



Research article

Emotions and music through an innovative project during compulsory secondary education

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ABSTRACT

This article presents the results and main conclusions of a quasi-experimental study after the implementation of an innovative project extended as a multi-year programme, called 'MusMotion', applied in compulsory secondary education, which is based on the relationship between music and emotions, as well as its effects on the academic performance of adolescents. The research analysed and tested an educational innovation project that improves students' academic performance, as well as the classroom climate between teachers and students ($N = 444$). A key strand of this research concerns the use of music to support students' emotional development and awareness. As we will explain, the results of this research have shown positive outcomes that have direct implications for pedagogy and classroom practice.

The results confirm that there is a relationship between emotions and students' academic performance, and the innovative educational programme MusMotion can help to improve students' academic performance and the classroom climate by improving their state of mind. Educational systems, through the management of emotions via music, could help many children who today may have difficulty with their emotions.

1. Introduction

When children reach adolescence, they go through a period of change that affects them both physically and emotionally. It is a time of discovery and bewilderment, in which their emotions can become uncontrolled because they do not know how to manage them. Emotions entail changes in human beings of diverse types: in feelings and moods, such as nostalgia, joy, or sadness; in cognition, and in behaviour [1].

To this must be added the difficulties caused by the global COVID-19 pandemic, which has affected the entire population and especially adolescents. The consequences of COVID-19 have become a critical issue in education. There are many research works and articles published in different countries that investigate the disruptive and unexpected changes that adolescents have shown due to the

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measures adopted as a result of the pandemic: social distancing, strict lockdowns, home isolation, and the suspension of all in-person educational procedures [2–6].

In the face of these challenges, emotional education is a key tool for achieving a satisfactory level of personal well-being, and its application is fundamental at all ages, but especially in childhood and adolescence. Several authors suggest that the education system does not adequately prepare students and provide them with the tools to be able to deal with the challenges and expectations of the future. Having a good knowledge of the curriculum does not guarantee that the student will be able to succeed in adulthood with life skills [7–9].

This research has identified that emotional education enables the development of skills such as emotional awareness, self-regulation, self-efficacy, and integrity. The acquisition of these skills provides adolescents with better development options for both their personal and professional futures at the end of their pre-university studies [10–14].

In recent decades, scientific evidence has shown that music can help us to manage our emotions and feelings, gain control over ourselves, increase our self-esteem, and balance our emotional well-being [15–24]. Human beings can coexist with music at any moment and any time. It is an art that allows us to vividly recall events of the past, enjoy the present and imagine the future, thanks to the intrinsic outpouring of emotions. The use of music as therapy –music therapy– can have concrete effects on the human being [25–29]. These effects can be of various forms.

- Biochemical effects: through the secretion of hormones, neurotransmitters, and neuromodulators.
- Cognitive effects: by facilitating the focusing of attention and concentration on the musical experience and work, the restructuring of thoughts, and the development of a sense of order and emotional analysis, facilitating the reasoning process through relaxation.
- Motor effects: through specific activities that work on and/or stimulate coordination, balance, and mobility.
- Social effects: music has the capacity to unite and share, and therefore facilitate dialogue. Specific activities can promote experiences of social interaction, generating complicity between group members.
- Psycho-emotional effects: receptive and active musical techniques facilitate the expression of emotions and feelings verbally and non-verbally, while awakening, evoking, provoking, strengthening, and promoting the elicitation of new emotions and feelings.
- Physical effects: music can have a relaxing or stimulating effect that can help us to release internal energy and, for this reason, can also help to achieve emotional balance.
- Psychological and transcendental effects: music therapy can help us to process life changes, to process losses, as well as to reflect upon and give new meaning to our experiences.

In educational terms, music at the end of the 20th century started to become an object of research because of the impact it has on the development of general and emotional skills, as well as its social impact. However, the need for music education as an educational value has been recognised long before throughout history by thinkers from Greek antiquity such as Plato, Aristotle, as well as by other figures from different spheres of the religious, political, or academic spheres, such as Saint Augustine, Boethius, Martin Luther, John Amos Comenius, Pestalozzi, etc. The argument that defends music education as a value continues to this day [30,31].

The study of the implications of music in psychology, communication, formal and informal learning, as well as the interrelation between the different arts, is becoming more and more frequent in scientific works on music education [32,33]. Although neuroscience has a long history in the scientific world, in the case of specific publications on music and education, it is only since the last few years that it is having more impact, but we are still in the early stages.

The literature and previous studies have been reviewed to explore how music can contribute to improving students' mood and be an effective tool for improving classroom climate and academic performance. Recent trends in research on musical behaviour and development suggest that researchers are becoming increasingly aware of the significance of development in music and through music [34].

In recent years, there has been growing interest in the importance of emotions and their direct influence on academic performance and school climate. The teaching and learning process is linked to emotional states that regulate students' tasks [35–37]. This line of research is supported by numerous authors who have found a direct relationship between emotional quotient (EQ) and academic performance. Several studies –for instance, Billings et al. (2014), Brouzos et al. (2014), and Wong et al. (2021)– highlight that the promotion of a positive school climate is beneficial for academic development, influences students' behaviour, and may be a determinant to improve their grades [38–40].

2. Innovation project 'MusMotion'

MusMotion is an innovative self-designed project that aims to improve the academic performance and classroom climate among adolescent students in compulsory secondary education. It is based on the regulation of the pupils' mood and, emotional and personal state, using music as a transversal element for this purpose.

This project can be extended as a multi-year programme, but in our research, we analyse data from the first year of the implementation of this project.

The project consists of 3 different phases.

- 1st Phase: initial test among all participants to determine their perceptions of the relationship between music and emotions.
- 2nd Phase: implementation of the project (workshops, talks, reflections, practical cases, etc.) and analysis of the process.
- 3rd Phase: final test among all participants to determine their perceptions of the relationship between music and emotions.

