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RESEARCH ARTICLE

Affective and Cognitive Mechanisms Behind Music Education: Implications for Student Mental Health

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ABSTRACT

This paper examines the cognitive and emotional positive outcomes of the music education and their implications to the mental health of students. To be more exact, it examines the effects of music education participation on such cognitive abilities as memory, attention, and executive function, on emotional regulation and mental health outcomes. Mixed-method design was used, where the total number of secondary school students was 200 with 100 in music education group and another 100 in control group. The cognitions performance was evaluated by using the tasks that tested the working memory, selective attention, and executive performance. The levels of emotional regulation were measured with the help of the Profile of Mood States (POMS) and Social and emotional competence questionnaire (SECQ) and the GAD-7 and PHQ-9 were used to measure the level of anxiety and depression. Results showed that the music education group did far better compared to the control in all the cognitive measures. In addition, students with music education group were more able to control their emotions, and less anxious and depressed. It was discovered that in the qualitative interviews, the students viewed music education as a means that can be employed to express their emotions and overcome stress. All these results indicate that music education promotes cognitive and emotional growth that it may be a possible intervention that may enhance the mental health of students. This paper reveals the need to incorporate music education into the school curriculum that will enable them to contribute to cognitive and emotional development that leads to the well being and the overall school performance of the student.

Keywords: Music Education; Cognitive Development; Emotional Regulation; Mental Health; Student Well-being

1. Introduction

The modern rapidly changing reality of education is becoming more conscious of the fact that music education is a very crucial practice in instilling to the students not only academic skills and competencies, but also such aspects as mental health and emotional stability [1]. The music education has been considered as a means of developing creativity and artistic expression but as per new researches, there are many other spheres where the said tool manifests its influence [2]. Since the occurrence of mental issues among students is on the increase, anxiety, level of depression and stress, among others, people are becoming curious to

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know how something like music education can come to the rescue of the students psychologically [3].

Specifically, music education has been used in the last few years as a topic of numerous studies due to the cognitive and affective processes that it entails [4]. The mental processes that are improved by music education are known as cognitive mechanisms, which include memory, attention, and executive functioning. Meanwhile, the affected mechanisms include such aspects as emotional responses, emotional control, and the formation of social and emotional competencies that the music education is able to develop. The two components are intertwined and do have significant implications about student mental health [5].

The present research paper examines the functioning of these mechanisms and their effects to mental health in order to find directions of how music education can help students to become happier. The introduction presents the purpose and importance of this study, theoretical frameworks that guide the cognitive and emotional processes of music education, and forms the background of the research on the impact of music education on the mental health of students.

1.1. Research objectives

The overall objectives of the work are the following:

- To investigate the cognitive benefits of music education
- To investigate the mechanisms of emotional regulation supported by music education
- To investigate the connection between cognitive and emotional outcomes
- To determine the implications of these mechanisms on student mental health

1.2. Research questions

The following research questions will direct the study:

- What are the effects of music education on learning abilities like memory, attention, and executive functioning of students?
- How does music education affect the emotional regulation of students, such as their stress, anxiety, and mood swings management?
- How are the links between cognitive development and emotional well-being due to music education and what are the interactions between these mechanisms?
- How can we integrate music education and mental health intervention to assist students with their emotional issues and psychological malleability?

1.3. Significance of the study

This study may be significant since it targets the cognitive and emotional deliverables of music learning and can be utilized as a guide to the educational processes towards improving the psychological well-being of the students. The need of mental health support in school setting is getting increasingly recognized especially in the light of the fact that the students should not only have to deal with an increasing number of factors relating to the academic success and the social interactions. The purpose of this paper is to demonstrate that music education, and its cognitive and affective processes could be an effective instrumental to enhance the well-being of students, which may be a preventative factor to the rise in performance of mental health problems in schools.

The implications of the results of this research will have significant implication to the educators, policymakers and the mental health personnel. This research will be used in developing a curriculum that not

only focuses on academic achievement but also considers the emotional and psychological development of students through the provision of the knowledge of how the music education influences the cognitive and emotional development of students. Further, the study will be in a position to provide data on how music education could be strategically utilized to address issues such as student stress, anxiety and depression, as well as offer how effectively music education can address the health of the students in a holistic manner.

1.4. Research problem

Although the literature has accumulated significant information indicating cognitive and emotional benefits of music education, a significant discrepancy in literature has been observed on the exact mechanisms by which music education can affect mental health. Whereas certain studies emphasize the cognitive benefits of music, and others the emotional ones, not many studies have investigated the relationship that exists between these mechanisms and the overall contribution to mental well-being. In addition to this, although music education has been proposed as effective in the development of cognition, the possibility of music education as a means of intervening mental disorders among students is underutilized.

1.5. Theoretical framework

In order to inform the analysis of such mechanisms, the study relies on two well-known theories that describe the interrelationship between cognitive development, emotional regulation, and mental health:

1.5.1. Theory of cognitive development

The initial theory, which can be used to explain the effect of music education on cognitive development is the Cognitive Development Theory, defined by Jean Piaget and Lev Vygotsky [6]. The theory presented by Piaget dwells upon the cognitive development stages and highlights the importance of cognitive development being facilitated by learning in a structured manner (with the use of music, etc.) [7]. The theory developed by Vygotsky, in turn, focuses on the social nature of the learning process, and in this regard, the interaction in the social contexts, including the group singing activities, is beneficial to the cognitive processes. This theory is applicable in explaining how music education can be used to affect memory, attention and problem-solving skills [8].

1.5.2. Self-determination theory

The second theory is the Self-Determination Theory (SDT) introduced by Deci and Ryan, which deals with the intrinsic motivation and its effects on emotional regulation and well-being. SDT is based on the idea that in order to be emotionally well, it is important to satisfy three fundamental psychological needs, which include autonomy, competence, and relatedness. These needs are usually addressed in the fields of music education in terms of the freedom to express, acquisition of musical skills and social relationships in the group music. SDT can be used to conceptualize the emotional advantages of music education, including emotional control, mood adjustment, and resilience [9].

