

Musical stimulation as an educational tool for the integral development of students with Autism Spectrum Disorder in the school environments

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Abstract. Music is a crucial strategy for promoting communication, social relations and behavioral development, thanks to its benefits in the main areas of human development, such as language and communication. The main objective of this research is to analyze the benefits of musical stimulation in the development of students with Autism Spectrum Disorder (ASD), based on an innovative educational project implemented in an educational center in the Primary Education stage with a group of students with special educational needs associated with ASD. This project uses musical stimulation as an educational tool to improve the teaching-learning process of these students. This qualitative and quantitative study uses direct observation, interviews and questionnaires as data collection instruments. The results obtained reveal that musical stimulation is a very useful tool for working on the common difficulties of ASD, obtaining a positive impact on the integral development of the participating students. Specifically, improvements have been observed in different dimensions, including better communication among these students, increased social relations and normalization of conduct and behavior.

Keywords: Music stimulation; Autism Spectrum Disorder; Educational Innovation; Teaching-Learning Process; Educational Orientation; Primary Education.

[es] La estimulación musical como herramienta educativa para el desarrollo integral del alumnado con Trastorno del Espectro Autista en el ámbito escolar

Resumen. La música es una estrategia clave para favorecer la comunicación, las relaciones sociales y el desarrollo comportamental, gracias a los beneficios que reporta en las principales áreas del desarrollo de las personas, como por ejemplo el área del lenguaje y la comunicación. El objetivo principal de esta investigación es analizar los beneficios de la estimulación musical en el desarrollo del alumnado con Trastorno del Espectro Autista (TEA), a partir de un proyecto educativo innovador implementado en la etapa de Educación Primaria con un grupo de estudiantes con necesidades educativas especiales asociadas a TEA de un centro educativo. Este proyecto utiliza la estimulación musical como herramienta educativa para mejorar el proceso de enseñanza-aprendizaje de dicho alumnado. El estudio, de naturaleza cualitativa y cuantitativa, utiliza como instrumentos de recogida de información la observación directa, la entrevista y el cuestionario. Los resultados obtenidos revelan que la estimulación musical es una herramienta de gran utilidad para trabajar las dificultades comunes del TEA, obteniendo un impacto positivo en el desarrollo integral del alumnado participante. En concreto se han observado mejoras en diferentes dimensiones, incluyendo una mejor comunicación entre dicho alumnado, aumento de las relaciones sociales y normalización de conductas y comportamientos.

Palabras clave: Estimulación musical; Trastorno del Espectro Autista; Innovación Educativa; Proceso de Enseñanza-Aprendizaje; Orientación educativa; Educación Primaria.

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1. Introduction

The reality of the difficulties that Autism Spectrum Disorder (ASD) can pose is a topic of increasing topicality and importance nationally and internationally. According to the World Health Organization (2018), in childhood, one in 160 has ASD (Elsabbagh et al., 2012). In addition, epidemiological studies conducted in recent decades show an increase in the worldwide prevalence of this disorder (Reviriego et al., 2022). In general, these individuals manifest altered sociability, difficulties in language and nonverbal communication, and alterations in their interests and activities (Rogel-Ortiz, 2005).

Classic autism, nowadays known as ASD, was first described in the 1940s when it was identified as a disorder with similar clear margins in a group of individuals. Subsequently, more extensive criteria have been used to detect different disorders of central triad symptoms that originate a variable associated symptomatology and diverse levels of affectation (Ministry of Health of Chile, 2011). However, the current trend is to unify the diagnoses of ASD as a spectrum without subtypes (Reviriego et al., 2022). Nevertheless, autism is described as a complex syndrome characterized by diverse and multiple causes and manifestations. ASD is conceptualized as:

Neuropsychological disorder of a continuous course often associated with mental retardation, with onset before the age of three years, manifested by a qualitative impairment of social interaction and communication, as well as restricted, repetitive and stereotyped behavioral patterns with varying levels of severity. (López et al., 2009, p.557)

One of the common manifestations among people with ASD is the high prevalence of difficulties in verbal and nonverbal communication. In some cases, they do not develop any type of oral language; in others, they require support from alternative and augmentative communication systems. They may have normo-typical language skills but difficulty using them in communication in specific social contexts (Vidriales et al., 2020). Other disorders associated with ASD are attention deficit hyperactivity disorder, obsessive-compulsive disorder, mood disorder or behavioral problems (Marchesi et al., 2017).

ASD is framed, according to the Diagnostic and Statistical Manual of Mental Disorders DSM-5 of the American Psychiatric Association (2014), within the neurodevelopmental disorders. It cites, as main characteristics, that it originates in the first period of development and produces deficits in the personal, social, academic or occupational sphere and alterations in the control of executive functions or intelligence. Thus, ASD is defined as a disorder characterized by persistent deficits in communication and social interaction in various contexts, including deficits in social reciprocity, nonverbal communicative behaviors used for social interaction, and skills for developing, maintaining and understanding relationships. In addition to the existence of restrictive or repetitive behavior patterns, interests, or activities (American Psychiatric Association, 2014).