During the last phase, a reflection stage will be included, where an attempt will be made to identify improvements to include in the teacher training that enables them to subsequently apply it in the classroom, using the relationship between music and emotions, thus improving the educational system and day-to-day processes in the classroom.

The specific objectives of the 'MusMotion' project are as follows.

- Emotional awareness: to improve awareness of one's own emotions and those of others, and to notice the emotional climate in each context.
- Emotional regulation: to improve the regulation of the mechanisms and processes that we activate when we feel threatened or in danger, whether at a personal, social, or cultural level, in response to an intense emotion.
- Social competence and personal autonomy: to improve our ability to cope and make decisions on one's own initiative. Social competence and personal autonomy are of the utmost importance to create a climate of equality.
- Competences for life and well-being: to encourage the adoption of appropriate and responsible behaviours to cope successfully with the daily challenges of life, be they personal, professional, family, social, leisure, etc.
- Classroom climate: to improve the school environment experienced by teachers and students by building on their perceptions of the school context that determines their behaviours, well-being, and peer teacher relationships.

All the objectives were implemented through the organisation of different activities: workshops, reflections, and conferences. The educational methodologies used were based on cooperative learning, class assembly, active participation and communication, attention to emotional intelligence, the use of routines related to social skills, conflict resolution strategies, and the use of music to express and perceive emotions.

The number of sessions used for the implementation of the innovative project, throughout the academic year, was a total of 25. The frequency of these sessions was weekly if there were no holidays or exam periods. The sessions normally took place in the Music room, except for the conference sessions, which were placed in the Events room.

In each session, different activities were carried out, which are detailed in the following section. Each session lasted 50 min. In these sessions, different melodies were introduced and through group dynamics, workshops and reflections, the identification of emotions, their expression and self-regulation were worked on.

2.1. Activities

2.1.1. Workshops

All the students attend different workshops during the scholar academic year, with different topics.

- Associate a piece of music with each emotion: Group reflections are shared, and each emotion is studied in groups.
- Talking with songs: They can sing or hum the fragments, or electronic devices such as mobile phones or tablets can be used to play the fragments.
- Musical transitions: This is a workshop that helps to improve the self-control of each subject by playing background music for a few minutes.

2.1.2. Reflection

There is at least 1 trimestral reflection where all students share their reflections on the relationship between music and emotions.

These reflections can be programmed as a coexistence between the classrooms, where exhibitions, talks, and colloquia are organised with the aim that all participants share their reflections and learn from each other.

2.1.3. Conferences

Conferences about emotions, music, self-regulation, etc., are organised in the classrooms, where experts in the field can participate and show, in a practical manner, each case and the difficulties that they have encountered, as well as their advice regarding how to overcome them.

To encourage active attendance at conferences, it would be highly recommended to award 1 extra point to the attending students if they submit a summary.

2.2. Qualitative and quantitative assessment

The evaluation of the project is carried out using two Likert-type scales, one dedicated to academic satisfaction and the other to the overall evaluation of the project.

The academic satisfaction scale is composed of seven items and the programme evaluation scale is composed of eight items. These scales will be explained in more detail in Section 4.2.

3. General and specific objectives

Being aware of the importance of music in education and its close relationship with emotions, this research aims to quantify and discern the relationship between emotions and the academic performance of adolescent students between 12 and 15 years of age, and,

finally, to implement and evaluate an innovative project, called MusMotion, to aid the development of emotional skills and improve the classroom environment for secondary school students by using this programme and its innovative methodology.

3.1. General objective

Upon understanding the relationship between music, emotions, and academic performance, we aim at designing and implementing a programme to educate emotions through music and test its effect on a group of adolescents.

3.2. Specific objectives

1. To explore, determine and describe the nature and strength of the relationship, if any, between emotions and the academic performance of students.
2. To design a programme to induce emotions through music, as a kind of music therapy. To that end, a list of melodies to induce certain emotions in adolescents is to be obtained.
3. After implementing the programme, analyse the changes produced in the participants depending on whether they belong to the experimental or control group in terms of the effectiveness of the MusMotion innovation project around academic performance and classroom climate.

4. Method

4.1. Participants

The sample consisted of 444 high school students who voluntarily decided to participate in the investigation and who were subdivided into two groups. Study 1 participants included 224 adolescents aged 12–14 years ($AM = 12.90$; $SD = 0.65$), evenly distributed by gender and age (53.13% girls; $N = 60$ aged 12 years; $N = 125$ aged 13 years; $N = 39$ aged 14 years; 46.88% boys), and of middle socio-economic status. Study 2 participants included 220 adolescents aged 13–15 years ($AM = 13.66$; $SD = 0.66$), evenly distributed by gender and age (53.18% girls; $N = 59$ aged 13 years; $N = 122$ aged 14 years; $N = 39$ aged 15 years; 46.82% boys), and of middle socio-economic status. All participants in both studies were enrolled in years 1–3 of compulsory secondary education in state-subsidised schools in the Community of Madrid, Spain (Fig. 1). No missing data were found.

4.2. Measures

The instruments used for measurement were as follows.

- The Emotional Awareness Questionnaire [41] is a Likert-type scale consisting of 30 items with 3 possible answers (0 = Not true, 1 = Sometimes, 2 = True), which is composed of 6 factors. The 6 factors are:
 - o Differentiating emotions: ability to identify, discriminate, and understand the cause of one's emotions;
 - o Sharing emotions verbally: ability to communicate one's feelings to others;
 - o Not hiding emotions: reflects the open and appropriate expression of emotions;
 - o Body awareness: reflects the ability to connect physical sensations with emotions;
 - o Attending to others' emotions: refers to an interest in listening to and/or perceiving the emotions of others;
 - o Analysis of one's own emotions: indicates interest in perceiving and understanding one's own emotions.