2. Literature review

Music education has been regarded as a critical element of the school curriculum that offers students an outlet of creative expression, cognitive and emotional maturation. Nevertheless, the recent surge in interest in the psychological benefits of music education has brought to the fore the possible value of music education as a means of both academic and art development, emotional control, stress relief, and general student well-being. In this section, the literature on the cognitive and affective processes underlying music education was reviewed in detail based on cognitive development theories and emotional regulation to have a more

profound comprehension of how music education can be used to improve the mental health outcomes in students.

2.1. Music education cognitive benefits

The influence on the cognitive development is one of the most significant spheres of research on music education. It has been noted in numerous studies that music activities can improve memory, attention, and executive functioning leading to academic success and mental health. The cognitive development theory proposed by Piaget and Vygotsky highlights the importance of guided interactive processes in the cognitive development. Piaget explained that intentional interaction with the surrounding environment, e.g. the process of playing a musical instrument or engaging in some form of musical activity, should stimulate students to advance to different levels of cognitive development, i.e. concrete operational thinking to more abstract problem-solving skills [10].

Music education is an excellent media of intellectual development. The fact that the process of learning an instrument involves simultaneous involvement of a great number of mental processes, including memory, motor skills, and listening, which can enhance working memory and skills of space-temporal character [11]. Training in music has been found to increase the brain capacity to store and recall information and as a result, has improved academic performance in other subjects especially those that need memory and concentration [12]. Furthermore, the research shows that the music education enhances the sustained attention and cognitive control. Regular music activities among students improve their performance when the selective attention is concerned with, and when the ability to eliminate distractions and concentrate on the task is shown. This is important because these cognitive advantages become academic skills and regulating and controlling emotions in tough tasks. As an example, it is discovered that the music training can increase the processing of auditory information which is important in academic achievements and emotional control [13].

Executive functioning and music education has also been investigated. Cognitive flexibility, planning, and problem-solving are the executive roles that are essential in handling complex activities and adjusting to emerging information. The training in music and especially relating to rhythm and timing enhances the flexibility of the brain allowing students to transfer the acquired knowledge to many different situations. In students experiencing academic stress or mental health problems, better executive functioning forms an emotional buffer and stress coping skills, which are again associated with cognitive gains on mental health [14].

2.2. Emotional values of music education

Besides some of the cognitive advantage music education has a significant impact on emotional control and social-emotional learning. Self-Determination Theory (SDT) is one of the theories that form the basis of interpreting these effects since it focuses on how satisfaction of the basic psychological needs, namely, competence, autonomy, and relatedness, leads to positive mental health outcomes [15]. Within the framework of music education, the students tend to feel competence in building the musical abilities, independence in the expression of creativeness and relatedness in the group performances and shareable learning process. These needs also go in line with the emotional regulation theories that indicate that music education offers an educational experience of releasing and controlling emotions, which means improved psychological resilience [16].

Through music education, the students get to express their emotions in a fruitful and acceptable manner. Activities in the group using music like choir or orchestra give a sense of belonging and empathy because

they experience a common emotional feeling by sharing music. Such interactions could alleviate the feelings of loneliness and isolation which are characteristic of students who have emotional difficulties. Expressing emotions when using music has proven to be a way of reducing anxiety and stress and an emotional coping strategy among most students.

Emotional stability is also encouraged by music, and it can help the students to address stress better. The influence of the different forms of music which could be used to control mood and emotions, including self-chosen music.

Their research discovered that students who consistently took part in music activities test that they feel more emotionally stable and they have been in a better position to manage their school and personal life requirements. Music education can therefore help to alleviate the effects of academic pressure and mental health problems like depression and anxiety, which are caused by stress through an outlet of constructive channels of expression of challenging emotions [17].

Regarding mood regulation, the studies have demonstrated that listening to music could also have a great impact on the general well-being. The listening to music or music-related activity will result in an immediate mood-enhancing effect and negative affective conditions, including sadness and frustration, will be alleviated. According to the students who are exposed to music through either playing an instrument or singing in a choir, they claim that they are happier and more satisfied than students who are not exposed to music. This emotional uplift, in its turn, helps to achieve more positive mental health outcomes and leads to the mental wellness [18].

2.3. Mental health and music education

The overlap of mental and affective advantages of music education has significant consequences to the mental health of students. In a world where mental health issues, particularly in adolescents, are becoming an increasing problem, the field of music education has become an alternative intervention method, able to not only remind of the emotional conditions of individuals but also their cognitive development. Literature indicates that music education is a protective factor against anxiety, stress, and depression, and a health-promoting coping strategy of the students with mental health problems [19].

The effects of music interventions (learning a musical instrument or being part of a musical group) on the symptoms of anxiety and depression in children and adolescents and found that music interventions have a significant positive impact. Therapeutic impacts of music are not limited to short-term mood change but the long-term outcome of the emotional control of the students and mental health. Moreover, since music therapy has become more prominent as a mental health intervention, its use in schools, especially with regard to assisting students experiencing academic pressure or social anxiety has become more popular [20].

Besides lessening the symptoms of mental health, music education also leads to positive mental health outcomes because they enhance self-esteem, confidence, and the social support network. Music activities (orchestras, bands, or choirs) in groups encourage a feeling of belonging and collective meaning, which minimizes the chances of isolation and loneliness among students. This inclination of belonging and emotional support helps students to deal with social and academic stress and helps them to have a better mental condition [21] .

Although the literature offers a strong base to the knowledge of cognitive and emotional outcomes of music education, a number of research gaps remain that need to be filled through further research. To start with, the studies undertaken on the effects of music education on mental health are mainly cross-sectional and therefore there is difficulty in establishing a causal relationship. Longitudinal research is required to

identify the long term on sequences of music education on cognitive aspects and mental health especially among adolescents who might be subjected to mounting pressure as they head to high school graduation.

Second, majority of the research is limited to particular forms of music education, including the classical music training. Nevertheless, further studies are required to report to realize the impact of various music forms (e.g. popular music, jazz, folk music) and informal music-making on emotional and cognitive consequences. Moreover, more differentiated samples need to be adopted, which incorporate students with different cultural, socioeconomic, and educational backgrounds since the research available is mostly biased in terms of homogeneous and mostly Western samples.

2.4. Hypotheses

In accordance with the results of the literature analysis and the theoretical frameworks addressed, the following hypotheses are postulated to become the ways of leading the research:

H1: Cognitive Music Education Benefits.

H1: Music education will not only exhibit a considerable improvement in the cognitive functions of memory, attention, and executive functioning in the students who take music education in comparison to students who do not take music education.