Continuing with the DSM-5, several diagnostic criteria characterize ASD. First, persistent impairments in communication and social interaction in different domains. Second, restrictive and repetitive patterns of behavior, i.e., interests or activities manifested by stereotyped or repetitive movements, monotony, inflexibility, restriction or hyper/hyporeactivity to sensory stimuli or unusual interests. Third, these symptoms are present early in the developmental period. Fourth, the symptoms cause clinically significant impairment in social, occupational and other areas of usual functioning. Finally, these impairments are not explained by intellectual disability or global developmental delay. The DSM-5 incorporates several specifiers that allow for individual variability within the spectrum and deepens the description of some characteristics of the symptoms by establishing three levels of severity (level 1 requires support; level 2 requires substantial support; level 3 requires very substantial support).

On the other hand, according to the International Statistical Classification of Diseases and Related Health Problems (ICD-11), ASD is also classified within neurodevelopmental disorders. The ICD-11 highlights that it occurs during the developmental period, affecting the cognitive and behavioral part and generating significant difficulties in acquiring and executing specific cognitive, motor and social functions. Thus, individuals with ASD are defined as having persistent deficits in the ability to initiate and maintain reciprocal social interaction and social communication, as well as a range of restricted, repetitive and inflexible patterns of behavior and interests.

The development of individuals with ASD in the educational environment is usually accompanied by difficulties in learning and the relationship with the peer group. Thus, Rivière (2001) establishes the following educational needs of students with ASD:

- Educational needs related to disorders of social relatedness, i.e., initiating interactions with adults and peers or establishing eye contact;
- Educational needs related to disorders of joint reference abilities, i.e., developing shared gazes with peers and adults or, understanding and using facial expressions;
- Educational needs related to qualitative disorders of intersubjective and mental abilities;
- Educational needs related to the development of communicative functions, such as developing intentional and shared relationship strategies, communicative intent, or gaze maintenance;
- Educational needs related to expressive language, i.e., establishing alternative and/or augmentative communication systems or, developing functional and spontaneous language;

- Educational needs related to comprehensive language through visual support, receptive vocabulary development, expanded verbal comprehension or metaphors;
- Educational needs related to the qualitative disorder of anticipation skills since it is essential to experience sequences of activities, acceptance of changes by anticipating, planning and predicting, and the development of spatial-temporal structuring skills;
- Educational needs arising from the qualitative disorder of mental and behavioral flexibility, expanding their interests and promoting their motivation;
- Educational needs arising from the qualitative disorder of self-activity, i.e., performing functional actions autonomously and understanding the importance and purpose of the activities performed;
- Educational needs in the field of fiction and imagination skills, i.e., sharing playful relationships;
- Educational needs in the area of imitation skills, such as rewarding or stimulating behaviors;
- Educational needs in the area of suspension, through learning to represent actions, objects or situations and from the development of the understanding of metaphors, jokes or ironies.

According to Vidriales et al. (2020), the main characteristics of students with ASD are related to the different educational needs that must be addressed in the school context, such as focusing on communication and social interaction, considering behavioral and thinking flexibility, taking into account the processing of sensory stimuli, and, in general, making reasonable accommodations and individualized support.

The symptomatic heterogeneity presented by people with ASD is reflected in many diverse dimensions, especially in language and communication. Thus, a spectrum of functioning includes behaviors characteristic of communicative intentionality to use behaviors of higher functional and formal complexity (Martos and Ayuda, 2002). According to Artigas (1999), following the study of language disorders in children with ASD, it is evident that these disorders do not differ from those who do seem to have autism. During infancy, it is frequent that ASD leads to a delay in language acquisition, to which the sensation of not understanding the meaning of language could be added. In addition, very elaborate jargon may be observed in infancy, as if an attempt was made to imitate adult language. Some sophisticated words or phrases, totally decontextualized, could appear intercalated. Immediate and/or delayed echolalia are also frequent. The absence of an interlocutor is characteristic during long speeches that accompany infantile games, speeches empty of content, with a quite careful intonation. The lack of facial expression is also representative, especially when they try to communicate something.

Several categories define the type of linguistic problem in people with ASD. Thus, Rapin (1997) defines syndromes of linguistic deficits in the autistic, which are not different from those that a non-autistic child might have. First, auditory-verbal agnosia is related to the inability to decode language received through the auditory pathway. Secondly, phonological-syntactic syndrome, considered the most common specific language disorder, is characterized by semantic and grammatical poverty and poor vocalization. Thirdly, the lexical-syntactic syndrome is characterized by difficulty evoking a word appropriate to a concept or idea. Fourth, the semantic-pragmatic syndrome is characterized by difficulty respecting turn-taking, conversation starters, figurative language and clarifications. Fifth, selective mutism occurs when there is an ability to speak, but in specific situations, the use of language disappears. Moreover, prosody disorders, in terms of difficulty in making a correct intonation and rhythm necessary in the use of language.

One of the strategies applicable to students with ASD is the use of music. According to Bolívar et al. (2019), the pedagogical strategy of music favors the set of processes and sequences that comprise the intellectual didactic activities derived from the contents and that seek specific objectives. In this regard, and as Hillecke et al. (2005) point out, music involves communication and can be used for the training of non-verbal communication skills, which can be very useful in the case of behavioral alterations and autism. Researchers such as Wan et al. (2010), cited by Osma (2018), evidenced that music can improve situations of desolation and loneliness that students with ASD may suffer, thus improving the development of their emotions. It should be taken into account that in the area of communication, music favors speech and vocalization, regulating sensory and motor behavior. In addition, by selecting music with more marked rhythms, the aim is to reduce stereotyped behaviors. In this sense, Willems' (1970) experiences relate aspects of the integral development of human beings with the main elements that constitute music: rhythm with physiological life, with action; melody with affective life, with sensitivity; and harmony with mental life, with knowledge. These analogies, considered of great importance in the development of the personality, when applied to children with deficiencies, gave rise to what is known today as Music Therapy.