All the factors presented adequate psychometric properties in previous studies [41]. The indices of the Spanish version (using the maximum likelihood method and robust S-B correction) are as follows: $p < .001$, $\chi^2(378) = 5709.25$, S-B $\chi^2(335) = 805.7900$, NFI =

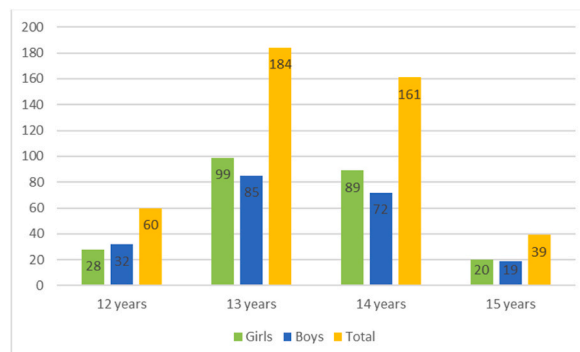


Figure 1. Distribution of participants according to gender and age ($N = 444$).

0.92, CFI = 0.91. IFI = 0.91, RMSEA = 0.03 [42].

- The Mood Questionnaire [43] is a Likert-type scale consisting of 16 items with 3 possible answers (0 = not true, 1 = sometimes, 2 = true) and assesses the frequency of different mood states: Sadness, Fear, Anger, and Happiness.

The psychometric properties of the Spanish version are also adequate: $p < .001$, $\chi^2(98) = 379.624$, S-B $\chi^2(98) = 286.943$, NFI = 0.936, CFI = 0.957. IFI = 0.957, RMSEA = 0.036 [42].

- Academic performance was assessed by means of the average mark for the academic year in which the data were collected as follows:
 - o Failed: average mark <5 ;
 - o Pass: average mark $\in [5, 6)$;
 - o Good: average mark $\in [6, 7)$;
 - o Remarkable: average mark $\in [7, 9)$;
 - o Outstanding: average mark $\in [9, 10]$.

In addition, two groups were established depending on whether the students had passed all the subjects of the course.

- Classroom Climate was assessed using the Brief Scale for Assessing Classroom Climate in Secondary Education [44]. It is a Likert-type scale consisting of 11 items with 10 possible responses (from 1 = never to 10 = always) that measures 2 dimensions:
 - o Group cohesion: this is an observable horizontal dynamic factor among the components of a group and refers to the degree of satisfaction, involvement, and cohesion existing among them.
 - Satisfaction and involvement;
 - Cohesion among equals.
 - o Group management: this is a vertical factor between teacher and learner and refers to the way in which the teacher successfully influences the development of the class through order and organisation, task orientation, and the quality of his or her relationship with the learners.
 - Teacher student relationship;
 - Order and organisation;
 - Task orientation.

The validity properties of the scale were all satisfactory, including content validity, criterion validity, construct validity, and reliability.

- In the case of academic satisfaction with the classes, the scale suggested by Lent et al., composed of seven items that assess the degree of satisfaction of students with respect to academic activity, was used [45]. Each of the students who participated in the study responded using a 5-point Likert-type scale, ranging from 1 for “totally disagree” to 5 for “totally agree.”
- The programme evaluation was conducted with an ad-hoc questionnaire for this research. The questionnaire was a Likert-type scale consisting of 8 items with 4 possible answers (0 = never, 1 = sometimes, 2 = many times, 4 = always) measuring 3 dimensions. Three items referred to emotional well-being, 3 items assessed classroom climate management, and 2 items measured programme and classroom organisation. The programme evaluation questionnaire was completed by the participating students before and after the implementation of the educational innovation programme conducted.
- The Geneva Emotional Music Scale [46] is a Likert-type scale consisting of 25 items with 5 possible answers (0 = not at all, 1 = somewhat, 2 = moderately, 3 = quite a lot, 4 = very much) that assesses personality, emotion, and music. This was the validated scale used in the project. Thanks to this scale, the melodies that were to be used in the following year in the teaching innovation proposal were objectively chosen to arouse the desired emotions for the preparation of the classes.

4.3. Design and procedure

The research was conducted during two academic years, between September 2019 and June 2021, once it was approved by the Ethics Committee of University Rey Juan Carlos (identification code: 1003202108821). To carry out this research, the purpose and procedure of the studies were explained to all participants, who provided written informed consent, which covered written informed consent, the right to information, confidentiality, anonymity, gratuity, and the option to abandon the study [47]. Once they accepted the proposal, the research began.

During the first year of this research, we analysed whether there was a relationship between academic performance and students' emotions. This first study was carried out in June 2020, analysing school averages for the academic year 2019/2020 in a secondary school in the Community of Madrid ($N = 224$ students) using two validated scales: the Emotional Awareness Questionnaire and the Mood Questionnaire. Students completed the tests in approximately 40 min. The statistical power ($1 - \beta = 0.95$) exceeds the minimum levels required with ($\alpha = 0.05$). This statistical power analysis was carried out using the open-source software G*Power v.3.1.9.7, which allows estimating statistical power. The appropriate total sample size was obtained for our study.

Once the initial hypothesis was confirmed, the relationship between students' academic performance and their emotions was

verified, and the validated musical scale GEMS25 was used to obtain a list of melodies and songs that complemented and aided the educational innovation project that was implemented during the second year of the study. These melodies were classified according to basic emotions.

The melodies that were ranked as the calmest were used to calm the pupils and the melodies that scored highest in positive and happy valences were used to improve their mood.

During the second year of the research, the MusMotion innovation project was implemented fully during the academic year 2020/2021, between September 2020 and June 2021, and, once the academic year was over, the results were analysed ($N = 220$ students). The results of the untreated control group and the experimental group were compared, i.e., quasi-experimental case control research with pre-test and post-test was carried out. Classroom climate data were collected using López and Bisquerra's validated scale, the Short Scale for Assessing Classroom Climate in Secondary Education [44]. Students completed this scale in 30–35 min. The teachers who taught in both groups did not know which group was the control group and which group was the experimental group, thus ensuring that there was no bias as the evaluators were blinded.