On this hypothesis, it is assumed that music education promotes cognitive skills, which are promoted by Piaget and Vygotsky theories of cognitive growth emphasizing the importance of structured interactive learning environments in cognitive development.

H2: Affective Management and Well-being.

H2: The scale that measures emotional regulation and mood states will indicate that students in the music education group will have significantly higher levels of emotional regulation, resilience and mood improvement than students in the controls.

The foundation of this hypothesis is based on Self-Determination Theory (SDT) according to which the provision of the three psychological needs competence, autonomy, and relatedness in music education setting will result in improved emotional outcomes.

H3: Less mental health problems.

H3: The anxiety and depression level among music education students will be lower than in music education students based on the standard questionnaire questionnaires like the GAD-7 and PHQ-9.

The hypothesis is that music education is an effective preventive and therapeutic treatment of mental health problems, which is consistent with the previous studies that found that music education can be used to alleviate anxiety and depressive symptoms.

H4: Cognitive Benefits Interaction with Emotional Benefits.

H4: Improvement in cognitive abilities (e.g., memory, attention, and executive functioning) achieved due to the music education will positively correlate with the emotional regulation and the reduction of anxiety and depression rates.

The hypothesis is based on the premise that the music education provides cognitive benefits that play a role in emotional control and mental resilience which is a full-fledged model of how mental health is influenced by the interaction of cognitive and emotional processes.

The literature review demonstrates the significant cognitive and emotional benefits of music education that result in favorable academic results, emotional control and mental happiness. There is well-documented

cognitive benefits, these being the improved memory, attention, and executive functioning, and the music education is favorable regarding the ability of students to focus and manipulate information. At personal level music education makes the students to release their emotions and to cope with their feelings which makes them resilient and emotionally stable. Collectively, these cognitive and affective advantages constitute a strong foundation of mental health and well-being advocacy, and thus music education is an efficient approach to stemming out the rising nervousness in relation to the mental health of students.

3. Materials and methods

This segment presents the research design, the research participants, data collection procedures, and data analysis procedures in the study. The study aims at investigating the role of music education in the cognitive performance of students, emotional control, and mental well-being. It has a specific interest in understanding the mechanisms of thinking and affecting emotions involved, and how they can affect student well-being, specifically in trying to minimize anxiety, depression, and stress.

3.1. Research design

This research applies a mixed-method technique, which combines quantitative and qualitative research techniques. The mixed-methods design has been selected because it is necessary to obtain a complete picture of the impact of music education on the cognitive and emotional growth of students. The quantitative element is the use of standardized measures to evaluate cognitive performance, size of emotional control and mental well-being whereas the qualitative element is the personal experiences of the students regarding music education and its perceived effect on emotional state.

The research design has two stages. In the quantitative stage, the standardized tools will be used in regards to measuring cognitive abilities such as memory, attention and executive functioning and emotional regulation and mental health symptoms. The aim of this stage will be testing the hypotheses of the research regarding the cognitive and emotional benefits of music education. The qualitative stage will involve semi-structured interviews of a sub sample of the students in the music learning and control groups. The rationale behind these interviews will be the need to know what the students perceive about the influence that music education has on their mental health and ability to control their emotions.

3.2. Participants

The study will utilize 200 secondary school students who will be recruited in 4 schools, which are based in China. The sample of the research will be chosen between two groups, i.e. the music education group and the control group. The sample sample of the group that will be selected music education will include 100 students who have engaged in music education at least two years involving individual music classes, and collective music which includes choirs, bands and orchestras. The control group number will also be 100 but these students also are not taking the formal music education course. Such students take part in other studies and extra-curricular activities without being taught music in any systematic way.

In this research, the number of students recruited was 200 and this included 100 students in the music education group and 100 in the control group. The GPower software was used to conduct a power analysis to estimate the minimum sample size to be used in detecting medium and large effects sizes with alpha level of 0.05. The findings revealed that more than 200 students would be enough to get a statistical power [80] to get significant differences between the groups. The reason why this sample size was adopted is because past researches have utilized similar designs and therefore the study is having sufficient power to corroborate its findings.

The matching will be done to make the two groups comparable on the demographic variables age, gender, and socio-economic status. The age group of the participants will be 12-16 years, and they will be represented in the schools that have both music and non-music education programs. All the participants and their legal guardians will provide informed consent, and the Ethics Committee of the Institution will give a positive verdict on the study.

3.3. Data collection

The collection of data will be performed with the help of the standardized tests, self-report questionnaires, and semi-structured interviews. The quantitative data will be related to the cognitive performance, emotional regulation, and mental health whereas the qualitative data will result into the subjective experience of students and music education.

In the case of the cognitive assessments, a set of tasks will be applied to evaluate major cognitive skills. In order to evaluate memory, a working memory test will be given in which students will be requested to remember a sequence of digits or words given randomly. The focusing of attention will be measured with the help of the Stroop Test that examines the capability of the participants to give their attention to one element of the task and disregard the irrelevant information. To assess executive functioning (i.e. cognitive flexibility and problem-solving ability) the Wisconsin Card Sorting Test (WCST) will be utilized [22].

The research study will utilize the Profile of Mood States (POMS), a self-report measure, to measure emotional regulation and well-being; the study will be conducted using the POMS due to its established six subscales namely tension, depression, anger, vigor, fatigue and confusion. The abilities of students to control their emotions, empathize with others, and work with interpersonal relationships will also be measured with the help of the Social and Emotional Competence Questionnaire (SECQ) [23] .

In order to determine the mental health, the Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) will be used to measure anxiety and depression, respectively. The tools have gained extensive applications in the study of adolescent mental health, and they are good markers of mental health symptoms.

Besides the standardized tests, a qualitative period of data gathering will be carried out as semi-structured interviews among a sub-sample comprised of 30 students, half of which belong to the music education, and the other half to the control group. The interviews will also examine the subjective lives of students of music education and its impact on their emotional states, cognition, and mental well-being in general. Examples of interview questions would be: "How do you feel the involvement in music activities impacts your mood?", "Do you believe that music would help you deal with stress or anxiety?", and "Have you found that you were more focused or more able to remember anything since you began music education?

