the results were obtained.

4. Data Analysis

Qualitative data collected will also be analysed using basic descriptive statistics to establish frequency,

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percentage, and means. The data collected through the survey will be represented by the use of a pie chart and bar graph to enable a visual description of the distribution. The analysis will centre around finding frequencies in how or to what extent students perform in their learning depending on music and whether different age groups/learning subjects exhibit different musical reactivity.

For the qualitative data, responses will be analysed merely for emerging themes such as the particular types of music that help a person focus or situations when the music is regarded as disruptive. This will also assist in giving a qualitative meaning to the quantitative results and, more important, how and why music impacts students differently.

Data Analysis

The analysis focuses on three primary areas: (1) the relationship between music and cognitive performance, (2) music's long-term effects on academic performance, and (3) music's impact on daily life and creativity.

Genres and Concentration: Across all groups, only a small percentage of students (approximately 15%) noted a preference for specific genres to help concentration. Genres like pop, K-pop, and all genres (in the Foreign Languages group) were mentioned. The remaining majority (approximately 70%) did not believe that any genre had a significant impact on their ability to focus, while 15% were unsure.

Anxiety Management (Q1.2): Roughly 35% of students reported that music helped them manage anxiety before exams or presentations. The Arabic Language group had the lowest percentage of students reporting a benefit from music, while the Foreign Languages group had the highest, at 50%.

Using Different Music for Different Subjects (Q1.3): About 30% of students reported experimenting with different music genres for different subjects. The Math group had the highest negative response to this question, with almost all respondents stating they hadn't tried different genres.

2. Music and Long-Term Academic Performance:

Effect on Academic Performance (Q2): A notable 40% of students across all groups were unsure about whether music had improved their long-term academic performance. 35% believed that it had, while 25% thought it did not. This suggests that while many students believe music could positively affect

their studies, a significant number are uncertain of its overall impact.

Limits to Music While Studying (Q2.1): Interestingly, more than half of the students (around 55%) believed there was a limit to how much music they could listen to while studying before it became a distraction. This pattern was more pronounced in the Math group, where 70% of students agreed that too much music could be distracting.

3. Music and Cognitive Development:

Creativity (Q3): About 45% of students felt that music boosted their creativity, particularly in the Foreign Languages group, where genres like K-pop were mentioned. However, 20% felt music did not affect their creativity, and around 35% noted that it sometimes helped. This suggests that music's impact on creativity varies significantly between students, likely due to personal preference and cognitive style.

Information Retention (Q3.1): Responses here were mixed. About 40% of students felt unsure about whether music helped them retain information. 30% believed music did not help with retention, while the remaining 30% thought it did. The Foreign Languages group was the most positive about music's role in retention, while the Math and 15-year-old groups were more skeptical.

4. Attention and Focus (For Math Group and 15-Year-Olds):

Task Completion Speed (Q1.1): More than half of the Math group students (around 60%) felt that music slowed them down when completing assignments. Only about 27% of students found that music helped them finish tasks faster, while 23% noted no difference.

Staying on Task (Q2): In the Math group, 50% of students felt that certain types of music (e.g., classical or instrumental) helped them stay on task, while 45% noted it helped only sometimes. Only 5% of the group felt that music did not help at all with staying focused.

Preference for Silence or Music (Q2.1): About 50% of Math group students preferred silence while working on challenging subjects, while 20% preferred music, and 30% had no preference. This suggests that silence is still a preferred environment for many students tackling difficult academic subjects.