Both groups in the quasi-experimental study were homogeneous and balanced in terms of gender and age.

MusMotion is an innovation project that can be extended as a multi-year programme, but, in our research, we analysed data from the first year of implementation of this project.

The instruments used in the studies were administered collectively during allocated class time, using the computer-assisted web interview technique, via Microsoft Forms.

All non-native Spanish instruments were linguistically and culturally adapted. The translation procedure was back-translation: they were translated into Spanish by means of a first translation, forward translation, conducted by two translators who were native speakers of the target language and had a good command of the original language of the instrument. Subsequently, the two translations were compared, and corrections were made, focusing on conceptual equivalence and linguistic agreement. Subsequently, a backward translation was carried out, i.e., a reverse translation into the original language of the instrument. This backward translation was carried out by a different translator who had a good command of the target language and whose native language was the language of the original version, and who was not involved in the purpose of this translation. The back-translation was reviewed, and the original instrument was compared with the new adapted version, both in the same language, and finally it was reviewed again in case discrepancies arose to be discussed and, if necessary, changes could be made, or the translated version could be used if there was agreement on the semantic equivalence of the original and translated versions.

The person responsible for the implementation of MusMotion was the specialist teacher of the music subject, and, occasionally, external collaborators from outside the school were involved by providing workshops, talks, reflections, practical cases, and conferences.

Pre-tests were administered to both the control and experimental groups at the beginning of the course in September 2020, and the post-test was administered in June 2021. During the course, project monitoring sessions were held to keep abreast of the situation, its evolution, and any support that could be given between the researcher and the person responsible for the project's implementation. The degree of satisfaction with the implementation of the project was also evaluated periodically.

4.4. Data analysis

Statistical studies of the data in this research were conducted using SPSS (IBM SPSS Statistics) statistical software. Missing values were evaluated, considering the items of each instrument, to estimate whether they responded to a random distribution [48]. The arithmetic mean, SD, skewness, and kurtosis were also calculated in each case.

In the first study, descriptive analyses, Spearman's bivariate correlations, Student's t-tests, and stepwise hierarchical regression analyses were carried out and the assumptions made were tested [49].

Descriptive analyses and Student's t-tests were again used in the second study. The descriptive statistics of the MusMotion evaluation were obtained through a questionnaire that was completed with the pre-test and post-test by all students in the control group and the experimental group.

Academic satisfaction was also evaluated, carried out in this case using Lens et al.'s validated scaling of students' satisfaction with MusMotion [45].

5. Results

Compliance with statistical assumptions was verified, an exploratory factor analysis was applied to demonstrate the underlying structure of the scale, and its internal consistency was estimated using Cronbach's alpha statistic. First, the amount and pattern of missing data were examined using the missing value analysis routine in SPSS. No studies were performed to assess the randomness pattern of the missing values as these did not account for more than 5% of the missing values. No outliers were observed [50]. Following Zabala's recommendations, the T-distribution was used to determine statistical significance, and the results were favourable, with no cases exceeding the considered threshold [51]. Skewness and kurtosis were also calculated to determine the distribution of the variables. In this way, it was possible to determine the characteristics and homogeneity without the need to represent them graphically [52].

5.1. Study 1

In study 1, correlation analysis, differential analysis, and predictive analysis were carried out to analyse whether there was a relationship between academic performance and emotional awareness, whether there were differences in emotional variables according to academic performance, and whether certain variables of emotional awareness and mood states could affect academic performance.

5.1.1. Correlational study

The relationship between academic performance and emotional awareness was analysed using Pearson’s coefficients (Table 1). A statistically significant and positive relationship was observed with the variables “verbal exchange of emotions”, “body awareness”, “attention to the emotions of others”, and “emotion analysis”, and a negative relationship with “distinction emotions”.

Similarly, a statistically significant relationship was observed with mood states (Table 2): a positive relationship with happiness, and a negative relationship with sadness, anger, and fear.

Table 1 shows that there were correlations between academic performance and several of the items studied on emotional awareness (Table 1). There was a very good correlation with distinction emotions, a good correlation with body awareness and emotion analysis, a moderate correlation with attention to the emotions of others, and a low correlation with verbal exchange of emotions.

Table 2 shows that there were significant correlations between academic performance and several of the mood items studied (Table 2). There was a high correlation with happiness and sadness, a moderate correlation with anger, and a low correlation with fear.

5.1.2. Differential analysis

Secondly, a multivariate analysis of variance (ANOVA) was performed to test whether there were differences in the emotion variables according to academic performance. Once the Levene test was performed, it was determined that equal variances could be assumed for each item, according to the significance obtained by this test. Subsequently, the result obtained from the bilateral significance was evaluated for each of the items analysed. In this way, significant differences were observed in the following: distinction emotions ($F = 0.384$; $gI = 222$; $p \leq .050$), verbal exchange of emotions ($F = 32.990$; $gI = 47.203$; $p \leq .000$), body awareness ($F = 6.279$; $gI = 66.174$; $p \leq .005$), attention to the emotions of others ($F = 0.021$; $gI = 222$; $p \leq .000$), emotion analysis ($F = 0.279$; $gI = 222$; $p \leq .005$), sadness ($F = 0.087$; $gI = 222$; $p \leq .000$), happiness ($F = 7.160$; $gI = 49.765$; $p \leq .000$), and anger ($F = 0.007$; $gI = 222$; $p \leq .050$).

Subsequently, to facilitate the comparison between groups, the study participants were regrouped according to whether or not they had passed the course analysed, and then Student’s t-test was performed with these two groups (Table 3). As can be seen in the following Table 3, there were statistically significant differences in the same variables as in the ANOVA: distinction emotions, verbal exchange of emotions, body awareness, attention to the emotions of others, emotion analysis, sadness, happiness, and anger (Table 3).

5.1.3. Predictive analytics

Thirdly, a stepwise multiple linear regression analysis was performed, with the variable “academic performance” (average mark of the students at the end of the course) as the criterion variable, and distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others, and sadness as predictors (Table 4).