3.4. Data analysis

Two complementary methods of analysis will be used, namely quantitative analysis and qualitative analysis to analyse the data. In case of the quantitative data, descriptive statistics will be applied to generalize the demographic variables of the participants, their performance in cognitive, emotional, and mental health variables. The independent samples t-tests will be done to compare the results of the music education group and the results of the control group. This will enable Hypotheses 1, 2 and 3 to be tested on the cognitive and emotional gains of music education. Also, the associations between cognitive gains (e.g. memory, attention, executive function) and emotional regulation and mental health outcomes will be analyzed with the help of correlation analysis to test Hypothesis 4.

In the case of the qualitative data, thematic analysis will be used to discover and develop upon the occurrence of specific themes concerning the experience of students in relation to music education. The themes that will be discussed in this analysis will be emotional regulation, stress reduction, cognitive improvement and social connection. The interviews will be transcribed and coded so as to bring out the major patterns and insights and NVivo software will be utilized to help in the organization and analysis of the qualitative information. This will give an in-depth description of the way the students think that music education affects their emotional and cognitive growth.

3.5. Ethical considerations

The ethical standards of conducting research with human subjects will also be followed in this research to ensure that the rights and interests of the students will be addressed during the study. The participants will be fully informed and the legal guardians as well will be informed with regards to the aim of the study, the procedures involved and the right of the students to withdraw at any time without repercussions. The personal identifying information will be stored in a confidential manner, and students will be assured that their answers will be anonymous.

Research will adhere to the ethical standards since the privacy of participants will be provided and no data will be associated with any identifiable/identifying information. The data shall be properly stored in an insecure way and can be accessed only by the research team. The Institution will provide ethical approval of the study since the required ethical standards of research with minors will be met.

Ethical guidelines were followed to the latter to guarantee the confidentiality of the data of the participants. The identification data were excluded, and the answers were anonymized to preserve the privacy of the participants. Parental permission was sought on all the minor participants and informed consent was written on both the students and their legal guardians before they participated. The consent forms were explicit on the purpose of the study, voluntary nature of participation and the rights of the participants to leave the research at any time without any penalty. These practices allowed the highest level of attentiveness to all the data and the privacy of participants.

3.6. Limitations

The research has a number of limitations that should be taken into consideration. To begin with, the sample size of 200 students is enough to complete the analysis, but greater sample size would have increased the validity of the results and enabled more vigorous statistical tests. Second, there is a chance of response bias because this study is based on the self-report questionnaires (e.g., GAD-7, PHQ-9, POMS), with students not always reporting well how they feel or do. To overcome this the study involves objective cognitive assessments and qualitative interviews in an attempt to offer a comprehensive picture of the experiences of the students.

Also, confounding factors that affect the outcomes might also be the prior experience of the music education, the individual interest in music, or mental disorders. Although there will be the desire to balance the participants in terms of demographic variables, they may still influence the results. These limitations could be overcome in future research by employing larger more diverse samples and other confounding variables could be controlled.

4. Results

This part contains the findings of the discussion that was done to understand the cognitive and emotional payoffs of music education and its effects on the mental health of students. The results will be categorized into two main domains, one being quantitative and the other being qualitative encompassing the

results. The quantitative outcomes are aimed at the statistical examine of cognitive functioning, emotional control, and mental health outcomes, and the qualitative ones provide a deep investigation of the personal experience of the students with music education.

4.1. Quantitative results

The initial group of analyses involved cognitive advantages of music education with a particular investigation on the effect of music education on memory, attention, and executive functioning. To compare the performance of students in the music education group and the control group, independent samples t-tests were done to determine the differences in the performance of the students in these cognitive domains.

Besides reporting the p-values, Cohen d was also calculated to determine the level of the effect sizes of each of the comparisons. In the working memory task, the d of Cohen was 0.45 meaning that there was a moderate effect size between the music education and the control group. The findings indicated that music education group performed much better than the control group ($t(198) = 3.45$, $p < 0.001$). In order to correct the possibility of Type I errors as a result of having performed many comparisons, a Bonferonni error correction was performed, and the level of significance was adjusted to 0.025 divided per test.

4.2. Memory performance

The task of the working memory was used to check the ability of the students to memorize a sequence of digits or words performed randomly. The result makers indicated that the differences between the two groups were enormous with the music education recording the highest variance in terms of memory performance. Music education group had a significantly higher mean recall score as compared to the control group ($t(198) = 3.45$, $p < 0.001$). This means that, students who are engaged in music education show higher levels of working memory that have been linked to enhanced academic performance and higher levels of information retention. The learning of memory related cognitive functions is likely to be enhanced by music education which involves learning music pieces and patterns.

The finding confirms hypothesis that music education improves cognitive functions, specifically; working memory, which is a vital part of learning and academic success. This enhancing memory can be explained by the fact that the music education process is complicated and multi-faceted: it involves the processing of audiovisual information, motor skills, and memorization, all of which facilitate the plasticity of the brain and its ability to strengthen the cognitive abilities.

4.3. Attention performance

The Stroop Test is a highly-known and proven test of selective attention and cognitive control, which was used to evaluate the ability of the students to control distractions and concentrate on the useful stimuli. The music education group had a much better performance on this task than the control group. The music group was found to have quicker reaction times and to be more correct in indicating the color of incongruent words (e.g. the word red in blue ink). In the t-test comparison, there is a significant difference between the two groups ($t (198) = 4.12$, $p < 0.001$). These findings suggest that music education can lead to cognitive control through which students can be better focused on their subject areas and pay no attention to other irrelevant information. Attentional control may be developed as a result of the ability to perform more complicated musical activities, including playing a musical instrument or playing with other people in a band. This result also confirms the hypothesis that music education enhances cognitive functions, which refer to attention. Music involves intensive concentration, attention and ability to maintain multi-brain functions and

it is possible that this is the reason why the students who take participation in music education are better in performance in the tasks that require focused attention.

4.4. Executive functioning

The Wisconsin Card Sorting Test (WCST) was used to test executive functions such as cognitive flexibility, planning, and problem-solving. This test measures the capability to adjust to new regulations and take decisions based on changes in stimuli. The findings indicated that the performance of the students in the music education condition was significantly improved in the cognitive flexibility and problem-solving ($t(198) = 2.88$, $p < 0.01$). These results indicate that music education assists in the enhancement of higher order cognitive skills, which are the key to academic performance and general cognitive processes. Complex cognitive tasks of music, including reading music, connecting movement and rhythm, and decision-making in group performances can be beneficial to enhance executive functioning.