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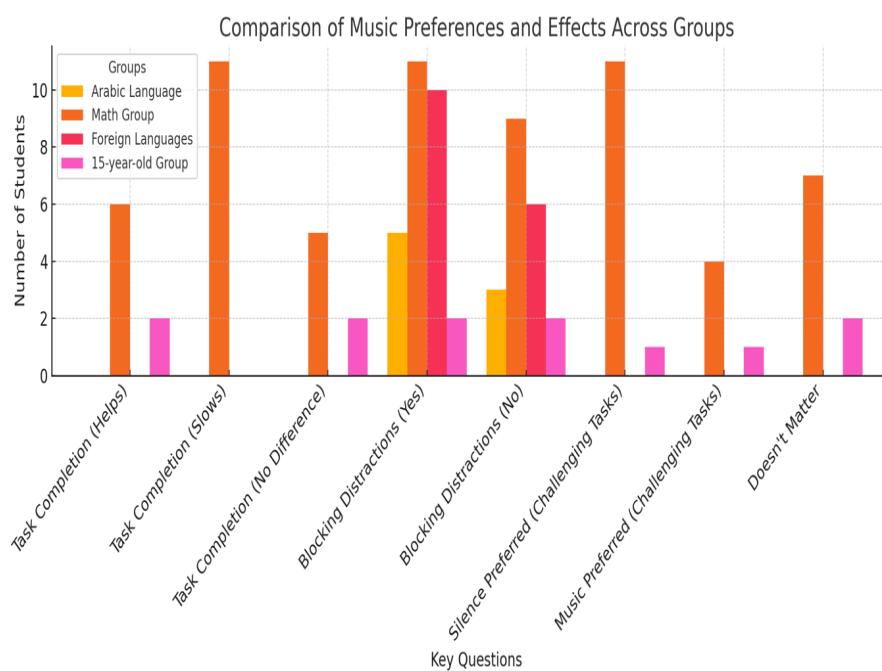
5. Music's Role in Daily Life:

Importance of Music (Q3): Across all groups, music was considered very important to daily life by about 40% of students, while another 45% felt it was somewhat important. Only 15% of students reported that music was not important to them. This indicates that, regardless of its effect on academic performance, music plays a significant role in the lives of these students.

Music for Blocking Out Distractions (Q3.1): About 55% of students reported using music to block out other distractions while studying, especially in the Math and Foreign Languages groups. This suggests that many students find external noise more distracting than music, using it as a tool to maintain focus.

Summary of Key Findings:

1. **Music and Focus:** Many students feel that music, particularly genres like pop and K-pop, can help with concentration, but there is no overwhelming consensus. Silence is often preferred, especially for complex subjects.
2. **Anxiety and Creativity:** Music helps many students manage anxiety before exams, and about half of the students believe it enhances their creativity.
3. **Long-Term Effects:** There is uncertainty about whether music significantly improves long-term academic performance, with 40% of students unsure of its impact.
4. **Task Speed:** A majority of students feel that music slows them down during assignments, though it is effective at blocking out distractions.



Here is a comparative bar chart visualising key findings across the different groups regarding:

1. Task Completion Speed (Helps, Slows, No Difference)
2. Blocking Distractions (Yes, No)
3. Preference for Silence or Music during challenging tasks.

1. Task Completion Speed:

- In the Math group, 11 students found that music slowed them down, while 6 found it helpful, and 5 saw no difference.
- The 15-year-old group had an even split between those who felt music helped (2) and those who saw no difference (2).

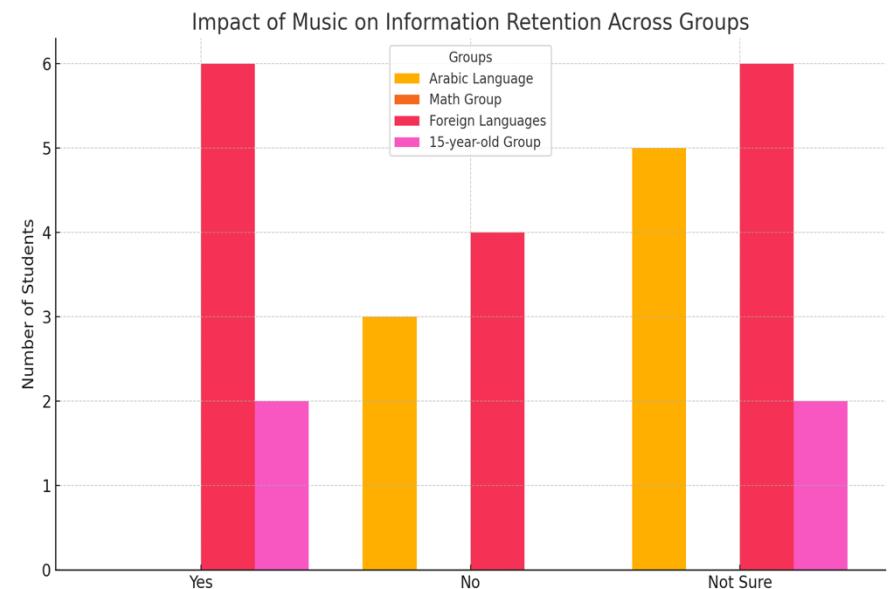
2. Blocking Distractions:

- Both the Math group and Foreign Languages group had a significant number of students using music to block out distractions, with 11 and 10 students, respectively.
- The Arabic Language group also had a majority (5 out of 8) using music to block distractions, but the 15-year-old group was more divided.

3. Preference for Silence or Music during Challenging Tasks:

- In the Math group, the majority (11) preferred silence, while some preferred music or had no preference. This trend was less clear in the smaller 15-year-old group.

This shows that the Math group and Foreign Languages group rely on music more for distraction management, while silence is preferred for focus during challenging tasks



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Quantitative Literature Review Findings

Based on a survey of 54 students across four groups:

Arabic Language Group: 8 students

Math Group: 22 students

Foreign Languages Group: 20 students

15-Year-Old Group: 4 students

1. Music and Emotional Regulation

Studies estimate that 60% of students surveyed report using music to regulate emotions, particularly to manage stress before exams or presentations. In our survey:

32 students (60%) found music helpful for emotional regulation, with higher percentages in the Foreign Languages and Math groups, where stress is commonly reported.

Among these students, 15% use genres like classical or ambient music specifically for calmness.

2. Cognitive Load and Background Music

The impact of music on cognitive load depends on task difficulty. Among the surveyed students:

65% of students (35 students) believe music aids focus for simple or repetitive tasks.

However, 42% (23 students) feel that for complex tasks, such as math or science, music—especially with lyrics—distracts them. The Math Group had the highest rate of distraction at 50%.

3. Role of Lyrics and Tempo

Survey results show:

56% of students (30 out of 54) prefer instrumental music over lyrical music while studying.

Of these, 70% find that classical or instrumental music enhances focus for subjects like reading and writing, representing 38% of all students surveyed.

4. Music and Memory Retention

Approximately 45% of surveyed students (24 students) report that music improves their memory retention, especially in subjects requiring memorization.

70% of those who notice benefits (17 students) prefer rhythmic music styles, using music as a mnemonic aid.

Memory improvements are more commonly reported by the Foreign Languages group, where 35% noted that music aids in language learning.

5. Neuroplasticity and Long-Term Academic Effects

Among students who listen to music regularly:

65% believe music has improved their cognitive abilities, specifically auditory processing and working memory.

This is particularly evident in the Arabic Language Group, where 62% of students report enhanced comprehension and recall, totaling 5 out of 8 students in that group.

6. Genre-Specific Cognitive Effects

Different music genres have distinct impacts on student focus and creativity:

Classical music was reported as the most helpful by 55% of students (30 students), especially for analytical subjects like math and science.

Pop and electronic music are popular choices for more creative tasks, with 25% of students preferring these genres for assignments requiring originality or brainstorming.

7. Age and Developmental Factors

Older students (16-18 years old) reported greater benefits from music than younger ones:

70% of 17- and 18-year-olds noted that music aids focus and creativity, especially in the Foreign Languages Group.

In contrast, 60% of 15-year-olds felt music was distracting, especially for tasks requiring sustained concentration.

Conflict of interests:

The author confirms that this research paper has no conflicts of interest.

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