Several authors have analysed children's musical stimulation for therapeutic purposes (Cuervo, 2021). According to Bruscia (1998), Music Therapy is a scientific discipline and a profession that places the educational area as the principal axis of intervention or professional practice. In education, Music Therapy is applied to people with special educational needs and considers these subjects' physical, sensory, emotional, cognitive and social needs (Sabbatella, 2005). Wan et al. (2010) propose the design of interventions where mirror neurons are involved, something that is possible to do with the use of musical instruments since, in addition to setting in motion motor patterns, it is essential to develop mechanisms of imitation and communication.

On the other hand, Osma (2018) points out some objectives that are achieved by working with music: improving communication, speech production, improving structure and rhythm; promoting imitation and joint attention;

improving the recognition of affective signals; promoting social skills; improving memorization; decreasing vocal stereotypies; promoting creativity; and contributing to the development of communicative skills, mainly gestural. Soria-Urios et al. (2011) point out that music stimulates communication and expression, an aspect that improves and favors the sensitive and motor behavior of people with autism. The use of music adapted to the characteristics of ASD integrates the use of musical instruments, something that favors communication skills among the children participating in these types of stimulating sessions (Gold et al., 2006). In this line, the MUA organization, "Music for autism" (2013), points out that it is possible to set different specific therapeutic objectives to work with students with ASD. For example, singing can be promoted to tolerate waiting times, to promote oral and expressive language, to encourage eye contact and social smiles, or to develop group membership. Developing instrumental performance, exploration and/or improvisation is also important. It is noted that Jiménez (2017) highlights:

Musical activities notably benefit students in developing their schoolwork and learning. As we reflected following the contributions of experts in the field, music is a source of motivation, and they face learning with greater predisposition. It improves concentration, attention, imagination, observation, self-esteem, respect for oneself and others, will, memory, observation, initiative, and self-confidence, among other things, basic aspects of having a positive self-concept. If possible, the affective-social skills and abilities in the case of students with different abilities will be pursued with more intention since their development, achievement and internalization will enhance inclusion, a priority objective to be achieved. (p.325)

In our educational context, various educational projects and experiences have been developed that focus on music and/or music therapy to support the work developed with students with special educational needs and/or educational inclusion in educational institutions. For example, Cisterna and Orellana (2018) investigated the effects of the use of musical practice in the ordinary school classroom on the aggressive and disruptive behaviors of a child with ASD, which generated an unfavorable climate in the teaching-learning process and interaction with the rest of his peers. The intervention proposal was characterized by musical activities supported by music therapy and inserted in musical pedagogical workshops, through which the qualities of sound, the participation and socialization of the student, and different dynamics and games were developed. After implementing the intervention proposal, it was possible to observe a positive integral development in all the students and a decrease in the aggressive behaviors of the child with ASD in the regular classroom. In particular, it was noted that after the implementation of the musical pedagogical workshops, the condition and quality of life of all students, interpersonal relationships, participation, emotional well-being and, above all, coexistence within the regular classroom improved.

It is also worth noting the experience developed by Martínez (2016) with students with special educational needs, focused on students with ASD. This experience arose from an Early Attention Center and a Music School collaboration. The main objective was to teach classes to favor fun and leisure and to integrate these students into the school's regular classes in the future. 45-minute sessions characterized the experience, three groups of five students, the use of corners for each activity and ample central space, as well as a wide variety of material resources and activities related to motor warm-up, instrumentation, choreographed games, songs and relaxation. What started with scant knowledge of the students and their problems resulted, over time, in surprising and significant achievements: at a motor level, they advanced in fine and gross motor skills; at a cognitive level, they progressed in attention, participation and understanding of orders; at a social level they achieved cohesion among the students; at a communicative level they evolved at different levels; at a linguistic level they improved their language reducing echolalia and repetitions, and at an emotional level they were able to make associations between emotional states.

For their part, Garrote et al. (2018) investigated the effects of music on ASD, aiming to analyze how music can influence this group's personal, emotional and social development. After applying a music therapy program to a sample of 4 subjects with ASD, behavioral data were collected from the assessment of parents and teachers. These music therapy sessions were carried out at the group level as a playful technique of controlled relaxation, where communication at the social level, i.e., shyness, inhibition and mutism, were undertaken. The results revealed a series of benefits after participating in the program, especially connected to reducing these students' attention problems and aggressive behavior. Likewise, it was confirmed that the program contributed to improving the abilities and behaviors of students with ASD, especially regarding their social skills.

Another study of great interest is the one presented by Del Barrio et al. (2019), in which music therapy is included as part of the early childhood and primary school educational project, which had among its student cohort 32 students with special educational needs. The results of this study highlight that music therapy provides a complementary service that not only addresses the difficulties of students with special educational needs but also complements the work of the professional team, helping to create a comprehensive educational model and interdisciplinary character as a whole of the school. Specifically for students with ASD, these authors conclude that music therapy improves motor, emotional, cognitive, communicative, social and musical skills.