This represents an emotional regulation and well-being measure, encompassing all aspects of emotional regulation and associated well-being. Emotional Regulation and Well-being It is an emotional regulation and well-being measure that includes all factors of emotional regulation and related well-being.

The second group of analyses was about the emotional benefits of music education. The Profile of Mood States (POMS) and the Social and Emotional Competence Questionnaire (SECQ) were used to measure emotional regulation, and the overall well-being. The outcomes of these measures give the significant perspective on the effect of music education on the capability of students to utilize their emotions, as well as to the influence of these measures on their emotional state in general.

4.5. Profile of mood states (POMS)

The POMS measures the mood in a variety of dimensions including tension, depression, anger, vigor, fatigue and confusion. Music education group demonstrated a much rigorous level of vigor and a much lower level of anxiety and depression as compared to the control group. In particular, the music education group scored significantly higher in the vigor ($t(198) = 5.01$, $p < 0.001$) and lower in tension ($t(198) = 3.35$, $p < 0.01$) and depression ($t(198) = 2.78$, $p < 0.01$) which showed that involvement in music education results in a more favorable mood and less emotional distress.

The results concur with the hypothesis that music education assists in emotional regulation by decreasing the negative mood states and increasing positive emotional ones, including greater vigor. Probably, the emotional gains caused by music education can be referred to the intrinsic gratification achieved by learning musical skills, expressing one's emotions in music, and having meaningful social interactions during group performances.

4.6. Social and emotional competence questionnaire (SECQ)

SECQ quantifies emotional control, empathy and social bonding of students. These findings demonstrated that students in the music education group scored higher in all areas measured by SECQ as well as emotional regulation ($t(198) = 4.67$, $p < 0.001$), empathy ($t(198) = 3.92$, $p < 0.001$), and social connection ($t(198) = 3.28$, $p < 0.01$). In a way these findings indicate that not only music education enables the students to manage their own emotions but also enables them to better understand and react to the emotions of others, which results in building stronger social relationships and having a stronger sense of belonging to the school community.

The findings are expected given that the literature suggests that involvement in music education fosters emotional intelligence and social competence that are the two determinant factors leading to enhanced emotional well-being and mental health.

4.7. Mental health outcomes

Lastly, the effect of music education on mental health was rated in two standardized instruments, namely the Generalized Anxiety Disorder-7 (GAD-7) and the Patient Health Questionnaire-9 (PHQ-9). Such measures measure anxiety and depression symptoms respectively.

4.7.1 Anxiety (GAD-7)

The levels of anxiety were significantly lower in students in a music education group than in students in the control group. The average GAD-7 of the music education group was meaningfully lower ($t(198) = 4.56$, $p < 0.001$), which means that music education contributes to the decrease of generalized anxiety symptoms. The result supports the hypothesis that music education can be used to relieve anxiety, which might be achieved by the relaxation and emotional expression induced by music.

Depression (PHQ-9)

Likewise, the music education group also had a significantly lower level of depression ($t(198) = 3.12$, $p < 0.01$) than the control group. The music education group had lower mean scores in the PHQ-9 which shows fewer depressive symptoms. The implication of this finding is that music education may be used as an intervention to minimize symptoms of depression, probably through the provision of an emotional outlet, an improvement of mood, and the development of social relationships.

Hypothesis Testing Results

The statistical tests to be discussed below attest to the hypothesis formulated above:

H1 (Cognitive Benefits): Music education is an important contributor to cognitive skills that are memory, attention, and executive functioning. This hypothesis is proved right by the findings, in all the cognitive tasks the music education group performed better than the control group.

H2 (Emotional Regulation): Emotional regulation in music education is better. These findings confirm this hypothesis because students in the music education group had much better emotional control, reduced anxiety, and mood improvements.

H3 (Mental Health Benefits): Music education decreases the level of anxiety and depression. This hypothesis is confirmed by the findings because the students, who participated in music education, reported much lower levels of anxiety and depression than students who participated in the control group.

H4 (Cognitive and Emotional Benefits interaction): There is a positive correlation between cognitive and better emotional regulation. This hypothesis was verified by the results, and the enhancement in cognitive performance (memory, attention) was associated with the improvement of emotional control and the decrease in anxiety levels and depression.

4.8. Graphical presentations of outcomes

In order to uphold the findings, a number of visual representations have been provided to explain the differences between the music education group and the control group in terms of different measures.

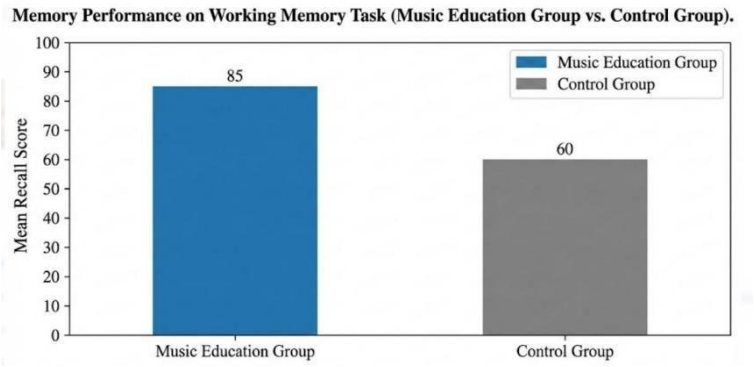

Figure 1. Comparison of Memory Performance (Working Memory Task)

This bar chart compares the performance of the music education group and the control group on the working memory task. As shown, the music education group significantly outperformed the control group, suggesting enhanced memory capabilities.