As can be seen in Table 4, 58.6% of the variation in students’ academic performance can be explained by distinction emotions, which, once corrected for the effect of the sample and the independent variables, is 58.5%, with a standard error of the estimate of 0.842.

Secondly, 71% can be explained by distinction emotions and body awareness, which, once corrected for the effect of the sample and the independent variables, is 70.7%, with a standard error of the estimate of 0.707.

Thirdly, 75.4% can be explained by distinction emotions, body awareness, and happiness, which, once corrected for the effect of the sample and the independent variables, is 75.1%, with a standard error of the estimate of 0.652.

Fourthly, 78.1% can be explained by distinction emotions, body awareness, happiness, and emotion analysis, which, once corrected for the effect of the sample and the independent variables, is 77.7%, with a standard error of the estimate of 0.617.

Fifth, 79.4% can be explained by distinction emotions, body awareness, happiness, emotion analysis, and attention to the emotions of others, which, once corrected for the effect of the sample and the independent variables, is 78.9%, with a standard error of the estimate of 0.600.

Table 1
Correlation between academic performance and emotional awareness.

		Emotional Awareness Questionnaire					
		Distinction emotions	Verbal exchange of emotions	No hiding of emotions	Body awareness	Attention to the emotions of others	Emotion analysis
Academic performance	Pearson Correlation	-.802**	.175**	-.001	.598**	.491**	.626**
	Sig. (bilateral)	.000	.009	.988	.000	.000	.000
	N	224	224	224	224	224	224

* $p < .05$; ** $p < .01$.

Table 2
Correlation between academic performance and mood.

		Mood Questionnaire			
		Sadness	Happiness	Anger	Fear
Academic performance	Pearson Correlation	-.635**	.722**	-.403**	-.298**
	Sig. (bilateral)	.000	.000	.000	.000
	N	224	224	224	224

* $p < .05$; ** $p < .01$.

Table 3
Mean differences in emotional variables according to whether or not the student passed the course studied (Student's t-test).

	Items	Pass or not?		t	p
		Yes AM (SD)	No AM (SD)		
Emotional Awareness Questionnaire	Distinction emotions	1.03 (.26)	1.86 (.24)	18.994	.000
	Verbal exchange of emotions	1.13 (.32)	.65 (.47)	-6.250	.000
	No hiding of emotions	1.03 (.21)	1.01 (.31)	-.433	.667
	Body awareness	1.17 (.29)	1.03 (.24)	-3.287	.002
	Attention to the emotions of others	1.60 (.24)	1.42 (.22)	-4.302	.000
	Emotion analysis	1.40 (.32)	1.23 (.29)	-3.164	.002
Mood Questionnaire	Sadness	.29 (.31)	.68 (.29)	7.398	.000
	Happiness	1.70 (.29)	1.11 (.37)	-9.607	.000
	Anger	.48 (.34)	.61 (.31)	2.235	.026
	Fear	.55 (.34)	.56 (.25)	.244	.808

Table 4
Regression analysis on academic performance.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.766 ^a	.586	.585	.84204
2	.842 ^b	.710	.707	.70696
3	.868 ^c	.754	.751	.65221
4	.884 ^d	.781	.777	.61659
5	.891 ^e	.794	.789	.60037
6	.894 ^f	.799	.793	.59393

Note. ^aPredictors: Distinction emotions. ^bPredictors: Distinction emotions, body awareness. ^cPredictors: Distinction emotions, body awareness, happiness. ^dPredictors: Distinction emotions, body awareness, happiness, emotion analysis. ^ePredictors: Distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others. ^fPredictors: Distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others, sadness.

Finally, 79.9% can be explained by distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others, and sadness, which, once corrected for the effect of the sample and the independent variables, is 79.3%, with a standard error of the estimate of 0.594.

The next table to be studied is the ANOVA of predictive analysis.

According to Table 5, all p -values are low enough to indicate, in all cases, that the predictor variables have a statistically significant association with students' academic performance.

Below is the coefficients table, from which the regression equations of the six estimated models can be obtained using the values shown for constants and all the items included in each model (Table 6).

All variables have p -values less than 0.05, so it can be concluded that all of them have a statistically significant association with students' academic performance. In this way, the following regression equations are obtained using the models shown in Table 5.

- According to Model 1: Academic performance = 9.003 - 2.450 * (Distinction emotions)
- According to Model 2: Academic performance = 6.491 - 2.009 * (Distinction emotions) + 1.739 * (Body awareness)
- According to Model 3: Academic performance = 4.789 - 1.558 * (Distinction emotions) + 1.440 * (Body awareness) + 0.951 * (Happiness)
- According to Model 4: Academic performance = 4.162 - 1.454 * (Distinction emotions) + 1.034 * (Body awareness) + 0.822 * (Happiness) + 0.860 * (Emotion analysis)
- According to Model 5: Academic performance = 3.293 - 1.388 * (Distinction emotions) + 1.094 * (Body awareness) + 0.726 * (Happiness) + 0.747 * (Emotion analysis) + 0.658 (Attention to the emotions of others)

Table 5
ANOVA of predictive analytics.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	223.201	1	223.201	314.796	.000 ^a
	Residual	157.405	222	.709		
	Total	380.606	223			
2	Regression	270.152	2	135.076	270.267	.000 ^b
	Residual	110.453	221	.500		
	Total	380.606	223			
3	Regression	287.021	3	95.674	224.913	.000 ^c
	Residual	93.584	220	.425		
	Total	380.606	223			
4	Regression	297.346	4	74.337	195.531	.000 ^d
	Residual	83.259	219	.380		
	Total	380.606	223			
5	Regression	302.029	5	60.406	167.585	.000 ^e
	Residual	78.577	218	.360		
	Total	380.606	223			
6	Regression	304.058	6	50.676	143.660	.000 ^f
	Residual	76.547	217	.353		
	Total	380.606	223			

Note. ^aPredictors: Distinction emotions. ^bPredictors: Distinction emotions, body awareness. ^cPredictors: Distinction emotions, body awareness, happiness. ^dPredictors: Distinction emotions, body awareness, happiness, emotion analysis. ^ePredictors: Distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others. ^fPredictors: Distinction emotions, body awareness, happiness, emotion analysis, attention to the emotions of others, sadness.