Finally, it is worth mentioning the study developed by Martínez-Hernández and Herrada (2020) that analyzed the relationship between the ability to reproduce rhythms and the verbal development of students in the third year of Infant Education. For this purpose, a quasi-experimental study with pre-test and post-test phases was carried out, characterized by administering the specific test: Cumanin Child Neuropsychological Maturation Questionnaire, to measure the variables of musical rhythmic stimulation and verbal development. The selected sample comprises 100

subjects with similar characteristics, between 4 and 5 years of age, from the 3rd year of kindergarten in a public school in a town in the Community of Madrid. The action plan stands out for being an educational intervention project called *The world is musical by nature*, which was implemented in the experimental group of the sample. The results showed an increase in the scores in the post-test phase of the research compared to the pre-test phase; that is, the scores collected at the beginning of the research were significantly lower than those collected after the implementation of the project. Thus, this study shows that rhythmic-musical stimulation can be an appropriate educational tool to improve verbal development during childhood and proposes to take as a starting point the procedures implemented in the music classroom to develop project work in the early childhood education classroom, especially in activities where rhythm work is deepened.

Next, it is presented a study that explores the benefits of musical stimulation for students with ASD in the school context, considering music as an educational tool in this field. Specifically, considering all of the above, the idea arose of approaching the Educational Project, hereinafter called "*Music-ASD*", developed in a subsidized school located in the Community of Madrid. Within the framework of this project, a case study of musical stimulation with primary school students has been carried out to analyze different variables, which are summarized below.

2. Method

2.1. Objectives

The general objective of this study is to analyze the benefits of the educational *Music-ASD* project to promote, through musical stimulation, the development of students with ASD from 6 to 12 years old in Primary Education. Within this framework, the specific objectives are: to analyze the benefits produced in the area of communication of students with ASD through the development of musical stimulation, to investigate the process of improvement in the social relationships of students with ASD after the implementation of musical activities; and to assess the restrictive behaviors of students with ASD after participation in the musical stimulation project.

2.2. Project *Music-ASD*

The primary purpose of the project *Music-ASD* of this educational center is to develop musical stimulation activities so that music becomes a vehicle for connection and inclusion with the reference groups of students with ASD. It is intended to encourage these participants to learn to interact socially, develop verbal and non-verbal language, and work on restricted behaviors and interests, thus favoring proper management in the social environment.

The main methodology of the intervention in the project is fundamentally active, characterized by the primary use of music. The activities have a playful and motivating aspect, so students are encouraged to collaborate and participate more during the sessions. In the context of music, work is done as a group while at the same time, the individual differences of each student are taken into account. The connection between psychological and corporal functions is pursued, speaking of a sensorial and rhythmic method. In each session, a rich and stimulating musical context is created for the students through activities where they sing (welcome, interaction and farewell songs), play and experiment with instruments, improvise (rhythm and musical accompaniment exercises in songs), and listen to recorded and live music. The songs used are didactically designed to work on all the components of music, as well as auditory discrimination and different types of music. In addition, other elements such as musical stories, trips, music and painting, music and movement (free, guided, dances), music and relaxation, etc., are also emphasized. Group techniques and oral communication are emphasized during all the project sessions. In this way, the whole group participates equally, and interaction among the students is emphasized since there is open communication.

The educational center where this project is being developed is a subsidized school in all its stages. It is located in Madrid (Spain), near the Casa de Campo, next to two popular middle-class neighborhoods with a significant increase in the presence of migrants. This school provides education from 3 to 18 years of age, covering the stages of Infant Education, Primary Education, Compulsory Secondary Education and Baccalaureate.

The project was born in the 2016/2017 school year as an innovation proposal from the ASD team, the specialist in Therapeutic Pedagogy, the Social Integrator and the Guidance Counselor. This initiative began as a pilot test, and today it is established within the center's day-to-day routines. Six students participated in the program in that first academic year, all with Autism Spectrum Disorder, although with quite different evolutionary profiles. Implementing the *Music-ASD* project required the approval of the Management Team, the students' class tutors, the Head of Studies, and the Coordinator of the Primary Education stage. For its implementation, no references were obtained from other similar initiatives or contact with other centers or institutions. The economic resources needed to develop the *Music-ASD* project are those of the classroom for students with ASD, i.e., no additional resources are needed since the classroom's economic resources are also those of the project.

At the time of this study, the specialist personnel actively participating in the *Music-ASD* project are the music teacher, the teacher who specialized in therapeutic pedagogy and the social integrator. The music teacher is the main person in charge of carrying out the musical activities characteristic of the *Music-ASD* Project at the school, always

supported by the specialist in therapeutic pedagogy and the social integrator, who provide the necessary support to students who require it at specific times. The specific timetable for this project in the academic year analyzed was one hour a week (Fridays from 9 a.m. to 10 a.m.), based on the availability of the music teacher. Students with ASD participate in this project outside their reference classroom during that hour. Likewise, the teaching team has coordinated so as not to bring forward subjects or to carry out tests or exams, thus avoiding any harm to the performance of these students. The families of the students with ASD are aware of the application of the *Music-ASD* project at the center and authorize their children's participation.