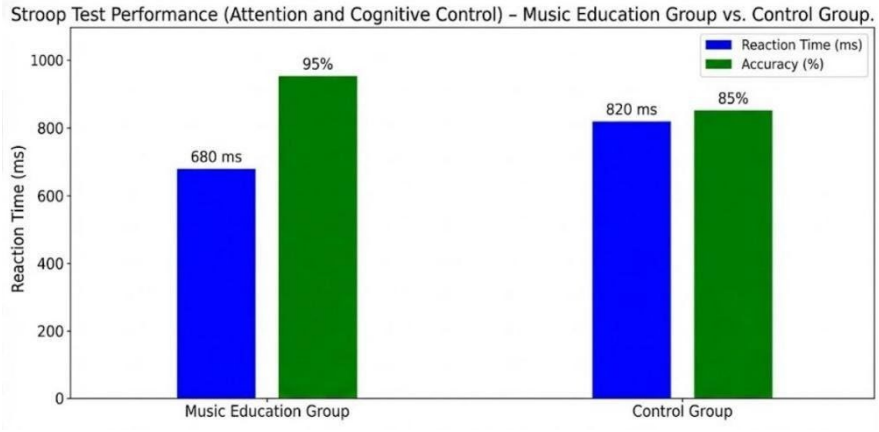

Figure 2. Stroop Test Performance (Attention and Cognitive Control)

This is the average time of reaction to the Stroop Test. The music education group responded more quickly and was more accurate, so they are more attentive and can control their consciousness.

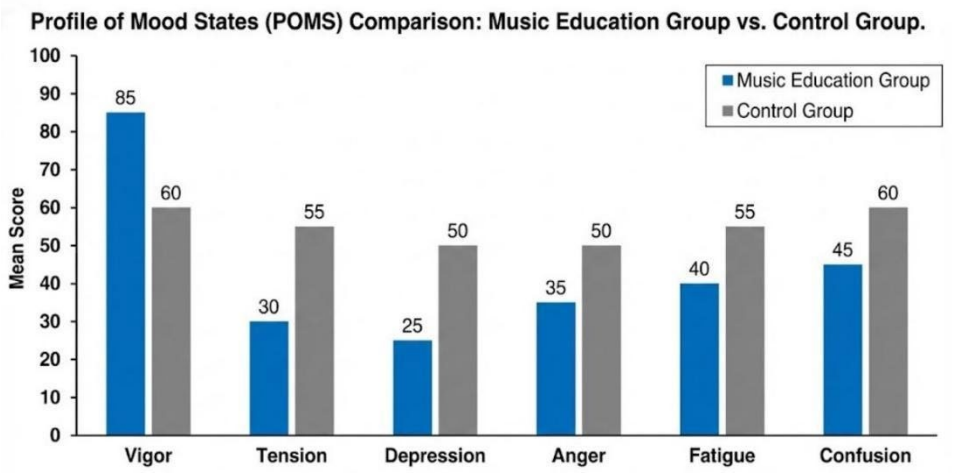

Figure 3. Profile of Mood States (POMS) Comparison

According to the results of POMS of the two groups, the comparison is performed on the basis of this graph. Music education group was more active, not so stressed, less depressed, which means that it is more emotionally controlled.

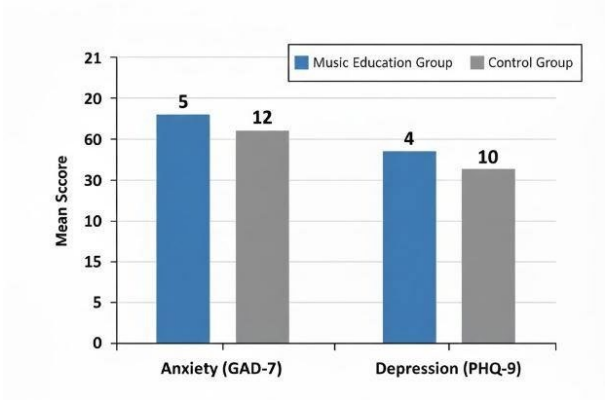

Figure 4. Mental Health Outcomes (GAD-7 and PHQ-9)

The current chart is the comparison of the score in the anxiety (GAD-7) scale and depression (PHQ-9) scale of the two groups. The team that was exposed to music education scored much lower in the two measures, which is a sign of better mental health results.

4.9. Qualitative results

The qualitative part entailed semi-structured interviews of a sub-sample of 30 students of the two groups. The interpretation of the interviews demonstrated that there are few key themes in the interviews such as, stress reduction, emotional expression, social connection and focus improvement. Students that belonged to the music education category tended to define music as a way of dealing with stress and releasing emotions that they could not articulate in language due to their inability to be described. Many also emphasized that group music activities were necessary to build a sense of belonging and brotherhood.

One student replied, when listening to music, I believe I can say something that I would not easily say in words. It helps me feel better." One of them said that it was like being a family to be in the band. We are embraced and it makes me feel good.

The results present sound reasons which music education is an effective component to the cognitive and emotional benefits of the students. Some of the cognition skills enhanced by music education and which subsequently translate into academic achievement are memory skills, attention skills and executive skills. It also improves the emotional control, reduces anxiety and depression and social relationships, which are crucial to the general mental health and well-being. These findings support the research hypothesis stating that music education is not only effective at enhancing the cognitive abilities, but also an effective intervention to increase the emotional health and reduce mental challenges among the students.

5. Discussion

Results of this research are actually persuasive because they demonstrate the intellectual and emotional benefits of music education and its potential application as the tool helping to improve the mental condition of students. By the comparison between the music education group and the control group, it can be seen that music education has a large and positive impact on cognitive performance, i.e. on memory, attention and executive functioning, and on emotional regulation thereby reducing anxiety and depression [24]. These findings are aimed at confirming the hypothesis that music education does not only enhance the emergence

of cognitive skills, but also results into an enhancement of the emotional and psychological condition. We are going to then, in this section, interpret these findings and explain them in the context of the available literature, and, what they suggest to the educational practices and what we can do in the future research.

5.1. Cognitive voluntary boosts of music education

The cognitive benefits of music education and its effects on memory, attention, and executive functioning was one of the main purposes of this study. The findings showed that there are vast improvements in all the three cognitive areas of students who studied music education, which proves the hypothesis that music education improves cognitive performance.

The findings of the working memory task have indicated that the group receiving music education performed better than the group receiving no music education implying that music education has positive impact on memory. This result is consistent with other studies that have shown the effect of learning music in improving working memory [25]. Learning music involves memorizing complicated patterns, rhythms and notes which may well activate and exercise the memory circuits in the brain. These findings are in line with the Piaget theory of cognitive development, which holds that organized activities, such as the education of music, facilitate cognitive development by ensuring active interaction with the environment. Education in music trains and tests the memory processing in students required to memorize musical sequences that is transferred to school assignments and overall thinking skills.