Table 6
Coefficients of predictive analytics.

Model		Unstandardized B	Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	9.003	.172		52.365	.000
	Distinction emotions	-2.450	.138	-.766	-17.743	.000
2	(Constant)	6.491	.297		21.883	.000
	Distinction emotions	-2.009	.125	-.628	-16.137	.000
3	Body awareness	1.739	.179	.377	9.692	.000
	(Constant)	4.789	.385		12.447	.000
	Distinction emotions	-1.558	.135	-.487	-11.502	.000
4	Body awareness	1.440	.172	.312	8.361	.000
	Happiness	.951	.151	.274	6.297	.000
	(Constant)	4.162	.383		10.867	.000
	Distinction emotions	-1.454	.130	-.454	-11.221	.000
5	Body awareness	1.034	.180	.224	5.728	.000
	Happiness	.822	.145	.237	5.674	.000
	Emotion analysis	.860	.165	.209	5.211	.000
	(Constant)	3.293	.444		7.415	.000
6	Distinction emotions	-1.388	.127	-.434	-10.892	.000
	Body awareness	1.094	.177	.237	6.199	.000
	Happiness	.726	.144	.209	5.058	.000
	Emotion analysis	.747	.164	.181	4.564	.000
	Attention to the emotions of others	.658	.182	.124	3.604	.000
6	(Constant)	3.590	.456		7.865	.000
	Distinction emotions	-1.307	.131	-.409	-10.010	.000
	Body awareness	1.073	.175	.233	6.135	.000
	Happiness	.618	.149	.178	4.153	.000
	Emotion analysis	.713	.163	.173	4.389	.000
	Attention to the emotions of others	.644	.181	.121	3.566	.000
	Sadness	-.360	.150	-.094	-2.399	.017

- According to Model 6: Academic performance = 3.590 - 1.307 * (Distinction emotions) + 1.073 * (Body awareness) + 0.618 * (Happiness) + 0.713 * (Emotion analysis) + 0.644 (Attention to the emotions of others) - 0.360 * (Sadness)

Given the above equations, it might seem that all variables have similar weights, but this is not the case. This is due to the differences in the magnitudes of their scales. The standardised regression equation, i.e., taking the values of the standardised beta coefficient, is the one that shows us all the variables in the same dimension. In this way, we have the exact weight of each variable in the standardised equation of each predictive model, with the distinction emotions coefficient being higher than all the others in all the models. Likewise, if we look at the t-value, which indicates the statistical significance of the different coefficients, we observe a maximum value for distinction emotions, followed by body awareness, and, finally, happiness in all the models.

5.1.4. GEMS25

The result of GEMS25 for each emotion was as follows.

- Wonder:
 - o Grieg: Peer Gynt Suite No. 1, Op. 46 - I. Morning Mood.
 - o Rachmaninoff: Rhapsody and Theme by Paganini No. 18.
- Transcendence:
 - o Prokofiev: Romeo and Juliet, No. 13 Dance of the Knights.
 - o Elgar: Marcha nº1 Pomp and Circumstance.
- Power:
 - o Beethoven’s Piano Concerto No. 5 in E flat major op. 73 “Emperor”, III – Rondo. Allegro
 - o Vivaldi: The Four Seasons, Summer (Presto)
- Tenderness:
 - o Robert Schumann - Träumerei, "Kinderszenen" No. 7, Scenes from Childhood.
 - o Johan Sebastian Bach: Suite for orchestra No. 3 en D major, BWV 1068 · Aria.
- Nostalgia:
 - o Franz Liszt: Liebesträume No. 3 in A-flat major (Dream of love)
 - o Franz Liszt: Harmonies Poétiques et Religieuses, III – Benediction de Dieu dans la solitude.
- Peacefulness:
 - o Michel Pépé: Le Nouvel Arc en Ciel.
 - o Kenny G: Sentimental.
- Joyful Activation:
 - o Jason Farnham: Payday.
 - o Locally Sourced: Jason Farnham.
- Sadness:
 - o Ludwig van Beethoven: Piano Concerto No. 5 in E flat major op. 73 “Emperor”, II - Adagio un poco mosso.
 - o Frédéric Chopin: Prelude op. 28 No. 2 in A minor.
- Tension:
 - o Franz Liszt: Fantasy and Fugue on Bach.
 - o Rimsky Korsakov: Flight of the Bumblebee.

5.2. Study 2

In study 2, differential analyses were carried out between students in the control group and those in the experimental group, according to their final grade and the classroom climate.

5.2.1. Differential analyses

Student’s t-test was performed between the control group ($N = 109$) with a final score ($AM = 6.369$; $SD = 1.405$; $SE = 0.135$) and the experimental group ($N = 111$) with a final score ($AM = 7.864$; $SD = 1.250$; $SE = 0.119$), according to their final scores (Table 7).

As can be seen in the table above, the statistic for the test of equality of variances, Levene’s test, has a value of 1.286, with statistical significance ($p = .258$), indicating that the variances are equal, as it is greater than 0.05. After assuming equal variances, we look at the t-statistic with its p -value to assess the degree of compatibility between the hypothesis of equality of means and the difference between observed population means. In this case, the contrast of equality of means is -8.346 and has a p -value of .000, less than 0.05, so the conclusion is that there is no compatibility between the hypothesis of equality of population means and the differences between the means of groups represented by the experimental group and the control group for the data obtained. There are significant differences for the experimental group and the control group.