Finally, there were seven participants in this project (six boys and one girl), aged between 6 and 12 years, with special educational needs associated with ASD, and attending grades 1, 2, 3, 3, 4 or 6 of Primary Education (see Table 1). Their common characteristics are difficulties in social interaction, verbal and non-verbal alterations, limited repertoire of interests and behaviors, and limited ability to function adequately in the social environment.

Table 1. Summary of student characteristics.

Number	Age (Grade)	Students in reference class	Therapeutic pedagogy support hours (PT)	Social integration support hours (IS)
1	7 (1st grade)	26	10	15
2	8 (2nd grade)	26	10	15
3	8 (3rd grade)	25	10	15
4	9 (4th grade)	26	10	15
5	12 (6th grade)	25	10	15
6	12 (6th grade)	26	5	5
7	12 (6th grade)	25	5	5

2.3. Methodology and Procedure

In order to analyze the benefits produced through musical stimulation among the students of the educational center described above, empirical research was carried out from a double qualitative and quantitative perspective. The data collection methods have been direct observation, interview, and a questionnaire submitted to different educational agents. Specifically,

- Non-participant observation: Observation carried out in the classroom at the time of the musical stimulation of the *Music-ASD* project. It consisted of non-participant observation (see Appendix), since it was carried out in the space where the observed scene was taking place (Stake, 1999). This is intended to collect information without actively intervening in the activities carried out between students and teachers so as not to produce changes in the possible responses of the subjects to the musical stimulation provided. In this line, the recording system of the observed events has been characterized by the collection of detailed descriptions through field notes, anecdotes and a diary of the observed sessions, which have made it possible to gather the necessary information to obtain categories of analysis. The categories obtained were the following: relationships within the peer group, relationships with teachers and other professionals, imitation of actions and behaviors, emotional responses, use of the body and movements, use of objects and instruments, adaptation to changes, visual and auditory response, response and use of taste, smell and touch, verbal and non-verbal communication, and activity level. The observation was carried out during the musical stimulation sessions in March and April of the same year.
- Semi-structured interviews: Interviews were conducted with different educational agents involved in the project during May: the school counselor, therapeutic pedagogy specialist, the social integrator, the trainee social integrator, the music teacher and the class tutors of each grade in which the participating students are enrolled. The main objective of these interviews is to gather the knowledge and opinions of these educational agents (Stake, 1999) about musical stimulation and its implementation through the *Music-ASD* project.
- Questionnaire: Also in May, a questionnaire was administered to the seven families of the participating students with ASD. The questionnaire allows for a quantitative treatment of the data collected (Meneses and Rodríguez, 2011). This questionnaire was based on the Likert scale measurement tool with five response levels (1, strongly agree to 5, strongly disagree). It was used to analyze the degree of agreement of the families on musical stimulation and the *Music-ASD* project.

Concerning the procedure for organizing and analyzing the information, the most relevant data from the non-participant observation were considered in each of the categories established for each participating subject in the sessions (see Annex 1). Following the transcription of semi-structured interviews, we proceeded to the discourse analysis. Regarding the information collected in the questionnaire, a frequency analysis of descriptive statistics was per-

formed to determine the distribution of responses to the items. Finally, this information was triangulated to determine whether or not the hypotheses of the present study were corroborated. Likewise, a report of the study's results was made and delivered to the school counselor to inform the families of the students and the professionals participating in the project.

3. Results

The results obtained, although interrelated, are presented based on the hypotheses put forward in this study to facilitate their analysis.

3.1. Changes in communication

The testimonies of the educational agents confirm that students with ASD participating in the project improve in aspects such as expression, interaction and participation in activities and body expression. In addition, these students increase their interests, reduce hypersensitivity to sounds and the normalization of behaviors and behaviors. According to these testimonies, there is even an improvement in group cohesion, social relations and expression of emotions and interests of the participating students, leading, by extension, to an improvement in interpersonal communication.

In communication, the students are doing very well because it is a group that does not have great difficulties in this area. However, the project sessions are helping them to connect more in their reference classrooms. In addition, as the students play similar games and dynamics during an additional hour of music with their reference classroom, they feel more connected. They have improved their ability to withstand noise and also in the area of corporal expression. (Guidance counselor)

In the end, what they achieve fosters their expressiveness and communication. Exposing them to musical activities makes them more spontaneous. Therefore, music helps and benefits their communication. (Teacher specialized in Therapeutic Pedagogy)

Along the same lines, the results of the questionnaires to the families of students with ASD show tremendous support for the musical stimulation project, considering that it has significant effects on their children's communication. As shown in Figure 1, 43% of the people surveyed strongly agree, and 57% agree with the project.

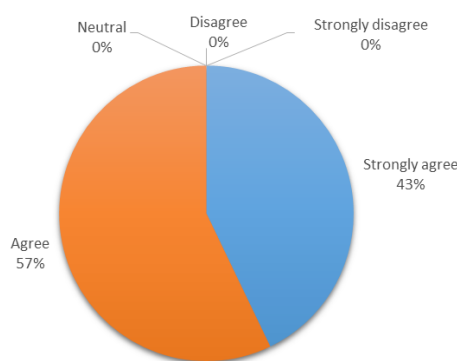


Figure 1. Percentage of families' response to "The project has significant effects on the communication of students with ASD."