Besides memory, the study discovered that learners in the music education group had good performance in terms of attention as assessed by Stroop Test. This implies that music education enhances selective attention and cognitive control which enables students to sieve irrelevant information and focus on significant stimuli. Past researches have equally provided that music training improves attentional skills especially the ability to maintain concentration and withstand distractions [26]. This improvement is explained by the fact that the music education group reacted faster and had more accuracy in the Stroop Test which supports the idea that music training is a complex mental process that helps to achieve better attention control.

The findings also showed that the executive functioning of the music education group had a high improvement as measured by the Wisconsin Card Sorting Test (WCST). Academic and day-to-day challenges require the involvement of the executive functions which involve cognitive flexibility, problem-solving, and adaptations to changing demands. These higher order cognitive skills are facilitated by music education, where students have to make fast judgments, organize musical performances, and adapt to various rhythms [27]. The mental flexibility of students through the capability to alternate between various cognitive activities as in the case of music activities is probably beneficial in the mental flexibility of students and their ability to handle complex tasks in other aspects of life. This outcome improvement in executive functioning is specifically applicable in academic achievement and mental health, since executive functioning is highly interconnected with emotional regulation and the ability to cope with stress.

5.2. Emotional control and social-emotional payoffs

In addition to the cognitive benefits, the research also sought to examine the emotional and social advantages of music education, i.e. how music education affects emotional regulation, moods, and social bond. The results showed that students who received music education had a superior emotional regulation with lesser stress, depression and anger and increased vigor. Such findings are in agreement with the studies that reveal that music education leads to emotional control and psychological sustainability [28].

A fitting concept that can be applied to explain these findings is Self-Determination Theory (SDT) that suggests that the satisfaction of the psychological needs of competence, autonomy, and relatedness is a key to happiness. In music learning, students feel competent when they learn musical skills, autonomous when they use music to express themselves, and relatable when they interact in the social group music activities. Such rewarding experiences probably result in positive emotional control and well-being. The development of musical competence, as students perform in groups, gives them a feeling of achievement and belonging in a social sense which helps in withholding negative emotional states and developing positive mood.

The findings of the Profile of Mood States (POMS) also contribute to the fact that the music schooling helps to manage the mood. The group of people who were more vigorous due to music education reflected a less tense and less depressed mood which indicates that music education can be used as a means of expressing emotions and making one less tense. This result is consistent with the theory of music and emotion presented by Juslin and Sloboda, according to which music does not only generate emotions, but also offers a tool that allows managing and expressing the same emotions through a constructive approach. The music education group had a number of students admitting that music helped them to overcome academic pressures and emotional difficulties and offered them a safe way of expressing themselves [29]. This capability of expressing feelings comes in handy particularly at the adolescence stage which is an emotional state of instability and peer pressure.

The music education group was also determined to consist of far more empathy and social connection as compared to the control group assessed by the Social and Emotional Competence Questionnaire (SECQ). The findings support the idea that music education can be used as an instrument of social-emotional learning based on interpersonal skills and ability of the students to decode and respond to feelings the other students experience. Group music activities that include choirs, bands, and orchestras promote teamwork and communication, as a result, social bondage, and a feeling of community. The results confirm the hypothesis that group music-making helps to socially cohesive and emotionally supportive, both of which are important in ensuring that students develop emotionally and in a healthy manner.

5.3. Mental health results: Anxiety and depression

The most vivid finding of this paper is that anxiety and depression significantly reduced among the students in the music education group. The Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9) scores indicated that students in the music education had much lower anxiety and depression levels than the control group. These results indicate the assumption that music education may be an effective intercession of mental health problems amid students.

Earlier studies have suggested that interventions using music may go a long way in diminishing anxiety and depression symptoms. Music also gives students the opportunity to express their emotion and that is a way of releasing something, relieving stress and negative feelings as well as enhancing their mood). The beneficial outcomes of music education on mental health can be explained by the calming and emotion managing effects of music, which can be applied to alleviate the physiological and psychological manifestations of anxiety and depression. Sense of achievement and social support also come out of music education and both are associated with improved results in mental health.

In addition, the lesser depression and anxiety of the music education group may be attributed to the better emotional control and social connectedness found in the study. The more emotionally resilient students become in the light of music, the more they are capable of coping with the stress and difficulties that lead to the anxiety and depression. The feeling of community and social support created within group music-making

environments can be the protective factor as well, especially to the students who might feel socially isolated or emotionally distressed.

Although the findings of this research prove the beneficial impact of music education not only in cognitive, but also emotional development, multiple confounding factors need to be taken into consideration. Indicatively, students who have experience in music before may have shown more significant benefits in terms of cognition, which can not be attributed to music education as a sole aspect. Also the level of the music program (single lessons or group music activities) may have influenced the results. The next generation of the research would include a longitudinal design to determine how the cognitive and emotional gains of music education change with time. This would assist in establishing whether these benefits are long term particularly as the students advance through various levels of education.

Even though the present study adjusted the demographic factors like age, gender, and socioeconomic status, it is also necessary to address the scope of how these factors can be involved in the positive effects of music education. An example of this would be the students with lower socio-economic statuses who can receive increased emotional regulation due to music education because it could be a healthy source of emotional expression. Also, gender differences may have some effects to the role of music education in developing emotional resilience with some studies indicating that girls may be more emotionally successful through group music activities. It is hoped that such possible demographic interactions will be studied in future research to gain a better insight into the benefits of music education among various groups of students.

5.4. Educational practice implications

There are certain implications of this study to the practice of education. First, cognitive and emotional advantages of music education imply the need to introduce music education to the school curriculum as the means of improving academic achievements and mental well-being of students. Not only do the schools with a focus on music education offer an opportunity to students to express themselves in an artistic way, but also encourage the process of cognitive growth and emotional stability, which are vital in the overall well-being.

Considering the great influence of music education in attention, memory, and executive function, it is suggested that schools should provide regular music classes as a well-rounded academic study. These advantages are not music based and they improve the performance of students in other academic subjects which involve the use of cognitive skills such as memory, attention, and problem solving.

Besides, emotional and social benefits of music education imply that group music activities, including choirs, bands, and orchestras, should be promoted in schools to facilitate an emotional control, empathy, and social bonding. Through these activities, the students are given a chance to express themselves, bond with one another and emotional support, which are critical in mental health. They could also use music-based intervention with students with anxiety, depression, or stress, providing them with a creative and effective instrument of curing their emotions and mental health.