The fact that the value 0 is not included in the confidence interval limits for the difference also indicates that we can reject the hypothesis of equality of means.

Finally, the mean score of the experimental group is higher than that of the control group, which suggests that the MusMotion innovation proposal is effective and helps students to improve their academic performance.

Table 7
Differences in means in students’ final grades at the end of the course (Student’s t-test).

	Levene’s Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	1.286	.258	-8.346	218	.000	-1.49516	.17915	-1.84824	-1.14208
Equal variances not assumed			-8.337	214.125	.000	-1.49516	.17934	-1.84865	-1.14166

Student’s t-test was also performed to study the differences between the climate of the control group and the climate of the experimental group.

All items measured in terms of classroom climate were higher in the experimental group than in the control group, with task orientation being the item with the largest difference of all, followed by order and organisation and cohesion between equals (Table 8).

From the table above (Table 9), we can derive the following observations.

- The statistic of the test of equality of variances, Levene’s test, in the items “satisfaction and involvement”, “cohesion between equals”, “order and organisation”, and “task orientation” has a value of 28.164, 18.747, 24.451, and 37.835, respectively, with statistically significant *p*-values (*p* = .000) in the four items, which indicates that the variances are not equal in any of the cases, being less than 0.05. After not assuming equal variances in any of the previous items, we observe the t-statistic with its bilateral *p*-value for each of them and evaluate the degree of compatibility between the hypothesis of equality of means and the difference between observed population means. In the four cases, the contrast of equality of means is, for each item, equal to −18.390, −25.745, 30.959, and −52.043, respectively, with statistically significant *p*-values (*p* = .000) in all of them, less than 0.05, so the conclusion is that there is no compatibility between the hypothesis of equality of population means for any item, and the differences between the group means represented by the experimental group and control group for the data obtained in satisfaction and involvement, cohesion between equals, order and organisation, and task orientation. It can be stated that there are significant differences for the experimental group and the control group.

The fact that the value 0 is not included in the confidence interval limits of all these items above for the difference also indicates that we can reject the hypothesis of equality of means.

- The statistic for the test of equality of variances, Levene’s test, in the teacher student relationship, has a value of 3.021, with a *p*-value of .084, indicating that the variances are equal, being greater than 0.05. After not assuming equal variances, we look at the t-statistic with its bilateral *p*-value to assess the degree of compatibility between the hypothesis of equality of means and the difference between observed population means. In this case, the contrast of equality of means is −8.926 and it is statistically significant with a *p*-value of .000, less than 0.05, so the conclusion is that there is no compatibility between the hypothesis of equality of population means and the differences between the means of groups represented by the experimental group and the control group for the data obtained regarding the teacher student relationship. There are significant differences for the experimental group and the control group.

Again, the fact that the value 0 is not included in the confidence interval limits for the difference also indicates that we can reject the hypothesis of equal means.

The evaluation of MusMotion was carried out by means of a questionnaire, in which all scores increased in the post-test. The results were as follows: emotional well-being items (pre-test: *AM* = 2.42, *SD* = 0.62; post-test: *AM* = 4.86, *SD* = 0.58), classroom climate management (pre-test: *AM* = 2.16, *SD* = 0.85; post-test: *AM* = 4.23, *SD* = 0.62), and programme and classroom organisation (pre-test: *AM* = 2.84, *SD* = 1.32; post-test: *AM* = 4.12, *SD* = 1.57). As for the satisfaction questionnaire scores, a very high score was achieved (*AM* = 4.91, *SD* = 0.51).

6. Limitations

This study presents some limitations; for example, the research may have been affected by the outbreak of the COVID-19 pandemic (March 2020). Study 1 was affected for 3 months by the confinement, and study 2 was 100% affected by the pandemic. However, the classes were conducted face-to-face and, in view of the results, did not have a negative influence on the students. The project met its objectives despite the context in which it was implemented and developed. Thanks to this project, we have even been able to help the students to cope better with the pandemic.

The second limitation of this research is that the project has been implemented exclusively in one school; the size of the sample is a further limitation (*N* = 444). However, although the implementation and analysis of the data collected in this study has been carried

Table 8
Group statistics on class climate.

		N	Mean	Std. Deviation	St. Error Mean
Satisfaction and Involvement	Control Group	109	13.1927	1.75582	.16818
	Experimental Group	111	16.7477	1.00425	.09532
Cohesion between equals	Control Group	109	13.3670	1.32400	.12682
	Experimental Group	111	17.2432	.85510	.08116
Teacher-student relationship	Control Group	109	15.0459	1.61810	.15499
	Experimental Group	111	16.7117	1.10690	.10506
Order and Organisation	Control Group	109	12.3028	1.42403	.13640
	Experimental Group	111	17.1892	.83681	.07943
Task orientation	Control Group	109	17.8349	1.68607	.16150
	Experimental Group	111	27.2973	.88003	.08353

Table 9
Differences in means in the classroom climate of the experimental and control groups at the end of the course (Student's t-test).

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Satisfaction and Involvement	EVA	28.164	.000	-18.476	218	.000	-3.55509	.19242	-3.93433	-3.17585
	EVNA			-18.390	171.188	.000	-3.55509	.19331	-3.93667	-3.17351
Cohesion between equals	EVA	18.747	.000	-25.842	218	.000	-3.87627	.15000	-4.17191	-3.58063
	EVNA			-25.745	184.245	.000	-3.87627	.15056	-4.17332	-3.57922
Teacher – student relationship	EVA	3.021	.084	-8.926	218	.000	-1.66584	.18662	-2.03365	-1.29803
	EVNA			-8.897	190.556	.000	-1.66584	.18724	-2.03517	-1.29651
Order and Organization	EVA	24.451	.000	-31.097	218	.000	-4.88644	.15714	-5.19614	-4.57673
	EVNA			-30.959	174.017	.000	-4.88644	.15784	-5.19796	-4.57491
Task orientation	EVA	37.835	.000	-52.316	218	.000	-9.46243	.18087	-9.81892	-9.10595
	EVNA			-52.043	162.120	.000	-9.46243	.18182	-9.82147	-9.10340

Note. EVA = Equal Variances Assumed; EVNA = Equal Variances Not Assumed.

out in a high school in Spain, thanks to the universality of our project and the music used, MusMotion can be applied to adolescents in other countries and open up new possibilities for study, data comparison, and conclusions.