The above results are consistent with the observation in the project sessions since it is revealed that students with ASD imitate, without great difficulty, actions and movements; have some difficulties in offering adequate emotional responses; through simple movements, use their bodies actively; show interest in specific objects and/or instruments; have adequate verbal communication and poor nonverbal communication; and respond to a dynamic level of activity.

3.2. Improvement in social relations

The teaching staff interviewed affirm that the *Music-ASD* program has positive effects on the social relations of the participating students, which is reflected in the improvement of peer group relations, and in more adapted behaviors and attitudes.

Given that it is easier to express themselves through music, the social relations of these students improve. They take care of each other, look for each other, love each other under all conditions and understand each other, most of the time, thanks to the various musical activities. When the session begins, if one of them is not there, they miss each other, and it is they who decide to go and look for their classmate in class. (Music teacher of the *Music-ASD* Project)

Moreover, these testimonies confirm that these benefits extend to various educational contexts, especially to the reference classroom of students with ASD. The strategies used help to improve students' social skills.

Through cooperative games and activities, interaction with others is worked on, an essential aspect when working with students with ASD. Therefore, their social relationships improve in general, since they are helped to generalize in contexts such as the playground, dining room, and reference class. (Social Integrator)

Among the group that makes up the musical stimulation sessions, social relationships are strengthened. Especially within the classroom, since there are more playful and fun moments, less structured and with a different distribution. I believe that in the end, what they work on here in terms of relationships with their classmates is extrapolated to their reference classroom. (P.T. specialist teacher)

Families also confirm that the musical stimulation sessions included in the *Music-ASD* project improve their children's social relationships since 43% of those surveyed strongly agree and 57% agree with this (see Figure 2).

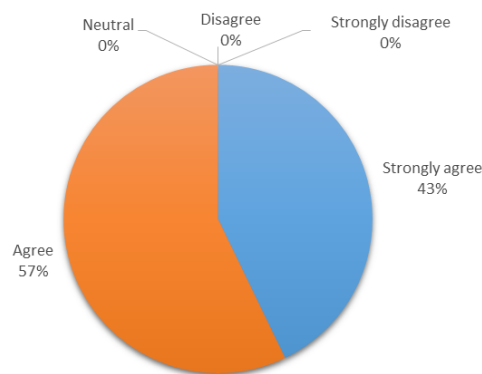


Figure 2. Percentage of response from families to “*The project improves the social relationships of students with ASD.*”

Finally, non-participant observation revealed that most students try to relate adequately with their peer group and the professionals involved in the project.

3.3. Decrease in restrictive behaviors

Several testimonies corroborate that the restrictive behaviors of students with ASD decrease. Likewise, the students who present restrictive behaviors decrease in intensity after musical stimulation. These testimonies affirm that the student's behavior improves from the beginning of the sessions.

Some students' behaviors have decreased since the beginning of the sessions, especially when these behaviors appear at the time of the sessions. Because with musical stimulation techniques we usually work on the students' behavior. (Social integrator)

Musical stimulation relaxes students. It often depends on the moment they are in, but in general, I consider that it helps them to manage their behaviors and behaviors, (P.T. specialist teacher)

In addition, they consider that the different activities favor student relaxation. However, it has been pointed out that this depends on the type of activity developed, so the importance of ending the session with calm and relaxing activities to favor the subsequent inclusion in the reference group is highlighted.

When they finish the stimulation sessions, they come to class much more relaxed, which helps reduce their sometimes somewhat negative behavior. (3rd grade P.E. Tutor)

There are days they come out of class calmer, and other days they don't. Some activities upset them. In some activities, they get upset depending on how they are that day. Even so, the activities designed for the last part of the session are designed to work on relaxation, so they do come out calmer. (Guidance counselor)

The responses of the families of students with ASD confirm that they strongly agree (29%) to agree (71%) that the musical stimulation sessions of the project developed reassure the students (see Figure 3).

The results of the non-participant observation are also consistent with the above, as they reveal that students with ASD accept changes if they are not too abrupt and they adequately respond to the senses.

To conclude this section dedicated to results, it should be mentioned that different opinions denote the need for further training of the school staff involved in developing this type of musical stimulation project and for extending the number of hours of the sessions to increase their impact. Likewise, the possibility of involving students with other educational needs in the project is also suggested since specific musical interventions could contribute to improving these needs.

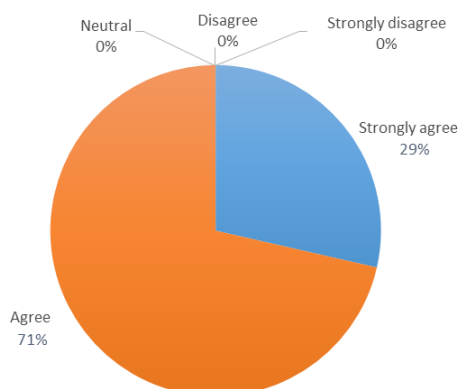


Figure 3. Percentage of families' response to "The project favors the relaxation of students with ASD."