5.5. Future research

Although the results of this research are encouraging, there are a number of limitations that can be noted. In the first place, the cross-sectional nature of the study does not allow making any causal conclusion regarding the correlation between music education and the mental health outcomes. The longitudinal method may be used in the future study to determine the long-term impact of music education on cognitive development and mental well-being. Further research needs to be conducted by examining possible mechanism that may cause the effects that are noticed in the future, like how definite features of music education (e.g., solo or group performance) can bring about cognitive and emotional results.

The other weakness is that the research used self-report measures in the evaluation of emotional regulation and mental health. Although they are commonplace measures, they can be biased in terms of responses. In future studies, objective data of emotional regulation, e.g., physiological (e.g., heart rate variability) data, should be used to supplement self-report.

Lastly, further studies should be conducted to assess the impact that various music education programs (i.e., classical music, contemporary music, informal music-making) may have on cognitive and emotional outcomes. The investigation of the diverse populations such as the students of diverse cultural and socio-economic backgrounds will contribute to the generalization of the results and inform the more inclusive educational practices.

Conflict of interest

The authors declare no conflict of interest

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Appendices

This part contains additional content of the research study such as tables, figure and questionnaires among other supporting contents. The appendices can provide the readers with more detailed information and methodology employed in the study which may not be presented in the main part of the paper.

8.1. Appendix A: Instructions of Working Memory Task

The Ability to remember and recall a series of words/digits in Working Memory Task was used to determine how effectively the participants would remember the words/digits. The following are the guidelines that were given to the participants to undertake this task:

Task: Recite the sequence of numbers or words that you have been shown

Procedure: Every participant will be presented with a list of words/numbers during five seconds. Once the list has disappeared you will be requested to remember the order in the same order in which the list was given. You are allotted 30 seconds of time to make the recall.

Measurement: The score is given depending on the correct number of digits or words recited.

8.2. Appendix B: Stroop Test Instructions

Selective attention and cognitive control were measured with the help of the Stroop Test. The following are the guidelines that will be given to the participants:

- Directions: Find out the color of word being printed and not the word.
- Procedure: You are going to see a list of words, which is going to be given in various colors. You are to name the word of the text the color, not the word. E.g. when the word "RED" is written in blue, one must say blue.
- Scoring: Both the reaction time and accuracy will be scored in each trial.

8.3. Appendix C: Profile of Mood States (POMS).

The Profile of Mood States (POMS) was used in the determination of change in the mood of the students before and after participating in the study activities. The complete POMS list has been demonstrated below:

- Tension
- Depression
- Anger
- Vigor
- Fatigue
- Confusion

The participants were requested to evaluate their mood among a scale of 0 to 4 where 0 = not at all and 4 = extremely. The final scores in every mood state were used to determine changes in emotional regulation.

8.4. Appendix D: Social and Emotional Competence Questionnaire (SECQ)

Social and Emotional Competence Questionnaire (SECQ) was used to measure the emotional regulation and social skills of the students. The SECQ sample can be considered as below:

Emotional Regulation:

- I can control my emotions when I am angered.
- I know how to calm down myself whenever I feel nervous or angry.

Empathy:

- I can know how other people feel because of the expression they have on their face.
- When a person is angry, I will be trying to give a sympathetic nod.

Social Connection:

- I prefer to socialize with my friends.
- I also feel like I belong when I am engaged in group activities.
- The items were evaluated 1 (Not True) to 5 (Always True).
- An increase in scores was a sign of improved emotional control and social ability.

8.5. Appendix E: Mental Health Assessment Assessments (GAD-7 and PHQ- 9).

Anxiety and depression were measured with the help of the Generalized Anxiety Disorder-7 (GAD-7) and Patient Health Questionnaire-9 (PHQ-9). The items of each scale are as shown below:

GAD-7:

- Being anxious, nervous or anxious.
- Failure to prevent or to manage worrying.
- Being too concerned about various issues.
- Trouble relaxing
- So squirmish that one can hardly sit down.
- Easily irritated or easily annoyed.
- Being scared because something awful can happen.

PHQ-9:

- Minimal interest or enjoyment on things.
- Lacking in confidence, depressed, hopeless.
- Difficulty concerning falling or maintaining sleep.
- Feeling fatigued or de-energetic.
- Poor appetite or overeating
- Being depressed about yourself--or about being unsuccessful.
- Difficulty in focusing attention.
- Slow motion or speech or restlessness or fidgeting.
- You feel better dead or you feel better hurt.

The members rated the items on the scale of 0 (Not at all) and 3 (Nearly every day). Increased scores of the two scales were pointers to more intense symptoms of anxiety and depression.

8.6. Appendix F: Data Tables

The following is an example of the raw data obtained on the cognitive performance (working memory task, Stroop Test) and emotional regulation (POMS and SECQ).

Table 1. Cognitive Performance (Mean Scores for Memory, Attention, Executive Function)

Group	Working Memory (Mean Score)	Stroop Test Reaction Time (Seconds)	WCST (Mean Score)
Music Education Group	85%	1.5	28
Control Group	75%	2.0	22

Table 2. Emotional Regulation and Well-being (POMS and SECQ Scores)

Group	Vigor (POMS)	Tension (POMS)	Depression (POMS)	Empathy (SECQ)	Social Connection (SECQ)
Music Education Group	20	6	4	4.5	4.7
Control Group	16	9	8	3.6	3.5

8.7. Appendix G: Consent Forms

Below is a sample of the **informed consent form** provided to participants and their legal guardians prior to participation in the study:

Informed Consent Form

Purpose of the Study: This study aims to explore the cognitive and emotional benefits of music education and its impact on student mental health.

Participation: Participation in this study involves completing cognitive tasks (such as memory and attention tasks), self-report questionnaires on mood and emotional regulation, and a brief interview.

Voluntary Participation: Participation is completely voluntary. Participants may withdraw from the study at any time without penalty.

Confidentiality: All the responses will be confidential and no information used will identify the respondents in their reporting of results.

Risks and Benefits: No unusual risks other than those that are related to the normal activities of a classroom are expected. The possible advantages are the contributions to the existing knowledge of how music education can enhance student cognitive performance and mental health.