Another limitation in the project involves the issue of not being able to perform a randomised study since the groups were already allocated by the institution and were therefore already given, i.e., the class groups.

This case study illustrates reflections that should be taken into consideration for the implementation of sustainable emotional education through music in the future.

7. Discussion and conclusions

The purpose of this research was to determine whether there was a relationship between emotions and academic performance and to apply an innovation project that, through music and its power to evoke emotions, could improve the academic performance of students in compulsory secondary education.

There are two main conclusions derived from this study: emotions influence students' academic performance, and the innovative educational programme MusMotion, using music as a guiding thread, can help to improve students' academic performance and the classroom climate by improving their state of mind.

The results obtained in the two studies carried out show a relationship between emotions and students' academic performance, a statement also supported by the results of the previous scientific literature [53–69]. Specifically, emotion distinction and body awareness are the most influential terms regarding academic performance, according to our analysis, as we observed very high correlations with respect to these factors and students' academic performance. Their correlations were so high that these variables could explain 71% of the variation in a student's academic performance.

Furthermore, our research found evidence that not only emotions and emotional awareness influence students' academic performance, but that mood is also vital. According to Mayer and Salovey (2009), emotional regulation for intellectual and emotional growth requires the student's willingness not to limit the important role that their emotions play [70]. This is much easier to achieve with positive emotions than with negative emotions. Every student will be able to achieve better academic performance if he/she is able to regulate his/her emotions and those of others, moderating the negative ones and increasing the positive ones. This statement is confirmed by the analysis of study 1, which found that happiness and sadness are the most influential moods regarding academic performance (see Table 2).

How many teachers and parents would like to know how to predict a student's performance? Surely, there are many, as confirmed by Jayaprakash (2018), McCarthy et al. (2019), and Willems et al. (2019) [71–73]. In this research, we have managed to obtain the most influential variables regarding a student's academic performance, which can predict it with a very high percentage of reliability: these variables are distinction emotions, body awareness, and happiness, obtaining the formula of model 3 (see Table 6). If we add emotion analysis, attention to the emotions of others, and sadness to these variables, we can predict performance with even greater accuracy (see Tables 4–6), being the most complete combination of the predictive study, explaining 79.9% of the cases (see Table 4).

Another key element of this research has been music, a resource that can be used in education to improve academic performance if used wisely in our case, through an innovative project called MusMotion, which manages to properly channel the properties of music in favour of improving students' academic performance through the evocation of emotions [13,14,19,20,24,74–82]. This was confirmed to be a reality in study 2. The innovative project, as well as the list of melodies obtained in our study, can be used by future researchers and other educators who wish to work on emotions with their students and, additionally, improve their school performance. It is an opportunity to advance the study of improving academic performance through music.

Furthermore, our research shows that a good school climate facilitates the positive educational progress of students. On the contrary, the absence of a satisfactory school climate leads to student apathy, indiscipline, discouragement, and a lack of commitment,

participation, and collaboration with peers and teachers, and all of this results in low grades and frequent early school drop-out. Therefore, it is necessary to address the school climate in education systems to ensure that it is satisfactory, creating a pleasant environment for students in which they can express their opinions, collaborate, participate, share ideas, create, and learn in a natural, spontaneous, respectful, and harmonious environment [83,84].

Therefore, the six specific objectives set at the beginning of the work were achieved through the two studies carried out, and the obtained result confirmed any initial expectations. Through the innovative MusMotion programme, it has been possible to improve the current education system through emotional intelligence, emotions, and music, thanks to the use of the relationship between them.

Educational systems, through the management of emotions via music, could help many children who today may have difficulty with their emotions. Music can help pupils to understand themselves and even to externalise their emotions and acquire the same skills as other children who have less difficulty in doing so innately. Updating the curriculum and taking this into account can facilitate the educational success of these individuals, who might previously have felt frustrated; it may be possible, despite them having different emotional capacities, to help them not to feel frustrated and to avoid failing on a professional and personal level.

Music can be used to motivate pupils and help to enhance their natural abilities in all subjects, and it can be used as a common thread in interdisciplinary projects where different specialities are combined. Likewise, as demonstrated in study 1, emotions are an essential part of the students' lives, and it is for this reason that it would be very convenient to add subjects related to emotional intelligence to the curriculum of the current educational system, to directly address these needs and enhance the students' abilities. Students are not homogeneous and therefore we must cater for diversity.

Given that students' motivations are different, diversity is important, and if educational centres do not know how to manage this reality, it may lead to situations of school failure due to a malfunctioning of the educational system.

It is necessary to consider emotional intelligence, the classroom climate, respect, and knowledge of traditions in a multicultural way that favours the integration of all pupils, so that no child feels alienated or discriminated against in the classroom, regardless of their nationality or educational needs.

As can be seen, there is no simple solution to address all problems, and it is necessary to investigate and analyse all educational models in all countries, create a dialogue with all those affected, and, above all, with the pupils themselves to improve their emotional intelligence in schools and classrooms, and to train people capable of finding autonomy, integration, and happiness in the society in which we live, for the benefit of all.

Data availability statement

Data associated with the study has not been deposited into a publicly available repository and will be made available on request.

CRedit authorship contribution statement

Jose-Manuel Valero-Esteban Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Carlos-María Alcover**: Supervision, Conceptualization. **Yolanda Pastor**: Supervision, Conceptualization. **Arminda Moreno-Díaz**: Writing – review & editing, Supervision, Formal analysis, Data curation, Conceptualization. **Ana Verde**: Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Investigation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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