4. Discussion and Conclusions

From a qualitative and quantitative perspective, this empirical study analyzes the benefits of the innovative educational *Music-ASD* project, focused on the musical stimulation of students with ASD attending a primary school. The results obtained allow us to draw a series of conclusions.

Firstly, it can be concluded that the musical stimulation sessions of this project benefit the area of communication of students with ASD, given the improvement in aspects related to group cohesion, social relationships and the normalization of behaviors. These results coincide with the contribution of Osma (2018), who comments that music develops the area of communication, as it favors speech and vocalization of boys and girls with ASD by regulating sensory and motor behavior. As Bolívar et al. (2019) pointed out, music allows to optimize the set of processes and sequences of various intellectual didactic activities.

In addition, it has been found that this project has favored the social relationships of students with ASD within the peer group and with professionals involved in the project, promoting interaction and communication. These results align with Jiménez (2017), who states that musical activities favor the development of students' work and school learning and improve respect for others.

Another of the conclusions obtained is that the musical stimulation sessions with students with ASD improve their behavior, reducing the intensity of restrictive behaviors. In this sense, the results reveal the impact of this project supporting and completing the teaching-learning process of students with special educational needs, in this particular case of students with ASD, and favoring inclusive education in the regular school. Thus, as an educational tool, musical stimulation facilitates communication, improves social relationships and reduces restrictive behaviors of students with ASD while allowing to train creativity, expression, interpersonal relationships, perception, reasoning, memory, behavior and movement. Related to this, Garrote et al. (2018) determined that a music therapy program applied to students with ASD contributed to improving their abilities and behaviors.

Given all of the above, it is possible to corroborate the general hypothesis of this study, that is, that the *Music-ASD* musical stimulation project improves communication, social relations and behaviors of the participating students with ASD. Likewise, due to its relationship with this hypothesis, it can be affirmed that the objectives established in the study have also been achieved.

In light of these conclusions, there is a need to review the professionalization process of both music education and special education teachers: as regards professionalization in music education, competencies would be required to enable them to work with all students, especially with the most vulnerable ones; while in special education professionalization, didactic-musical training should be considered to open new paths of collaboration and interprofessional intervention to make inclusive music education effective. Likewise, it would be a positive action to expand music therapy training in both professions and even make it possible the incorporation of music therapy professionals in educational centers, in line with what is indicated by authors such as Sabbatella and Del Barrio (2021), who suggest the incorporation of new professional profiles specialized in the integration of the therapeutic and psycho-pedagogical approaches of music for the care of students with special educational needs in special, early childhood and primary education centers. It is also considered essential to favor cooperation between families and professionals in the educational center to favor joint work with the whole student body and, in general, for the better functioning of the school center.

Finally, it is suggested to continue researching the possibilities offered by musical stimulation as a tool for the integral development of students with ASD, and even students with other educational needs, through projects developed in formal education.

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6. Annex

CATEGORIES OF ANALYSIS	INTERPRETATIONS
Relations with peers, faculty and other professionals	Student 1: Sometimes ignores adults. Strong and constant attempts are necessary to get sustained attention in an activity.
	Student 2: Is dissatisfied with forced interactions. Occasionally, solid and consistent attempts by teachers are needed to get their attention. Behavior with peers is appropriate.
	Student 3: Avoids looking at adults in the eye or is uncomfortable with forced adult interactions. Behavior with peers is appropriate.
	Student 4: If interactions are forced, shows shyness. Responds and contacts adults and peers easily.
	Student 5: Tends to become upset when it is pointed out that something is wrong.
	Student 6: Tends to get upset when told that something is wrong. Avoids looking at adults in the eye.
	Student 7: Tends to get upset when told that something is wrong. Behavior with peers is appropriate, except in arguments.
Imitation of actions and behavior	Student 1: Imitates very simple behaviors with help and persistence from the practitioner. Often imitates after some time has elapsed.
	Student 2: Imitates with help and persistence from teachers.
	Student 3: Imitates simple actions and behaviors after constant encouragement.
	Student 4: Imitates with ease, sometimes with persistence. Imitates movements and sounds appropriate to the context in which he/she is developing.
	Student 5: Imitates sounds, words and movements with ease. Sometimes needs encouragement to imitate or perform an action or task.
	Student 6: Imitates without difficulty. Sometimes their actions and behaviors are persistent.
	Student 7: Imitates easily. On many occasions, his or her behaviors are persistent over time.
Emotional responses	Student 1: Shows inappropriate emotional responses in type and intensity. Occasionally does not relate to the surrounding context.
	Student 2: Occasionally, responses are not related to the context. Few changes in facial expression and posture are observed.
	Student 3: His/her reactions are appropriate in type. In contrast, the intensity of these responses are, sometimes, not related to the context.
	Student 4: Emotional responses appropriate in type and intensity. Rarely are reactions not related to context.
	Student 5: Occasionally shows inappropriate emotional responses in intensity.
	Student 6: Shows inappropriate emotional responses in intensity. Occasionally, these responses are not related to the context.
	Student 7: Occasionally shows inappropriate emotional responses in intensity. In response to these responses, he/she needs to disconnect from the situation by changing the context.
Use of the body and movements	Student 1: Has clumsy and even uncoordinated movements. Generally, their behavior is slow. Has motor difficulties.
	Student 2: Moves easily, although there are some awkward movements.
	Student 3: Moves easily and nimbly. Rarely has awkward movements. Some repetitive movements are observed.
	Student 4: Few peculiarities are present, such as some repeated movements. Moves with ease and normal coordination.
	Student 5: Moves easily, although some awkward or stiff movements are present.
	Student 6: Moves in an agile manner. Occasionally, some repetitive movements are observed.
	Student 7: Easy and somewhat active movement. Coordination normal. Some awkward movements are observed at times.

CATEGORIES OF ANALYSIS	INTERPRETATIONS
Use of objects and instruments	Student 1: Focuses attention on concrete objects. Difficult to distract when engaged with a particular instrument in a particular activity.
	Student 2: Occasionally shows atypical interest in a particular object.
	Student 3: Shows interest in objects. It is difficult to distract him/her from an object after an activity utilizing that object.
	Student 4: Shows interest in using a particular object. He is fixated on a particular instrument and focuses his attention on it. There are particular objects in front of which he/she is extremely nervous.
	Student 5: Shows normal interest in different objects. It is difficult to distract him/her from an object after an activity utilizing that object.
	Student 6: Shows interest in objects. It is difficult to distract him/her from an object after an activity utilizing that object.
	Student 7: Shows normal interest in different objects. Sometimes he/she uses one object focusing his/her attention only on this one object.
Adaptation to change	Student 1: Resists change of activity or use of the same material. May feel sad when a previously established routine is altered by a professional.
	Student 2: Resists sudden changes and feels sad if daily routine is altered.
	Student 3: Acceptance of changes in routine if these are not abrupt. Shows interest in knowing the reason for the changes made.
	Student 4: When an adult changes activity, accepts the change knowing why. Sometimes he/she gets upset in these situations.
	Student 5: Resists sudden changes in activities and tasks. It is difficult to distract him/her from what he/she is doing.
	Student 6: Accepts changes in activities and tasks and the reasons for them. Sometimes gets upset in these situations.
	Student 7: Resists changes in routine, especially if they are abrupt. It is difficult to distract him/her from what he/she is doing.
Visual and auditory response	Student 1: Sometimes need to be reminded what to look at. Avoids looking into eyes and looking at objects from an unusual angle. Response to sounds is appropriate.
	Student 2: A reminder is needed about what is being done during a task. Response to sounds is appropriate.
	Student 3: Occasionally avoids looking at adults in the eye. Response to sounds is appropriate.
	Student 4: Is interested in looking at or listening to particular objects or instruments. Occasionally avoids looking people in the eye. Uses sight along with other senses.
	Student 5: Interested in looking at or listening to particular objects or instruments. Rarely avoids looking at adults in the eye. Uses sight along with other senses.
	Student 6: Occasionally avoids looking at adults in the eye. Response to sounds is appropriate. Uses sight along with other senses.
	Student 7: Occasionally must be reminded to look at a person or object during some tasks or activities. Response to sounds is appropriate.
Response to and use of taste, smell and touch	Student 1: Shows interest in touching objects when presented with them. Taste and smell are used when necessary.
	Student 2: Shows interest in touching objects. Taste and smell are used when appropriate.
	Student 3: Shows interest in touching objects. Taste and smell are used when necessary.
	Student 4: Shows interest in touching objects that attract attention. Taste and smell are used when necessary.
	Student 5: Shows interest in touching objects. Taste and smell are used when necessary.
	Student 6: Shows interest in touching objects. Taste and smell are used when necessary.
	Student 7: Shows interest in touching objects that catch his/her attention. Taste and smell are used when necessary.

CATEGORIES OF ANALYSIS	INTERPRETATIONS
Verbal and non-verbal communication	Student 1: Speech is sometimes absent. When present, has peculiar speech and asks many questions. Has difficulties in articulating. Generally unable to express needs non-verbally.
	Student 2: Speech is sometimes absent. When speech originates, they ask topically focused questions. Rarely communicates what they want through gestures or expressions.
	Student 3: Speech may be absent, but most sentences are meaningful. Vague use of non-verbal communication.
	Student 4: Age-appropriate verbal communication. However, some echolalia or excessive words and repetitions in meaningful language exist. Immature use of non-verbal communication.
	Student 5: Age-appropriate verbal communication, excessive at inappropriate times, e.g., in explanations of tasks or activities. More or less mature use of non-verbal communication.
	Student 6: In general, speech is adult-like, correct and professional. Immature use of non-verbal communication.
	Student 7: Speech may sometimes be absent. Uses meaningful sentences but with many questions, sometimes focused on topics. Immature use of non-verbal communication.
Level of activity	Student 1: Slightly lazy and slow at times. Their level of activity interferes with the performance of actions and tasks.
	Student 2: Slightly inactive and slow at times. His level of activity interferes with the execution of some activities.
	Student 3: Slightly active. This level of activity interferes with the performance of actions and tasks.
	Student 4: Sometimes very active and difficult to contain. Their high activity level interferes with the execution of tasks or activities proposed by teachers. In general, he/she is upset and nervous.
	Student 5: Very active. Their level of activity interferes with the performance of all their actions.
	Student 6: Slightly active. Their level of activity often interferes with the performance of activities.
	Student 7: Slightly active. This level of activity interferes with the performance of most tasks and activities.